GENERIC SUBSTITUTION AND PRESCRIPTION DRUG PRICES :

Economic Effects of State Drug Product Selection Laws

Alison Masson

and

Robert L. Steiner

Federal Trade Commission

1985

GENERIC SUBSTITUTION AND PRESCRIPTION DRUG PRICES:

ECONOMIC EFFECTS OF STATE DRUG PRODUCT SELECTION LAWS

by

Alison Masson

and

Robert L. Steiner

Staff Report

of the

Bureau of Economics
Federal Trade Commission

October 1985

FEDERAL TRADE COMMISSION

TERRY CALVANI, Acting Chairman
PATRICIA P. BAILEY, Commissioner
MARY L. AZCUENAGA, Commissioner

BUREAU OF ECONOMICS

DAVID T. SCHEFFMAN, Acting Director and Deputy Director for Competition and Antitrust
JOHN L. PETERMAN,
Associate Director for Special Projects
RONALD S. BOND,
Deputy Director for Operations and Consumer Protection
RICHARD S. HIGGINS, Deputy Director for Regulatory and Industry Analysis
KEITH B. ANDERSON,
Assistant Director for Regulatory Analysis
ROBERT D. BROGAN,
Assistant Director for Competition Analysis
MARK W. FRANKENA,
Assistant Director for Consumer Protection
PAULINE M. IPPOLITO,
Assistant Director for Industry Analysis
PAUL A. PAUTLER, Assistant Director for Antitrust

ACKNOWLEDGEMENTS

The senior author, Alison Masson, wrote the final version of the report. She was also responsible for the final specification of all the econometric work, as well as most of the data preparation. Robert L. Steiner conceived the idea for the study in 1980 and with J. Howard Beales III submitted the original research proposal. He worked initially with Beales and then with Masson until he left the Federal Trade Commission in September 1983, and he subsequently has served as a consultant on the project.

Gerard Butters also virtually deserves co-authorship. Analytically perceptive always, he questioned, suggested, and clarified ideas in progress, in discussions beyond count. His assistance on statistical and technical issues was extremely valuable. His comments on several earlier drafts substantially improved this final report. In addition, his periodic insistence on a plot of the path to the final product has helped us reach the end of that path -- this completed report.

So many others have contributed so much in so many ways to this report that it is impossible to name them all. Within the Bureau of Economics, Pauline M. Ippolito and Ronald S. Bond provided continuing support. John P. Brown, a former Assistant Director for Consumer Protection, was instrumental in encouraging the project in its early phases. Michael P. Lynch and Charles Smithson, to name but two of numerous helpful colleagues, provided counsel on ways to model the problem. The enormous data processing task was ably and cheerfully programmed by John Hamilton, with the assistance of Allen Jefferson and Mead Krim. Many people worked on the preparation and digestion of the data, including Barbara Battle, Lynn Carpenter, Inez Cerame, Ieva Cucinelli, Katina Dorton, Alan Emerson, Lawrence Getzoff, Thomas Roney, Carolyn Samuels, and Cheryl Williams. Statistical advice was provided by generous colleagues. Mark Plummer for a time redirected his analytical abilities from his own economic research to masterminding, with heroic persistence, the conversion of the entire report from one word-processing system to another, creating order (as in tables with straight columns) out of chaos. Betsy Zichterman typed the seemingly endless tables and put the report into a presentable final format.

The magnitude and complexities of the data might have overwhelmed the project had not IMS America continued to provide patient answers to our multitudinous questions. In particular, Steven Schectman, Paul Ryser and Peter Duskey were very helpful.

We are grateful for information and discussions with many other people outside the Federal Trade Commission as well. Discussions with Theodore Goldberg, whose lead we were following in studying drug product selection, provided valuable guidance, as did his team's extensive research reports. Peter Rodler, Charles Spalding, and Thomas Fulda of the Health Care Financing Administration shared insights about the basic data and provided the list of leading generic entities which allowed all the empirical work to begin to move forward. Among the forms of assistance provided by staff at the Food and Drug Administration, the drug listings given us by Bruce Byer and Jacki Leung of the Drug Listing Branch were especially appreciated. Ty Kelley of the National Association of Chain Drug Stores, Thi D. Dao then of the Pharmaceutical Manufacturers Association, Richard Penna then of the American Pharmaceutical Association, Richard Levy of the National Pharmaceutical Council, members of the Generic Pharmaceutical Industry Association, and Edward Spierbeck of Drug Fair were among those in and around the business of producing and selling prescription drugs who graciously shared their experience and expertise with us. Pharmacy board officials across the country patiently answered our repeated efforts to understand exactly what state statutes and formularies really meant. Professors John Vernon of Duke University and Carolee DeVito of the University of Miami provided careful reviews of an intermediate draft. Conversations with other researchers have provided answers to some puzzling questions while often producing yet more intriguing issues, only some of which we have been able to address in this report.

TABLE OF CONTENTS

FIGURE AND TABLES

CHAPTER 1

INTRODUCTION

As of mid-1984 all states have laws allowing pharmacists some choice in selecting which brand of drug to dispense in filling a prescription that names a specific brand.[1] The stated purpose of these drug product selection (DPS) laws is to lower the prices consumers pay for prescription drugs through substitution of lower-price versions of the drug for the higher-price brands typically prescribed by physicians.[2] The previous anti-substitution laws required the pharmacist to dispense whichever brand the physician named. The newer drug product selection laws under certain conditions allow the pharmacist to substitute another generically equivalent drug. Since most prescriptions are written using the proprietary name of a specific brand, rather than the established generic name of the drug product, DPS laws in effect shift the choice of brand for most prescriptions from the physician to the pharmacist. The premise underlying DPS laws is that the pharmacist has a greater incentive than the physician to identify the cheapest source of supply and to pass along at least part of the savings to the consumer.

It is the large price differences between leading brands and "generic" versions of the "same" drug that suggest that consumers could save substantially from substitution.[3] Using

---

1/ By 1980 -- the year analyzed in this report -- only three states still prohibited substitution. Louisiana's law went into effect in October of 1980, Texas' at the beginnning of 1982 and Indiana's in mid-1984.

For a history of the anti-substitution laws and of their replacement with drug product selection laws see Staff Report to the Federal Trade Commission, Drug Product Selection, 1979, hereafter cited as FTC Staff Report (1979).

2/ "Generic substitution" is another term often used for drug product selection, and indeed the substitution of unbranded drug products for branded items is envisioned by the statutes in that lower-price products typically include those sold under the generic name only. The term "drug product selection" encompasses a broader range of pharmacist behavior. In filling generically written prescriptions, pharmacists must always choose a drug product. Also, a substitution may involve a second brand rather than a lower-price unbranded version.

The type of substitution analyzed in this study is limited to brand interchange within a generic entity (or drug entity), defined as the set of products which all have the same (combination of) active chemical ingredient(s).

3/ In this study, "generics" are defined as being all products other than leading brands, thereby including some products sold under a proprietary name in addition to products sold under the generic name alone. See Appendix A6 for the definitions of "leading brands" and "generics" and Chapter 3 for data on leading brand and generic prices.

measures of the brand-generic price gap, a number of previous studies have attempted to measure the potential savings which DPS laws offer. These estimates have been large, on the order of hundreds of millions of dollars per year.[4]

This study is an empirical analysis of the effects of these laws. We measure these effects in terms of substitution rates and differences in prices while controlling for influences other than the laws. While our primary data are for 1980, we also discuss more recent trends.

I. EQUIVALENCE AMONG DRUG PRODUCTS

Consumers benefit from substitution only if there is no significant offsetting diminution in therapeutic efficacy. One important prerequisite for the spread of drug product selection laws was the growing acceptance of the view that for many drugs various brands could be interchanged without loss of therapeutic efficacy.

The issue of *therapeutic* equivalence among *generically* equivalent products is real. Two same-strength products in the same generic entity, containing the same active chemical ingredients in identical proportions, may not always have the same effects in a patient, because differences in inactive ingredients used for binding or coloring may modify the effects of the active ingredients or create their own unintended side effects.

However, for many generic entities, there is now substantial agreement that no serious inequivalence problems exist,

---

4/ See FTC Staff Report (1979), which reviews several estimates. These estimates all assume that dollar savings are not offset by a diminution in therapeutic efficacy. Most estimates are of the maximum potential benefits, that is, the savings that would occur if substitutions were in fact made in every instance permissible. Of course, the actual amount of "savings" depends on the extent to which pharmacists have the opportunity to substitute and on whether they actually choose to exercise the substitution option, as well as on any indirect price effects of the DPS laws.

based either on testing or on long experience.[5] For some others, tests have shown that products are not equivalent and that free interchange is not appropriate.

All state drug product selection laws prohibit substitution of products judged to be inequivalent, but they differ in the means by which they specify which products are considered to be equivalent. In some states reliance is placed entirely on independent judgment of the pharmacist, although a criterion typically using the terminology of bioequivalence or therapeutic equivalence may be incorporated in the statute. In many states (two-thirds of the states in 1980) a formulary lists permissible (or, alternatively, impermissible) drug product interchanges.[6] The formulary's legal grant of permission to substitute is for a particular drug entity very like the broad grant provided by the existence of a drug product selection statute: without it, substitution is illegal, regardless of how much encouragement other provisions of the law give to substitution in general. Data for all states permitting substitution in 1980 show that substitution was permitted on 73.6

5/ In a 1979 Federal Register notice, the FDA Commissioner was reported as being "convinced that only a small fraction of all drugs present bioequivalence problems, and that, among those drugs that are currently marketed by more than one supplier, the problem drugs have now mostly been identified." 44 Federal Register 2942, January 12, 1979. Two products are said to be bioequivalent if their absorption into the blood stream and their subsequent excretion into the urine occur at the same rate and to the same extent; in practice, bioequivalence is held to imply therapeutic equivalence. Under FDA regulations some but not all drugs have been tested for bioavailability. In fact, the lack of bioequivalence does not necessarily lead to a significant difference in therapeutic effect. According to the FTC Staff Report (1979, p. 241), "small differences in bioavailability were likely to produce therapeutic problems for drugs with either a steep dose-response curve or a narrow range separating effective and toxic levels. Most clinically useful drugs have relatively flat dose-response curves; therefore, only large differences in bioavailability were likely to alter their therapeutic effect." Members of the expert panel whose report was published by the Office of Technology Assessment in 1974 "estimated that roughly 85 percent to 90 percent of all prescription drugs were not critical dose drugs for which bioavailability studies were necessary." FTC Staff Report (1979, p. 238, footnote.)

6/ Formularies which list permissible substitutions are called "positive" formularies; those that list drugs in which substitution is prohibited are "negative" formularies. The effects of this difference are discussed in Chapter 5, as are secondary effects of formularies, such as limiting liability and simply providing information.

percent of all prescriptions for 45 leading multi-source drugs studied.[7]

State formularies vary greatly; the proportion of all prescriptions in these 45 drugs on which substitution was permitted in 1980 ranged from 29 to 98 percent.[8] This shows that there is no single, universally agreed upon list of drugs which should be considered interchangeable.[9] Since 1980 the Food and Drug Administration has published its judgments in a periodical list entitled Approved Prescription Drug Products with Therapeutic Equivalence Evaluations.[10] Many states use the FDA list as a basis for their own formularies or, in the absence of a state formulary, recommendations to practicing pharmacists. Without such a standard compilation of official opinion, drug product selection laws would have been much more difficult to implement.

For the purposes of this study, we use the therapeutic evaluations embodied in state formularies as the standard for determining when a substitution can be made with no loss in therapeutic effectiveness. We do, however, note the inconsistency of this standard across states for some drugs.

II. THE ECONOMIC RATIONALE FOR SUBSTITUTION LAWS

In "perfect" markets, consumers choosing between two identical products with different prices would choose the lower-price product, and the price differential could not be maintained. However, in many "real" markets, price differentials

---

7/ The data and the selection of the 45-drug sample are described in section III below and in greater detail in Appendix A6.

8/ See Appendix Table A1-1 for 1980 data by state.

9/ General agreement on the advisability of prohibiting substitution in a particular drug entity is reflected in the fact that for some drugs substitution is permitted in all states while for others substitution is prohibited in most formulary states. Appendix Table A3-2 shows for each of the 45 drugs analyzed in this study the number of states which permitted substitution in that entity in 1980. The proportion of prescriptions on which substitution was permissible in 1980 (excluding the three states which prohibited all substitution) ranged from 55 to 100 percent across the 45 drugs.

10/ U.S. Department of Health and Human Services (1980 and subsequent editions).

persist, and in the market for prescription drugs the legal prohibitions against substitution have contributed especially to sustained price differentials.

The difference between the price of the leading brand in a prescription drug entity and the price of alternative brands in the same entity is typically large: a 1980 average across 37 leading multi-source drugs, weighted by sales in number of prescriptions, was $8.22 for the leading brand and $6.22 for the average of other brands, a difference of $2.00, or nearly 25 percent of the leading brand price.[11] Despite this broad price gap most prescriptions are filled with the leading brand. None of 12 leading drugs whose patents expired between 1970 and 1976 had in 1979 a market share of less than 90 percent in (wholesale) dollar terms, although market shares were lower (70 to 90 percent) in terms of units sold.[12] Market share erosion is moderate at best in the years following patent expiration.[13]

The institutions of the prescription drug market are markedly different from those in most other product markets. For prescription drugs, it has not been the consumer who has made the choice among brands; it has been the physician. A physician's prescription is a necessary precondition for the purchase of a prescription drug, and it is the physician who designates both the chemical compound and, on four-fifths of

---

11/ Of the 45 drugs selected for study, in only 37 did sales of both brands and generics, by our definitions, actually appear in the 1980 data.

12/ The analysis of dollar market share is in Statman and Tyebjee (1981). The analysis of unit market share is contained in a letter from Mark B. Goodson, Associate Manager, Public Policy Planning, Hoffmann-La Roche Inc. to Robert L. Steiner, January 6, 1982. The computations were based on IMS data and covered 6 of the 12 drugs in the Statman/Tyebjee analysis. By mid-1981 the unit market shares had fallen to 58 to 84 percent in these drugs.

13/ Of course, one possible explanation of the persistence of the price differential is that leading brands are superior in quality. Despite official state formularies stating that certain brands are interchangeable, some consumers or their physicians may find that one brand is more effective or confers fewer side-effects than another. Even in the absence of laws or institutions restricting their options to purchase prescription drugs, some consumers would therefore be willing to pay a premium for certain brands of powerful drugs, just as they do now for over-the-counter drugs and other products.

all prescriptions, a specific brand of the drug.[14] In the absence of the opportunity to substitute, consumers have no opportunity to exercise an unfettered choice of brand on most of the prescriptions received.

Physicians' behavior reveals not only a marked preference for prescribing brand-name drugs but also for specifying the first brand marketed in a drug entity.[15] In the absence of substitution, this proclivity towards prescribing the pioneer brand in effect extends the drug's dominance even after the expiration of the patent which conferred the initial legal monopoly. One explanation of this pattern is that physicians' prescribing habits are formed early in the life of a newly-introduced drug, at a time when there is only one version of the drug, protected by a patent monopoly and promoted heavily by its manufacturer. These habits are resistant to change, even in the face of the lower prices set by post-patent competitors of the leading brand.

Of course it is possible that physicians' preferences for brands accurately reflect consumers' preferences, but there are strong arguments to the contrary. First, there is evidence that physicians are poorly informed about relative prices of drugs.[16] Second, physicians' incentives to choose the most cost-effective drug seem weak. A patient buys a bundle of services from the physician and may consider the particular brand of the drug to be a minor aspect in choice of a physician, giving much greater importance to diagnostic ability and overall quality of care. Moreover, to the extent that choice of physician is influenced by the cost of the physician's services, the variability in other components of that total cost -- such as the cost of the consultation itself and the cost of laboratory tests -- may swamp differences in prescription costs. Finally, patients themselves are not knowledgeable about the availability and relative prices of different brands within a generic entity and therefore may not

---

14/ In 1980, 79.9 percent of multi-source prescriptions specified a brand. This figures is a weighted average for 45 multi-source drugs.

The remaining 20.1 percent were written generically. Regardless of whether the law permits substitution on brand-written prescriptions, selection of a particular product is necessarily left to the pharmacist and the consumer when the prescription has been written by generic name only.

15/ Bond and Lean (1977).

16/ See discussion and references in FTC Staff Report (1979, pp. 64-67).

notice when the physician's prescription is not the best alternative available.[17]

Since physicians are an unlikely force behind a switch to lower-cost brands after the patent period has expired, an erosion of the patent-conferred monopoly must depend on others who have both the power and the incentive to respond to lower prices. That is the role envisioned for the drug product selection laws: to transfer some of this power to pharmacists.[18] Consumers are the ones most interested in a lower price, and pharmacists must respond to consumer demand because of direct competition with other pharmacies on prescription prices. Also, pharmacists have an immediate incentive to dispense a generic rather than a leading brand because typically the retail dollar gross margin on the generic is higher.[19] Anti-substitution laws, then, prevented pharmacists from dispensing the highest-profit products, and DPS laws can be viewed as the removal of a constraint on pharmacists' choices. Under the DPS laws, the profit-seeking drug retailer is more likely to choose a drug product with a lower (wholesale) cost and to sell it to consumers at a price below that of the leading brand. By making use of the pharmacist's interest in higher profits, DPS laws offer consumers the benefit of lower prices.

III. DATA USED IN THIS STUDY

Our primary data are from the National Prescription Audit (NPA) compiled by IMS America, Ltd. and are for 1980; we also make use of some more recent data from various sources. In the

---

17/ See Chapter 3.

18/ Under all state DPS laws, the physician retains the authority explicitly to prohibit substitution on a particular prescription. In almost all states consumers also have the right to refuse substitution.

19/ See Chapter 3. Also, on publicly funded prescription drug programs, such as Medicaid, pharmacies may by the regulations be given an incentive dispense low-cost versions, as is done with the Maximum Allowable Cost (MAC) program which sets reimbursement ceilings for some drugs. Private insurers now also build into their reimbursement schedules incentives for generic dispensing.

1980 NPA, over a million individual retail prescription transactions were recorded from a panel of about 800 retail pharmacies in 48 states and the District of Columbia. For each prescription we have information on the drug product prescribed and the drug product dispensed, and the retail price. We cannot tell, however, whether the physician prohibited substitution. Some data from IMS' 1980 U.S. Drugstore Audit, on drug invoice costs at the pharmacy level, are also used.

From the 1980 data we selected 45 multi-source entities, the definition of a generic entity setting the broadest boundary within which substitution may be permitted.[20] The number of brands within an entity ranged from 2 to over 100. These 45 entities constituted nearly all the multi-source drug entities that appeared among the top 100 entities ranked by dollar sales to drugstores. Of these 45, only 37 turned out to have observations in our sample for both the leading brand and at least one generic. When brand-generic comparisons are made, these 37 drugs are used rather than the entire 45. In addition to cross-tabulations, we used multivariate regressions (generalized least squares for the price analyses and logit for the brand choice analyses) to separate out effects of individual provisions of the laws and to hold constant other economic influences.

IV. RESULTS OF THE STUDY

The aim of the drug product selection laws was to reduce the prices consumers pay at retail for their prescription drugs by shifting some market share from higher-price leading brands to lower-price versions of the drug, and this aim was accomplished. Substitutions are made and average prescription prices do fall. The magnitude of the accomplishment, however, was smaller than might have been anticipated, even when the upsurge in the last few years is taken into account.

20/ Dosage form and strength must also be identical. In some generic entities in some states, substitution is permissible only for selected dosage forms.

Like others before us, we find that substitution has been infrequent. Overall, in 1980 substitution occurred on about 5.5 percent of prescriptions written for a specific brand for which an alternative product was available.[21] When prescriptions for which substitution was legally proscribed are removed, this rate rises to 7.3 percent. Even if approximate adjustments are made for the fact that physicians sometimes prohibit substitution explicitly, the overall substitution rate could not have been higher than 10 percent of all prescriptions eligible for substitution in 1980.[22]

Substitution has been increasing and it is predicted to increase even more. The substitution rate in 1984 was double that in 1980, occurring still on probably less than a fifth of all eligible prescriptions.[23] Consumers, pharmacists, and physicians have presumably been gaining experience and knowledge about both the opportunities for substitution and its desirability. Moreover, the Hatch/Waxman Act of 1984, which makes less costly the introduction of generic products after the expiration of the patent of a leading brand, is expected to evoke a significant increase in the number of generic products on the market. Our overall measures of 1980 behavior, then, are an understatement of the role of substitution in 1985 and beyond.

Even in 1984, however, substitution was relatively infrequent. This is puzzling in light of the incentives both consumers and pharmacists have to substitute. The most likely explanation is lack of clear and accurate information. In particular, it may be that consumers and pharmacists read into the fact that physicians specify a brand a strong preference on the physician's part for that particular brand, even when the physician does not choose to exercise the legal option to prohibit substitution explicitly. The physician may not, in fact, have that strong a preference, but the consumer's or pharmacist's uncertainty deters acceptance of a substitute brand.

21/ Nearly all (95 percent) substitutions were from leading brands to generics.

22/ See Chapter 2.

23/ See Chapter 2.

There are many sources of variation in the frequency of substitution. Substitution rates are very different from drug to drug, from none at all to a maximum, in 1980, of over 20 percent. Substitution was most common for Medicaid consumers and least common for privately insured consumers, with uninsured consumers intermediate. We tested the hypothesis that chain drugstores are more likely to substitute than independents but found that the data did not support it. The extent of substitution varies also from state to state.

One possible source of variation is the specific content of the state laws. Each DPS law is a composite of individual provisions, specifying the design of the physician's prescription pad (making it convenient or inconvenient for the physician to prohibit substitution), stating whether or not cost savings due to substitution must be passed through to the consumer, and regulating other aspects of the substitution process. In 1979 the FTC and the FDA together recommended to the states adoption of a set of specific provisions believed to promote drug product selection most effectively. The FTC/FDA Model Drug Product Selection Act is reproduced in full in Appendix A2.[24]

Some of the individual provisions of the state laws are shown to make a significant difference in the incidence of substitution. The contents of formularies, which prohibit substitution on certain drugs, of course have a substantial impact on overall substitution. Given that substitution is permitted, however, the presence of a (positive) formulary, appears to diminish substitution. The design of the physician's prescription pad is shown to be very important, confirming earlier findings and validating the recommendation of the Model Act. In particular, if prohibition of substitution is made especially convenient for the physician, substitution occurs less frequently because, presumably, physicians prohibit it more often. States which require pharmacists to discuss substitutions with customers have higher rates of substitution, suggesting that where consumers' attention is drawn to the

---

24/ The Commission's recommendations were based in part on the FTC Staff Report (1979).

substitution option, they accept it. Where substitution is mandated, it occurs more frequently in some drugs, although most prescriptions are still dispensed as written. Finally, a requirement that cost savings be passed through to the consumer surprisingly does not seem to discourage substitution, despite the FTC Staff Report's (and our) prediction to the contrary.

Lower average prescription prices through a higher generic market share can result not only from substitution but from other mechanisms as well. While for many drugs substitution is the primary source of the dispensing of generics, in others the dominant source is generically written prescriptions. Because many of the latter drugs are especially high-volume drugs, generically written prescriptions accounted for over two-thirds of all generics dispensed in 1980; of the generic market share of 25.1 percent for the U.S. as a whole in 1980, generically written prescriptions contributed 18.0 percentage points, substitutions 4.1 percentage points, and prescriptions written for specific non-leading brands 3.0 percentage points.[25] Therefore, both dispensing choices on generically written prescriptions and brand-vs.-generic prescribing choices are central in determining generic market share and therefore average prescription prices. Both types of decisions may be affected by the presence of the opportunity to substitute.

The opportunity for substitution may increase the probability that a generic will be dispensed on *generically-written* prescriptions, due to consumers' enhanced knowledge and thereby acceptance of generics. Another link is that the increased possibilities for substitution may induce pharmacies to stock generics in drug entities where otherwise they would have stocked only leading brands and to use these generic products to fill generically written prescriptions that otherwise would have been filled with a leading brand. Our data show that the laws are associated with a slight increase (about 1.5 percent) in the generic share of products dispensed on generically written prescriptions.[26]

25/ See Table 6-3.
26/ See Chapter 6.

Even more vital in determining generic market share are variations in generic prescribing, since nearly 90 percent of all generically-written prescriptions are filled with generic products. Generic prescribing varies a great deal both from drug to drug and from state to state. Our data show that the existence of a DPS law is associated with a higher incidence of generic prescribing, but the interrelationship between DPS laws and generic prescribing is complex and we cannot ascertain how much of the interstate differences are due to the law and how much to other influences.[27]

V. AN ESTIMATE OF THE OVERALL IMPACT OF DPS LAWS

We have estimated the overall price impact of the DPS laws in 1980 by use of multiple regression.[28] Because of our inability to determine how much generic prescribing is influenced by the law, we provide two estimates which bracket the possibilities. Across the 45 multi-source drugs analyzed, the weighted average price decrease is -$.059 per prescription if none of the differences in generic prescribing are attributed to the law and -$.103 if all are. For 1980, the total dollar saving attributable to DPS laws was between $44 and $80 million (1980 dollars), using the two alternate assumptions. This estimate refers only to multi-source prescriptions, but we found no evidence of offsetting price increases on single-source drugs due to the DPS laws.[29] While substantial in absolute terms, this is about one-half of 1 percent of total purchases of prescription drugs through retail outlets, estimated to be $12 billion in 1980.[30]

In light of changes since 1980, our 1980 estimates seriously underestimate the effects of the laws in 1985. Given a doubling of the substitution rate and increases in the number of prescriptions and in the average price of prescriptions, we

---

27/ See Chapter 6.
28/ See Chapter 8.
29/ See Appendix A7.
30/ IMS Research Group (1981, p. 32).

extrapolate from our 1980 results to an estimated total dollar effect of from $130 to $236 million in 1984 (1984 dollars). With the future growth of generics augured by the change in regulatory requirements implementing the Hatch/Waxman Act of 1984, these dollar savings are likely to be even greater in the future.

VI. LIMITATIONS OF THIS STUDY

There are some possible effects of drug product selection laws which our study cannot measure. One effect of increased substitution may be that manufacturers of leading brands will feel pressure to lower their prices (at least relative to what they otherwise would have been.) That is, although an analysis of pricing by pharmaceutical manufacturers is beyond this study, it seems plausible that brand prices will not rise (in response to drug product selection) and will probably fall. The quantity demanded of leading brands, as measured by pharmacy purchases, will decline or at least not rise as rapidly as in the absence of drug product selection. But because this pressure on prices will be manifested over time, our study which is confined to a single year cannot test for it.

This study does establish whether or not the preconditions for any manufacturer response to DPS exist, in that only if the laws do in fact lead to loss of market share will a manufacturer have an incentive to alter pricing policies. Since substitution does occur, although not at a great rate, it seems likely that manufacturer-level prices, especially on leading brands, will decline as a result. Similarly, increased demand by pharmacies for generic products may induce manufacturers to supply generics sooner and in more drug entities. Evidence that the laws have led pharmacies to select within the generic category those products with lower costs suggests that even among generics there has been room for competitive pressure on price.[31] To the extent that manufacturers lower their prices, retail prescription prices may be lowered even more as a result of the drug product selection laws. Since entry into the

---

31/ See Chapter 7.

production of generics is presumably easy, prices for generics are unlikely to rise even if demand is higher.

In fact, the power of drug product selection to lower consumer prices for prescription drugs may be greatest through this effect on manufacturer-level prices. Just as a reduction in the retailer margin on a drug will benefit all consumers, not just those who actually receive substitutions, any reduction in the price of a leading brand as a result of manufacturer-level price reductions will lower prices even for consumers who choose to stick to that brand. Lower prices would be paid not only by consumers in states which permit substitution in the particular drug entity but also by those where the formulary excluded the drug.

We identify two types of possible offsets to the benefits of lower prices resulting from the drug product selection laws. First, a substituted drug might be inferior to the drug prescribed. While this is undoubtedly an issue for some drugs, it is now generally held that for many drugs substitution is possible without loss of therapeutic efficacy. Second, it has been argued that DPS will diminish manufacturers' incentives for research and development and that the consequence will be less drug innovation. Thus, it is argued, although consumers may pay a lower price for a prescription now, they suffer later by the absence of valuable new therapies which the lost profits (on brand-name drugs) would have generated. While it is clear that enhanced substitution opportunities decrease the expected profitability of research aimed at the introduction of new, patentable drugs, and therefore decrease or slow down the introduction of new drugs, the magnitude of this effect is not known.[32] In this study we do not assess the effects of DPS laws on drug innovation and, therefore, their effects on total welfare. Our aim is to contribute one important component to

---

32/ Grabowski and Vernon (1979) conclude that "the effects of substitution laws on innovation incentives are consequential in nature and are highly sensitive to the longevity of patent lives over the ranges considered (i.e., 10 to 17 years.)" They analyze the effects on the expected rate of return on investment in drug research and development by use of alternative assumptions about the length of the effective patent life and the percentage reduction in net income after the expiration of the drug's patent.

such an overall assessment: a test of whether DPS laws lead to lower retail prescription prices.

Our estimate of the effects of DPS laws on retail prices is not intended to be a measure of the impact of DPS laws on overall welfare. As the *FTC Staff Report* points out, most of the benefits are "transfer" benefits, from brand-name manufacturers to consumers. Only a small portion would be a real welfare gain, in the sense of expanded consumption of prescription drugs, for example, from unfilled prescriptions or underprescribing due to the higher prices that prevailed.[33]

VII. CONTRAST WITH PREVIOUS STUDIES OF DRUG PRODUCT SELECTION

This work is distinguished from previous studies of drug product selection in several ways.[34] Earlier studies typically were confined to one or at most several states. Differences in states' experiences were sometimes attributed to an individual provision in the law even though several other provisions may also have differed, as well as economic influences not embodied in the laws. With our nationwide data, we are better able to generalize about states' experiences with specific provisions of the laws.

We offer a fuller discussion of the economic determinants of substitution and of the other effects of drug product selection laws. This leads, for example, to the analysis of brand and generic prices in addition to the price effect of substitution itself. We place substitution in the context of other influences on generic market share and thus on average prescription prices by providing data also on other dispensing decisions and

---

33/ Of an earlier FTC benefits estimate of between $283 and $469 million annually, only $37 to $61 million were not simply transfers. FTC Staff Report (1979, p. 201).

34/ A number of papers have been published by Theodore Goldberg and his associates, based on a major research project centered at Wayne State University. Results of these and other studies are being compiled to be published by the National Center for Health Services Research in Goldberg and Raskin, eds., (forthcoming). We review only briefly some of these earlier results; see Chapter 5.

the prescriber's decision as to whether to name a brand or to prescribe generically.

VIII. OUTLINE OF THIS REPORT

Measures of the overall incidence of substitution in the year of our study, 1980, and more recently, 1984, are reported in Chapter 2, following a description of the universe of prescriptions for which substitution is possible and permissible. The data underlying these and other results are described in Appendix A6, and some detail on state formularies is presented in Appendix A3. Chapter 3 analyzes why substitution might be expected at all and then turns to the puzzle of the surprisingly low incidence of substitution. Chapter 4 reports on several sources of variability in substitution rates: drug identity, customer insurance coverage, store ownership type (chain and independent), and state. Data on the striking differences among drugs in substitution rates as well as prescribing patterns and many other attributes are given in Appendix A5, a table showing data for each of the 45 multi-source drugs included in this study.

Chapter 5 is about the individual provisions of the DPS statutes. First, these regulations are described and hypotheses are developed. The recommendations of the FTC/FDA Model Act are also reviewed. A more detailed discussion of the statutory provisions and a table summarizing them is presented in Appendix A1, and the FTC/FDA Model Act is reproduced as Appendix A2. Also in Chapter 5, a multiple regression logit model used to analyze the effects of major legal provisions on the probability of substitution is presented and the results reported. Some data on the legal provisions classified in greater detail are given in Appendix A4, and additional technical discussion of the regression procedures used is found in Appendix A7.

In Chapter 6, variations in overall generic market share and its components are discussed. Generic prescribing is emphasized because of its importance in explaining variations in generic market share. Multiple regression is used in Chapter 7 to address the question of whether the DPS laws have affected

the retail prices of individual leading brands and generic products.

In Chapter 8, multiple regression is used to estimate the DPS laws' effect on the average retail prescription price in 1980. These estimates are then projected to the total volume of multi-source prescriptions. The last chapter, Chapter 9, summarizes our findings and returns to the issue of the performance of prescription drug manufacturers and retailers viewed as an integrated system.

CHAPTER 2

THE INCIDENCE OF SUBSTITUTION

Substitution occurs on only a small proportion of prescriptions. We report summary data for 1984 and look at 1980, the year analyzed in this study, in more detail. One reason is that in 1980 only about a third of all prescriptions were eligible for substitution, but even for eligible prescriptions, the substitution rate was low. Data on the past probably understate the future role of substitution, since substitution rates have been increasing rapidly and the recent passage of the Hatch/Waxman Act may lead to more rapid entry of generic products.

I. OVERALL RATES OF SUBSTITUTION IN 1984

According to IMS' most recent figures, substitution occurred on 5.4 percent of all new prescriptions during the first half of 1984.[1] When the base is taken as only those new perscriptions which were written for a specific brand of a multi-source

---

1/ Chappell (Oct. 1984, p. 31). Chappell is a vice-president of IMS America, Ltd.

It has been suggested that the IMS methodology systematically underestimates the extent of substitution. Shopping studies by McKercher (1980) and Morgan and Kagan (1984) find much higher rates than those found in studies using an auditing methodology, such as that used by IMS. IMS itself alludes to possible underreporting: "While the actual volume of substitution may be underreported in the NPA, we continue to see a believable trend." IMS America, Ltd., "1983 Review" (1984, p. 48). Other estimates of overall generic market share, obtained from representatives of several major drugstore chains and from financial analysts as reported in national publications, when taken in conjunction with patterns of prescribing and dispensing shown by IMS' NPA, are consistent only with higher rates of substitution. By a very rough computation, we estimate that with the maximum possible understatement by IMS would require a doubling of their reported substitution rates. Even if there is understatement, however, it would not affect the validity of our 1980 cross-sectional results unless the understatement occurred in some biased way, and the maximum adjustment would raise 1984 substitution rates only to the level of "modest" rather than "low".

drug -- conditions necessary for substitution to be a possibility -- the rate is 9.5 percent.[2] If all the criteria for eligibility for substitution could be taken into account, as discussed below in the context of our 1980 data, the rate would be somewhat higher.

II. DATA USED FOR 1980 SUBSTITUTION RATES

Except for the summary figures for 1984, the substitution rates in this and subsequent chapters are computed from detailed data from IMS' 1980 National Prescription Audit (NPA).[3] Measures of overall substitution in 1980 provide the context for our detailed cross-section analysis, which utilizes the 1980 data.

We used only a portion of the entire 1980 NPA data set. The 45 multi-source drug entities we used were all of the top 100 entities which were multi-source except for the elimination of entities in which there was no single strength (in milligrams) tablet or capsule for oral consumption which had at least 500 observations; 5 multi-source entities with data problems were also eliminated.[4] We further delimited the sample by selecting for each entity a single solid oral dosage form, a strength, and the top five prescription sizes in numbers of tablets or capsules. (See Appendix A6 for further description of the data and the sample.)

For this report, substitution is defined as the dispensing of one manufacturer's or distributor's product when the prescription has named a different firm's version of the same drug

---

2/ Chappell, p. 30.

3/ The 1980 and 1984 rates are therefore subject to two possible sources of understatement: 1) undermeasurement of substitution due to IMS' data collection methodology; and 2) failure to exclude from the base, because of lack of data, those prescriptions on which physicians prohibited substitution. See discussion in footnote 1 and section III below.

4/ Drug rank was determined by total dollar sales to drugstores, based on data from IMS' U.S. Drugstore Audit; the list of top entities was provided to the FTC by the Health Care Financing Administration. The identification of entities which are single-source was based on number of suppliers listed in IMS' coding manuals for its NPA.

entity (in the same dosage form and strength.)[5] This includes substitution from one leading brand to another, or from one generic brand to another, as well as from a leading brand to a generic. Thus the term "substitution" is more inclusive than "generic substitution," which refers only to those substitutions from a leading brand to a generic. In fact, nearly all substitutions (94.1 percent in 1980) are from a leading brand to a generic, where "generic" is used to include all brands other than those which are among the top 200 products prescribed or which are named on at least 20 percent of the prescriptions in the specific drug entity.[6]

The summary substitution rates in this report use as a base prescriptions for 45 leading multi-source drugs in all states. They are weighted averages of the 1980 substitution rates for each of the 45 drugs. Unless otherwise indicated, the weights used are the shares, for each drug, of the number of new and refill prescriptions for solid oral dosage forms of the drug in the United States in 1980.[7]

By our estimate, in 1980 substitution occurred on 5.5 percent of prescriptions written for multi-source drugs for which a brand was specified and for which substitution was therefore a possibility, for the 45 leading multi-source drugs used in our study. IMS' published substitution rates for 1980, based also on the NPA, were 5.1 percent of all new multi-source brand-written prescriptions, or 2.78 percent of all new prescriptions.[8]

5/ Where the product actually dispensed was not recorded, there is no way to judge whether a substitution was made. We exclude such observations from our analysis of substitution.

6/ The list of the 200 most frequently prescribed products is published annually in the April issue of Pharmacy Times, based on IMS's NPA. See Appendix A6 for discussion of these definitions.

7/ See Appendix A6 for discussion of these weights.

8/ Chappell (Oct. 1984, p. 30). The difference between our estimate (5.5 percent) and the published IMS summary estimate (5.1 percent) is due to the fact that our computation is based on only a portion of the data used for the IMS summary. We also weight the data by each drug's share of U.S. prescription sales, weights which may differ from those used by IMS. If instead we use as weights the share of dollar retail sales of each of the 45 drugs, the substitution rate is somewhat lower: 4.7 percent as compared to the 5.5 percent. That is, of all dollars spent (on these 45 multi-source entities), 4.7 per cent were associated with substitutions. The difference between these two rates reflects

The 1984 figures given above are based on the same IMS data base and are IMS' own published summaries. Comparing the 1980 and 1984 figures shows that the rate of substitution approximately doubled over those four years.[9]

III. PRESCRIPTION ELIGIBILITY FOR SUBSTITUTION

One reason that substitutions constituted only 3 percent of all new prescriptions in 1980 is that drug product selection laws enlarge the pharmacist's ability to choose which brand of a drug to dispense only under very special circumstances. There are five criteria for a prescription to be eligible for substitution. Because each of these requirements shrinks the proportion of prescriptions for which substitution can be considered, in the end only about a third of all prescriptions are candidates for substitution.

First, no substitutions are possible for single-source products such as new products still under patent protection. In 1980, the year we studied, multi-source prescriptions -- for generic entities in which at least two products were available -- accounted for a little over two-thirds of new prescriptions.[10] Because of the success of some newly introduced and therefore still patent-protected drugs, the single-source share of prescriptions is higher in 1984.[11]

---

the fact that substitution was more frequent on less expensive drugs. Our definition also excludes from the denominator those prescriptions for which the brand dispensed was not identified, .2 percent of brand-written prescriptions.

9/ Another source, Market Measure Inc., confirms the trend. According to the Market Measures' National Substitution Audit, the percent of all new retail prescriptions on which substitution occurred rose from 0.65 percent in March 1977 to 4.70 percent in March 1983. See Zeich (1983).

10/ IMS Research Group, "1980 Review" (1981, p. 21). Of all new prescriptions, 31 percent were for single-source drugs, the remaining 69 percent for multi-source. Of the top 100 drug entities in 1980, 41 were offered by only one supplier.

11/ The share of prescriptions written for single-source products rose from 31 percent in 1980 to 35 percent in 1982, and there was a concomitant drop in the number of the top 200 leading brands which are in multi-source entities, from 152 in 1980 to 144 in 1982. IMS America, Ltd., "1982 Review" (1983, pp. 43-45). Chappell comments on the continuation of the same trend (Oct. 1984, p. 30).

Second, the prescription for the multi-source drug must name a particular brand of a drug. By definition, substitution is not possible on a generically written prescription because any brand may be used in filling it.[12] In 1980, 80 percent of multi-source prescriptions named a particular brand.[13] Although until recently there had been a trend towards more generic prescribing, the data for 1983 reported by IMS suggest a reversal; even for the older antibiotics, which account for much of the generic prescribing,[14] a smaller percentage of prescriptions were written generically in 1983 than in 1982.[15]

Third, the state in which the prescription is filled must not have a general anti-substitution law. As of now, all states permit some substitution, but until this year one of the major sources of growth of prescriptions for which substitution was possible was the spread of additional state drug product selection laws. In 1980, three states prohibited all substitution: Indiana, Texas, and, until October when its substitution law went into effect, Louisiana.[16] These three states accounted for 8.7 percent of the 1980 prescriptions studied.[17]

Fourth, the state law must not only allow substitution in general but substitution on prescriptions for the particular drug must be permitted by the formulary. In 1980 almost two-

---

12/ Some state drug product selection laws regulate which products may be dispensed on generically written prescriptions, in some cases restricting the choice to certain products listed on the drug product selection formulary and in some cases specifying that the product dispensed must be one with a low cost, variously specified. See Chapter 5.

13/ In the 45 leading multi-source entities we analyzed, 20.1 percent of prescriptions were written generically.

When this second criterion was met, 54 percent of all prescriptions were eligible for substitution in 1980.

14/ Generically written prescriptions are concentrated in certain drug categories; over half of all generically written prescriptions were for antibiotics, according to IMS' NPA for January-June 1984. Chappell (Oct. 1984, p. 29).

15/ Chappell (Oct. 1984).

16/ Oklahoma's 1961 law can be read to allow substitution within a generic entity but has also been sometimes characterized as an anti-substitution law. Its language is far less clear in permitting substitution than most of the newer laws. We treat Oklahoma as allowing substitution.

17/ The exclusion of these three states reduced the 1980 opportunity for substitution to 49 percent of all prescriptions in the United States, or 71 percent of multi-source prescriptions.

thirds of the states with drug product selection laws had formularies which imposed selected restrictions on substitution. Formularies vary from allowing substitution on nearly all drugs to prohibiting substitution on many.[18] When all states permitting substitution on some or all multi-source drugs are taken together, our data for the 45 drug entities studied show substitution permitted on 80.6 percent of all multi-source brand-written prescriptions in 1980, disallowing substitution on the remaining 19.4 percent.[19]

Fifth, since in every state the physician retains the right to prohibit substitution on a prescription, substitution is possible only when the physician has not ruled it out. In many states, such prohibitions occur less than 5 percent of the time but in others the incidence seems to be as high as 60 percent.[20] One reason for this striking difference in physician behavior is the mandated design of the physician's prescription pad -- whether prohibition is made easy or difficult.[21] This seemingly minor factor operates in conjunction with habitual behavior on the part of prescribers. There is some evidence suggesting that physicians "more often exercise their

---

18/ See Appendix Table A1-1.

19/ When formulary restrictions are added to the restrictions previously discussed, only 39 percent [80.6 percent of the previous 49 percent] of all prescriptions, including those for single-source drugs, were eligible for substitution in 1980. Alternatively, when formulary restrictions are taken into account, substitution was possible on 74 percent of all brand multi-source prescriptions in 1980 [80.6 percent times the 91.3 percent in DPS states.]

If all states permitted substitution, as was true by 1984, the comparable figures would be 81 percent of brand-written multi-source prescriptions and 43 percent of all prescriptions.

20/ Three reviews of multiple studies are: 1) Goldberg and DeVito (1981); 2) Gurley and Gagnon (1981); and 3) Traxler and Siegenthaler (forthcoming). Another cross-state analysis is an article based on survey data compiled by Market Measures (Zeich, 1984). Zeich states that the numbers are based on prescriptions for 13 varied products in a sample of retail stores (about 100 in all) in New York and Pennsylvania -- both two-line signature-pad states -- in early 1982. The rate of physician prohibition in those two states had been somewhat higher in a 1978-79 survey, when six other states were also surveyed. The other states had prescription forms less conducive to physician prohibition of substitution. Zeich's estimate of a 5 percent rate in one-line states is based on the earlier survey.

21/ See Chapter 5 and Appendix A4 for discussions and evaluations of prescription pad formats.

'veto' because they oppose product selection as an intrusion into their professional autonomy than because of possible medical concerns about a particular drug product."[22] For example, prohibitions occur with about the same frequency across all drugs, regardless of their therapeutic category, and equally often for single-source drugs, and on generically-written prescriptions as well, even though for the latter two categories substitution is by definition impossible and therefore a prohibition of substitution makes no sense.[23] If physicians prohibited substitution on 10 percent of prescriptions -- a rough figure -- 35 percent of all prescriptions were eligible for substitution in 1980, or 67 percent of brand-written multi-source prescriptions.[24]

When all of these restrictions are taken into account, substitution was an option available on about two-thirds of all brand-written multi-source prescriptions. This is equivalent to about one-third of all prescriptions in 1980.

Figure 2-1 shows how the new 758,000 prescriptions audited by IMS in 1980 yielded only 414,000 prescriptions on which substitution was possible (disregarding physician prohibitions and state laws and formularies.)[25]

22/ FTC Staff Report (1979, p. 275).

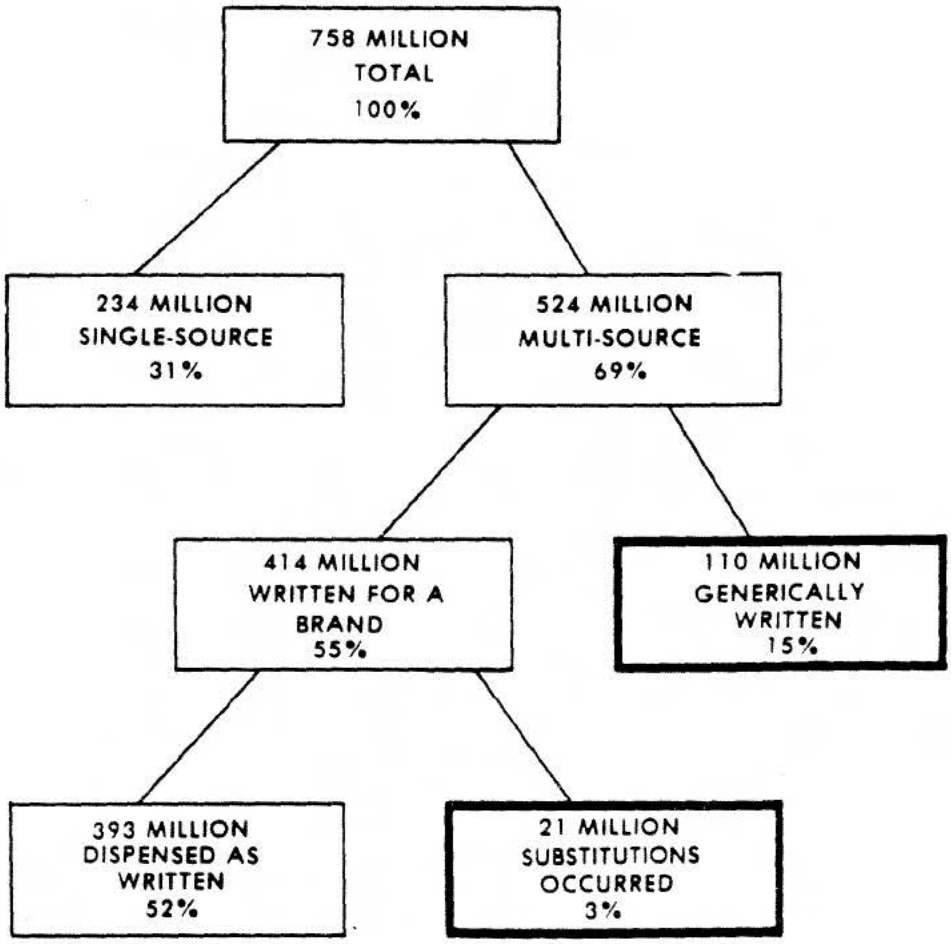
23/ Ibid. (1979, pp. 275-278). A recent study of Kentucky's experience confirms this pattern. "In fact, the prohibition of substitution was slightly greater for prescription orders for single-source entities -- where no product choice is possible -- than for multiple-source prescription orders -- where some product choice is possible, 6.4% versus 5.3% respectively. Prohibition of substitution even occurred to a certain extent (4.6%) on generically written prescriptions, where the prescriber had not indicated a product choice and the pharmacist had to select a product to dispense." DeVito (1982).

24/ If all states permitted substitution the comparable figures would be 36 percent of all prescriptions, or 53 percent of brand-written multi-source prescriptions.

25/ This IMS ratio is 55 percent of all new prescriptions, higher than ours because of the several major restrictions on substitution not being taken into account.

FIGURE 2-1

New Prescriptions, 1980:
How Prescribed and How Dispensed



SOURCE: IMS Research Group, IMS America, Ltd., "The U.S. Pharmaceutical **Market** 1980, **A Review,"** Ambler, Pa., 1981, p. 21.

IV. SUBSTITUTION ON ELIGIBLE PRESCRIPTIONS IN 1980

What is even more striking, then, is that even of the prescriptions which met all five criteria for a prescription to be eligible for substitution in 1980, fewer than 10 percent were substituted.[26] Based on their own research at about that time, Goldberg and DeVito concluded:

> It may be a bit of an exaggeration, but it seems fair to conclude that consumers generally do not request substitution, physicians generally do not prohibit substitution, and pharmacists generally do not substitute. It seems apparent that relative apathy has prevailed on all sides.[27]

Specifically, according to our 1980 data for 45 multi-source drugs, 7.3 percent of all prescriptions meeting the first four criteria -- multi-source brand-written prescriptions on which both state statute and formulary permitted substitution -- were substituted. If we make a rough adjustment for the fifth criterion, the incidence of physician prohibitions, for which we lack data, the 7.3 percent would imply about a 8.1 percent rate if physicians prohibit substitution on 10 percent of multi-source brand-written prescriptions. The basic conclusion must be that substitution fell far short of the maximum potential of 100 percent.

V. THE EFFECT OF DRUG PRODUCT SELECTION LAWS ON SUBSTITUTION

Table 2-1 summarizes the differences in the overall rates of substitution in 1980 according to the legal opportunity to

---

26/ See computations in following discussion.
27/ Goldberg and DeVito (1981, p. 79).

TABLE 2-1

Overall Substitution Rates,
by Legal Opportunity to Substitute, 1980[1]

	Substitution illegal (According to either general statute or formulary)	Substitution legal	Both
States without DPS law	0.4%	N/A	0.4%
States with DPS law	1.8	7.3	6.0
All states	1.4	7.3	5.5

1/ The base is brand-written multi-source prescriptions. The row and column headings define the pool of prescriptions for which the substitution rate is computed. For example, the figure in the second row and first column indicates that substitution occurred for 1.8 percent of all brand-written multi-source prescriptions written in states with DPS laws but for which substitution was nonetheless illegal (because substitution on prescriptions for the drug was prohibited by state formulary.)

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

substitute.[28] Two types of comparisons are useful. First, all prescriptions for multi-source drugs are used as a base. Second, only those prescriptions for which substitution is permitted according to the state's formulary are used as the base. On the one hand, to compare substitution across all drugs is to ignore the formulary restrictions and therefore to understate the rate of substitution when it is allowed. On the other hand, a comparison of substitution on prescriptions

28/ As explained above, these substitution rates understate substitution as a percent of eligible prescriptions because prescriptions on which the physician has prohibited substitution cannot be excluded from the denominator in the data which we used. For the remainder of the report, however, the substitution rates reported will be those based on the IMS 1980 data, the overall average of which is 7.3 percent.

in states with formularies (i.e., some of the states with DPS laws) and substitution on prescriptions in states without formularies (including any state prohibiting substitution) makes the substitution-prohibited prescriptions appear to have substitution rates *relative to* the substitution-permitted prescriptions lower by more than would be true had the formularies been the same in all states. States with formularies tend to prohibit substitution on precisely those drugs for which substitution would have been relatively infrequent if it had been allowed.

Thus, using as a base prescriptions for only those drugs for which substitution is allowed tends to overstate the substitution rates that would prevail if substitution were allowed on prescriptions for all drugs.[29]

In states with DPS laws substitution occurred on 7.3 percent of all eligible prescriptions as opposed to 1.4 percent of perscriptions where substitution was illegal.[30] When

---

29/ Tests of statistical significance are not reported on this table nor on following tables for several reasons. First, in many comparisons, the differences are large and would obviously meet conventional tests of significance. Second, even for small differences the extremely large number of observations underlying each measure means that the estimate of the variance of the proportion is extremely small and therefore the value of t for the difference between two proportions is extremely large. For example, the 0.4 percent estimate in the first column is based on 14,774 prescriptions, the 1.8 percent estimate on 29,903. The value of t for the difference between these two proportions (drawn from independent populations) is 17.5. Third, a number of the relationships portrayed in cross-tabulations are tested again in the context of multiple regression analysis of substitution decisions and of prices, reported in Chapters 5, 7 and 8. Statistical tests of all coefficients are reported there.

30/ It is evident that substitution, as measured with our data, is not totally absent even when statute or formulary forbids it. There are several possible explanations for the "apparently illegal" substitutions. One, of course, is simple non-compliance with the law. A second is mistakes in coding the data, whether at the pharmacy level, in IMS' transcription, or in our coding of the formularies. A third possible explanation is that a physician may give selected pharmacists blanket permission to substitute on certain drugs, telling the pharmacies in effect to treat certain brand-written prescriptions as if they were written generically. This permission may be recorded in writing.

Although a formulary has the appearance of great precision, in practice there are some ambiguities. Therefore, for some drugs there may be reasonable differences in interpretation as to whether substitution is permitted. In seeking clarification of states' formularies with state Boards of Pharmacy, we

substitution computed across all 45 drugs are used as a basis for comparison, the resulting 6.0 percent in the 47 states where a general DPS statute was in effect in 1980 is an order of magnitude larger than the 0.4 percent rate in states where the statute prohibited all substitution. There can be no doubt that DPS laws have led to more substitution.

VI. THE UPWARD TREND IN SUBSTITUTION

Since 1980, the trend in substitution has been steadily and strongly upward, with the rate of substitution on all new prescriptions rising from 2.78 percent in 1980 to 4.29 percent in 1982, to 4.91 percent in 1983, to 5.4 percent during the first half of 1984.[31] Some of this increase is due to changes

---

were frequently told that since neither complaint nor request for advice had been received about the specific drug, no determination had been made and therefore the law was not well defined. This was true especially in states which tied their formularies to the FDA list of therapeutic equivalents. That list left some ambiguities, since the FDA gave no equivalency ratings for drugs marketed prior to 1938 (and therefore not subject to the pre-market clearance procedure) for drugs marketed between 1938 and 1962 that were approved for safety but not effectiveness and were still being reviewed under the administrative procedures of the Drug Efficacy Study Implementation (DESI) program (e.g., isosorbide dinitrate, nitroglycerin, dipyrimadole). Thus a state which generally allowed substitution on drugs rated "A" in the FDA list and prohibited it on drugs rated "B" had neither rating to guide decisions on unrated drugs. The same was apparently true for "old" drugs, i.e., those marketed before the imposition of the New Drug Application regulations; these also are unrated. (The FTC/FDA Model State Act handles this problem by suggesting that states following the FDA "Therapeutic Equivalents" list add to it all drugs not subject to FDA approval for safety and efficacy, drugs approved only for safety prior to 1962, and drugs marketed prior to 1938.)

An analysis of actual substitutions in our data which were apparently prohibited by formulary suggested that confusion about the formulary may have been involved. There were, for example, instances where the formulary and prescription referred to slightly different dosage forms, or where one specified a single-entity prescription and the other a combination. Borderline misinterpretations of the formulary cannot, of course, explain the substitutions in the three states prohibiting substitution altogether, but they may be one reason why there are more "apparently illegal" substitutions in states permitting substitution generally, many with formularies, than in the three baseline states.

31/ Chappell (Oct. 1984).

in the proportion of all prescriptions eligible for substitution, but most of it seems due to an increased exercise of the substitution option when it is available. When the base is taken as all multi-source brand-written prescriptions, this rate has also nearly doubled between 1980 and 1984.[32] If, as for 1980, we use as a rough adjustment a 10 percent rate of physician prohibitions and assume equivalent formulary coverage, the 8.1 percent substitution rate on wholly eligible prescriptions estimated for 1980 would be estimated to have risen to nearly 15 percent in 1984.

There is good reason to expect substitution to continue to increase. Acceptance by prescribers, dispensers and ultimate users can be expected to continue to grow, and local advertising of generics programs by drug chains will spread awareness of the advantages of substitution to consumers. Market Measures, a marketing research firm, suggests that substitution "will continue to increase at a rate of 15% to 20% yearly for the next [few] years."[33] IMS also predicts that substitution rates will probably continue to rise and that the absolute volume of prescriptions on which substitutions are made is even more certain to grow.[34]

A number of important patents are due to expire soon; if new entry follows, there will be further opportunity for drug product selection. The Hatch/Waxman Act, passed in 1984, permits more rapid entry of follow-on products, after patent expiration, for drugs approved by the FDA since 1962.[35] At the time this bill became law, there were a number of drugs with large sales already off patent where no competitor had entered to challenge the pioneer brand. The largest of these was Dyazide, a brand name for the combination drug triamterene with hydrochlorothiazide, with 1983 sales of over $200 million, off patent since 1980.[36] There is now a competing version of this

---

32/ Chappell (Oct. 1984, p. 31).

33/ Zeich (1983, p. 73).

34/ IMS America, Ltd., "1982 Review" (1983, p. 45).

35/ Hatch/Waxman Drug Price Competition and Patent Term Restoration Act of 1984.

36/ Data for the drugs named in this paragraph are taken from "Pillbox War . . .," Wall Street Journal (August 13, 1984, p. 1).

combination. Other off-patent drugs are now more likely to face competing brands. The patent for chlordiazepoxide (Valium), with 1983 sales of $250 million, expired in 1985, as did the patent for ibuprofen, sold as Motrin, with 1983 sales of $185 million. The patent for chlorpropamide, sold under the name of Diabinase, with a $125 million market, expired in 1984. In addition, a number of the top-selling drugs are due to go off patent soon. By one count, there were 44 major drugs accounting for $2.5 billion in sales in 1983 due to go off patent by 1988.[37] The opportunity for generic entry, in combination with a less costly FDA approval process, suggests that the generic market share will increase substantially.

VII. CONCLUSION

By 1984, substitutions were occurring on a moderate proportion -- perhaps 16 percent -- of eligible prescriptions. These rates represent both an economically important change from the anti-substitution era and, at the same time, a refusal of the substitution option on most of the opportunities available.

Substitution activity has doubled in the four years since 1980 and there are strong indications that it will continue to grow. The Hatch/Waxman Act of 1984 makes entry of generics less costly. The forecast of more generic products on the market will mean a broader scope for substitution.

Substitution is possible on only about one-third of all prescriptions. Formularies and physician directives prohibit substitution on some prescriptions, and many prescriptions are written either generically or for single-source drugs, in either case making substitution impossible. Because of these criteria for eligibility for substitution, substitutions were made on just over 5 percent of all new prescriptions in 1984.

37/ "The Shift to Generic Drugs," New York Times (July 23, 1984, p. D5).

The remainder of this study is an analysis of substitution patterns in 1980, based on IMS' National Prescription Audit. According to our data for 1980, substitution occurred on 7.3 percent of eligible prescriptions; a reasonable adjustment for physician prohibitions raises the rate to 8.1 percent. These substitutions constituted about 3 percent of all new prescriptions.

CHAPTER 3

WHY ISN'T SUBSTITUTION PREVALENT?

The leading brand in a generic entity nearly always is sold at a higher price than other versions of the same entity, and typically the price difference is large. This opportunity for consumer savings is what propelled the movement towards drug product selection laws.[1] Nevertheless, substitution is not the common practice. In this chapter we address this puzzle. Although we do not have direct tests of hypotheses about the infrequency of substitution, we do have some suggestive indirect evidence.

I. INCENTIVES FOR SUBSTITUTION

The retail price differential is clearly large, as Table 3-1 shows. In all but three of the 37 drug entities summarized in the table, the price of an average prescription of the leading brand was greater than the price of an average prescription of other brands, and in one of these three the difference is reversed when prescriptions of the same size are compared.[2]

Can the infrequency of substitution be explained by financial disincentives to substitute on the part of pharmacists? On the contrary, pharmacists too have incentives to substitute. If consumer prefer generics due to their lower

---

1/ This discussion is cast in terms of consumers who are not insured for out-patient prescription drug costs. The effects of Medicaid and other private insurance are discussed in Chapter 4. In fact, 80 percent of the prescriptions in our sample were for "cash" customers, although some of these customers undoubtedly had insurance coverage of which the pharmacist was unaware.

2/ See Appendix A6 for discussion of these three anomalies.

TABLE 3-1

Brands and Generics:
Retail Prices, Invoice Costs, and Retail Dollar Gross Margins, 1980

	Brands	Generics	Brand-Generic Difference
Retail Price	$8.22	$6.22	$2.00
Invoice Cost	4.86	2.65	2.21
Retail Dollar Gross Margin	3.35	3.57	- .22

1/ The numbers are sales-weighted averages across the 37 drugs where both leading brand and generic were dispensed, with the standard weights (solid oral dosage form, number of prescriptions) across all states. Data for individual drugs are given in Appendix A5. The nature of the data is discussed in Appendix A6.

SOURCE: Computed with data from the 1980 IMS National Prescription Audit and the 1980 IMS U.S. Drugstore Audit.

prices, then retailers who substitute will profit by drawing business away from competitors.[3] Moreover, the retail dollar gross margin earned on a generic version is typically higher than that on the leading brand,[4] so that even on the individual transaction substitution to a generic is more profitable than dispensing the brand as written. As Table 3-1 shows, the generic price is, on average, lower than the brand price by less than the difference between their invoice costs; the dollar gross margin was higher on generics than on brands for

3/ One study showed, however, that a higher level of competition between retail pharmacies was not associated with increased substitution. Kralewski et al. (1983).

4/ Retailer dollar gross margin is defined as the difference between the retail price and the invoice cost of the product.

23 of the 37 drug entities.[5] We regard these estimates of the differences between brand and generic margins as being conservative. As discussed in Appendix 6, we have reason to believe that our data overstate invoice costs and moreover overstate the invoice costs of generics more than the costs of brands; if this is true, the gross margins on generics is understated by more than the gross margins on brands.[6]

To investigate the role of margins in the substitution decision directly, we compared the retail margins when, first, the leading brand named on the prescription was in fact dispensed and, second, when a generic version was substituted for the designated brand. As shown in Table 3-2, gross margins are higher for 7 of the 10 top-substitution drugs.[7]

That gross margins are higher on the generic versions of prescription drugs is not surprising. On products or brands on which consumers are most sensitive to price differences, gross margins can be expected to be lowest. The more price information consumers have and the greater the incentive to patronize a low-price store, the greater the competitive pressure on prices and therefore on margins. Where a leading brand of a prescription drug has large sales, there is simply more information about it afloat in the market than on a product purchased less frequently. Consumers can compare price more easily on a well-known prescription brand: it is easier to ask a friend who takes the same brand of medication about the price paid; it is easier to find its price from an in-store price poster; and it is possible to telephone several stores and

---

5/ A one-tailed binomial test of the 23:14 split of signs is significant at the 10-percent level. This comparison is for prescriptions of a standardized size (for each entity.) These computations are across all legal regimes.

6/ Indeed it is possible, as one chain executive to whom we spoke believes, that gross margins are actually greater on generics than on brands in nearly all drugs.

7/ The three exceptions are drugs where the cost data used (or, in the case of amoxicillin, the categorization of brands and generics) are especially suspect.

TABLE 3-2

Retail Dollar Gross Margins[1] on Substituted and Non-substituted Prescriptions for the 10 Top-Substitution Drugs,[2] 1980

Drug	Brand Prescribed, Brand Dispensed	Brand Prescribed, Generic Substituted
Hydrochlorothiazide	$2.98	$3.55
Chlordiazepoxide	2.66	3.74
Amitriptyline	6.25	4.01
Penicillin VK	3.52	3.60
Amoxicillin	4.21	3.50
Atropine sulfate/ Diphenoxylate	2.96	3.32
Meclizine	3.39	3.79
Isosorbide dinitrate	2.88	3.64
Hydralazine/Hydrochloro-thiazide/Reserpine	3.02	2.13
Doxycycline	3.54	5.32

1/ For each drug, the gross margins were compared for an average-sized prescription. The substitutions are only those where a generic was dispensed.

2/ The ten drugs are listed in descending order by substitution rate.

SOURCE: Computed with data from the 1980 IMS National Prescription Audit.

specify exactly the product on which the price quotation is sought. In contrast, it is both more difficult to ask two stores their prices on a generic with a longer and unfamiliar name, and it is more difficult to be sure that the two products would have the same therapeutic effect. Because price competition is more intense on leading brands, prices are held by competition nearer the costs of providing the product, and therefore gross margins are lower on leading brands than on the

less well-known generics.[8] Finally, since drawing a customer to the store for a particular product is likely to yield additional sales of other products, the multi-product nature of the retailer magnifies the pressure on the margin of a leading brand.[9]

This ranking of gross margins is common in other product lines as well. In retail supermarkets, for example, private label brands or store brands typically have higher gross margins than products which are heavily advertised nationally. Well-known products are often featured in retail advertising with temporary low prices, because it is these products which attract the attention and therefore the patronage of customers. Albion summarizes a large number of studies by Steiner and others by saying, "all these studies have shown the expected inverse relationship between advertising and gross margins, excepting a few of both Borden's and Preston's findings in food products." Albion reports his own data to

---

8/ This argument is similar to, but not exactly the same as, saying that the elasticity of store-level demand is higher for leading brands than for less well-known products, and, given the inverse relationship between demand elasticity and profit as a percent of sales, gross margin is lower where elasticity is higher: MR, marginal revenue, is equal to P(1-[1/e]), where P is price and e is price elasticity of demand. Since a profit-maximizing firm sets marginal cost (MC) equal to marginal revenue, MC = P(1-[1/e]). Algebraic manipulation gives (P-MC)/P = 1/e, which states that the retailer's gross margin is inversely proportional to the elasticity of demand.

There are two important distinctions between this familiar simple model and the application to an analysis of the competition between retail pharmacies when substitution is permitted. First, it is a comparison of the dollar gross margins, not the percentage gross margins, which establishes the pharmacy's incentive to substitute. Second, the inverse relationship between elasticity and percentage gross margin is strictly accurate only for products with independent demands, whereas a central feature of the present problem is the interdependence of brand and generic demands, a considerably more complicated problem. However, when interdependent demands are taken into account an equivalent result can be shown, as in Lynch (Jan. 1983, Sept. 1983): that if a retailer sells both brands and generics (actually, high-profile and low-profile products), in equilibrium the dollar gross margin of the generic is higher than that of the brand.

9/ Holton (1957).

"show that, on average, the highly advertised brands sell for gross margins that are 22 percentage points lower than the unadvertised brands and 12 percentage points lower than the less advertised brands."[10]

II. WHY THERE IS SO LITTLE SUBSTITUTION

Why, in the face of the brand-generic differentials in both retail prices and gross margins, is there so little substitution? The contrast between the fact that in 1980 generics were dispensed on nearly 90 percent of generically written prescriptions, where the doctor had not named a brand, but were dispensed on no more than 15 percent of brand-written prescriptions on which substitution is possible and permissible -- two situations which are legally nearly identical -- allows us to set aside some possible explanations for the infrequency of substitution.[11] First, generics are clearly viewed as appropriate for a substantial number of prescriptions. Overall, according to our data, consumers bought generics for 25 percent of their multi-source prescriptions in 1980, physicians wrote 20 percent of multi-source prescriptions by the generic name in 1980, and pharmacists dispensed generics on nearly all of these generically written prescriptions.[12] Second, since pharmacists routinely dispense generics on generically written prescriptions, the absence of a generic in inventory cannot explain

---

10/ Albion (1983).

11/ State laws frequently impose some extra regulations on substitutions (e.g., requiring that the customer be informed of the substitution) and occasionally on generically written prescriptions (e.g., requiring that the product dispensed be below average wholesale cost in the drug entity.) Also, substitution choices are more commonly constrained by a formulary than are choices for generically written prescriptions. Therefore the two types of transactions are not identical before the law.

The contrast in dispensing patterns is present when drugs are analyzed individually. See Appendix Table A5-1.

12/ See Table 6-3. Of course, the proportion of prescriptions written and dispensed generically varies from drug to drug, but most multi-source drugs are sometimes prescribed generically and thereupon dispensed generically. Similarly, there may be some individual holdouts against substitutions among health professionals and among consumers.

the overall infrequency of substitution, even though it may be the explanation for failure to substitute in some instances.

What possible explanations remain? The pharmacist may infer from the simple fact that the prescription is not written generically that the consumer does not want a generic. Alternatively, the simple fact that the physician has named a brand rather than written the prescription in generic terms may be taken as a signal of the physician's unspoken preference for the brand, even when the physician has refrained from indicating that only the named brand is legally acceptable. It could be the pharmacist who chooses to honor this unspoken preference, for any of several reasons, regardless of the consumer's wishes, or it could be the consumer's wish to adhere to the physician's brand which prevents the pharmacist from substituting. We discuss these in turn.

A. Generically Written Prescriptions as a Signal of Consumers' Preferences

Pharmacists may infer consumers' distaste for substitution from the fact that the prescription specifies a brand, on the premise that the physician's decision as to whether to write the prescription by the generic name reflects the patient's own preferences. By this theory, customers with generically written prescriptions have already indicated either directly (to the physician) or indirectly (through the choice of a physician who typically prescribes generically) that a generic product is acceptable, and those with brand-written prescriptions have demonstrated their reluctance to purchase a generic. Pharmacists eager to accede to the customer's wishes would honor the preference so expressed. The signal need not be taken as perfect; if most consumers presenting generically written prescriptions prefer the low-cost brand and most consumers presenting brand-written prescriptions prefer the higher-priced leading brand, the pharmacist will not find it worthwhile to risk displeasing the occasional customer whose preference is not signalled by the prescription.

That prescriptions are written generically more often for some types of patients than for others suggests that the choice

is not unilateral on the physician's part. As Table 3-3 shows, customers covered by private insurance received generically written prescriptions 16 percent of the time, compared with 21 percent for "cash" consumers, who had more incentive to buy lower-priced products.

On the other hand, a Food and Drug Administration survey showed that only 3 to 6 percent of patients ask their doctors about how to take the drug prescribed, precautions, or side-effects.[13] If patients fail to ask even about these behavioral and health issues, it seems unlikely that they will challenge the doctor's choice of brand.[14]

The evidence is inconclusive as to whether, or how uniformly, a generically written prescription is a guide to the patient's preference for a generics.

B. Pharmacist's Inference that the Physician Disapproves of Substitution

Pharmacists may infer from the fact that a brand was named that the physician has a strong preference for that brand. Pharmacists' adherence to physicians' implicit wishes is shown by some evidence that substitution is more frequent when the physician's authorization of substitution is explicit rather than implicit. In the period of transition following North Carolina's 1980 adoption of a DPS law, physicians in that state used prescription pads with various formats. Pharmacists substituted much more frequently when the doctor was explicit in permitting substitution (13.1 percent substitution on prescriptions written on double-line pads) than on prescriptions where substitution was impliedly permitted in

13/ Morris et al. (1983).

14/ The physician might know from experience that the particular patient wants prescriptions written generically.

TABLE 3-3

Proportion of Prescriptions Written Generically, by Insurance Coverage, 1980

	Proportion of prescriptions written generically
Cash[1]	20.6 %
Medicaid	20.6
Private insurance	15.8

1/ Presumably some insured prescriptions have been recorded by the pharmacist as uninsured, i.e., cash, since the consumer who files for direct reimbursement may not tell the pharmacist about the insurance.

SOURCE: Computed from data for 45 drugs from IMS' 1980 National Prescription Audit.

that the physician had not explicitly prohibited it (5.4 percent substitution on single-line prescriptions.)[15]

Pharmacists may comply with physicians' brand "preference" because of a conviction that the wishes of another professional

15/ Gurley and Gagnon (1981). Note, however, that our multi-state evidence, reported in Appendix A4, does not confirm the hypothesis that explicit authorization by the physician leads to more substitution. Our test was necessarily indirect and may show only that explicitness does not have an even stronger effect than the convenience to the physician in either permitting or prohibiting substitution.

should be honored.[16] The satisfaction associated with fulfilling this professional role may be great enough to make up for the profits lost from not substituting when consumers would otherwise have accepted substitution. However, we doubt that the American Pharmaceutical Association would have been as active as it was in seeking the repeal of anti-substitution laws if most of its constituency were strongly opposed to substitution. Also, if consumers sought out those pharmacies whose average prices were lower due to substitution, competitive pressures would be felt by those who did not substitute, and the financial cost of choosing not to substitute would rise beyond that of the foregone higher margin on generics. It seems, therefore, that the absence of widespread substitution cannot be fully explained by pharmacists' personal preferences.

It is possible that physicians impose significant financial penalties on pharmacists who substitute. However, physicians do not always learn whether substitutions have been made, and they may not direct patients to one pharmacy rather than another; they may therefore not be in a position to inflict financial penalties on pharmacies whose practices they dislike. Moreover, the physician can always explicitly prohibit substitution on the prescription, obviating the necessity of trying to persuade the patient to patronize selected retail outlets.

16/ In addition to professional or financial concerns about the doctor's preferences, there are other possible reasons for a pharmacist's unilateral decision not to substitute. If dispensing the brand named on the prescription is an ingrained habit, even the time and effort needed to decide whether a substitution is appropriate may seem to be an unacceptable added cost. Concern about liability may inhibit substitution, although the results of the regressions on substitution decisions, reported in Chapter 5, did not confirm the importance of protection against added liability.

C. Consumer Resistance to Substitution

While pharmacists' personal views against the appropriateness of substitution may be one explanation for the infrequency of substitution, it seems that experience with, or at least a belief in, *consumer* resistance to substitution must be a major reason why pharmacists do not substitute. That enterprising pharmacists have not substituted extensively strongly suggests that consumers either have refused substitutions or, if they have accepted them, they have switched to another store for the next prescription, thereby penalizing the substituting pharmacist and convincing others not to try.

The strongest support for the conclusion that consumers have a strong and conscious preference for leading brands is that retail brand prices are well above retail generic prices for nearly all drugs. If instead consumers were unaware or uncaring about differences between brands and generics, pharmacists would be able to charge as high a price for the generic as for the brand.

Real therapeutic differences among brands of a drug may account in some instances for consumers' willingness to pay a premium for a leading brand, but also consumers have very imperfect information about the alternatives. Consumers report being relatively uninformed about either the therapeutic equivalence of various versions of a single drug entity or about prices.[17] In fact, consumers may not even know that a generic alternative for a particular prescription exists. Even after use, it is difficult to judge the merits of a drug product since the cause of a failure to recover quickly from an illness might be the physician's misdiagnosis, or selection of

---

17/ According to The CBS Consumer Model, a national survey done in 1983, consumers rate themselves as being between "not very informed" and "somewhat informed" on the effectiveness of generic prescription drugs; 45 percent said they were "not at all informed."The CBS Consumer Model (1984, p. 14). Consumers reported as "quite important" (4 on a scale of 1 to 5) the need for information on this subject. Consumers considered themselves less than somewhat informed (2.78 where "somewhat informed" was 3.00) on brand vs. generic prescription costs (p. 14.) They considered it between "somewhat important" and "quite important" (3.81) to have such information (p. 15). The CBS survey used a national probability sample of households.

the wrong chemical entity, or a patient's idiosyncratic physiology -- or some problem with the specific brand of the drug selected; prescription drugs are to some extent "credence" goods.[18]

For many consumers, there is little reason to try to learn about alternative brands of a single drug, and search costs may be high. Consumers are constrained from making the choice unilaterally; the best they can do is to influence the physician or the pharmacist. Moreover, at least for a short-term medical problem, it is usually not worthwhile to gather information about the equivalence (or inequivalence) of various brands or about the price difference between the brand and the generic. If therapeutic equivalence is not understood, price differences are less sure to reflect good buys and, conversely, if price differences are not noted, there is little incentive to investigate the appropriateness of substitution. The dearth of prescription advertising directed to consumers raises the cost to consumers of learning about drug alternatives and prices. Also, except for maintenance drugs, the infrequency of purchase means that consumers probably retain little price information.

This incomplete information is likely to bias preferences towards the familiar, frequently prescribed brands. Some consumers may believe that lesser known brands, or drug products sold under the generic name only, are of lower quality or that there is greater variation in the quality, simply because of their lack of prominence. An unknown brand may seem to be accompanied by greater riskiness as to both efficacy in curing the illness and absence of side-effects. The consumer behavior literature strongly suggests that when

---

18/ Nelson (1970) classified consumer goods as "search" goods or "experience" goods. Darby and Karni (1973) added a third category, "credence" goods, for goods (or qualities of goods) "which, although worthwhile, cannot be evaluated in normal use."

consumers do not know the quality of different brands, especially in products where there is a high perceived risk, they are likely to equate price with quality.[19]

That consumers appear to have a strong preference for the leading brand over the generic might explain the low rate of substitution, but it cannot explain the acceptance of generics on nearly all generically written prescriptions. The contrast suggests that consumers make yet another inference: a physician who names a brand has a strong preference for that exact brand. To the extent that physicians have named a brand more out of habit than as a result of deliberate comparison of the alternatives, the consumer's inference is based on a misperception.

III. CONCLUSION

In summary, it appears that there is resistance on the part of consumers to substitution. Apparently consumers believe that the physician has specifically disapproved of substitution on each brand-written prescription, even though this may not be the case at all. Consumers may fail to ask physicians or pharmacists about substitution, in part because they do not know it is possible. Pharmacists, in turn, apparently fear consumer resistance in the form of lost sales and therefore do not often suggest substitution and may have other personal reasons for refraining from substitution. Some mutually profitable transactions may never be initiated. However, this resistance is not immutable. Because substitution is a relatively new option, the consumer is likely to be ill-informed about opportunities, limitations, and consequence.[20] Similarly, pharmacists initially reluctant to substitute may over time become more comfortable with the idea as they confirm the medical appropriateness of the use of generics and discover

---

19/ Gardner (1971). In the context of an illness which evokes fear and uncertainty, any added risk may be magnified in importance.

20/ Of consumers surveyed, 44 percent did not know whether substitution was permitted in their state. "Patients Loyal . . .," Drug Topics (May 7, 1984, p. 44).

the strength of consumers' interest in substitution. The evidence suggests that, in addition to legal permissibility, some mix of increased awareness of the opportunity for substitution, and a clearer understanding of the physician's judgment about the appropriate use of generics on the prescription seems to evoke a greater acceptance of generics.

CHAPTER 4

VARIATIONS IN SUBSTITUTION RATES

Substitution rates reveal substantial variation. We present data on four sources of variability of substitution rates -- drug, state, insurance coverage, and type of pharmacy. By drug, substitution ranged from none whatsoever to over 20 percent of eligible prescriptions in 1980. Privately insured prescriptions were less likely to be substituted than either "cash" or Medicaid prescriptions. Although we hypothesized that pharmacies which were part of chain organizations would substitute more frequently than independently owned pharmacies, the data showed no significant difference in substitution behavior between the two types of pharmacies in 1980. In some states the rate of substitution was twice or three times the national average. (The analysis of state-to-state variation is deferred to Chapter 5, where individual provisions of the state DPS statutes are studied in detail.)

I. INDIVIDUAL DRUGS

The weighted average across 45 drugs conceals wide variation in substitution rates from drug to drug. But, as Table 4-1 shows, only 9 drugs have rates above 10 percent (using the IMS data for 1980): even on the drugs with the highest substitution rates, the option to substitute was exercised relatively infrequently.

Some of the obvious hypotheses about the cross-drug differences in substitution were not borne out. For example, we expected to find that drugs used on a maintenance regimen were more frequently substituted than drugs used for short-term therapy, since consumers would have a greater financial incentive to seek out and purchase a lower-price version if repeat purchases were predictable. However, the correlation

TABLE 4-1

Substitution Rates by Drug, 1980[1]

Drug	Percent of Substitution
Hydrochlorothiazide	24.1
Chlordiazepoxide	19.3
Amitriptyline	18.4
Penicillin VK	17.3
Amoxicillin	17.3
Atropine sulfate/Diphenoxylate	17.0
Meclizine	16.4
Isosorbide dinitrate	14.9
Hydralazine/Hydrochlorothiazide/ Reserpine	14.2
Doxycycline	10.4
Hydrochlorothiazide/Spironolactone	9.2
Dipyridamole	8.8
Brompheniramine/Phenylephrine/ Pseudoephedrine	8.3
Ampicillin	8.2
Chlordiazepoxide/Clidinium bromide	7.8
Tolbutamide	7.6
Conjugated estrogens	7.1
Chlorthalidone	5.9
Acetaminophen/Chlorzoxazone	5.9
Tetracycline	5.6
Spironolactone	4.6
Phenytoin	3.8
Allopurinol	3.6
Dexbrompheniramine/Pseudoephedrine	3.2
Trimcinolone	3.1
Chlorpropamide	2.8
Hydroxyzine	2.3
Sulfamethoxazole/Trimethoprim	2.0

TABLE 4-1--Continued

Drug	Percent of Substitution
Theophylline	1.3
Terbutaline	1.1
Nitroglycerin	1.1
Metronidazole	1.0
Diethylpropion	1.0
Phentermine	.4
Minocycline	.4
Furosemide	.3
Erythromycine base	.3
Hydrochlorothiazide/Triemterene	.2
Amitriptyline/Perphenazine	.2
Cephalexin	0
Erythromycine ethylsuccinate	0
Ibuprofen	0
Mestranol/Norethindrone/Placebo	0
Hydrogenated ergot alkaloids	0
Quinidine sulfate	0

[1] The drugs are listed in descending order by substitution rate. Computed for prescriptions on which substitution was permitted. These are the 45 leading multi-source drugs used throughout the study. The denominator does not exclude those prescriptions on which the physician prohibited substitution.

SOURCE: Computed with data from the 1980 IMS National Prescription Audit.

between the substitution rate and the proportion of all prescriptions for the drug which were refill prescriptions, where the refill rate is used as a measure of long-term use, was .06.[1] Similarly, consumers might be expected to seek or accept substitutions on higher-price drugs, but the data show instead that lower-price drugs are more frequently substituted; the correlation between substitution rate and average prescription price, across 45 drugs, was -.39. This is apparently in part because the older antibiotics are both relatively inexpensive and frequently substituted. The frequency of substitution in some of the antibiotics in turn reflects confidence in the interchangeability of brands, itself due to long and widespread usage and (until 1984) the FDA's certification that each *batch* met standards of quality (unlike other drugs, which are not batch-certified.) Third, the correlation between the substitution and the difference between brand and generic gross margins was very small, -.02. On the other hand, there was some support for the hypothesis that substitution was correlated with the size of the brand-generic price differential; that correlation coefficient was +.27.[2]

II. CUSTOMER INSURANCE COVERAGE

Another influence on the extent of substitution is the means of payment for the consumer's prescription. Consumers whose drug costs are covered by insurance are less likely to be concerned with finding a lower-price drug and therefore may be expected to purchase the high-price brand prescribed rather than to seek or accept a lower-price substitute. In our data, 9.2 percent of the prescriptions were reported as being paid for by private third-party insurance. This estimate is undoubtedly understated, for when consumers apply directly to

---

1/ See Appendix Table A5-1 for refill rate and Table 4-1 for substitution rates by drug. Data for the other correlations are found in the same tables.

2/ Of course, product prices themselves might have been changed in response to the implementation of a drug product selection law, although this does not appear to have happened. See Chapter 7.

their insurance company to obtain reimbursement, the pharmacist is unlikely to be aware of the insurance coverage. An additional 11.1 percent of prescriptions were recorded as sold to customers covered by state Medicaid programs, which unlike Medicare do cover outpatient prescription drug costs. This estimate is likely to be more accurate, since pharmacists receive payment for these sales only by themselves applying to the state government for reimbursement. Medicaid consumers typically pay a fixed copayment, e.g., $.50 or $1.00, for any prescription, while private insurance plans may utilize either a flat or a percentage copayment.

When consumers pay out-of-pocket little or nothing more for a more expensive prescription than for a cheaper one, any price sensitivity is diminished. From the perspective of consumer demand, we would expect the most substitution for "cash" consumers and the least for Medicaid consumers. Since those privately-insured consumers with a percentage copayment have some, albeit limited, incentive to seek low prices, the substitution rate for the privately-insured segment would be expected to be higher than that for Medicaid.

However, to base predictions only on the buyer's incentive would be to overlook the very important influence of Medicaid reimbursement rules, especially for those drugs covered by the federal Maximum Allowable Cost (MAC) program, and any additional drugs added by a state's "mini-MAC" program. For these drugs, the pharmacist is under a strong incentive to dispense low-cost brands to Medicaid patients. The MAC program establishes a maximum reimbursement for the ingredient-cost portion of the pharmacy's costs, and if the pharmacy dispenses a more expensive brand, it has to absorb the higher cost itself. Therefore it can be expected that on MAC drugs the incidence of substitution will be highest for Medicaid consumers.

The pattern is clear with respect to the association of payment type and substitution rate: the ranking from most to least substitution is Medicaid, cash, and privately insured. Table 4-2 gives the summary data over all 45 drugs. Regardless of the legal environment, Medicaid is highest and privately insured lowest.

Since substitution rates vary substantially across drugs, it is conceivable that the overall substitution rates for

TABLE 4-2

Substitution Rates by Insurance Coverage and by Opportunity to Substitute, 1980[1]

	Medicaid	Cash	Private Insurance
Substitution prohibited	2.0%	1.4%	0.5%
Substitution permitted	10.5	7.3	4.2
All states	8.1	5.4	3.4

1/ The substitution rate for cash may be understated, since it is likely that pharmacists mistakenly recorded as cash some prescriptions which were actually privately insured.

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

Medicaid prescriptions, for example, could be high simply because frequently substituted drugs are more often prescribed to Medicaid patients or are less frequently ineligible for Medicaid reimbursement, according to state Medicaid formularies, than infrequently substituted drugs. Indeed, while the overall average Medicaid share was 11.1 percent, in 7 of the 10 top-substitution drugs the Medicaid share of prescriptions was at least 20 percent.[3]

Despite the variation in Medicaid shares of prescriptions, Table 4-3 shows that the substitution pattern in each of the ten most frequently substituted drugs is the same as when computed using a 45-drug average: Medicaid is highest and private insurance lowest. Of the 11 drugs next highest in substitution (not shown), all with substitution rates over 5

3/ While we can identify the drugs in the federal MAC program, we do not know which additional drugs, and in which states, are covered by comparable reimbursement constraints.

TABLE 4-3

Substitution by Insurance Coverage by Drug for the 10 Top-Substitution Drugs, 1980[1]

Drug[2]	Medicaid	Cash	Private Insurance
Hydrochlorothiazide[3]	56.0%	22.4%	13.6%
Chlordiazepoxide[3]	58.5	18.2	7.6
Amitriptyline	36.2	16.9	10.3
Penicillin VK[3]	33.7	17.0	12.3
Amoxicillin[3]	14.1	11.8	11.3
Atropine sulfate/ Diphenoxylate[3]	46.7	15.4	11.7
Meclizine	26.4	15.8	9.0
Isosorbide dinitrate	20.8	15.3	7.0
Hydralazine/Hydrochlorothiazide/Reserpine	30.1	11.7	2.9
Doxycycline	12.0	10.8	6.4
Other federal MAC drugs in 1980:			
Ampicillin[3]	4.1	8.9	5.5
Tetracycline[3]	7.8	5.5	5.2
Overall average[4]	10.4	7.2	4.2

1/ For prescriptions for which both statute and formulary permit substitution.

2/ The ten drugs are listed in descending order by substitution rate. In addition, data on two other MAC drugs in our sample of 45 drug entities are given.

3/ A drug for which there was a Medicaid MAC ceiling in 1980.

4/ The overall average is computed across all 45 drug entities in our sample.

SOURCE: Computed with data from the 1980 IMS National Prescription Audit.

percent, Medicaid was highest in 6, and privately insured prescriptions were lowest in 9.

The substitution rate was highest for Medicaid consumers for almost all MAC drugs; those drugs which were in the federal MAC program in 1980 are marked with an asterisk in Table 4-3.[4] For only one of the 7 MAC drugs, ampicillin, the Medicaid rate is not the highest; in this drug, there is no product with a large enough market share to be classified as a leading brand and there are a number of products with similar costs.

Because substitution is most frequent for Medicaid consumers and least frequent for those with private insurance, the *magnitude* of substitution differences between states may be explained in part by differences in the proportions of different kinds of consumers. These proportions do differ from state to state. For example, nearly a third (30.6 percent) of Michigan's prescriptions were privately insured, many of them presumably as part of the United Auto Workers benefits package. This is a much higher proportion than that for the country as a whole, 9.2 percent. Similarly, there is variation in the size of the Medicaid population. Overall, Medicaid prescriptions were 11.1 percent of the total, but there were 8 states with less than half this proportion[5] and 2 states reporting over 40 percent.

A comparison of states with and without general drug product selection legislation is probably not confounded by differences in the proportion of the population covered by Medicaid. While the three states without statutes permitting substitution in 1980 had fewer Medicaid prescriptions, on which substitutions are more frequent than on uninsured prescriptions, than states which generally permitted substitution, these states also had fewer privately insured prescriptions, on which substitutions are less frequent. (In the multivariate regression analysis of substitution, variables are included to control for insurance coverage of the prescription.)

4/ Two of the remaining top ten substitution drugs in our sample are anti-obesity drugs with a Medicaid share of less than 5 percent, reflecting the fact that many state Medicaid formularies excluded drugs in this category.

5/ See Table A4-1. As of 1980 two states (Arizona and Wyoming) did not participate in the Medicaid program.

III. STORE TYPE (INDEPENDENT AND CHAIN)

The advantages that chains have interact with the drug product selection laws to make substitution even more profitable for chains than for independents.[6] This suggests that chains might be expected to substitute more frequently than independents. However, the data do not support this hypothesis; there is no consistent pattern as to a difference between chains and independents in substitution behavior in 1980.

Stores which are members of large chains are believed to have lower costs than small independents.[7] In particular, chains can obtain drug products at lower cost than independents.[8] By combining purchases for many large outlets, chains' total purchases are large enough to reach the lowest prices in a manufacturer's or wholesaler's quantity discount schedule.[9] This cost advantage is probably greater for generics than for branded drugs, since for some drugs generics may be dispensed infrequently by a single store and since

---

6/ Although any ownership group of stores may be called a chain, the term often excludes firms with fewer than 10 units. Accordingly, we use the term "independent" to include small chains as well.

7/ Chain outlets are typically larger-volume stores than independents' and thereby realize more within-store economies of scale. According to the Lilly Digests, the average dollar prescription sales in 1980 were $212,949 for independents and $315,341 for chains. (The '81 Lilly Digest (1981, p.5) and the 1981 NACDS-Lilly Digest (1981, p. 5). Among chains alone, the NACDS-Lilly Digest noted that "the larger volume operations were able to generate almost seven times the number of prescriptions with about a 40 percent increase in employed pharmacist hours as compared with data for stores in the smallest sales category. NACDS-Lilly Digest (1981, p. 12).

8/ We are not able to measure the size of this cost advantage with our data. However, a study of invoice costs in a sample of Iowa pharmacies found that members of chain organizations paid less for drug products than independent pharmacies paid. The study also found that drug acquisition costs declined as store prescription volume increased. Stores with the highest annual prescription volume purchased for less than those with the lowest annual prescription volume. Norwood (1977).

9/ These discounts may reflect true cost savings, such as shipment in larger units, or avoidance of certain marketing or accounting costs. Moreover, chains may perform some warehousing functions themselves. The appropriate comparison is between the cost to an independent and the cost to the chain warehouse with the warehousing and other distribution costs added on.

chain-wide needs may be great enough to justify private-label arrangements or even vertical integration. Insofar as chains get more special deals on generics than on leading brands, drug product selection laws offer a greater opportunity for chains than for independents.

Chains can also take advantage of economies of scale in advertising. A chain advertisement in a metropolitan newspaper reaches many more potential customers for whom an outlet of that chain is convenient than does a single independent store's advertisement. In addition, the rates newspapers charge for advertising typically offer substantial discounts based on the total lineage and on frequency or continuity of use. Because chains sell a much wider range of merchandise, the discount for prescription advertising is increased because of the larger amount of non-prescription advertising.

Chains' cost advantages in advertising, purchasing and other areas allows them to charge lower prices than independents. Our data show that in virtually every drug entity, medium and large stores which are member of chains with 11 or more units have lower prices than other stores. The average price, computed across all prescriptions in all 45 drug entities studied, was in 1980 $7.48 for chains and $8.37 for independents.[10]

Chains may combine their scale advantage in advertising, the ability to purchase generics cheaply, and their relatively low prices in general in featuring a generics program. In 1980, for example, shortly after the state of Maryland replaced its restrictive drug product selection law with a new statute that eliminated the pass-through provision and considerably enlarged its formulary, a major chain in the Washington, D.C. area ran a series of large-space newspaper ads.[11] Again in 1984 and 1985 this chain has run full-page ads in the *Washington Post* listing prices by individual brand and

---

10/ Chains are shown to have lower average retail prices than independents for identically specified prescriptions. On 7 leading brands (for all those drugs among the 10 most frequently substituted where there was a single leading brand), average chain prices were lower by $.41 to $1.34.

11/ Drug Store News (July 21, 1980, p. 3).

generic,[12] and other chains have announced their readiness to meet advertised prices.

Three circumstances argue that instead independents may substitute more frequently than chains. First, salaried chain employees have a less direct incentive than owner-pharmacists to dispense the product with the higher profit.[13] Second, independents may be more likely to make arrangements with individual physicians that allow substitutions to be made on specified brand-name prescriptions, since the smaller scale of the independent store may provide greater assurance to the physician that specific instructions will be understood by all dispensing pharmacists. Third, according to representatives of several large chains interviewed in 1981, the pass-through and extra information requirements posed particular disincentives for chains to substitute, the former because with their high profiles chains are impelled to obey laws that may not generally be enforced, and the latter because the extra information requirements required them to deviate from their chain-wide systems.

There is no consistent pattern as to differences between chain and independent substitution behavior in 1980.[14] Table 4-4 shows that in our sample where substitution is permitted, chains substitute more frequently than independents (7.6 percent v. 7.2 percent.) But within individual drugs this was not always the case; on 4 of the 10 top-substitution drugs it was independents that substituted more. Moreover, if formulary restrictions are disregarded and substitution is measured for all drugs and for all states, independents are shown to have substituted more frequently than chains (5.7 percent v. 5.0

12/ July 17, 1984m p. A-11.

13/ For example, according to The New York Times, "Medi-Save Pharmacies, a chain with headquarters in Baton Rouge, La., pays pharmacists in its 100 outlets 50 cents for every generic prescription they fill." "The Shift to Generic Drugs" (July 23, 1984, p. D5).

14/ That substitution behavior of chains and independents in our sample does not differ greatly means that results seemingly associated with the laws are unlikely to be explained away in terms of oversampling of chains in some states and of independents in other states.

TABLE 4-4

Substitution by Chains and Independents, by Opportunity to Substitute, 1980

	Large Chains (More than 10 stores)	Independents and Small Chains (10 or fewer stores)
Substitution prohibited	.9%	1.7%
Substitution permitted	7.6	7.2
All states[1]	5.0	5.7

1/ A smaller proportion of all chain observations happened to be for "substitution permitted" than of all independent observations. This explains the seemingly odd result that the overall chain substitution rate is only 5.0 percent when 7.6 percent of prescriptions were substituted where permitted, while the overall independent rate is 5.7 percent although only 7.2 percent of prescriptions were substituted where permitted.

SOURCE: Computed from data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

percent). This reversal may be due to greater use by independents of special grants of permission to substitute by prescribing physicians.

Our evidence that chains did not substitute more frequently than independents is consistent with a Market Measures study which found that chains substituted on 3.8 percent of prescriptions and independents on 5.3 percent.[15] Indeed, the Market Measures estimates suggest the opposite, that independents substitute more often.

15/ Zeich (1983, p. 75).

IV. STATE-TO-STATE VARIATION

The existing empirical work on drug product selection shows that experience with drug product selection laws has varied widely across states. Within the set of state studies reviewed by Gurley and Gagnon, the range of reported substitution rates was broad, from 2.6 percent to 8.6 percent of brand-written multi-source prescriptions on which the physician had not prohibited substitution, and from 6 to 56 percent when prescriptions for which the formulary prohibits substitution were excluded.[16] Market Measures reported a range in March 1983 among seven large states of 4.1 percent (of all new prescriptions) in New York to 10.6 percent in Michigan.[17]

Our data also show wide variations in substitution from state to state.[18] Table 4-5 shows the distribution of states by substitution rate in 1980.

The two methods of computing the substitution rate result in substantially different rankings. In particular, states with more restrictive formularies rank higher according to the method based on only those prescriptions for which the formulary permitted substitution. This difference in ranking is as one would expect because, first, as the formulary is made more restrictive, a fixed number of substitutions becomes a higher percentage of the number of eligible prescriptions and, second, the bias towards drugs which invite substitution most frequently is greatest on formularies which are the most restrictive.

Whichever measure is used, three points stand out. First, the variation across states is substantial. Second, even the highest state substitution rates are not very high, far short of 100 percent. Third, there was a large number of states with very little substitution, about a quarter of the states being below 3 percent.

16/ Gurley and Gagnon (1981, Appendix C). These percentages are higher than the national figures given in Chapter 2, in part because the denominator used for the state measures is smaller by the removal of physician prohibitions of substitution.

17/ Zeich (1984).

18/ See Appendix Table A4-1 for data by state.

TABLE 4-5

Substitution Rates, Distribution of State Averages, 1980[1]

	When substitution rates are calculated across drugs for which substitution is permitted	When substitution rates are calculated across all drugs
Over 20%	2	-
15 - 20	5	2
10 - 15	5	4
8 - 10	8	7
6 - 8	10	9
4 - 6	3	5
2 - 4	7	12
1 - 2	4	5
0 - 1	3	3
Average	7.3	6.0

1/ Only states with DPS laws are included.

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

A caution about our estimates by state is necessary, however. The underlying data are not collected in such a way as to assure reliability of any individual state estimate.[19] In this chapter, we have used the state estimates to establish the variation in substitution rates and to illustrate the effect on state-to-state comparisons of the bias in selection of drugs for formularies. We believe our conclusions on these issues would not be affected by within-state sampling errors.

19/ Sampling issues are discussed further in Appendix A6.

V. CONCLUSION

Substitution activity varies considerably from drug to drug and according to other circumstances as well. Whether the pharmacy was independently owned or a member of a chain did not make much difference in the likelihood of substitution in 1980. In contrast, whether the customer's prescription purchases were insured or not made a substantial difference. Medicaid prescriptions were most likely to be substituted and prescriptions covered by other private insurance were least likely to be substituted. State-to-state variation in substitution is substantial as well; Chapter 5 analyzes the effects of differences in state drug product selection laws while holding constant some other state characteristics believed to affect substitution behavior.

CHAPTER 5

THE IMPACT OF DIFFERENCES IN STATE LAWS

In this chapter we measure the effects of differences in the states' drug product selection laws. No two state statutes -- in actuality, packages of individual provisions -- are the same. Each individual provision of a drug product selection statute can be analyzed as to its probable effects on substitution via its effects on the pharmacy's costs or demand.[1]

In order to isolate the effects of a single type of provision, the technique of logit regression was used to control for the effects of store and state characteristics as well as for other provisions of the DPS laws. The present study differs from previous studies also in that its use of data across all states except Alaska and Hawaii permits broader-based generalizations than were possible in studies of one or a few states. Even so, given the myriad provisions of state laws, the complications introduced due to the differences among drugs, and the relatively small dispersion across states in the amount of substitution, it is difficult to reach definite conclusions. We did obtain significant results in our regressions as to the effects of some of the legal provisions upon substitution, but other provisions were not shown to have any significant effect. (The regression results were for the most part consistent with the patterns revealed in cross-tabulations of state averages by provision, which are given in Appendix A4.)

In preview, several results stand out. First, a prescription pad format which makes it easy for physicians to prohibit substitution is associated with lower substitution rates. On this provision, we confirm a major result of previous research. Second, where pharmacies are required to provide more information about substitutions to consumers, substitution

---

1/ One major provision of nearly all the laws, the format of the prescriber's prescription pad, affects pharmacy decisions only indirectly, by altering the mix of prescriptions presented to pharmacies. However, this provision is thought to have a strong impact on prescribing patterns and therefore on the overall impact of drug product selection laws.

is more common. Third, a positive formulary is associated with less substitution. Fourth, contrary to expectations, states which require pharmacies to pass drug cost savings through to consumers do not have lower substitution rates. Fifth, while substitution is more frequent in states where it is mandatory, mandatory provisions affect substitution rates only modestly.

We first describe the major types of provisions of the drug product selection laws, as well as some collateral regulations, and the effect we expect each to have on substitution. Arguments put forward in the FTC Staff Report, in support of provisions included in the FTC/FDA Model Drug Product Selection Act, are reviewed.

Our analysis of the statutory provisions implicitly assumes that restrictions on behavior are in fact enforced. To the extent that the strength of enforcement differs from state to state, our conclusions about the apparent effects (or lack of effects) of the statutory provisions themselves are weakened. We are told that the intensity of enforcement does vary; it is typically the responsibility of the state Board of Pharmacy, and interviews with state Board personnel revealed large differences in the philosophy of enforcement and the resources devoted to it. Overall, enforcement appears to range from strict to virtually none, but even this information is difficult to interpret. Among states with roughly equal overall emphasis on enforcement, there are considerable differences in the attention devoted to particular statutory areas. Enforcement of some provisions may encourage substitution while enforcement of others (e.g., formulary) may limit it. Moreover, the basic nature of a drug product selection law is the *removal* of restrictions, so if comparisons were made over time, for example, the more relevant measure would be the intensity of enforcement of the anti-substitution laws which preceded the laws authorizing substitution.

This chapter's brief discussion of the statutory provisions is augmented by Appendix A1, which contains a full description of the provisions and a table (Table A1-1) showing the provisions in effect in each state in 1980. The table includes also the recommendations which made up the FTC/FDA Model Act. The Model Act itself is reproduced as Appendix A2.

I. TYPES OF STATUTORY PROVISIONS

We use six categories to describe the general nature of the different types of major statutory provisions in the drug product selection law:

A. Mandatory or Permissive Substitution
B. Format of the Physician's Prescription Pad
C. Formulary
D. Pharmacist Liability
E. Cost Pass-through
F. Notification

The variations in statutory specifications are many. For example, prescription pads are often described as "one-line" or "two-line" (for number of signature lines available to the physician.) Among two-line prescription pads we found three different formats, differing as to the placement of the "substitution permitted" and "substitution prohibited" signature lines. Our detailed classifications are presented and explained in Appendix A1.

A. Mandatory or Permissive Substitution

Over three-quarters of the states left the substitution decision to the pharmacist's option in 1980.[2] (On Medicaid prescriptions substitution was mandatory in some states.) Other states made substitution mandatory as long as the physician or the formulary had not forbidden it; in nearly all states, the consumer had the right to refuse substitution as well. With some variations, most states that mandated substitution required that the pharmacist substitute a less expensive generic equivalent, provided there was one in stock. Some states which mandated substitution and used a formulary tied the mandated substitution to the formulary but permitted

2/ Consumers typically have the right to reject a substitution. This is not true in all states; in New York, for example, "[the] law does not give the patient the option of choosing the brand name product when substitution is permitted by the prescriber." New York State Department of Health (April 1, 1980, p. ix).

substitution on other drugs as well; others required substitution on formulary drugs and forbade it elsewhere.

In states with mandatory substitution one might at first expect to find a 100 percent substitution rate, but there are several reasons why the rate should fall short of 100 percent. First, physicians prohibit substitution on some prescriptions, although we cannot measure the extent. Second, in most states where substitution is mandatory, the requirement is empty if the pharmacy has no substitute in inventory. The likelihood that the pharmacies' inventories include generics thus determines the efficacy of a mandatory provision. Whether or not a pharmacy will choose to stock a generic alternative depends on the extent of generic prescribing in the market and on Medicaid regulations, in combination with the store's proportion of Medicaid customers.

In fact, some have argued that a mandatory provision will not lead to higher levels of substitution because other permissive provisions will induce as high a level. The FTC/FDA Model State Statute left substitution as optional for the pharmacy rather than mandating it.[3] The recommendation was based on the belief that mandatory laws were "both unnecessary and unworkable," unnecessary because economic incentives would encourage pharmacists to substitute and unworkable in the absence of costly enforcement, partly because pharmacists would resent and therefore resist intrusive governmental regulation. In addition, evidence was cited as to the relatively low rate of substitution even in states where it was mandated.

These arguments might be taken to imply a prediction that a mandatory provision will not have any significant effect on substitution. However, assuming some enforcement and holding other things constant, we expected that where substitution was mandatory, the substitution rate would be higher.

B. Format of the Physician's Prescription Pad

State statutes require or permit a wide array of formats that make it relatively easy or difficult for the doctor to

---

3/ FTC Staff Report, pp. 274-275.

allow substitution on brand-written prescriptions. In part, the statutes accomplish this by specifying whether substitution is permissible when the physician gives no specific directions about substitution. The statutes also specify whether the doctor's explicit instructions on the prescription form can be preprinted or conveyed by a check in a box or must instead be communicated by a handwritten phrase or abbreviation. At one extreme, the law in many states permits pharmacists to substitute unless the physician has handwritten "Dispense As Written" or similar words. At the other, the physician might have to write out several words to permit substitution or can even preprint the pad with the words "Do Not Substitute."

Where the format of the prescription pad makes it easy for the physician to prohibit substitution, more brand-written prescriptions reaching the pharmacy are likely to carry such prohibitions and the pharmacy will have less opportunity for substitution. Previous research has suggested that this influence on store-level demand affects the substitution rate significantly.

The FTC/FDA Model State Statute specified a single signature line prescription pad with the presumption that substitution was permitted unless the physician handwrote "medically necessary" or words of the same meaning.[4] Preprinted instructions were ruled out to ensure that the physician's decision to prohibit substitution was made consciously. The FTC Staff Report argued that making such designations relatively inconvenient for the physician was appropriate for two reasons. First, prohibitions of substitution should be necessary only infrequently, especially if a positive formulary were in place and kept current. Second, patterns of physicians' actual use of their option to prohibit substitution seemed to suggest that it was done as much from habit as from careful consideration of the circumstances surrounding the particular prescription.[5]

4/ FTC Staff Report (1979, pp. 275-278).
5/ See Chapter 2.

C. Formulary

A formulary dictates those drug entities within which substitutions are permissible, and in some states it lists the specific products within the entity which may be considered interchangeable as well. The formulary acts like an on-off switch as to the legality of substitution, a drug-specific equivalent of the general drug product selection (or, alternatively, anti-substitution) statute.

The general character of the formulary, as well as specific inclusions and exclusions, may affect a pharmacist's proclivity to substitute. Suppose that for some specified generic entity substitution is legal in each of three states. Suppose one state to have no formulary, that is, to allow substitution in all categories; the second state to have included this generic entity on a positive formulary; and the third state to have excluded it from its negative formulary. The nature of the way legality is provided is likely to make a difference in the pharmacist's willingness to substitute.

The presence of a formulary of any sort may encourage substitution more than if there is no formulary. Quite apart from concern about the legal constraint embodied in the formulary, pharmacists who wish to make accurate and responsible professional decisions as to which drugs are interchangeable will substitute more frequently if they have a convenient source of authoritative information regarding appropriate substitutions.[6] The list may also be useful in the pharmacy's decision as to which brands to carry, especially if the formulary itself lists brands or manufacturers. This may have some spillover effect for stocking and dispensing decisions for generically written prescriptions.

6/ A formulary which is distributed to all pharmacies will have the greatest impact. If instead a list is simply maintained at the state Board of Pharmacy, the list will be consulted far less frequently. For example, some state statutes incorporate an FDA list as the state formulary, but if the state does not republish the list, the pharmacy must either call the Board of Pharmacy for information or take the initiative to acquire its own copy. (The FTC/FDA Model Act provides for distribution of the list to all pharmacies and prescribers, thereby assuring that the formulary will be most useful. FTC Staff Report (1979, p. 285).)

The FTC/FDA Model Act includes a formulary and ties it to the FDA's list of "Therapeutic Equivalents" in order to assure extensive coverage and a basis for automatic updating.[7] The recommendation for a formulary was based in part on the recognition that some drug products have been shown to have serious bioequivalence problems and should therefore not be freely interchanged. Moreover, evidence of higher rates of substitution in states with formularies was cited.

A formulary plays a second role in addition to defining what the state considers a legal substitution (or a mandatory substitution.) A formulary may provide a pharmacist some protection against liability by private parties. This implicit protection against liability is another reason to believe that the existence of a formulary encourages substitution. Liability provisions are discussed in the next section.

There has been considerable controversy as to whether a positive or a negative formulary is superior.[8] The FTC/FDA Model Act contains a positive formulary (tied to the FDA list) on the grounds that pharmacists expressed a preference for positive formularies and that explicit inclusion of the drug provides greater reassurance to the pharmacist and will produce the highest rate of substitution. A positive formulary informs pharmacists that other experts have deemed these products interchangeable, while omission from a negative formulary may convey only that bioinequivalence is not established; the pharmacist may refrain from substitution if the implication is that substitution is not assuredly appropriate. A positive formulary which lists brands may further facilitate a pharmacist's selection of low-cost versions to put into inventory.

There are, however, arguments that a negative formulary may be superior to a positive formulary. One drawback of a positive formulary is the possibility that bureaucratic delays or political pressures may cause states to be slow to add new entities and brands to a formulary, even after the drugs have appeared on the FDA's "Approved List." The delays may affect

---

7/ FTC Staff Report (1979, pp. 281-285).

8/ Two states have both negative state formularies and positive pharmacy-level formularies (Florida and Ohio).

the extensiveness as well as the accuracy of the formulary. In response to this argument, the FTC/FDA proposal to tie a state's formulary automatically to the FDA list assures speed in updating and saves the cost of duplicative evaluation of drugs. A second advantage of negative formularies, insofar as they are brief, is that they may be easier for a pharmacist to use and remember -- knowing that substitution is allowed in all but a few entities which he must check -- than an extensive positive formulary. Thus, omission of a specific generic entity from a negative formulary may lead to more substitution than its inclusion in a positive formulary.

We offer no hypothesis as to the relative effects on substitution, over all, of a positive or a negative formulary. However, given that substitution on a prescription for a particular drug is permitted by the formulary, we expect substitution to be more likely with a positive formulary than with a negative formulary, and least likely when there is no formulary at all.

D. Pharmacist Liability

Somewhat fewer than one-half of the states with DPS laws had in 1980 an explicit provision exempting the pharmacist who substitutes with the prescriber's permission from any additional liability beyond that which applies in filling a generically written prescription. In some other states, officials at the state Board of Pharmacy have expressed to us their belief that selection of a drug on a positive formulary or avoidance of one on a negative formulary provides an implied exemption from additional liability. In any case, it seems less likely that the pharmacist would be considered to have acted unprofessionally or negligently as a result of substitutions made in accord with the state's formulary. The greatest exposure to liability occurs in states with neither a formulary nor an explicit provision that limits a pharmacist's liability when substituting.

The FTC/FDA Model Act left as optional an express statutory protection from greater liability when substituting than when

filling generically written prescriptions.[9] According to the *FTC Staff Report*, while pharmacists expressed concern about liability risks, no actual suits involving substitution were identified.[10] Moreover, pharmacists in states where the law actually contained an express protection were typically unaware of those provisions. Further, the Report states, "most liability provisions are more a restatement than a limitation of the legal standard likely to be applied by common law," although a restatement of those standards in the form of statutory provisions may serve to reassure pharmacists. On balance, the Report concludes, such a provision is probably a good idea but may have little impact.

Liability is an expected cost and decreases the incentive to substitute. In states where there is not as much protection when substituting as when filling a generically written prescription, there is likely to be less substitution.

E. Cost Pass-Through

Prescription drug retailers pay less for generic drugs than for the leading branded items in multi-source entities.[11] In nearly two-thirds of the states the pharmacist had in 1980 the option of passing on all or part of this difference in invoice cost on substitutions, with the law requiring only that the substitution be less expensive to the consumer. Even one penny less generally satisfies this requirement. Additionally, some states specified that a pharmacy could not charge more for a drug product when it was dispensed as a substitute than the store's normal and customary price for it.

Other states have enacted laws whose purpose is to ensure that most or all of the difference in acquisition cost is

---

9/ FTC Staff Report (1979, p. 286-288).

10/ Since publication of the FTC Staff Report, there has been at least one widely publicized case involving substitution. However, the pharmacist found guilty in this case had substituted a product which had not received FDA approval although in his and many other states pharmacists are required to dispense only FDA-approved drugs. Despite this distinction, it is reasonable to suppose that pharmacists' fears about liability would have been increased by this case.

11/ See Chapter 3.

passed through to consumers.[12] A pass-through provision requires pharmacies to lower the price on the substituted prescription by the amount of the difference in the pharmacy's own cost between the prescribed and the dispensed products. States differ in their methods of computation of the required pass-through, and one state (Washington) requires only a partial (60 percent) pass-through. Table 5-1 shows how a "full cost-pass-through" law works.

Pass-through provisions save consumers money when substitution occurs, but substitutions might occur less often. If a pharmacy is required to pass through to the consumer the entire difference between the acquisition cost of the prescribed product and the substituted product, the pharmacist's incentive to substitute is greatly diminished. As we showed in Chapter 3, prescription drug retailers generally make a larger dollar margin over their invoice cost on generics than on brands in the same entity. Thus, the full pass-through provision reduces the retail price and dollar margin on generics that are dispensed as substitutes on brand-written prescriptions. Some incentive to substitute remains, however, since dispensing low-price products may draw customers from other stores. Furthermore, if prices on substitutions are even lower in states requiring a pass-through and if consumers in those states either know of the provision or notice the greater price differences, consumers in pass-through states may ask for generic equivalents more often.

Emphasizing the usefulness of a profit incentive to induce the pharmacist to substitute, the FTC/FDA Model Act required no pass-through of the cost savings, requiring only that the price of the product dispensed by lower than the price of the product

---

12/ This concern is reflected in a feature article that appeared in the Washington Post (Sinclair, July 28, 1980). Sinclair notes that "drugstore mark-ups today absorb a substantial portion of the savings originally intended for consumers. Consumers do pay less for unbranded prescriptions in most cases--but not nearly as much as predicted."

TABLE 5-1

Pricing a Substituted Drug Under
a Full Cost-Pass-Through Law: An Example

	1.	Retail Price of Prescribed Brand	$ 8
	2.	Invoice Cost of Prescribed Brand	6
(1-2) =	3.	Dollar Gross Margin on Prescribed Brand	2
	4.	Invoice Cost of Substitute Brand	3
3 =	5.	Maximum Allowable Margin on Substitute Brand	2
(4+5) =	6.	Maximum Allowable Retail Price of Substitute Brand	5

prescribed.[13] The Staff Report noted also that pass-through provisions are difficult to enforce, in part because "an actual event (the sale of the dispensed product) must be compared with a hypothetical event (the sale of the brand prescribed but not dispensed.)" Also, an FTC-sponsored study found that one-third to one-half of the pharmacists in states with pass-through provisions did not know of the requirement, suggesting that compliance cannot be high. The FTC/FDA Model Act is silent on another price control provision sometimes used, a requirement that the price of the product when substituted be no higher than its usual and customary price. Competitive pressures were expected to keep the price of a single product from diverging in these two different circumstances of dispensing.

In sum, a pass-through provision is expected to be associated with a lower level of substitution but with a greater brand-generic price differential and lower retail prices on prescriptions when substitutions are actually made. However,

13/ FTC Staff Report (1979, pp. 278-279).

in light of difficulties in defining and enforcing compliance, the effect might be expected to be modest in magnitude.

F. Notification

State drug product selection laws sometimes require that the consumer be notified whenever a substitution is made or, in some instances, contemplated. Pharmacists are sometimes required simply to tell the consumer whenever a substitution has been made. In some states, the pharmacist must also state the retail prices of the alternative products. Sometimes the consumer must be asked to consent explicitly to the substitution, before the drug is packaged. There are extra labelling provisions in many states. We have included in this group of provisions any extra record-keeping requirements, although such a requirement does not constitute direct notification to the consumer, because, like the others, it imposes extra costs on the pharmacy in conjunction with any substitution. A state may have one or several of these notification and record-keeping requirements.

It is not clear whether notification requirements should be expected to deter substitution, by imposing costs on the pharmacy, more than they encourage substitution, by increasing consumer demand for it. (Record-keeping requirements may discourage substitution, since they impose costs but do not directly stimulate demand for substitutions.) To discuss with a consumer any preference about a possible substitution, or even to inform a consumer that a substitution has been made, takes additional pharmacist time and imposes a cost. Chains report that these requirements are a particular nuisance to them and discourage substitution, in part because of the interruption of a well-established dispensing routine. Even if the store has been providing the same information by some different method, the requirement may compel it to deviate from chain-wide standardized operating procedures. Such a routine must also be differentiated across chain outlets in states with different kinds of requirements. At the same time, any extra information provided to the consumer leads to an increased awareness of generics and the possibility of substitution. Changes in consumers' attitudes would add to pressures for

substitution. Certain provisions are more likely to have this effect than others. In fact, the requirements for oral disclosures, which might have the greatest impact, are also probably the most costly for the pharmacy in terms of interrupting a smooth routine.

There are three information provisions included in the FTC/FDA Model Act.[14] First, the consumer must be notified that a substitution is being made and of the right to refuse the substitution. Second, the prescription label must include the identity of the drug product dispensed. Third, the identity of the product dispensed must also be recorded in the pharmacy's file copy of the prescription. The latter two requirements were to apply to *all* prescriptions, not just those substituted. The first recommendation was designed to "make more meaningful" the consumer's right to refuse substitution while at the same time drawing attention to the option so as to encourage consumers increasingly to accept substitutions. Also, an FTC-sponsored survey indicated that the requirement would not be unduly burdensome to pharmacists. The Model Act stops short of requiring an explanation of possible price savings and of requiring discussion *prior* to filling the prescription because both requirements were thought to be unduly burdensome and therefore perhaps deter substitution. The labeling and recordkeeping requirements were also seen as unlikely to increase pharmacists' costs significantly.

The direction of the effect of the notification provisions is uncertain, since the increase in costs will deter substitution while the increase in information may lead to stronger demand for generic substitution.

14/ FTC Staff Report (1979, pp. 279-281).

G. Collateral Regulations[15]

A number of other provisions in this or other state laws may interact with drug product selection laws either to encourage or to discourage substitution. While these provisions were not considered to be so important as to require inclusion in the regression analysis, they nevertheless may have some influence.

1. Advertising Restrictions

The Supreme Court's 1976 *Virginia State Board of Pharmacy v. Virginia Citizen's Consumer Council, Inc.* decision overturned the prohibition in many state laws against retail price advertising of prescription drugs. Since then virtually every state that had had price advertising prohibitions has repealed its statute. Although no state currently enforces a strict prohibition on retail price advertising, nine states have restrictive provisions, ostensibly to control potentially misleading practices. Examples are provided in Appendix A1.

Restrictions against retail price advertising of prescription drugs are not normally part of a state's drug product selection statute. Nevertheless, advertising restrictions interact with the opportunity to substitute. Even if the restrictions affect advertising in general, not advertising of generics or the opportunity to substitute in particular, they raise the cost of effective advertising and therefore presumably reduce the quantity of any price advertising.[16] The impact of drug product selection laws where advertising is restricted is likely to be weaker, since advertising increases consumers'

15/ The FTC/FDA Model Act includes, in addition to the provisions detailed above, sections entitled "Definitions," "Enforcement," and "Effective Date," the latter two to be designed by the individual state, and one additional section concerning public education and monitoring. FTC Staff Report (1979, pp. 285-286).

16/ For example, prohibitions of cents-off coupons do not have a stronger effect on generics, and therefore substitutions, than they do on brands. On the other hand, a requirement that the generic name be given whenever a brand is advertised might spur substitution, given that any advertising at all is undertaken.

information about relative prices both across stores and between brands and generics.

In fact, there has been relatively little advertising of prescription drugs at retail, even since *Virginia Pharmacy*. Therefore, the presence or absence of legal restrictions on advertising may not translate directly into large differences in the actual amount of advertising and therefore into any impact on substitution. Nevertheless, executives of some chains, and it is chains which have done most of the retail prescription drug advertising that has occurred, have told us that such restrictions dampen their incentives to substitute and to undertake aggressive generic programs.

2. Prescriber Liability

A prescriber's decision to allow substitution may increase exposure to professional liability should the patient appear to have suffered from the substituted drug. Where physicians are at greater risk legally, they are less likely to authorize substitution by the pharmacist. About one-third of the states have enacted a provision exempting physicians from additional liability when they permit substitution.

3. Pharmacy Ownership

Two quite different types of ownership restrictions have been adopted. First, in about a quarter of the states physicians are prohibited from acquiring a controlling interest in a pharmacy. Second, in two states partnerships or corporations may not own drug stores unless a minimum specified interest is held by registered pharmacists. Both restrictions may decrease the number of stores in a market, but the restrictions might have an even more direct effect on substitution behavior. If physicians can direct patients to their own physician-owned pharmacies, these stores need stock only those brands which the physician chooses to prescribe, thereby reducing the incidence of substitution. It seems unlikely, however, that physician-owned stores would be free from competition from other stores, and therefore these restrictions probably have little impact on overall substitution patterns in a market. The other ownership

restriction, which inhibits the spread of chain outlets, might well have been expected to affect overall substitution had it been true that chains substituted more frequently than independents. Since the data do not support that hypothesis, the second ownership restriction is also unlikely to alter the incidence of substitution in a state.

4. Posting of Signs

Some states require the posting of prices. There are two kinds of price posting requirements. About one-fifth of the states require posting by all pharmacies of the retail prices of the top one hundred or so most widely prescribed drugs. About one-third of the states provide that the pharmacy prominently post a sign informing consumers of the availability of generics. Both types of signs are likely to lead to an increase in substitution as consumers' attention is drawn to price comparisons or to the substitution option.

5. Mail Order

Mail order pharmaceutical houses often sell prescription drugs at prices lower than available locally. Ten states have bans or significant restrictions on intrastate shipments by mail order pharmaceutical houses. Stores in these states may feel somewhat less competitive pressure to substitute and therefore substitution may be less frequent. The laws have not typically regulated interstate shipments, however, although as mail order is increasingly used for prescription sales there is corresponding controversy as to the desirability of some regulation.

6. Generically Written Prescriptions

In most states a pharmacist may fill a generically written prescription with any item in the chemical entity and sell it for any price he elects. In about one-third of the states, such decisions were regulated in 1980. As with mandatory substitution laws, most of the statutes dealing with generically written prescriptions required the dispensing of a low

cost (variously defined) generic item, provided one was in stock. As reported in Chapter 6, we were unable to show that such provisions have affected the decision as to whether a leading brand or a generic is dispensed on generically written prescriptions, but the regulations might have had a separate effect on the selection of a specific generic to dispense and on the price charged to the consumer.

II. MULTIVARIATE LOGIT REGRESSIONS

To look at the effect of each statutory provision while holding constant the other aspects of the law, we use multivariate regressions. The regression technique also allows us to hold constant, and to look at separately, the effects of non-legal influences.

Specifically, we used a logit model, which reflects the fact that the probability of substitution must lie between zero and one.[17] The logit model for the substitution choice is:

$$\text{Prob}(S_r) = \frac{e^{F(Z_r)}}{1 + e^{F(Z_r)}}$$

where $\text{Prob}(S_r)$ is the probability that a substitution is made on the r^{th} prescription and Z_r represents the values of a set of independent variables, defined below, for the r^{th} prescription.

When natural logarithms are taken on both sides of the equation,

$$\log\left(\frac{\text{Prob}(S_r)}{1 - \text{Prob}(S_r)}\right) = F(Z_r)$$

17/ In our 1980 data, however, most drugs had very low substitution rates. The logit technique may not give a good fit at the tails of a distribution. See section V of Appendix A7 for a discussion of this problem.

$$= a_1 + a_2 MAND_t + a_3 RXPRO_t + a_4 RXANTI_t + a_5 POS_t + a_6 NEG_t + a_7 LIAB_t + a_8 PASS_t + a_9 INFO_t + a_{10} QUAN_r + a_{11} SSINDEX_{it} + a_{12} CHAIN_{it} + a_{13} MED_r + a_{14} PRIV_r + a_{15} GEN_t + a_{16} TIME_t + ERROR_{rit}$$

where t = 1, 2, . . ., 47 indexes the state; for each t, i = 1, 2, . . ., N_t indexes the stores within that state; and for each i and t, r = 1, 2, . . ., R_{it} indexes the prescriptions dispensed by that store.

A separate regression is run for each drug. The data for each drug are further restricted to a single dosage form, a single strength, and the five most frequently dispensed prescription sizes in terms of number of tablets or capsules. (All five sizes are included in a single regression.) The unit of observation is the individual prescription transaction.[18]

The choice of a brand -- the dependent variable -- is coded as 0 if the prescription was dispensed as written and as 1 if instead a substitution was made.[19]

The independent variables include both indicators of the presence or absence of specific legal provisions and other economic influences on the store's brand choice and pricing decisions.

Appendix A7 contains a discussion of a number of technical econometric issues.

18/ See Appendix A6 for a description of the data and Appendix A7 on econometric issues, including choice of aggregation.

19/ See our definition of substitution in Chapter 2.

A. LEGAL VARIABLES

Eight dummy variables are used to capture the legal provisions discussed above and are coded 1 if the law includes the provision and 0 otherwise. To simplify the analysis, we combined some of the most detailed categories of a legal provision into more broadly defined measures. The exact provisions fitting into each of our final codes are listed in Appendix A1. Data on the substitution effects of some of the more detailed subcategories of the provisions are given in Appendix A4, based on cross-tabulations.

The expected sign, based on *a priori* hypotheses as discussed above, is given in parentheses for each variable. A positive coefficient therefore means that the presence of the provision was associated with a higher probability of substitution.

MAND (+)

Mandatory substitution (on all prescriptions, regardless of insurance type.)

If the state has a formulary that applies to mandatory substitution, e.g., substitution is required for drugs listed in the formulary applicable in the month when the prescription was dispensed (whether or not substitution is permitted on all others), *MAND* is coded 1 for those drugs on which substitution was mandated.

MAND = 1 for 10 states. *MAND* = 0 for 37.

RXPRO (+), *RXANTI* (-), and *RXNEUT* (omitted category)

"Pro-substitution", "anti-substitution", or "neutral" physicians' prescription pad.

Because there is so much variability in prescription pad formats we use three subgroupings: formats which make it most inconvenient for the physician to prohibit substitution and/or most convenient for the physician to indicate a definite decision that substitution is acceptable (*RXPRO*); formats which make it most convenient for the physician to prohibit

substitution (*RXANTI*); and those in between (*RXNEUT*, which is the category omitted in the regression, as being the same as having neither *RXPRO* nor *RXANTI*.) Variants of both single- and double-line formats -- a categorization used by some other researchers -- were assigned to each group since we also took into account the underlying presumption as to whether substitution was or was not permitted in the absence of a deliberate override by the physician. Moreover, this grouping allows us to categorize formats not easily labeled simply as single- or double-line. (The FTC/FDA proposed format is one of those in *RXPRO*.)

RXPRO = 1 in 20 states. *RXANTI* = 1 in 10 states. *RXNEUT* = 1 (or *RXPRO* and *RXANTI* both = 0) in 17 states.

POS (+), *NEG* (+), and *NO FORM* (omitted category)

Positive formulary, negative formulary, or no formulary.

If the state has a formulary of any sort which limits substitution, it is coded either *POS* or *NEG*, depending on whether the drugs listed are those for which substitution is permissible (*POS*) or prohibited (*NEG*).

States coded 0 on both *POS* and *NEG* have no formulary and therefore allow interchange between any two brands in any generic entity, subject to professional judgment. (If the state has a formulary that applies only to mandatory substitution, i.e., substitution is required for drugs listed in the formulary but permitted on all others as well, both *POS* and *NEG* are coded 0.)

Both *POS* and *NEG* are expected to have a positive sign not only because of a formulary's informational function but also because it may provide some protection from liability. *POS* is expected to have a larger coefficient than *NEG*.

POS = 1 in 16 states. *NEG* = 1 in 13 states. In 1 state *POS* = 1 in some months and *NEG* = 1 in other months. Both *POS* and *NEG* are 0 in 17 states.

LIAB (+)

Express statutory protection of the pharmacist from greater liability when substituting than when filling a generically written prescription.

Some implicit protection against added liability may be conferred by the presence of a formulary or by the fact that substitution is mandatory. These other effects on liability are picked up in the variables *POS*, *NEG* and *MAND*. Therefore *LIAB* is measured against a background wherein many other prescriptions may also present to the pharmacist little added liability from substitution.

LIAB = 1 in 21 states. (Of the 26 states with *LIAB* = 0, 11 had either *POS* = 1, *NEG* = 1, or *MAND* = 1.)

PASS (-)

Cost pass-through.

PASS = 1 in 17 states. *PASS* = 0 in 30 states.

INFO (?)

Notification.

Because the different information provisions impose different costs and provide different amounts of information to consumers, and because states have various combinations of information requirements, we coded *INFO* = 1 any state with at least one of a set of provisions seeming to exceed a threshold level of information and cost. Our coding scheme is described in Appendix A1. The Model Act's requirement would be coded 1 on the *INFO* variable.

INFO = 1 in 27 states. *INFO* = 0 in 20 states.

B. NON-LEGAL VARIABLES

There are six variables designed to capture the most important cost and demand influences on prescription brand

choices and prices. For most of these variables, the hypothesized signs draw on discussion in Chapter 4. More detailed discussion of these variables is found in Appendix A7.

QUAN (+)

The number of tablets/capsules in the prescription.

Purchasers of larger prescriptions have a greater incentive to identify and purchase a lower-unit-cost product.

SSINDEX (?)

An index of the store's average price of 18 single-source drugs, relative to the average price across all stores.[20]

This single-source price index is a summary measure of those demand and cost elements common in a single store's sale of both single-source and multi-source drugs.

CHAIN (+)

CHAIN = 1 if the store is a member of a chain with more than 10 outlets; *CHAIN* = 0 if the store is independently owned or part of a small chain.

MED (+), *PRIV* (-), and *CASH* (omitted category)

Mode of payment for the prescription. If the prescription was paid for through Medicaid, *MED* = 1, *PRIV* = 0 and *CASH* = 0. If the prescription was reimbursed through other private

---

20/ Thus a store with an average price across the 18 drugs of $15.00 would have a SSINDEX of 1.07 if the overall average, which is set equal to 1.00, were $14.00.

It would be inappropriate to use this variable if the drug product selection laws affect the prices of single-source drugs. We are satisfied that this is not so, at least to any significant extent. See Appendix A7.

insurance, *PRIV* = 1, *MED* = 0 and *CASH* = 0. If the prescription was paid for out-of-pocket, both the variables included in the regression (*MED* and *PRIV*) are = 0. The effect of *MED* is expected to be strongest on MAC drugs. The effect of *CASH* is embedded in the *CONSTANT* term.

GEN (+)

The proportion of prescriptions written generically in the state, computed across 45 drugs. For each drug, this average is adjusted to reflect the drug's U.S. average level of generic prescribing. This adjustment makes no difference statistically and was done only to make the scale of the coefficient on *GEN* more comprehensible.

In states where physicians more frequently prescribe generically, consumers are more likely to be familiar with generics and stores more likely to carry them in inventory.[21]

21/ The correlation coefficient (across states with a DPS law in 1980) between substitution on formulary-permitted drugs and the incidence of generic prescriptions on those same drugs was .54 in 1980, which is significant at better than the 1 percent level of significance. The data for both measures is a weighted average across 45 drugs. There were 47 pairs of observations.

The correlation coefficient between the same substitution measure and the incidence of generic prescribing across all drugs (which is closer to the measure actually used in the regressions) was not as high, .41, but still significant at better than the 1 percent level.

We have explored the possibility that the DPS laws lead to an increase in generic prescribing; see the discussion in Chapter 6. We conclude that much of the state-to-state variation in generic prescribing is due to forces other than the DPS laws. We suggest in addition that no specific provision of the law has a particular effect on generic prescribing and that therefore it is appropriate to control for GEN in explaining the effects of the provisions on the incidence of substitution.

TIME (+)

The number of months from first implementation of the state's drug product selection law to the month of the prescription transaction.[22]

Because information about and acceptance of an innovation grow over time, substitution is expected to be more frequent in states with longer experience with drug product selection.

C. RESULTS

Logit regressions were run for 24 drugs -- all those of the 45 multi-source drugs where the number of observations made it feasible. Table 5-2 reports the estimates of the coefficients, their standard errors, and statistical significance. For consistency, the tests reported for statistical significance are two-tailed. Where the coefficient is hypothesized to have a specific sign, the appropriate one-tailed test is easily inferred; a coefficient significant by a two-tailed 10 percent test is significant by a one-tailed test at the 5 percent level.

Table 5-3 summarizes the sign and significance patterns for the legal variables, first for the 10 drugs on which substitution was most frequent and then for all 24. The pattern among the top substitution drugs generally holds up for the other drugs, although the proportion of coefficients which are significant is usually lower for the less frequently substituted drugs. "Significance" is here measured at the level of 10 percent or better, using a two-tailed test. Less than half of the coefficients are significant and for some variables there are several negative and several positive significant coefficients.[23] The last column, "Effect", is a summary measure

---

22/ Oklahoma's law was passed very early, in 1961, more than 200 months earlier than 1980. In order to prevent this one observation from dominating the estimate on the TIME variable, we arbitarily used 99 months for Oklahoma.

23/ The use of individual prescriptions as the unit of observation may have led to some instances of false significance, due to the multiple counting of what may be a single decision, on the part of the pharmacy, to substitute or not to substitute on a certain type of prescription. This statistical issue is discussed further in Appendix A7.

across all drugs of whether the variable has a significant effect. It is based on the use of a binomial signs test (at the 10 percent significance level.)[24] By this binomial test, only 3 of the provisions have a significant effect: *RXANTI*, *INFO* and *POS*. For all three of these (but no others) it is also true that there are at least 6 significant coefficients of the predominant sign and no more than 2 of the other sign. We discuss the results on the individual legal provisions in turn.

While the recommendations of the FTC/FDA Model State Act were not based solely on the criterion of increasing substitution, that was one of the issues analyzed in the *FTC Staff Report* in conjunction with each recommendation. We therefore comment, for each type of provision, on the appropriateness, in the limited terms of this single criterion, of each recommendation.

1. Design of the Physician's Prescription Pad (RXPRO, RXANTI)

The strongest result is for *RXANTI*, confirming the result of other analyses that the design of the physicians' prescription pad has an important effect on the incidence of substitution. In particular, a format which makes it easy for the physician to prohibit substitution is associated with less substitution, although formats which make it more difficult for the physician to insist on a specific brand do not seem to lead to more substitution than a "neutral" pad.

The difference between *RXPRO* and *RXANTI*, and its significance were also computed from the regression results. "Anti" pads were associated with less substitution than "pro" pads in all of the 23 drug regressions where coefficients could be

---

24/ A pattern of 8 or more signs out of 10 would be significant at the 11 percent level, using two-tailed tests; 9 out of 10 signs therefore satisfies the conventional 10 percent level of significance. Out of 24, 17 must be of the same sign for statistical significance to be better than 10 percent when a two-tailed test is used.

A binomial signs test is strictly appropriate only if the trials (here, regressions) are independent. This condition is not met by our data, since it is the same panel of pharmacies represented in each of the individual drug regressions. This issue is discussed further in Appendix A7.

TABLE 5-2

Results of Logit Regressions on Substitution Choice by Drug[1]

DRUG	CON-STANT	MAND	RX-PRO	RX-ANTI	POS	NEG	LIAB	PASS	INFO
Hydrochlorothiazide	-2.12**[2]	.90**	-.28**	-1.03**	-.32**	.18	-.39**	.02	.05
	(.50)[3]	(.11)	(.10)	(.17)	(.13)	(.18)	(.09)	(.13)	(.10)
Chlordiazepoxide	-3.14	.36**	.31**	-.05	-.22	.09	-.31**	-.03	.18
	(.69)	(.15)	(.14)	(.18)	(.15)	(.24)	(.12)	(.16)	(.13)
Amitriptyline	-1.76**	.27	.13	-.11	-.25	-.30	-.18	.09	.10
	(.86)	(.20)	(.18)	(.25)	(.21)	(.27)	(.16)	(.23)	(.19)
Penicillin VK	-3.51**	.64**	-.10	-.41**	-.35**	-.70**	-.46**	-.26**	.46**
	(.38)	(.09)	(.07)	(.12)	(.09)	(.14)	(.07)	(.11)	(.08)
Amoxicillin	-1.59*	.17	.64**	.07	-.18	-.37	.13	.10	.67**
	(.86)	(.18)	(.16)	(.21)	(.17)	(.24)	(.14)	(.20)	(.16)
Atropine sulfate/ Diphenoxylate	-1.94**	.54**	-.37**	-1.09**	-.18	-.78**	-.37**	.20	.49**
	(.52)	(.13)	(.10)	(.19)	(.14)	(.21)	(.10)	(.13)	(.12)
Meclizine	-5.27**	.68**	.30	-.27	-.10	-.13	-.08	-.48*	.04
	(.98)	(.24)	(.20)	(.33)	(.24)	(.37)	(.19)	(.27)	(.21)

1/ GEN is omitted if there was less than 1 percent generic prescribing. For other drugs with very little generic prescribing, the GEN coefficient may be large but mean little in economic terms.

2/ Two-tailed statistical significance is denoted by ** at the 5 percent level, * at the 10 percent level.

3/ Asymptotic standard errors are given in parentheses.

4/ This coefficient could not be estimated reliably with the data.

TABLE 5-2, continued

DRUG	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[1]	TIME	N
Hydrochlorothiazide	.005**	-.14	.15	1.67**	-.74**	1.94**	-.003	4027
	(.001)	(.43)	(.10)	(.13)	(.14)	(.39)	(.003)	
Chlordiazepoxide	.007**	-.66	-.21	1.88**	-1.06**	14.03**	.007**	2339
	(.002)	(.61)	(.15)	(.20)	(.26)	(2.15)	(.003)	
Amitriptyline	.004	-1.35*	-.05	1.07**	-.60**	7.60**	-.000	1329
	(.003)	(.77)	(.18)	(.20)	(.29)	(1.67)	(.004)	
Penicillin VK	-.018**	1.18**	.60**	.99**	-.45**	2.17**	.000	1451
	(.004)	(.33)	(.08)	(.12)	(.12)	(.26)	(.002)	
Amoxicillin	.007	-1.82**	.49**	.23	-.24	.70	.001	2379
	(.011)	(.77)	(.16)	(.27)	(.24)	(.60)	(.003)	
Atropine sulfate/ Diphenoxylate	.010**	-.05	.48**	1.72**	-.54**	N/A	-.007**	3804
	(.002)	(.45)	(.11)	(.15)	(.18)	N/A	(.003)	
Meclizine	.006**	1.08	-.09	.52**	-.57*	13.83**	.015**	1283
	(.003)	(.81)	(.21)	(.22)	(.34)	(3.47)	(.004)	

TABLE 5-2, continued

DRUG	CON-STANT	MAND	RX-PRO	RX-ANTI	POS	NEG	LIAB	PASS	INFO
Isosorbide dinitrate	-3.38** (1.43)	-.77* (.43)	.15 (.31)	-.82* (.45)	.24 (.41)	-1.70** (.74)	.28 (.36)	.72** (.34)	-.41 (.31)
Hydralazine/ Hydrochlorothiazide/ Reserpine	-2.49 (1.61)	-1.94** (.56)	.80** (.32)	.10 (.50)	-.28 (.39)	1.94** (.49)	1.35** (.30)	.44 (.40)	.02 (.42)
Doxycycline	-1.60** (.78)	1.12** (.18)	-.50** (.15)	-.96** (.29)	-.24 (.22)	-.96** (.30)	-.55** (.15)	-.27 (.27)	1.28** (.18)
Hydrochlorothiazide/ Spironolactone	-2.73** (1.20)	-.01 (.29)	-.04 (.26)	-1.56** (.52)	.15 (.35)	-.70 (.53)	.01 (.23)	.36 (.34)	.41 (.30)
Dipyridamole	-2.21 (1.75)	1.15** (.57)	.66* (.34)	-2.36** (.94)	.12 (.59)	-.03 (.56)	.31 (.56)	.11 (.55)	.08 (.43)
Brompheniramine/ Phenylephrine/ Pseudoephedrine	.49 (1.13)	-.77** (.31)	-.31 (.24)	-.34 (.47)	-1.31** (.33)	-.38 (.31)	1.36** (.24)	-.40 (.24)	1.53** (.33)
Ampicillin	-4.27** (1.28)	-.07 (.32)	.15 (.25)	-1.19** (.39)	.08 (.28)	-.62 (.38)	-.04 (.22)	-.20 (.34)	.50** (.25)
Chlordiazepoxide/ Clidinium bromide	-.09 (1.05)	-1.07** (.43)	.34 (.23)	-.47 (.42)	-1.12** (.39)	-.19 (.36)	.73** (.26)	.80** (.30)	.05 (.30)
Tolbutamide	-7.49** (1.84)	-.07 (.82)	.46 (.51)	-.59 (.67)	-.33 (.70)	-1.11 (1.15)	-.44 (.59)	-.22 (.74)	-.36 (.72)

TABLE 5-2, continued

DRUG	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[1]	TIME	N
Isosorbide dinitrate	.005 (.004)	.74 (1.17)	.18 (.26)	.33 (.27)	-.97** (.40)	-1.71 (7.66)	.011* (.001)	817
Hydralazine/ Hydrochlorothiazide Reserpine	.010** (.005)	-1.82 (1.40)	-.79** (.39)	.41 (.31)	-1.33** (.63) N/A	N/A N/A	.017** (.007)	768
Doxycycline	.025* (.015)	-2.40** (.70)	-.04 (.16)	.23 (.26)	-.84** (.25)	22.50** (6.84)	-.001 (.004)	3242
Hydrochlorothiazide/ Spironolactone	.006* (.003)	-1.56 (1.03)	.04 (.24)	-.03 (.28)	-1.12** (.40)	85.12** (39.07)	.008 (.007)	1455
Dipyridamole	.007** (.003)	-1.32 (1.46)	-.39 (.37)	-.95* (.49)	-1.55** (.53)	5.65 (21.42)	.000 (.010)	958
Brompheniramine/ Phenylephrine/ Pseudoephedrine	.006 (.006)	-4.37** (1.00)	.20 (.20)	.80** (.26)	-.88** (.39) N/A	N/A N/A	.005 (.006)	2204
Ampicillin	-.006 (.014)	.83 (1.08)	1.46** (.27)	-.44 (.42)	-.64 (.41)	.70 (.56)	.009** (.005)	1738
Chlordiazepoxide/ Clidinium bromide	.010** (.003)	-3.71** (1.00)	-.95** (.29)	.52 (.35)	-1.53** (.48) N/A	N/A N/A	.011** (.005)	1744
Tolbutamide	.015** (.017)	3.61** (1.61)	-.31 (.48)	.14 (.41)	-1.13 (.75)	25.40 (17.62)	-.012 (.011)	574

TABLE 5-2, continued

DRUG	CON-STANT	MAND	RX-PRO	RX-ANTI	POS	NEG	LIAB	PASS	INFO
Conjugated estrogens	-1.12	-4.54	.96**	-.34	1.90**	-.49	2.12**	.61	1.94**
	(2.31)	(4.21)	(.42)	(.97)	(.76)	(.76)	(.58)	(.80)	(.61)
Chlorthalidone	.95	1.12	-.23	.00	1.68**	.16	.49	-.20	2.15**
	(2.19)	(.72)	(.64)	(1.14)	(.72)	(.58)	(.64)	(.60)	(.71)
Acetaminophen/ Chlorzoxazone	-.27	-.86*	.89**	-1.05**	-.79	.22	.91**	.66*	-.28
	(1.41)	(.52)	(.30)	(.53)	(.51)	(.34)	(.32)	(.35)	(.41)
Tetracycline	-4.09**	1.03	-.50**	-1.33**	-.30**	-.47	-.32*	.08	.96**
	(.92)	(.22)	(.18)	(.33)	(.23)	(.34)	(.17)	(.25)	(.19)
Spironolactone	.23	.34	.60	[4]	1.06	.54	.64	1.74**	-.85
	(2.86)	(.88)	(.69)		(1.17)	(.84)	(.67)	(.87)	(.74)
Allopurinol	-3.77	.43	1.22*	.71	-.16	.39	.00	.67	.05
	(2.78)	(.72)	(.67)	(.97)	(.95)	(.63)	(.63)	(.79)	(.74)
Dexbrompheniramine/ Pseudoephedrine	1.35	.78	.59	-1.53*	-.36	-.84	.78*	.56	.22
	(1.61)	(.50)	(.40)	(.91)	(.69)	(.68)	(.43)	(.42)	(.43)
Chlorpropamide	2.10	1.44*	.12	-2.40**	-1.56*	.02	-.77	.94	-.91
	(1.87)	(.78)	(.55)	(1.17)	(.81)	(.56)	(.57)	(.68)	(.65)

TABLE 5-2, continued

DRUG	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[1]	TIME	N
Conjugated estrogens	.008 (.005)	-4.03** (1.83)	.13 (.37)	1.48** (.45)	-.24 (.52)	-45.41 (34.25)	-.006 (.012)	905
Chlorthalidone	.003 (.004)	-5.80** (1.55)	-2.10** (.55)	-.89* (.50)	-.35 (.34)	-40.22 (51.81)	.007 (.011)	1487
Acetaminophen/ Chlorzoxazone	.009* (.005)	3.15** (1.39)	-.10 (.30)	-.09 (.46)	-.68* (.39)	N/A N/A	-.010 (.007)	1462
Tetracycline	-.002 (.003)	.31 (.82)	.78** (.19)	.57** (.30)	-.32 (.28)	.76 (.49)	-.001 (.005)	4217
Spironolactone	.003 (.008)	-4.58* (2.49)	-1.00 (.72)	.14 (.61)	[4]	N/A N/A	.003 (.021)	563
Allopurinol	.009 (.007)	-2.45 (2.11)	-2.45** (1.06)	.68 (.57)	-.42 (.66)	9.55 (6.28)	-.009 (.017)	755
Dexbrompheniramine/ Pseudoephedrine	-.003 (.011)	-5.34** (1.56)	-.77* (.41)	[4]	-1.12* (.62)	N/A N/A	-.002 (.010)	1862
Chlorpropamide	.005 (.006)	-5.63** (1.78)	-9.60 (15.86)	.49 (.37)	-2.36** (1.03)	29.59 (79.34)	.000 (.011)	1660

TABLE 5-3

Summary of Coefficient Signs for Individual Legal Provisions in the Logit Regressions on Substitution Choice

Variable		(+)	(+) and Signi-ficant[1]	(-)	(-) and Signi-ficant	Overall Effect[3]
MAND	10[2]	8	6	2	2	No
	24	15	8	9	5	No
RX-PRO	10	6	3	4	3	No
	24	16	7	8	4	No
RX-ANTI	10	2	0	8	5	No
	24	3	0	21	12	-
POS	10	1	0	9	2	-
	24	7	2	17	6	-
NEG	10	4	1	6	4	No
	24	8	1	16	4	No
LIAB	10	3	1	7	5	No
	24	12	5	12	7	No
PASS	10	5	1	5	2	No
	24	15	4	9	2	No
INFO	10	9	5	1	0	+
	24	19	9	5	0	+

1/ Statistical significance is measured at the 10 percent level, by a two-tailed test.

2/ Regressions for the 10 top-substitution drugs are summarized on the first line, the entire 24 drug regressions on the second line.

3/ According to a 10-percent significance level by a binomial test on the pattern of signs.

SOURCE: Table 5-2.

meaningfully estimated for these variables, and additional tests confirmed the statistical significance of this difference for 14 drugs.

The regression results are in conformity with the recommendation of the Model State Act insofar as the category of formats within which the recommended format fits, *RXPRO*, is shown to encourage more substitution than *RXANTI* formats. Moreover, a simple analysis of state substitution rates tabulated by specific format, found in Appendix A4, suggests that states with the recommended format typically had higher rates of substitution than states with most other variants within the *RXPRO* category. However, in that the *RXPRO* formats, as a group, are not associated with significantly more substitution than *RXNEUT* formats, we cannot conclude that most formats other than the one endorsed by the Model State Act are "worse."

2. Notification (INFO)

The requirement that more information be provided to consumers leads to more substitution. Before seeing the data, we were unsure which of the two opposing effects -- discouraging substitution by raising pharmacists' costs or encouraging substitution by providing more information to consumers -- would dominate. These logit results show the demand-enhancing effects to be stronger. Another way of framing the hypothesis might have been that pharmacies would less frequently suggest substitution in order to avoid the added cost of providing information and that therefore the rate of substitution would be lower. The data certainly do not support this hypothesis.

The results on the information requirements suggest that consumers are more responsive to the chance to substitute when they know more about it. This provides support for our argument in Chapter 3 that the low level of substitution overall may be due less to a fixed rejection on the part of consumers or others than to consumers' lack of information.

That consumers respond to information is confirmed also by reports from chain drugstore executives that their voluntary programs seem to have led to growing numbers of inquiries by

consumers about the possibility of substitution. In particular, some chains have printed out, with each prescription, either the price saving actually realized (when a substitution was made) or the saving foregone (when the prescription was dispensed as written.) A statement of the immediate saving available with substitution is an effective way to capture the consumer's attention. In other words, information on the opportunity for substitution and its price consequences makes a difference. This is not the same as saying that *requiring* a particular *form* of information dissemination is the only way by which this information will reach consumers.

The Model State Act recommended that consumers be told when a substitution is made (and of the right to refuse the substitution.) The regression results confirm the importance of provision of information to consumers in encouraging substitution, although the *INFO* category contains, along with the Model Act form of the information requirement, other ways in which consumers' attention may be brought to the opportunity for or fact of substitution.

3. Formulary (POS, NEG)

The logit results on the presence of a formulary are unexpected and odd. Our hypothesis was that a formulary would provide reassurance and information and thus lead to more frequent substitution is not borne out. Instead, the logit results show that a positive formulary has a negative impact on substitution (on those prescriptions for which substitution was permitted), relative to no formulary. A negative formulary is shown to have a less significant effect, although the predominance of negative signs on *NEG* suggests that substitution may be discouraged by the presence of any type of formulary. While positive and negative formularies each had significant effects on substitution in 10 of 24 regressions, when the signs on the differential effect between having a positive or a negative formulary are counted, they split evenly, suggesting that the real impact on substitution comes from having any formulary at all.

The FTC/FDA recommendation was for a positive formulary. If usefulness to pharmacists is measured by the incidence of substitution, this recommendation has not been borne out by our study. Our regression results show that positive formularies are associated with less, not more, substitution (given that substitution in the drug is permissible) than the absence of any formulary. However, the recommendation for a formulary was based on previous research which was unable to separate out the unique effect of a formulary and, moreover, was made not only to encourage substitution but also to ensure that products with problems of bioinequivalence were reliably excluded from the realm of possible substitutions.

4. Mandatory Substitution (MAND)

Our results on mandating substitution are also peculiar: mandatory substitution is not shown generally to lead to significant increases in substitution. Indeed, of the 9 negative coefficients 5 are significant. While it is possible to imagine that a mandatory provision might fail to lead to an increase in substitution -- if, for example, the other provisions would have led to just as much substitution -- it is not reasonable to expect such a requirement to lead to a decrease in substitution.

The Model Act recommended that substitution *not* be mandatory, a rule thought both unnecessary and unworkable. Our study confirms that mandating substitution does not lead to significantly higher levels of substitution.

5. Cost Pass-through Requirement (PASS)

We had expected to find that a pass-through requirement would be associated with less substitution. However, the data show no significant pattern of negative coefficients; a pass-through requirement does not significantly *deter* substitution. In seeking an explanation, we offer the possibility that a pass-through provision, expected to deter substitution by decreasing the pharmacist's incentive, has a second, countervailing effect on the rate of substitution: that when the saving available from substitution is greater, consumers may be

more eager to initiate or accept substitution. Similarly, the implementation of the pass-through may explicitly draw consumers' attention to the opportunity, and this too would enlarge demand.

The FTC/FDA recommendation was *against* a cost pass-through requirement, in the belief that such a requirement, even if workable, would deter substitution. Our results show, to our surprise, that the pass-through requirement does not systematically and significantly deter substitution. The Model Act's recommendation on this aspect of the law seems less important for encouraging substitution than anticipated.

6. *Liability (LIAB)*

An explicit statutory protection against added liability is shown to have no significant effect on substitution. Half the coefficients on *LIAB* are positive; half are negative. Perhaps because the specter of liability has not been realized in lawsuits, protection against such liability has not assumed importance in affecting substitution behavior. Moreover, some protection against liability is presumed in conjunction with other provisions sometimes present, such as a formulary or mandatory substitution. Our results might be read to mean that statutory protection does not encourage substitution more than do other forms of liability protection. The FTC/FDA Model Act left as optional a statutory provision on the subject of liability as associated with substitution. Our results confirm that statutory protection is not particularly important in determining substitution decisions.

7. *Magnitude of Effects*

For each of the 10 top-substitution drugs and for the average of these 10 and of all 24 drugs, Table 5-4 gives the percentage point changes attributable to the presence of each provision. That is, the coefficients from the logit regressions have been transformed to facilitate interpretation. In each instance the percentage point change is centered on the actual average frequency of substitution in the drug, which is implicitly based on the average probability of the presence of

each of the other provision.[25] The estimates seem very large. Even a 2 percentage point change on an average substitution rate of 16 percent seems surprising. Despite the insignificance of most of the coefficients, the estimated coefficients do provide the best (unbiased) measures of the effects.

RXANTI, which was shown above to have the most consistent effect across drugs, also had a strong effect on the probability of substitution. Substitution was 18 percentage points higher (9 for the top-substitution drugs) where the prescription pad had a "pro"-substitution format rather than an "anti"-substitution format. *RXPRO* is shown to have almost no different effect on rates of substitution from neutral prescription pads. When *RXANTI* is compared with "neutral" prescription pads, *RXANTI* is shown to have led to 16 percentage points less substitution (11 for the top-substitution drugs), little different from the comparison of *RXANTI* with *RXPRO*.

The two other provisions which showed significant sign patterns in the regressions, *POS* (the presence of a positive formulary) and *INFO* (notification requirements), both had a modest impact on the probability of substitution. *INFO* raised substitution by an average of 1 percentage point. In comparison with no formulary, a positive formulary lowered substitution rates by 5 percentage points and a negative formulary lowered them by almost as much (4 percentage points.) Across all drugs, positive and negative formularies were shown to have no measurably different effects on substitution rates.

It is surprising that *MAND* increased substitution only 1 percentage point overall (3 on top-substitution drugs.) A state with otherwise average provisions would therefore still be expected to have a substitution rate below 15 percent -- far short of the high rate nominally implied by a mandatory provision.

The cost pass-through provision had no measurable effect on the rate of substitution. Statutory protection against added liability was associated with 2 percentage points *less* substitution. In light of the mixed sign and significance patterns across the 24 regressions for these two variables, the

---

25/ See Appendix A7 for further detail.

TABLE

Effect of Individual Provisions on the

	SUBSTI-TUTION RATE	MAND	RXANTI v. RXPRO	RXANTI v. RXNEUT	RXPRO v. RXNEUT
Hydrochlorothiazide	.241	.12*[2]	-.17*	-.24*	-.07*
Chlordiazepoxide	.193	.05*	-.05*	-.01	.04*
Amitriptyline	.184	.03	-.03	-.01	.02
Penicillin VK	.173	.07*	-.05*	-.07*	-.02
Amoxicillin	.119	.02	-.04*	-.00	.07*
Atropine sulfate/ Diphenoxylate	.170	.05*	-.14*	-.22*	-.09*
Meclizine	.164	.06*	-.07*	-.03	.04
Isosorbide dinitrate	.149	-.10*	-.13*	-.10*	.03
Hydralazine/ Hydrochlorothiazide/ Reserpine	.142	-.31*	-.04	-.00	.04*
Doxycycline	.104	.05*	-.06	-.14*	-.08
Average, 10 drugs	.180	.03	-.09	-.11	-.02
Average, 24 drugs	.122	.01	-.18[3]	-.16[3]	.01

1/ Regessions included only observations for which substitution was permitted by both statute and formulary. The substitution rate in the first column is defined in the same way.

2/ * means the coefficient was significant at the 10 percent level, by a two-tailed test.

5-4

Probability of Substitution By Drug[1]

POS v. NEG	POS v. NO FORM	NEG v. NO FORM	LIAB	PASS	INFO
-.09*	-.05*	.04	-.07*	.00	.01
-.05	-.03	.01	-.05*	-.00	.02
.01	-.05	-.05	-.03	.01	.01
.06*	-.07*	-.14*	-.07*	-.04*	.05*
.02	-.02	-.05	.01	.01	.05*
.10*	-.04	-.14*	-.05*	.02	.05*
.00	-.01	-.02	-.01	-.07*	.00
.32*	.06	-.27*	.03	.06*	-.05
-.10*	-.00	.09*	.06*	.03	.00
.08	-.04	-.12*	-.05*	-.02	.05*
.03	-.03	-.07	-.04	.00	.02
-.01	-.05	-.04	-.02	-.00	.01

3/ The coefficients necessary for computing this difference could not be reliably estimated for one drug, so the average includes only 23 drugs.

SOURCE: Calculations based on Table 5-2. See Appendix A7 for details.

estimates of the magnitude of their effects may be best taken as underscoring the rejection of our prior hypotheses: contrary to expectation, a cost pass-through requirement does *not* lead to significantly less substitution, nor does statutory protection from liability lead to more.

8. Effect of the Non-legal Variables

Several of the non-legal variables show strong patterns of influencing substitution, mostly in accord with our hypotheses. Table 5-5 provides the data underlying these conclusions, based on the logit regressions for 24 drugs.

Insurance coverage makes a difference. In all drugs, substitution is less likely for a purchaser covered by private insurance; this corroborates the cross-tabulation data reported in Chapter 4. The cross-tabulations also showed that substitution is more frequent for Medicaid consumers, and this remains true even when other influences are taken into account, with positive signs on 18 of the 24 *MED* coefficients.

Some of the other variables also show the hypothesized effects; on others the pattern is weak or was not predicted. Where generic prescribing is more prevalent, substitution is more frequent. Substitutions occur more often on larger prescriptions. As discussed in Chapter 4, chains and independents are not shown to be significantly different in substitution behavior. The higher the single-source price index, the less likely is substitution. To the extent that a high index reflects a weaker intensity of competition, this is not surprising, but since the *SSINDEX* measures local cost conditions and other influences as well, the coefficient is difficult to interpret.

Long experience with the law may lead to more substitution but the effect is not strong. Although the sign pattern for the length of time since initial implementation of a drug product selection law is not sufficiently skewed to meet a binomial test for significance, a majority of the signs are positive and 6 of the 14 are statistically significant. The change in probability associated with a year-older law is less than 1 percent.

TABLE 5-5

Summary of Coefficient Signs for Non-Legal Variables in the Logit Regressions on Substitution Choice

Variable	(+)	(+) and Significant[1]	(-)	(-) and Significant	Overall Effect[2]
QUAN	20	11	4	1	+
SSINDEX	7	3	17	10	-
CHAIN	10	5	14	5	No
MED	18	9	6	2	+
PRIV	0	0	24	16	-
GEN[1]	14	7	3	0	+
TIME	14	6	10	1	No (+)

1/ Seven drugs had less than 1 percent generic prescribing, so the variable GEN was omitted.

2/ According to a 10-percent significance level by a binomial test on the pattern of signs.

SOURCE: Table 5-2.

III. RESULTS FROM PREVIOUS STUDIES

Much of the previous empirical work on the effects of individual provisions of the laws has been done by comparing results of studies done in individual states. There have been quite a few such state studies done. These studies will be reviewed in a forthcoming volume to be published by the National Center for Health Services Research.[26] We report here only on two compilations of cross-state results, each of which utilizes data collected in a consistent manner across all the states studied.

A recent summary of results from four states surveyed by the Goldberg team draws the following conclusions:[27]

1. The two-signature-line prescription form leads to much more frequent physician prohibition of substitution than when prescribers are required to write out a phrase such as "Dispense as Written." In Rhode Island, with a two-line form, physicians prohibited substitution 38 percent of the time, in contrast to a rate of 5 percent or less in states requiring a handwritten statement of prohibition (about 5 percent of multi-source prescriptions in Michigan, about 1.5 percent in Wisconsin, and less than 1.5 percent in Vermont.)
2. Positive formularies have a significant (positive) effect on the rate of substitution.
3. Mandatory substitution provisions result in higher substitution rates; Vermont, which has such a provision, was found to have a rate nearly double that of the other states studied.
4. There is no evidence that elimination of a pass-through provision will lead to greater substitution.

A second cross-state analysis has been reported by Richard Zeich who uses data from 1000 retail pharmacies nationwide sampled in the Market Measures National Substitution Audit.[28] Some of Zeich's results are at odds with those of Goldberg and DeVito:

26/ Goldberg and Raskin, ed., (forthcoming).
27/ Goldberg and DeVito (1981).
28/ Zeich (1984).

1. Substitution took place on 6.7 percent of new prescriptions in states with single-line prescription forms but on only 4 percent in states with two-line forms. (Substitution was also found to be increasing over time in one-line states but not as much in two-line states.) This appeared to be the result of the difference in the incidence of physician prohibition of substitution: 5 percent of new prescriptions in one-line states but 60 to 70 percent in two-line states.[29]

2. In the seven states with mandatory substitution, the substitution rate has been declining and was lower (4.8 percent) than in "permissive" states (5.3 percent), where substitution was increasing over time. Zeich concludes, "substitution rates for the mandatory and permissive states were close, suggesting that the legal factors make little difference."

3. On formularies, Zeich states, "States with formularies had higher substitution rates than those without them, and formularies that were state-generated were more effective in encouraging substitution than the Food and Drug Administration's. The highest substitution rates were recorded for negative state formularies."

These studies are in agreement with respect to the effects of the two-line prescription pad; they disagree about the effects of mandatory provisions and about the superiority of a positive formulary.

Our regression results, then, underscore previous work as to the importance of a prescription pad format which demands extra attention and effort on the part of a physician deciding to prohibit a substitution. On the use of a positive formulary, however, our results show a decrease in substitution, whereas others have found an association with higher levels of substitution. We note that simple cross-tabulations of our data, using average substitution rates by state, suggest this positive association, whereas this result is reversed in the regressions. This implies that positive formularies are frequently found in conjunction with other state characteristics which encourage substitution, but that the presence of a

29/ Measured in a few states only.

positive formulary itself cannot be identified as having that effect independently. The third provision which proved strong in effect in our analysis was the requirement that consumers be personally notified, in one or another way, about substitution; this type of provision was not the focus of study in earlier work.

Goldberg and DeVito found that mandatory substitution led to higher substitution rates, but Zeich did not; our results fail to show a strong positive effect of making substitution mandatory. On the pass-through provision, our results confirm those of Goldberg and DeVito, that the pass-through does not seem to deter substitution.

IV. EVALUATION OF FTC/FDA MODEL ACT

Finally, there is no simple, summary evaluation of the FTC/FDA Model Act. States have typically adopted some of the recommended provisions while modifying others. Conversely, there was no state from whose law all traces of the basic recommendations were absent. It was impossible, therefore, to make a direct empirical comparison of the effects of two competing packages of provisions defined in terms of the FTC/FDA Model Act.

What we have attempted to do is to measure the effect of each individual provision. As discussed above, some of the individual recommendations proved to be in line with encouraging higher rates of substitution, others were less important than predicted, and one (positive formulary) turned out to be associated with *less* substitution, rather than more.

But the recommendations were not based on this single purpose. A positive formulary, tied to the FDA's list of "Therapeutic Equivalents," for example, was seen to be important also in providing a sound list of drugs for which interchange was medically appropriate, and tying a (positive) formulary directly to the FDA list was seen as a way to simplify and make less costly the maintenance of an accurate and up-to-date list. Similarly, the recommendation that consumers be told when substitutions are made, a provision which also does appear to encourage substitution, has another

purpose of ensuring that consumers have the right of refusal. Therefore, the value of the Model Act's recommendations should not be judged by the recommended provisions' effects on the substitution rate alone.

Moreover, the FTC/FDA Model Act was put forward as a package of provisions, likely to have the greatest impact when adopted *as a package.* To the extent that there are interactions within a package -- that each provision does not simply have an independent and additive effect -- our logit technique fails to pick it up. To introduce even greater complexity into the statistical analysis would have demanded even more data than we had.

V. SUMMARY ON PARTICULAR LEGAL PROVISIONS

Certain provisions of state drug product selection laws clearly have strong impact. The presence or absence of a formulary is obviously important, primarily because a formulary delimits the universe of potential substitutions. However, given that permission to substitute has been granted for the drug for which the prescription has been written, the presence of a formulary, particularly a positive formulary, seems to inhibit substitution. The format of the prescriber's prescription pad is very powerful; a format which makes it very convenient for the physician to prohibit substitution is associated with significantly lower levels of substitution. The direct notification to consumers that a substitution has been made or is possible seems also to have led to more frequent substitutions.

For other provisions, our results can best be understood as showing that the hypothesized effect does not exist to any significant extent. For example, the most appropriate statement about the cost pass-through provision is that it did not *deter* substitution, as had been hypothesized, since there was no statistically significant negative pattern. Nor did a statutory limitation on protection from liability on substitution reveal any systematic and significant effect on the incidence of substitution.

Finally, a number of other provisions were shown to have been less important in their effects on the substitution rate than many observers have believed. As the volume of substitution increases, some of the provisions which had not, by 1980, demonstrated a significant influence may assume greater significance, although, given the 1980 results, the magnitude of any effects would probably be small.

CHAPTER 6

GENERIC MARKET SHARE

The drug product selection laws sought to lower average prescription prices by increasing the share of lower-priced generics, through substitution. In fact, generic market share is determined by several types of prescribing and dispensing choices, not just substitution. Whether or not all or most of state-to-state variations in generic market share should be attributed to differences in the DPS law depends on the extent to which each type of prescribing and dispensing decision is affected by the law.

In particular, since most generically written prescriptions are filled with generics, an important question is whether promulgation of a DPS law leads physicians to write more (or fewer) prescriptions generically. If generic prescribing is treated as unaffected by the laws whereas in reality the laws lead to more frequent generic prescribing, the effects of DPS laws are underestimated, since the added generic prescribing would increase the overall generic market share and lower the average retail price. Alternatively, if variations in generic prescribing should not be attributed to the DPS laws but are counted as if they are, the laws' effects are overstated.

In this chapter we first show the variation in generic market share from state to state and, in particular, the difference between states with and without DPS laws. We then describe the sources of generic market share in terms of types of prescriptions written and, for each type of prescription, the choice of brand dispensed. We analyze the effects of DPS laws on each of these decisions, paying particular attention to the relationship between the DPS laws and generic prescribing. Our conclusion is that our data do not discriminate between competing hypotheses as to the direction of causation between DPS laws and generic prescribing.

I. DIFFERENCES IN GENERIC MARKET SHARE BY OPPORTUNITY TO SUBSTITUTE

Generic market share varies from state to state, ranging from 12.1 percent to 33.5 percent.[1] Table 6-1 shows the distribution of state averages.[2]

Where generic market shares differ this much, average prescription prices do too. In 1980, consumers in a state with a 30 percent generic market share would have paid, on average, prescription prices which were lower by nearly 4 percent than prices paid by consumers in states where the generic market share was half as large (individual product prices held constant.)[3]

The generic market share is much higher in states permitting substitution than in states prohibiting substitution (26.3 percent compared to 13.2 percent.)[4] This pattern is true for

---

1/ Generic market share is defined here as a percentage of all prescriptions on which the identity of the product dispensed was given. See footnote 1 to Table 6-3 for a comparison with an alternative method of computation.

2/ See Appendix Table A4-1 for data by state.

3/ In 1980 the average price of a prescription filled with a leading brand was $8.22, compared with $6.22 for generics. (See Chapter 3, section I-A.) The average prescription price would therefore have been $7.92 with a generic market share of 15 percent and $7.62 at 30 percent. The $.30 difference is nearly 4 percent of $7.92.

4/ For these overall estimates, and for estimates by individual drug, we extrapolated the known dispensing patterns, by prescription type, to prescriptions where the identity of the product dispensed was not recorded. Most (98 percent) of these latter prescriptions were generically written, a prescription type for which the dispensed product was, where recorded, typically a generic (89 percent). If only those prescriptions on which the dispensed brand was recorded are included in the computation, the estimated generic market share is lower, 23.3 percent for the U.S. in 1980, than the 25.1 percent estimated for all prescriptions.

The generic market share is highest where substitution on a drug is permitted (by both statute and formulary), 30.7 percent. The generic market share on drugs for which substitution is not permitted (by either the statute or the formulary) is much lower, 9.1 percent. (See Table 6-3.) This comparison is exaggerated, however, because drugs selected for formularies are the very drugs in which generic prescribing is most likely.

TABLE 6-1

Generic Market Share,
Distribution of State Averages, 1980

Percentage	Number of States
10 - 15%	5
15 - 20	10
20 - 25	15
25 - 30	15
30 - 35	4
Average: 23.3%[1]	

1/ This average is computed directly across all prescriptions where the product dispensed was identified, for the whole United States sample. Computed by taking a simple average of state averages, it is 22.8 percent.

SOURCE: Appendix Table A4-1.

most individual drugs, as Table 6-2 shows. Among the ten top-substitution drugs there is only one exception (amoxicillin) to the pattern of lowest generic market share where substitution is prohibited by statute and highest market share where substitution is permitted by both statute and formulary.

II. OVERVIEW OF SOURCES OF GENERIC MARKET SHARE

Consumers receive generics sometimes as substitutes on brand-written prescriptions, nearly always on generically written prescriptions, and occasionally because the physician names a particular manufacturer's generic on the prescription. Generics are dispensed much more frequently on some drugs than on other drugs; 4 large antibiotic entities together accounted for 55 percent of all generically dispensed prescriptions in our 45-drug sample in 1980, and the 8 drug entities with

TABLE 6-2

Generic Market Share by Drug and Opportunity to Substitute for the 10 Top-Substitution Drugs, 1980[1]

Drug	Substitution prohibited by statute	Substitution prohibited by formulary	Both statute and formulary permit substitution
Hydrochlorothiazide	28.2%	55.0%	58.7%
Chlordiazepoxide	3.3	12.5	29.0
Amitriptyline	10.4	12.8	34.5
Penicillin VK	25.9	NA	63.0
Amoxicillin	27.3	54.3	38.6
Atropine sulfate/ Diphenoxylate	3.0	11.0	18.1
Meclizine	1.9	6.0	24.5
Isosorbide dinitrate	1.9	12.4	22.0
Hydralazine/ Hydrochlorothiazide/ Reserpine	3.8	10.2	19.6
Doxycycline	1.1	5.1	14.2

1/ The ten drugs are listed in order by substitution rate. These percentages are for all prescriptions, with known dispensing patterns extrapolated to prescriptions on which the product dispensed was not identified.

SOURCE: Computed with data from the 1980 IMS National Prescription Audit.

generic market shares over 30 percent accounted for 81 percent.[5] The generic market share therefore is determined both by physicians' prescribing choices and by dispensing choices for each type of prescription written, as well as by the distribution of drugs prescribed. Table 6-3 brings together

5/ Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

data on all sources of generic market share. It shows the proportions of prescriptions written for leading brand, for specific generics, and unspecified ("generically written"); the proportion of each type of prescription dispensed with a generic; and the contribution from each prescribing channel to the overall generic market share. These are given for a weighted average of 45 drugs, by opportunity to substitute.

The outstanding feature of the table is the dominance of generic prescribing in determining generic market share. For the United States as a whole in 1980, nearly three-quarters (71.7 percent) of the generic market share was due to generically written prescriptions. Generic substitution on prescriptions written for leading brands accounts for 16.3 percent of generic market share, and prescribing and dispensing of specified versions of generics provides the remaining 12.0 percent.[6]

This dominance of generic prescribing as the source of generic market share is due to a few drugs which are prescribed frequently and usually by the generic name; for 7 of the 8 drugs with a generic market share over 30 percent (2 with 100 percent) generic prescribing is the source of more than half of all generically dispensed prescriptions.[7] However, of all the 37 drugs with a generic market share of at least 1 percent, in over half the drugs (21) it was substitution from a leading brand which contributed a majority of generic dispensing. Only 10 drugs had generic prescribing as the dominant channel, and for 5 the primary source was prescriptions written for a

---

6/ Of the U.S. overall 25.1 percent generic market share of the 45 multi-source drugs, generics dispensed on generically written prescriptions contributed 18.0 percentage points, generic substitutions 4.1 percentage points, and specific generics dispensed as prescribed 3.0 percentage points.

7/ These 7 drugs (quinidine sulfate, nitroglycerin, tetracycline, ampicillin, penicillin VK, hydrochlorothiazide, and amoxicillin) account for 27.8 percent of the total number of prescriptions in the 45 drugs studied.

Looked at from the other side, of the 11 drugs with at least 10 percent of all prescriptions written generically, these prescriptions provided a majority of the generic market share in 8 drugs. For several drugs there is essentially no generic prescribing, perhaps because the drug's name is so long as to discourage it, e.g., the combination drug hydrochlorothiazide/reserpine/hydralazine.

TABLE

Sources of Generic Market Share by Type of

	Share of All U.S. Prescriptions	Percent Prescriptions Written For: Leading Brand	Specified "Generics"	Unspecified[2]
Substitution prohibited	26.4%	90.4%	2.7%	6.9%
Substitution permitted	73.6	71.9	3.1	24.9
States without DPS law	8.7	85.8	4.0	10.1
States with DPS law	91.3	75.9	3.0	21.1
All States	100.0	76.8	3.1	20.1

1/ For prescriptions on which the identity of the product dispensed was not scription written.

When only prescriptions on which the identity of the product dispensed is is the proportion of generically written prescriptions and their contribution estimates would be:

All States	100.0	78.9	3.2	18.0

2/ These are prescriptions that were written generically.

3/ Numbers in parentheses give percentage of total generic market share

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980

6-3

Prescription Written and by Opportunity to Substitute, 1980[1]

Percent Generics Dispensed on Prescriptions Written for:			Contribution to Generic Market Share from Prescriptions Written for:			Generic Market Share
Leading Brand	Specified "Generics"	Un-specified[2]	Leading Brand	Specified "Generics"	Un-specified[2]	
1.4%	98.2%	73.4%	1.3% (14.3%)[3]	2.7% (30.0%)	5.1% (56.0%)	9.1%
7.2	95.5	90.7	5.2 (16.9)	2.9 (9.4)	22.6 (73.6)	30.7
.4	99.2	87.8	.3 (2.3)	4.0 (30.3)	8.9 (67.4)	13.2
5.9	95.7	89.4	4.5 (17.1)	2.9 (11.0)	18.9 (71.9)	26.3
5.4	96.1	89.4	4.1 (16.3)	3.0 (12.0)	18.0 (71.7)	25.1

recorded, we applied the "percent generics dispensed" for the type of pre-

known are included, the overall generic market share estimate is lower, as to the overall generic market share. For All States, for example, the

5.4	96.1	89.4	4.2 (18.0)	3.0 (12.9)	16.1 (69.1)	23.3

attributable to each of the three prescribing channels.

IMS National Prescription Audit.

specific but non-leading brand. Table 6-4 gives data for individual drugs.

III. GENERIC PRESCRIBING

The drug product selection laws may alter not only the pharmacist's choices but the physician's as well. The laws typically specify how the physician can indicate whether or not substitution is permitted on a brand-written prescription. Whether the laws also affect the choice between naming a brand and writing the prescription by the generic name only is more difficult to assess.

A. VARIATION IN GENERIC PRESCRIBING BY OPPORTUNITY TO SUBSTITUTE

Generic prescribing was much more common in 1980 in states where substitution was permitted: there was only a little more than half as much generic prescribing in states which banned substitution altogether in 1980 as in states with DPS laws, 10.1 percent as compared to 21.1 percent of prescriptions for multi-source drugs.[8] As Table 6-5 shows, this pattern held true for individual drugs. It is clear that in any legal regime generically written prescriptions account for most of the generic market share but that this effect is even more pronounced in states and on drugs where substitution is permitted.

8/ The 21.1 percent figure is for all 45 drugs in DPS states and does not exclude prescriptions for drugs for which brand-written prescriptions would be ineligible for substitution by a formulary. For formulary-permitted drugs 24.9 percent of all prescriptions were written generically; for formulary-prohibited drugs in DPS states, 5.3 percent. There were a few states which allowed substitution but which had levels of generic prescribing similar to those of the three states which forbade substitution (under 15 percent). These states had levels of substitution nearly as low as in those three states, about 3.3 percent or less.

B. DID THE DPS LAWS LEAD TO MORE GENERIC PRESCRIBING?

This pattern raises the question of whether the DPS laws themselves lead to an increase in generic prescribing. The publicity surrounding passage of a DPS law and the discussion generated among physicians about it directs physicians' attention to the use of generic drugs, including writing prescriptions generically. Similarly, the publication of a formulary reduces a physician's cost in learning about the equivalence of specific brands. It is even possible that the inclusion of a drug on a positive formulary, for example, may indirectly confer some additional protection against liability; a physician could argue that if the official formulary countenances brand interchange, a generically written prescription -- which allows the pharmacist the same choices as on a brand-written prescription for which substitution is permitted -- is also appropriate.

If the rationale behind the DPS laws is true, however, the increase in generic prescribing caused by the law must be slight; the laws were seen as a way around change-resistant physician prescribing patterns. Indeed, the law makes it unnecessary for the physician to remember and to write the generic name even when the intention is to allow the patient to purchase a low-cost brand. This might lead to *less* generic prescribing.

While the physician's incentive to prescribe generically would not seem to be much increased by the passage of a DPS law, substitution offers pharmacies a new profit opportunity and may thereby direct their greater attention to all aspects of a generics program, including the task of convincing physicians that generic dispensing is acceptable. For example, more than one-quarter of all prescriptions are by telephone,[9] offering an opportunity for the pharmacist to check with the prescriber's office as to the acceptability of a generic. If the prescriber explicitly approves the generic, the pharmacist

---

9/ 26.3 percent of prescriptions in 45 multi-source drugs. Computation based on data from IMS' 1980 NPA.

TABLE 6-4

Sources of Generic Market Share by Type of Prescription Written by Drug, 1980[1]

Drug[2]	Type of Prescription Written: For Leading Brand	For Specific Manufacturer's Generic	Generically Written[3]	Overall Generic Market Share
Hydrochlorothiazide	11.9% (20.9%)	1.2% (2.2%)	43.8% (76.8%)	57.0%
Chlordiazepoxide	15.5 (58.7)	1.0 (3.8)	9.9 (37.4)	26.4
Amitriptyline	13.0 (41.5)	3.9 (12.5)	14.4 (46.0)	31.2
Penicillin VK	6.2 (10.2)	6.6 (11.0)	47.0 (78.7)	59.8

1/ For each drug entry and type of prescription written, the first line is the share of all prescriptions (for all types of prescription written) accounted for by generically dispensed prescriptions of that type; the second line is the share of the generic market for generically dispensed prescriptions of that type.

2/ Drugs are listed in descending order by substitution rate in 1980.

3/ Prescriptions for which no manufacturer is specified.

TABLE 6-4, continued

Drug[2]	Type of Prescription Written: For Leading Brand	For Specific Manufacturer's Generic	Generically Written[3]	Overall Generic Market Share
Amoxicillin	3.6 (9.6)	8.1 (21.7)	25.6 (68.7)	37.3
Atropine sulfate Diphenoxylate	15.4 (93.9)	1.0 (6.1)	0 (0)	16.4
Meclizine	12.9 (59.4)	NA (0)	8.8 (40.6)	21.6
Isosorbide dinitrate	11.5 (60.1)	.1 (.5)	7.5 (39.3)	19.1
Hydralazine Hydrochlorothiazide/ Reserpine	8.7 (63.3)	4.8 (35.1)	.2 (1.6)	13.8
Doxycycline	8.5 (69.2)	.3 (2.4)	3.5 (28.4)	12.3

TABLE 6-4, continued

Drug[2]	Type of Prescription Written: For Leading Brand	For Specific Manufacturer's Generic	Generically Written[3]	Overall Generic Market Share
Hydrochlorothiazide/ Spironolactone	7.7 (85.6)	.2 (2.2)	1.1 (12.2)	9.0
Dipyridamole	6.8 (65.9)	NA (0)	3.5 (34.1)	10.4
Brompheniramine/ Phenylephrine/ Pseudoephedrine	6.6 (82.0)	1.4 (16.8)	.1 (1.2)	8.1
Ampicillin	0 (0)	15.2 (15.2)	84.8 (84.8)	100.0
Chlordiazepoxide/ Clidinium bromide	6.7 (82.7)	.8 (9.9)	.6 (7.4)	8.1
Tolbutamide	5.4 (57.7)	NA (0)	4.0 (42.3)	9.4

TABLE 6-4, continued

Drug[2]	Type of Prescription Written: For Leading Brand	For Specific Manufacturer's Generic	Generically Written[3]	Overall Generic Market Share
Conjugated estrogens	4.1 (62.1)	.2 (3.0)	2.3 (34.9)	6.6
Chlorthalidone	4.2 (85.8)	NA (0)	.7 (14.2)	4.9
Acetaminophen/ Chlorzaxazone	3.8 (96.2)	.1 (2.5)	.1 (1.3)	3.9
Tetracycline	1.1 (1.4)	7.1 (9.1)	69.5 (89.4)	77.7
Spironolactone	3.7 (100.0)	NA (0)	0 (0)	3.7
Phenytoin sodium	2.7 (56.4)	NA (0)	2.1 (43.7)	4.8

TABLE 6-4, continued

Drug[2]	Type of Prescription Written: For Leading Brand	Type of Prescription Written: For Specific Manufacturer's Generic	Type of Prescription Written: Generically Written[3]	Overall Generic Market Share
Allopurinol	2.3 (43.1)	.3 (5.6)	2.8 (51.3)	5.4
Dexbrompheniramine/ Pseudoephedrine	2.4 (29.3)	5.7 (70.7)	0 (0)	8.1
Triamcinolone	1.7 (47.0)	.2 (5.7)	1.7 (47.3)	3.5
Chlorpropamide	2.2 (70.7)	0 (0)	.9 (29.3)	3.1
Hydroxyzine	1.6 (88.3)	NA (0)	.2 (11.7)	1.8
Sulfamethoxazole/ Trimethoprim	.3 (100.0)	NA (0)	0 (0)	.3

TABLE 6-4, continued

Drug	Type of Prescription Written: For Leading Brand	Type of Prescription Written: For Specific Manufacturer's Generic	Type of Prescription Written: Generically Written	Overall Generic Market Share
Theophylline	.3 (1.8)	13.8 (98.2)	0 (0)	14.1
Terbutaline sulfate	.5 (6.2)	5.1 (62.3)	2.6 (31.5)	8.1
Nitroglycerin	.4 (.8)	.7 (1.5)	44.4 (97.7)	45.4
Metronidazole	.9 (86.3)	.1 (9.6)	.0 (4.1)	1.0
Diethylpropion	.8 (5.0)	16.0 (95.0)	0 (0)	16.8
Phentermine	.3 (5.6)	.6 (11.8)	4.2 (82.6)	5.1

TABLE 6-4, continued

Drug	Type of Prescription Written: For Leading Brand	Type of Prescription Written: For Specific Manufacturer's Generic	Type of Prescription Written: Generically Written	Overall Generic Market Share
Minocycline	0 (0)	1.4 (100.0)	0 (0)	1.4
Furosemide	.4 (90.7)	NA (0)	.0 (9.3)	.4
Erythromycin base	.1 (1.2)	2.1 (36.9)	3.6 (61.9)	5.8
Hydrochlorothiazide/ Triamterene	.4 (100.0)	NA (0)	0 (0)	.4
Amitriptyline/ Perphenazine	.1 (.4)	18.6 (99.6)	0 (0)	18.7

TABLE 6-4, continued

Drug	Type of Prescription Written: For Leading Brand	For Specific Manufacturer's Generic	Generically Written	Overall Generic Market Share
Cephalexin	0 (0)	NA (0)	0 (0)	0
Erythromycin ethylsuccinate	0 (0)	NA (0)	0 (0)	0
Ibuprofen	0 (0)	NA (0)	0 (0)	0
Mestranol/Norethindrone/Placebo	0 (0)	NA (0)	0 (0)	0
Hydrogenated ergot alkaloids	0 (0)	NA (0)	0 (0)	0
Quinidine sulfate	0 (0)	.8 (.8)	99.2 (99.2)	100.0

TABLE 6-5

Proportion of Prescriptions Written Generically by Drug and by Opportunity to Substitute, 1980[1]

Drug	Substitution prohibited by statute	Substitution prohibited by formulary	Both statute and formulary permit substitution
Hydrochlorothiazide	29.1%	50.8%	46.1%
Chlordiazepoxide	1.7	9.1	11.0
Amitriptyline	3.7	7.0	17.8
Penicillin VK	20.1	NA	54.3
Atropine sulfate/ Diphenoxylate	0.0	0.0	0.0
Meclizine	1.9	6.0	10.4
Isosorbide dinitrate	1.0	7.2	
	9.1		
Hydralazine/ Hydrochlorothiazide/ Reserpine	.5	.3	.1
Amoxicillin	32.0	80.4	52.1
Doxycycline	1.1	2.1	5.3

1/ The ten drugs are listed in descending order by substitution rate.

SOURCE: Computed from data from the 1980 IMS National Prescription Audit.

may prefer to record the prescription as written generically, since under the laws of most states there are fewer regulations applicable to generically written prescriptions than to substituted prescriptions. In this way, those with the greater incentive for dispensing generics -- the pharmacists -- may be a link between DPS laws and an increase in generically written prescriptions, by first converting brand-written prescriptions into generically written prescriptions and, in a longer-term sense, educating physicians to write generically.

Any impact on generic prescribing due to the legal opportunity to substitute would be likely to grow over time, since an increase in the familiarity with and acceptance of generics would be a gradual process. The data are consistent with this hypothesis. The incidence of generic prescribing by state (in 1980) is correlated with the length of time since passage of a DPS law. The estimated correlation coefficient for 46 state observations (for all states with a DPS law by 1980) of the proportion of prescriptions written generically in 45 leading multi-source drugs in 1980 and the number of months since passage of the state's DPS law is .38.[10] This is statistically significant at better than the 1 percent level.

The correlation between early passage of a DPS law and a high level of generic prescribing does not establish the law as the cause of the prescribing pattern. It may be instead that both are due to an underlying attitude of the medical community towards generics. In states where many physicians have a favorable view of generics, they are more likely to support (or not oppose) legislation authorizing substitution and at the same time to prescribe generically more often. One corroborating fact is that early adoption of DPS laws was associated with prescription pad formats likely to lead to more substitution, while states with formats which facilitate physician prohibitions have newer DPS laws. The average number of months since first passage of a DPS law was 38.8 for prescription pads inconvenient for prohibitions, 25.0 months for

---

10/ Oklahoma is excluded from these calculations because of its extremely early (1961) but ambiguous law.

formats making prohibitions easier, and 33.7 months for formats between the two extremes.[11]

While the correlation between age of the DPS law and the incidence of generic prescribing is significant, a great deal of variation remains unexplained. Indeed the variation is considerable. Some states have double and, in one case, triple the amount of generic prescribing in other states; in 1980 the United States average was 18.0 percent of multi-source prescriptions, with 5 states between 10 and 15 percent and, at the other extreme, 2 over 30 percent. Table 6-6 shows the distribution.[12]

TABLE 6-6

Proportion of Prescriptions Written Generically, Distribution of State Averages, 1980

Percentage	Number of States
10 - 15%	6
15 - 20	16
20 - 25	18
25 - 30	7
Over 30	2
Average: 18.0%[1]	

1/ The simple average of state averages (20.7 percent) is higher than the U.S. average computed directly across all prescriptions (18.0 percent.) Both are computed across 45 multi-source drugs.

SOURCE: Computed from data from IMS' 1980 National Prescription Audit.

11/ Oklahoma is excluded; see preceding footnote.
12/ See Appendix Table A4-1 for data by state.

One possible origin of geographical differences in prescribing might be differences in training. If in pharmacology courses at one medical school bioequivalence is emphasized and generic prescribing encouraged, while in another medical school the subject receives little attention or examples of inequivalence are highlighted, graduates of the two schools may emerge with different attitudes about generic prescribing. Differences in training would translate to geographic differences in practice style if many graduates of a medical school tend to practice in the same state. Moreover, reviews of research on physician prescribing decisions emphasize the role of the medical community.[13] Temin states, "The role of the medical community is all important in altering prescribing habits."[14]

Nevertheless, it is likely that much of the variation in generic prescribing would elude easy explanation. Studies of the sometimes startling geographical variation in other medical practices have established that the variations cannot be adequately explained even by traditional theories. Researchers associated with the Rand Corporation state,

> [R]ates of use of [medical] services (mostly surgical procedures) have been found to differ greatly. They range up to sixfold between geographic areas, and they occur even for seemingly nondiscretionary services such as major surgery. Such differential rates have not been explained satisfactorily by economic, professional, or population characteristics, even age, health status, or informed consumer preferences.[15]

Therefore, some, but not all, of the interstate differences in generic prescribing may be attributed to the DPS laws. As long as the law itself had some independent effect, an estimate of the law's overall impact is incomplete without that increase in generic prescribing, and therefore in generic dispensing,

---

13/ Miller (1973-1974).
14/ Temin (1980, p. 113).
15/ Brook et al. (1984) summarizing work by Wennberg and others, e.g., Wennerg and Gittelsohn (1982).

and therefore in reduction of average price. Indeed, because of the consistent use of generics for filling generically written prescriptions, the indirect effect of the law might have been of greater economic significant than the direct effect of substitution itself.

IV. BRAND CHOICE ON GENERICALLY WRITTEN PRESCRIPTIONS

Although in all states most generically written prescriptions result in generically dispensed prescriptions, small differences in the proportion of generically written prescriptions on which a generic product is dispensed may somewhat offset or magnify the effects of prescribing patterns on the generic market share and on prices. DPS laws may influence brand choice on generically written prescriptions. Substitution may spur consumer interest in generics and increase pressure for generic dispensing whenever possible. The opportunity to substitute in combination with the need to choose a brand on generically written prescriptions may together provide enough volume to justify a pharmacy's adding a generic version to inventory and thus making it possible to dispense a generic on generically written prescriptions. However, for 8 of the 10 drugs on which substitution is most frequent, generic prescribing occurs on at least 3 percent of the prescriptions, suggesting that even in the absence of substitution the opportunity to dispense generically might have been large enough to warrant stocking a generic.

Table 6-3 shows that selection of a generic on generically written prescriptions was more frequent in our sample where substitution is permitted, but not by much.[16] When formulary restrictions are disregarded in states generally permitting substitution, allowing comparison across the identical set of 45 drugs, generics were chosen slightly more frequently on generically written prescriptions in states with DPS laws than

16/ Comparisons within individual drugs do not yield much useful information because where substitution is prohibited on these usually-substituted drugs there are so few observations of generically written prescriptions that estimates are imprecise.

in states without (89.4 percent compared to 87.8 percent, in 1980).[17]

Some of the laws contain one provision which is explicitly directed at the choice of brand on generically written prescriptions. In particular, some states require that a low-cost brand, specified variously, be dispensed when the prescription is written generically. Three states tie this choice to a formulary.[18] The average share by state of generics dispensed on such prescriptions is not different between states with and without any restriction on dispensing of generically written prescriptions, about 88 to 89 percent in both cases.[19] Therefore, we have found no evidence that the provision regulating dispensing on generically written prescriptions makes a difference as to what type of product is dispensed.

In summary, the drug product selection laws have at most a very slight indirect effect on generic market share through more frequent choice of a generic when the prescription is written generically. Because such a high proportion of generically writtent prescriptions are filled generically under any conditions (for drugs thought to be reasonably interchangeable), there is little scope for increasing the use of generics. The 10-percent gap may be resistant to further shrinkage simply because there are some drugs where some brands seem clearly preferable, some drugs where demand is small enough that small stores find it unprofitable to stock a second, generic version, and some consumers who strongly prefer leading brands.

17/ When formulary restrictions are taken into account, the difference is much more pronounced (90.7 percent v. 73.4 percent) but the comparison is confounded by the difference in drug coverage. That is, some of the drugs precluded from substitution by formularies are those on which dispensing of a generic may be least common everywhere.

Formulary restrictions typically do not apply to generically written prescriptions. For computations in this section, generically written prescriptions are classified by formulary restrictions which would apply to brand-written prescriptions for the drug whose generically-written prescriptions are being analyzed here.

18/ See the discussion of these provisions in Appendix A1.

19/ Percentages are computed across all 45 drugs.

V. PRESCRIPTIONS WRITTEN FOR SPECIFIC GENERICS

There is one more prescribing channel, prescriptions on which the physician designates a specific "generic", whether by product name or manufacturer name, which contributes an average of 3 percentage points to the overall generic market share. On nearly all of these prescriptions the specified brand is dispensed. The "generic" specified is dispensed slightly less frequently where substitution is allowed (95.5 percent) than where substitution is prohibited (98.2 percent). However prescriptions of this sort are written a little more frequently where substitution is permitted (3.1 percent v. 2.7 percent.) The net result is that the contribution to generic market share from prescriptions written for specific "generics" is slightly larger where substitution is allowed (2.9 percentage points v. 2.7 percentage points.)

VI. CONCLUSION

The generic market share in states permitting substitution was double that in states prohibiting substitution in 1980, and a higher generic market share implies lower average retail prescription prices. Part of this difference was due to substitution itself. Substitution from a leading brand to a generic added somewhat more than 4 percentage points to total generic market share of multi-source drugs in the United States. In states and on drugs where the law authorized substitution, this contribution was 5.2 percentage points, in contrast to 1.3 percentage points where the law or formulary prohibited substitution. While substitution leads directly to a decrease in average price paid, much of any price difference observed between states with different substitution regimes is due to differences in generic prescribing. In fact, there was a dramatic difference in generic prescribing between states without DPS laws (10.1 percent) and those with DPS laws (21.1 percent) (with market shares of individual drugs held constant.) Thus the size of the increase in generic market share cannot necessarily be attributed to the laws alone. The DPS laws had a much larger effect on generic market share (and presumably on prices) if this difference in generic prescribing

is attributed to the laws than if generic prescribing was due primarily to factors other than the DPS laws themselves.

The extent to which differences in average price due to differences in generic prescribing should be attributed to the DPS laws themselves is addressed again in Chapter 8 where multiple regression is used to analyze the effects of the laws on average prescription prices. Because of the uncertainty about the causes of variation in generic prescribing, the regressions are run two ways, one holding generic prescribing constant, the other allowing state-to-state variations in generic prescribing to be attributed to the law. The two estimates of the law's effects bracket the magnitude of the actual effect.

CHAPTER 7

BRAND AND GENERIC PRICES

Drug product selection laws might lead to changes in the prices of individual drug products. We therefore investigated the effects of the laws on the prices of brands and the prices of generics, using multivariate regressions.

The decision as to which version of the drug to dispense cannot be made independently of the prices set for the brand and the generic, and, similarly, the appropriate prices to set depends upon predicted dispensing patterns. For example, the larger the difference between the price of the brand and the generic, the more likely are consumers to seek out or to accept substitutions. A second example is that if the introduction of the opportunity to substitute spurs retail competition generally, prices of both brands and generics may be pushed down.

Moreover, the general intent of the law -- to lower retail prescription prices -- may be subverted or complemented by indirect effects in addition to substitution. The average price of a prescription (in a drug entity) is by definition determined by the price of the leading brand, the price of the generic, and the market shares of each. For example, if the law were to lead to a widening of the brand-generic price differential, the dollar impact of each substitution would be increased, but if this were a result of an increase in brand prices, the greater expense of brand-dispensed prescriptions would be some offset to the savings due to substitution.

Differences in retail prices are, in our study, essentially differences in retail margins, where the impact of retail competition shows up. We interpreted our results as if manufacturer-level or wholesale-level prices were the same across all states; if instead pharmacy acquisition costs vary from state to state in concert with the laws, our regressions pick up this effect as well. Our data did not allow a reliable test of the assumption of a single national wholesale price, but the relatively low cost of transshipment and the presence of large multi-state chains argues that prices would not vary from state to state, at least not according to differences in the states'

drug product selection laws. With our single-year data, we cannot explore changes in prices over time, although not only retailers but manufacturers as well may respond to substitution with price changes.

In fact, no simple prediction is possible as to the direction of any price change for either generics or brands. Moreover, the results of our econometric analysis seem to indicate that any price effects for individual leading brands or generics are not large.

I. POSSIBLE EFFECTS ON THE RETAIL PRICES OF GENERICS AND BRANDS

The introduction of the possibility of substitution in some ways introduces downward pressures on the price of the brand and on the price of the generic but in other ways relaxes such pressures. A pharmacy wishes to maximize the proportion of prescriptions dispensed with a generic, a function of the gap between brand and generic prices, while protecting or increasing its share of all prescriptions sold in the community, a function of the level of its brand and generic prices relative to other stores'.

Consider first the effects on the generic price induced by a legal change that allows substitution to occur. A store may be able to sell more generics than before even if the price of the generic is raised towards the price of the brand, as long as it stays below the brand price. At the same time, a slight increase in the price differential will have a higher payoff than when substitution is forbidden, since all consumers (not just those with generically written prescriptions) are free to choose a generic. Moreover, with an increased awareness that generics are possible substitutes for brands, consumers will pay more attention to the price differential. The opportunity for substitution may lead to an increase in retail prescription drug price competition in general and interstore competition on generics in particular. Advertising of generics programs will encourage and facilitate this trend. There are, then, contradictory pressures on the generic price: raise it to make more

money since people will switch even at a smaller price differential, but lower it to induce an even greater switch.

The net effect of these countervailing pressures on the generic price is difficult to assess. Without knowing how large each effect is, we do not put forward a hypothesis about the effect of the laws on generic prices.

The authorization of substitution also changes competitive pressures on the price of the brand. Customers who come to the store with brand-written prescriptions offer a greater profit opportunity to the store when substitution is possible than when the prescription must always be dispensed as written, because they may accept a substitution to a higher-margin generic. Thus, a store has a greater incentive to try to draw such customers into the store by lowering the price of the brand, especially since many consumers with a prescription written for a brand may compare stores' prices for that brand rather than for a generic equivalent. However, lowering the price of the brand has two other effects. First, the store loses revenue on purchases by customers who stick to the brand. And second, lowering the price of the brand also lowers the price differential between the brand and the generic, thus reducing the likelihood that a consumer will substitute and thereby reducing profits.

As on the price of the generic, there are contrary pressures on the price of the brand created by the opportunity to subsitute. Given the opposing pressure to lower the brand price to attract more customers, we are unwilling to hazard a prediction as to the effects on the price of the brand either.

II. REGRESSION ANALYSIS OF BRAND AND GENERIC PRICES

The regression model used to analyze prices is in many ways similar to that described in Chapter 5 for the analysis of brand choice. (In fact, the econometric models employ the (same) reduced form of underlying relationships explaining both brand choice and pricing decisions simultaneously.) Each regression contains data for a single drug, specified not only as to active chemical ingredients but also dosage form,

strength, and frequently dispensed quantities. Non-legal influences are measured by the same set of independent variables, with the addition of the variable *TIME*, the number of months since first passage of the state's DPS law.

One way in which the price regressions differ from the logit analysis of substitution is that because the price regressions are aimed at answering the broad question of whether the general opportunity to substitute affects the prices of individual drug products, there is only one legal variable, a dummy indicating whether or not substitution was permitted.) Since even this broad net failed to produce significant results, it did not seem useful to pursue an analysis of specific provisions of the state laws. All observations were used, including those for stores in states where substitution was prohibited by either general statute or formulary.

A second difference is in the level of aggregation of the variables. An average retail price of a prescription is computed for each store or for each chain organization (for units within a single state), whereas in the logit analysis each prescription was a separate observation. Price is taken to be the average price for 1980.[1] Because the dependent variable is a store average, the explanatory variables were similarly store-level averages where possible. Of the independent variables, only *QUAN* varies by drug entity and by type of product dispensed.

Third, the econometric technique is different. For the price regressions, we used multivariate linear regression. We incorporated a generalized least squares procedure to implement an error components model because error terms within each state may be correlated. Discussion of the error components model and other econometric issues is found in Appendix A7.

Two sets of regressions were run. One set of regressions was for the price of the leading brand in each of 43 leading multi-source entities, and the other set was for the price of the generic, or rather all generics together, in each of 33

1/ The exception is where a state's formulary changed mid-year, in which case there are occasionally two prices for each store in a state, one for each of the two portions of the year.

entities separately. (Regressions were run for every drug with enough observations.) In the first set, the only observations included were those for prescriptions on which a leading brand was dispensed. In the second, only generically-dispensed prescriptions were used. Since all generic versions of a drug were included together in a single regression, any price effect shown may not apply to any single generic product. (This was true also for a few drugs in which there were two leading brands.) Those regressions cannot distinguish between two possible responses to the law: selection of a different version from among the available set of generics, or altering the price of a specific generic.

The regression model, then, is

$$P_{it} = b_1 + b_2\, DPS_t + b_3\, QUAN_{it} + b_4\, SSINDEX_{it} + b_5\, CHAIN_{it} + b_6\, MED_{it} + b_7\, PRIV_{it} + b_8\, GEN_t + ERROR_{it}$$

where t = 1, 2, . . ., 49 indexes the state; and for each t, i = 1, 2, . . ., N_t indexes the stores within state t.

The variables, with hypothesized effects (for each variable, common to both brand and generic prices), are:

DPS^2 (?)

DPS = 1 if the state permitted substitution on the prescription in the month in 1980 when the prescription was sold, and DPS = 0 if the state prohibited substitution on the prescription in the month in 1980 when the prescription was sold.

For DPS to take the value of 1, two conditions were necessary. First, the state had to have a DPS law in effect in

---

2/ A few minor errors in coding were discovered after the regressions were run. Their effects on the results are believed to be extremely small. See page 10 in Appendix 7 for details.

the month the prescription was sold. Second, for states with formularies, substitution in the specific drug entity had to be permissible according to the formulary in effect at the time of the retail transaction.

QUAN (+)

The number of tablets/capsules in the prescription.
The cost of ingredients is higher for a larger prescription.

SSINDEX (+)

An index of the store's average price of 18 single-source drugs, relative to the average price across all stores.[3]
Cost and demand conditions giving rise to higher prices for single-source drugs presumably lead to higher prices on multi-source drugs as well.

CHAIN (-)

CHAIN = 1 if the store is a member of a chain with more than 10 outlets; *CHAIN* = 0 if the store is independently owned or part of a small chain.
Chains have been shown to have generally lower prices, reflecting lower costs.

MED (0), *PRIV* (0), and *CASH* (omitted category)

Mode of payment for the prescription. If the prescription was paid for through Medicaid, *MED* = 1, *PRIV* = 0 and *CASH* = 0. If the prescription was reimbursed through other private insurance, *PRIV* = 1, *MED* = 0 and *CASH* = 0. If the prescription was paid for out-of-pocket, both the variables included in the regressions (*MED* and *PRIV* are = 0.) The effect of *CASH* is embedded in the *CONSTANT* term.
Price discrimination between insurance categories of prescriptions is expected to be insignificant.

3/ See Appendix A7 for details.

GEN[4] (0) for generic prices; (+) for brand prices

The proportion of prescriptions written generically in the state, computed across 45 drugs. For each drug, this average is adjusted to reflect the drug's U.S. average level of generic prescribing. This adjustment makes no difference statistically and was done only to make the scale of the coefficient on *GEN* more comprehensible.

In states where physicians more frequently prescribe generically, consumers are more likely to be familiar with generics, making retail margins (and therefore in this study retail prices) lower for generics. For brands, it is unlikely that moderate differences in generic prescribing and therefore in generic market share would have much effect on individual product prices.

III. RESULTS OF THE REGRESSION ANALYSIS

Very few of the coefficients on the dummy for the legality of substitution were significant even at the 10 percent level. Tables 7-1 (brand prices) and 7-2 (generic prices) give the estimated coefficients and standard errors, and Tables 7-3 and 7-4 summarize the sign and significance patterns in the two sets of regressions. Of the 43 regressions on the price of the leading brand, only 4 *DPS* coefficients were significant and these were split evenly between positive and negative coefficients. Of the 33 regressions on the price of generics, only 2 of the *DPS* coefficients were significant, both negative coefficients. For the leading brand price, 26 of the 43 *DPS* coefficients were positive, while for the generic price, 23 of the 33 had negative coefficients on the dummy for the legality of substitution. On the basis of a two-tailed binomial test at the 10-percent confidence level, the sign pattern is insignificant for brands but significant (negative) for generics. For the leading brands, a weighted average of the 43 coefficients, with 1980 U.S. sales in numbers of prescriptions as weights,

---

4/ GEN was excluded in some drug regressions because there was no generic prescribing in the drug.

TABLE 7-1

Regression Results for Brand Prices by Drug

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Hydrochlorothiazide	-1.13**[3] (.28)[4]	-.00 (.13)	.07** (.00)	3.59** (.29)	-.59** (.11)	.52 (.34)	.71* (.37)	-.20 (.29)	.74	252	610
Chlordiazepoxide	-2.98** (.59)	-.17 (.23)	.10** (.00)	5.41** (.60)	-.80** (.19)	.65 (.59)	.72 (.68)	5.55** (2.22)	.65	147	558
Amitriptyline[5]	-4.37** (.56)	-.14 (.17)	.10** (.00)	7.06** (.50)	-.45** (.15)	-.01 (.45)	.05 (.45)	-1.73 (1.06)	.82	309	471
Penicillin VK	.05 (.15)	-.01 (.11)	.09** (.01)	2.69** (.21)	-.15* (.09)	-.27 (.27)	.16 (.30)	-.14 (.19)	.53	115	707
Amoxicillin	.03 (.40)	-.15 (.21)	.17** (.01)	2.77** (.48)	-.24 (.16)	.89 (.56)	-.95 (.60)	.21 (.39)	.38	47	530
Atropine sulfate/ Diphenoxylate	-2.58** (.37)	-.33** (.13)	.13** (.00)	5.46** (.36)	-.25** (.12)	-.75** (.33)	.26 (.37)		.76	349	678
Meclizine[5]	-4.12** (.56)	-.00 (.17)	.11** (.00)	6.29** (.52)	.19 (.15)	-.70 (.44)	.34 (.48)	3.63* (1.87)	.82	299	462

1/ Drugs are listed in descending order by substitution rate.

2/ GEN is omitted if there was no generic prescribing for the drug. For other drugs with very little generic prescribing the GEN coefficient may be large but mean little in economic terms.

3/ Two-tailed statistical significance is denoted by ** at the 5 percent level, * at the 10 percent level.

4/ Standard errors are given in parentheses.

5/ GLS was not possible; OLS was used instead.

TABLE 7-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Isosorbide dinitrate[5]	-3.02** (.75)	-.32** (.15)	.06** (.00)	5.61** (.66)	-.38** (.17)	.53 (.51)	.19 (.54)	4.99** (2.38)	.66	101	368
Hydralazine/ Hydrochlorothiazide/ Reserpine[5]	-8.06** (1.06)	-.18 (.19)	.13** (.00)	10.87** (.98)	-.74** (.25)	.12 (.69)	.16 (.78)	-151.44 (104.85)	.75	191	439
Doxycycline	-2.25** (.53)	.10 (.16)	.86** (.02)	4.55** (.51)	-.11 (.16)	.59 (.54)	.03 (.54)	-.86 (3.70)	.75	280	639
Hydrochlorothiazide/ Spironolactone	-5.65** (.74)	.32 (.21)	.16** (.00)	8.92** (.73)	.80** (.24)	.20 (.74)	-.30 (.82)	2.64 (23.77)	.81	303	503
Dipyridamole	-.90* (.52)	-.23 (.24)	.12** (.00)	5.19** (.76)	-.89** (.31)	-1.76* (1.02)	-2.50** (1.26)	1.73 (8.77)	.73	161	418
Brompheniramine/ Phenylephrine/ Pseudoephedrine	-.49** (.19)	.06 (.07)	.12** (.00)	2.70** (.23)	-.30** (.10)	-.09 (.30)	.27 (.38)	30.80 (59.54)	.71	233	671
Chlordiazepoxide/ Clidinium bromide	-1.94** (.34)	.06 (.12)	.13** (.00)	4.79** (.42)	-.76** (.15)	.82* (.49)	-.60 (.56)	-12.51 (26.35)	.82	400	627
Tolbutamide	-.84* (.43)	.13 (.18)	.11** (.00)	4.04** (.56)	-1.47** (.23)	.69 (.69)	.24 (.86)	-7.80 (5.11)	.80	194	347
Conjugated estrogens	-3.51** (.44)	.12 (.10)	.09** (.00)	6.04** (.44)	-1.06** (.14)	.55 (.43)	.42 (.48)	-4.12 (5.26)	.84	355	485

TABLE 7-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Chlorthalidone	-5.85** (.63)	.01 (.14)	.14** (.00)	8.47** (.60)	-.62** (.18)	-.80 (.51)	.07 (.56)	3.97 (10.55)	.84	413	535
Acetaminophen/ Chlorzoxazone	-1.87** (.38)	.06 (.10)	.13** (.00)	4.82** (.42)	-.10 (.13)	-.29 (.41)	-.90* (.47)	17.07 (115.52)	.77	281	594
Tetracycline[5]	-3.02** (.84)	.40 (.32)	.03** (.00)	5.83** (.77)	-.21 (.24)	-.66 (.71)	-.38 (.74)	-.11 (.44)	.23	24	538
Spironolactone	-4.52** (.98)	-.06 (.26)	.15** (.00)	8.28** (1.02)	-.58* (.31)	-.98 (.99)	1.34 (1.11)		.77	181	322
Phenytoin sodium	-1.40** (.40)	.08 (.11)	.04** (.00)	4.68** (.42)	-1.24** (.15)	.07 (.40)	1.30** (.49)	-8.86 (6.22)	.53	97	600
Allopurinol	-5.34** (.77)	-.24 (.22)	.23** (.00)	9.92** (.81)	-.50* (.27)	-3.26 (.90)	-.55 (.94)	-.45 (1.83)	.90	584	456
Dexbrompheniramine/ Pseudoephedrine	-.75** (.19)	.08 (.07)	.15** (.00)	3.16** (.24)	-.25** (.09)	.25 (.29)	-.12 (.33)		.80	417	645
Triamcinolone	-.18 (.51)	.09 (.16)	.27** (.02)	4.08** (.61)	.32 (.20)	1.90** (.78)	-.00 (.73)	-4.44 (9.27)	.56	49	263
Chlorpropamide[5]	-7.85** (.87)	.11 (.19)	.17** (.00)	10.99** (.80)	-.82** (.24)	-.78 (.63)	-.64 (.73)	-31.96 (21.34)	.82	347	541
Hydroxyzine	-1.54** (.33)	.06 (.11)	.17** (.00)	4.16** (.39)	.32** (.14)	.70 (.44)	-.14 (.53)	.50 (19.92)	.78	232	469

TABLE 7-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Sulfamethoxazole/ Trimethoprim	-1.28** (.27)	.16* (.10)	.36** (.01)	4.66** (.31)	-.32** (.12)	-.15 (.34)	.01 (.41)	-165.77 (253.00)	.68	250	828
Theophylline[5]	-2.33** (.80)	.03 (.16)	.12** (.00)	4.48** (.77)	-.44** (.20)	.34 (.73)	-.52 (.78)	19.10 (79.51)	.84	227	304
Terbutaline sulfate[5]	-3.96** (.66)	.08 (.14)	.10** (.00)	5.89** (.60)	.01 (.17)	-2.02** (.55)	-.05 (.61)	4.18** (1.76)	.85	290	352
Nitroglycerin	-.53* (.31)	.04 (.10)	.01** (.00)	3.25** (.38)	-.25** (.13)	.81* (.42)	1.31** (.50)	.08 (.24)	.25	22	450
Metronidazole	-2.10** (.59)	-.05 (.19)	.51** (.01)	4.66** (.62)	-.77** (.23)	-.52 (.68)	-.18 (.81)	147.60** (71.67)	.80	340	578
Diethylpropion	-1.71** (.32)	.11 (.11)	.26** (.01)	4.12** (.39)	-.34** (.14)	.34 (.49)	-.73 (.52)	96.07 (130.07)	.81	326	525
Phentermine	-.70** (.26)	.07 (.12)	.25** (.01)	2.68** (.33)	-.08 (.13)	.03 (.39)	-.85* (.50)	1.23 (3.41)	.85	327	413
Minocycline	-3.17** (1.23)	-.57 (.37)	.43** (.01)	7.28** (1.34)	.07 (.41)	-1.40 (1.86)	3.14* (1.73)	2.23 (9.56)	.79	161	296
Furosemide	-.62** (.15)	.08 (.07)	.11** (.00)	3.43** (.19)	-.96** (.09)	.13 (.24)	.57** (.31)	-26.94 (31.36)	.85	685	818
Erythromycin base	-.15 (.22)	-.03 (.09)	.12** (.01)	3.49** (.29)	-.22* (.12)	.03 (.36)	.71* (.42)	-1.08** (.42)	.47	91	708

TABLE 7-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Hydrochlorothiazide/ Triamterene[5]	-1.87** (.26)	.04 (.08)	.11** (.00)	4.94** (.29)	-.94** (.12)	.06 (.30)	.13 (.36)		.81	598	834
Amitriptyline/ Perphenazine	-4.92** (.88)	.07 (.20)	.16** (.00)	8.82** (.91)	-.15 (.26)	-1.61* (.82)	1.21 (.96)		.82	268	360
Cephalexin	-3.12** (.48)	-.10 (.10)	.39** (.01)	6.58** (.41)	-.45** (.14)	-.05 (.39)	-1.29** (.41)	-58.02 (81.53)	.70	272	828
Erythromycin ethylsuccinate	-.33* (.19)	.04 (.00)	.18** (.01)	3.23** (.26)	-.19* (.10)	-.25 (.32)	-.37 (.42)	-1.23 (5.19)	.65	190	712
Ibuprofen	-.62** (.27)	.13 (.12)	.14** (.00)	4.03** (.37)	-.95** (.16)	1.02 (.45)	.33 (.56)		.81	550	779
Mestranol/Norethindrone/ Placebo	-.72* (.48)	.25* (.17)	.21** (.00)	.79 (.58)	-.57** (.18)	.95* (.52)	.02 (.67)		.87	476	428
Hydrogenated ergot alkaloids	-4.69** (1.22)	.11 (.28)	.18** (.01)	9.30** (1.21)	-.02 (.36)	-3.52** (1.13)	.26 (1.31)		.77	151	277

TABLE 7-2

Regression Results for Generic Prices by Drug

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Hydrochlorothiazide	-.05	-.03	2.85**[3]	.03**	-.54**	.28	.05	-.39*	.45	75	622
	(.24)[4]	(.15)	(.26)	(.00)	(.11)	(.31)	(.48)	(.26)			
Chlordiazepoxide	3.29**	-.49*	.14	.05**	-1.22**	-2.19**	-1.78*	-2.06	.28	32	566
	(.48)	(.32)	(.49)	(.00)	(.22)	(.79)	(.93)	(2.72)			
Amitriptyline[5]	-.91	-.36	5.22**	.05**	-.60**	-2.27**	-.62	-3.92**	.46	31	249
	(1.10)	(.40)	(.98)	(.00)	(.27)	(.88)	(.95)	(1.94)			
Penicillin VK	-.08	-.02	2.92**	.05**	-.25**	.38	.88**	-.10	.41	76	756
	(.19)	(.14)	(.23)	(.01)	(.09)	(.28)	(.34)	(.20)			
Amoxicillin	-.27	-.03	4.61**	.14**	-.36*	.56	2.11**	-.69	.36	36	444
	(.44)	(.27)	(.52)	(.02)	(.20)	(.69)	(.79)	(.45)			
Atropine sulfate/ Diphenoxylate	.62	-.55	2.84**	.04**	-.39	.45	-.24		.28	17	253
	(1.09)	(.59)	(.86)	(.00)	(.27)	(.95)	(1.06)				
Meclizine	-2.94*	-.12	5.48**	.04**	.16	1.21	.89	.88	.32	13	174
	(1.61)	(.90)	(1.35)	(.01)	(.38)	(1.02)	(1.72)	(4.23)			

1/ Drugs are listed in descending order by substitution rate.

2/ GEN is omitted if there was no generic prescribing for the drug. For other drugs with very little generic prescribing the GEN coefficient may be large but mean little in economic terms.

3/ Two-tailed statistical significance is denoted by ** at the 5 percent level, * at the 10 percent level.

4/ Standard errors are given in parentheses.

5/ GLS was not possible; OLS was used instead.

TABLE 7-2, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Isosorbide dinitrate	.50 (1.44)	-1.27** (.51)	3.60** (1.29)	.02** (.01)	-.19 (.42)	3.61** (1.25)	1.06 (2.19)	3.02 (6.38)	.32	7	98
Hydralazine/ Hydrochlorothiazide/ Reserpine	1.50 (1.26)	.04 (.45)	1.58 (1.80)	.05** (.01)	-.18 (.57)	2.93* (1.79)	-4.19 (3.01)	-272.67 (243.11)	.21	5	110
Doxycycline[5]	.83 (1.58)	.79 (.70)	3.73** (1.35)	.66** (.04)	-.55 (.36)	-1.71 (1.41)	-.54 (1.60)	12.86 (11.34)	.68	45	149
Hydrochlorothiazide/ Spironolactone	-2.90* (1.53)	.34 (.66)	8.31** (1.62)	.10** (.01)	-.79 (.55)	.54 (1.82)	.21 (2.39)	-66.52 (63.02)	.74	36	88
Dipyridamole[5]	-3.54 (4.16)	-.58 (.80)	5.85 (3.67)	.07** (.01)	-.07 (.90)	-.51 (4.33)	2.70 (3.53)	2.76 (34.13)	.37	8	81
Brompheniramine/ Phenylephrine/ Pseudoephedrine	.18 (.56)	.28 (.20)	1.85** (.68)	.06** (.01)	-.73** (.23)	-.65 (.80)	-2.66** (1.26)	161.08 (168.66)	.43	12	105
Ampicillin	.19 (.19)	-.09 (.15)	3.22** (.25)	.08** (.01)	-.75** (.11)	-.64** (.30)	.06 (.36)	-.14 (.13)	.41	88	863
Chlordiazepoxide/ Clidinium bromide	.95** (.28)	-.14 (.14)	1.33** (.34)	.11** (.00)	-1.07** (.19)	.79 (.64)	-1.07* (.70)	-51.69* (33.90)	.70	212	643
Tolbutamide	-.13 (.51)	-.20 (.21)	3.48** (.54)	.10** (.00)	-1.56** (.26)	.91 (.82)	.77 (1.00)	-15.22** (5.85)	.74	150	370

TABLE 7-2, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Conjugated estrogens	-.19 (1.01)	-.09 (.37)	2.71** (1.17)	.06** (.01)	-1.00** (.40)	2.91** (1.22)	2.35 (2.59)	-4.08 (15.25)	.73	24	61
Chlorthalidone	.17 (.96)	-.05 (.44)	3.95** (1.15)	.08** (.01)	-.95* (.54)	5.34** (1.59)	.29 (2.26)	-23.83 (38.71)	.77	22	44
Acetaminophen/ Chlorzoxazone[3]	2.26* (2.79)	-.76 (.59)	1.35 (2.57)	.07** (.01)	-.38** (.57)	1.83 (2.05)	.38 (1.89)	-956.77 (778.38)	.47	8	52
Tetracycline	-.16 (.21)	.11 (.14)	3.26** (.22)	.03** (.00)	-.53** (.10)	.04 (.28)	.30 (.33)	-.27* (.15)	.41	86	841
Spironolactone	-1.03 (.73)	.48 (.55)	.60 (2.10)	.12** (.02)	.75 (.65)	23.47** (6.99)	8.44* (4.05)		.85	21	22
Phenytoin sodium	1.90 (1.67)	-.25 (.43)	1.57 (1.44)	.02** (.01)	-1.69** (.48)	-1.44 (1.74)	1.14 (2.76)	-6.99 (23.24)	.33	5	53
Allopurinol[5]	-6.40 (5.03)	.22 (1.06)	9.61** (4.30)	.18** (.02)	.20 (1.22)	-2.59 (3.28)	-4.23 (5.17)	-2.25 (7.59)	.79	23	43
Dexbrompheniramine/ Pseudoephedrine	-.23 (.36)	.29 (.20)	2.23** (.57)	.14** (.01)	-.55** (.23)	-1.09** (1.06)	.58 (1.14)		.76	83	156
Chlorpropamide	-.29 (4.57)	-.91 (1.42)	2.71 (4.45)	.06** (.02)	.17 (1.19)	2.50 (2.29)	.99 (6.96)	223.39** (107.17)	.37	4	40
Theophylline	-1.04 (1.12)	.02 (.38)	3.70** (1.54)	.14** (.01)	-.95** (.42)	.50 (1.69)	.94 (1.57)	47.24 (199.38)	.84	65	86

TABLE 7-2, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Terbutaline sulfate	.53 (1.98)	-.76 (.82)	.10 (2.36)	.10** (.01)	-1.08* (.69)	-1.58 (3.56)	.36 (3.06)	10.35 (9.84)	.70	12	33
Nitroglycerin	.71* (.42)	-.08 (.12)	4.02** (.45)	-.02** (.00)	-.29** (.14)	1.11** (.45)	-.23 (.68)	.23 (.27)	.29	18	300
Metronidazole[5]	-16.65** (5.96)	-3.12** (1.51)	20.99** (4.43)	.31** (.06)	3.16** (1.51)	-1.26 (3.52)	-2.54 (5.79)	430.66 (589.86)	.67	7	21
Diethylpropion	-.56* (.31)	.16 (.13)	3.06** (.34)	.26** (.01)	-.35 (.16)	-.52 (.59)	-.71 (.54)	-76.88 (162.25)	.77	254	532
Erythromycin base	.83** (.17)	-.15* (.09)	1.10** (.20)	.15** (.01)	-.44** (.11)	.70* (.41)	.33 (.43)	-.80* (.45)	.44	82	725
Amitriptyline/ Perphenazine	-3.60** (1.77)	-.26 (.36)	7.29** (1.78)	.17** (.01)	.48 (.43)	-3.79** (1.83)	.85 (1.72)		.84	107	118
Quinidine sulfate[5]	-8.25** (1.53)	-.19 (.41)	9.49** (1.42)	.09** (.00)	-.66* (.36)	1.00 (1.09)	.68 (1.29)	.69 (.48)	.64	67	262

TABLE 7-3

Summary of Coefficient Signs
in Brand Price Regressions

Variable		(+)	(+) and Significant[1]	(-)	(-) and Significant	Overall Effect[4]
DPS	10[2]	1	0	9	2	-
	43	26	2	17	2	No
QUAN	10	10	10	0	0	+
	43	43	43	0	0	+
SSINDEX	10	10	10	0	0	+
	43	43	42	0	0	+
CHAIN	10	1	0	9	7	-
	43	6	2	37	30	-
MED	10	6	0	4	0	No
	43	24	3	19	2	No
PRIV	10	9	1	1	0	+
	43	25	6	18	4	No
GEN[3]	9	4	3	5	0	No
	35	17	3	18	1	No

1/ Statistical significance is measured at the 10 percent level, by a two-tailed test.

2/ Regressions for the 10 top substitution drugs.

3/ In 8 drugs there was no generic prescribing, so the variable GEN was omitted.

4/ Measured by statistical significance at the 10-percent level of a two-tailed binomial signs test.

SOURCE: Table 7-1.

TABLE 7-4

Summary of Coefficient Signs
in Generic Price Regressions

Variable		(+)	(+) and Significant[1]	(-)	(-) and Significant	Overall Effect[4]
DPS	10[2]	2	0	8	2	No
	33	10	0	23	4	-
SSINDEX	10	10	8	0	0	+
	33	33	25	0	0	+
QUAN	10	10	10	0	0	+
	33	32	32	1	1	+
CHAIN	10	1	0	9	5	-
	33	6	1	27	20	-
MED	10	7	2	3	2	No
	33	20	7	13	5	No
PRIV	10	5	2	5	1	No
	33	22	3	11	3	+
GEN[3]	9	3	0	6	2	No
	29	11	1	18	6	No

1/ Statistical significance is measured at the 10 percent level, by a two-tailed test.

2/ Regressions for the 10 top substitution drugs.

3/ In 4 drugs there was no generic prescribing, so the variable GEN was omitted.

4/ Measured by statistical significance at the 10-percent level of a two-tailed binomial signs test.

SOURCE: Table 7-2.

was + $.03, less than 1 percent of the average prescription price of $8.58 for the leading brands in these 43 drugs. For the generics, the weighted average of the coefficients was $.21, about 3 percent of the 39-drug average price of a generic prescription of $6.20.

One reason that retail prices of generics were lower where substitution was permitted is that pharmacies themselves, when substitution was an option, selected among available generic products those with lower cost The simple average of the percent difference between the pharmacy invoice costs in states permitting and prohibiting substitution on the drug across the 10 top-substitution drugs was 11 percent in 1980; in only one of these drugs was the cost higher (by 1 percent) where substitution was permitted.[5]

The effect of the law might be expected to be strongest on drugs where substitution actually occurs most frequently. When only the 10 drugs with the highest incidence of substitution are examined, the generic price result is strengthened, with 8 of the 10 coefficients being negative, although the weighted average coefficient for the 10 was nearly the same as for the 33, - $.22. On the other hand, the results on the price of the leading brand for these top substitution drugs are inconsistent with the result for the 43 regressions taken as a whole: for the top 10 substitution drugs, the opportunity to substitute had a negative coefficient in 9 drugs, 2 of them significant, and the average coefficient was - $.12.

Most of the non-legal variables behaved as expected. *QUAN* was positive and highly significant in every brand and generic regression. *SSINDEX* performed nearly as well, being positive in all regressions and highly significant in all but one brand regression and in three-quarters of the generic regressions. *CHAIN* was negative in 37 of the 43 brand regressions (significant in 30) and in 27 of the 33 generic regressions (significant in 20.) The sign patterns on all three variables are statistically significant.[6] As expected, the results on customer payment type were mixed, revealing no strong pattern. Significant coefficients appeared about as frequently with

5/ Computed with data from the 1980 IMS U.S. Drugstore Audit.
6/ By a two-tailed binomial test at the 10-percent level.

positive signs as with negative signs, and the signs themselves were split.

The prevalence of generic prescribing did not have a strong impact on individual product prices. The signs on *GEN* split evenly in the brand price regressions and only 4 coefficients were statistically significant. The sign pattern for *GEN* in the generic price regressions is stronger, with 18 negative signs out of 29, and 6 of the 7 significant coefficients are negative as well (although this sign pattern is statistically insignificant.) This is consistent with our hypothesis that a greater prevalence of generic prescribing will have a downward impact on prices of generic products.[7]

IV. CONCLUSION

Overall, then, we conclude that the opportunity to substitute causes the retail prices of individual generic drug products to fall, but not that there is any systematic effect on the retail prices of individual leading brands (in both cases, given unchanged manufacturer-level prices.) We can, at least, rule out the possibility that significant price increases on leading brand offset some of the general price decline due directly to substitutions. This implies that to the extent that substitution occurs, the result is a reduction in the average retail prescription price. The results for generics show that the direct gains from substitution may be augmented by a decrease in the prices of generics.

7/ Of the 13 significant coefficients of GEN across both sets of regressions, however, 3 are for drugs where generic prescribing occurred on fewer than 2 percent of all U.S. prescriptions for the drug. Despite statistical significance, there can be little economic significance of (the very small) differences in generic prescribing in these drugs.

CHAPTER 8

AVERAGE PRESCRIPTION PRICES

In the end, it is the price and quality of the drug product actually dispensed which consumers care about, not whether a substitution was made nor whether the prescription was written generically or for a brand. The summary measure of the laws' immediate effect on consumers is the difference in the average price paid for a specified prescription between states where substitution was permitted and states where it was not, other things held constant. The difference in average price summarizes changes in individual product prices and changes in the generic market share.

We use multivariate regressions, by drug entity, to estimate the effect of the law on the price paid for a prescription, disregarding whether a brand or a generic was dispensed. The results of the individual drug regressions are then aggregated into an estimate of total savings in 1980 and then, by extrapolation, savings in 1984.

Any estimate of the average price effect depends crucially on whether increased generic prescribing is due to the law, since most of the differences in generic market share are due to differences in generic prescribing. At most, only some of the difference is properly attributable to the availability of the opportunity to substitute, but we do not know how much. We therefore offer two estimates, one in which we take as due to the law none of the generic prescribing differences, the other in which we take all. These two estimates serve as outside limits of the actual effects.

I. MULTIVARIATE REGRESSION ANALYSIS OF AVERAGE PRICES

We estimated the summary effect on the prices of multisource prescriptions by using regressions with the average price of all prescriptions in the drug entity, regardless of whether they were dispensed with a leading brand or with a

generic, as the dependent variable. The model is the same as used to analyze the prices of leading brands and of generics, as described in Chapter 7 and Appendix 7.[1] The dependent variable is a store-average price of all prescriptions for a specific drug, dosage form, and strength, for any of the five most frequent prescription sizes, in terms of number of tablets or capsules, for that specification. All observations for the drug were included in a single equation. Because of the uncertainty about the causal relationship between generic prescribing and the DPS laws, we run each regression equation twice, once with a variable for generic prescribing and once without. The resulting coefficient estimates on the *DPS* variable bracket the true effects of the law. The equation with generic prescribing held constant provides a lower-bound estimate of the total effect of a DPS law, while the equation omitting the variable provides an upper estimate. It is likely that the true effect of the law is somewhere in between, since some but not all of the variation in generic prescribing may be in response to the DPS law.

A. HYPOTHESES FOR THE REGRESSIONS

DPS is expected to have a negative coefficient, since substitution shifts market share from the higher-priced brands to the lower-priced generics. This coefficient is expected to be larger in the regressions which omit *GEN* since (part of) the large difference in generic prescribing between states with and without a DPS law is reflected in the coefficient on *DPS* itself.

The non-legal variables *QUAN*, *SSINDEX* and *CHAIN* are expected to behave as they did in the brand price and generic price regressions. *QUAN* is expected to have a positive coefficient since it serves to control for the fact that larger prescriptions are more expensive. A higher *SSINDEX* is likely to be associated with higher prices and *CHAIN* with lower prices. *MED* is expected to have a negative coefficient and

---

1/ A few minor errors in coding were discovered after the regressions were run. Their effects on the results are believed to be extremely small. See Appendix 7 for details.

PRIV a positive coefficient because of the differences in substitution and in generic prescribing as well.

GEN raises generic market share both by affecting the substitution rate and directly through dispensing on generically written prescriptions. It therefore is expected to have a negative effect on average price.

B. RESULTS

The results of these pairs of regressions for each of the 45 drugs are shown in Table 8-1. Sign patterns and significance levels, for both sets of regressions, are summarized in Table 8-2.

Taken individually, the results are mostly insignificant; in both models, in only 8 or 9 of the regressions is the coefficient on *DPS* statistically significant. In one, sense, the insignificance is surprising, since 1) substitution is definitely higher where it is permitted; 2) substitution must decrease average price since nearly all substitution is from a leading brand to a generic; 3) there do not seem to be offsetting increases in individual product prices;[2] and 4) individual generic product prices are lower.[3] In another sense, the insignificance is consistent with the low substitution rates observed for most drugs in 1980. The rate of substitution on eligible prescriptions was less than 2 percent in 17 drugs and over 10 percent in only 10 drugs. Moreover, less than three-quarters (on average) of the prescriptions for these drugs were eligible for substitution.

Taken overall, the results do verify that a DPS law led to lower prices in 1980, but only because of its effect in some selected drugs. The signs on the *DPS* coefficient split quite evenly; the sign pattern for the 45 regressions fails to reach statistical significance.[4] However, of the 8 significant coefficients (in the with-*GEN* regressions), 6 are negative; in the without-*GEN* regressions, 9 of the *DPS* coefficients are significant, of which 7 are negative. Also, in each set of

---

2/ According to the regression results reported in Chapter 7.
3/ According to the regression results reported in Chapter 7.
4/ By a two-tailed binomial test at the 10-percent level of significance.

TABLE 8-1

Regression Results for Average Prices by Drug

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Hydrochlorothiazide	.26	-.06	3.13**[2]	.04**	-.54**	-.62*	1.26**	-1.18**	.45	98	816
	(.24)[3]	(.14)	(.27)	(.00)	(.12)	(.34)	(.42)	(.28)			
	-.05	-.21	3.08**	.04**	-.53**	-.66*	1.45**		.45	114	816
	(.20)	(.13)	(.26)	(.00)	(.12)	(.34)	(.43)				
Chlordiazepoxide	.16	-.50*	4.09**	.07**	-.75**	-1.42**	.70	-3.95*	.40	63	657
	(.55)	(.30)	(.61)	(.00)	(.25)	(.70)	(.90)	(2.67)			
	-.06	-.65**	4.04**	.07**	.75**	-1.45**	.82		.40	73	657
	(.52)	(.28)	(.61)	(.00)	(.25)	(.70)	(.90)				
Amitriptyline	-.61	-.45**	4.72**	.08**	-.67**	-1.07*	1.08*	-3.47**	.63	140	567
	(.50)	(.22)	(.54)	(.00)	(.19)	(.55)	(.66)	(1.28)			
	-.62	-.62**	4.37**	.08**	-.70**	-1.09*	1.23*		.63	164	567
	(.43)	(.20)	(.51)	(.00)	(.19)	(.55)	(.68)				

1/ The first regression reported for each drug includes the variable GEN for generic prescribing; the second excludes GEN.
2/ Two-tailed statistical significance is denoted by ** at the 5 percent level, * at the 10 percent level.
3/ Standard errors are given in parentheses
4/ GEN is omitted if there was no generic prescribing for the drug. For other drugs with very little generic prescribing the GEN coefficient may be large but mean little in economic terms.
5/ GLS was not possible; OLS was used instead.

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Penicillin VK	.29**	-.02	2.90**	.06**	-.28**	-.06	.65**	-.48**	.45	109	918
	(.15)	(.11)	(.19)	(.01)	(.08)	(.22)	(.28)	(.16)			
	.16	-.15	2.90**	.06**	-.28**	-.06	.74**		.45	126	918
	(.13)	(.10)	(.19)	(.01)	(.08)	(.22)	(.28)				
Amoxicillin	-.41	-.13	4.08**	.14**	-.24*	.79*	.73	.03	.37	63	729
	(.32)	(.19)	(.39)	(.01)	(.15)	(.47)	(.54)	(.33)			
	-.41	-.12	4.09**	.14**	-.24	.80*	.72		.37	74	729
	(.32)	(.18)	(.39)	(.01)	(.15)	(.47)	(.54)				
Atropine sulfate/ Diphenoxylate	-.36	-.50**	4.02**	.11**	-.46**	-1.41**	.48		.58	167	733
	(.30)	(.17)	(.34)	(.00)	(.15)	(.42)	(.50)				
	-.36	-.50**	4.02**	.11**	-.46**	-1.41**	.48		.58	167	733
	(.30)	(.17)	(.34)	(.00)	(.15)	(.42)	(.50)				
Meclizine	.51	-.48*	3.23**	.08**	-.10	1.54**	1.18*	-1.59	.50	78	544
	(.51)	(.26)	(.57)	(.00)	(.22)	(.63)	(.82)	(2.60)			
	.43	-.55**	3.20**	.08**	-.10	-1.56*	1.23		.50	91	544
	(.49)	(.23)	(.57)	(.00)	(.22)	(.63)	(.82)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Isosorbide dinitrate	.27	-.70**	4.67**	.04**	-.37	.41	2.17**	.23	.41	41	404
	(.58)	(.22)	(.68)	(.00)	(.26)	(.74)	(.93)	(3.44)			
	.28	-.70**	4.68**	.04**	-.37	.41	2.15**		.41	47	404
	(.54)	(.22)	(.68)	(.00)	(.26)	(.74)	(.92)				
Hydralazine/ Hydrochlorothiazide/ Reserpine	-1.70*	-.26	6.40**	.11**	-.64**	-.63	1.46*	-245.56*	.52	76	481
	(.85)	(.26)	(1.01)	(.01)	(.35)	(.99)	(1.27)	(143.63)			
	-1.81**	-.32	6.08**	.11**	-.68*	-.64	1.19		.52	89	451
	.78)	(.26)	(.99)	(.01)	(.35)	(.99)	(1.28)				
Doxycycline	-1.45**	-.10	4.07**	.84**	-.23	.31	.32	-2.48	.73	264	669
	(.47)	(.17)	(.47)	(.02)	(.17)	(.56)	(.58)	(3.84)			
	-1.55**	-.12	4.06**	.84**	-.23	.32	.34		.73	307	669
	(.45)	(.16)	(.47)	(.02)	(.17)	(.56)	(.58)				
Hydrochlorothiazide/ Spironolactone	-3.27**	.16	7.34**	.15**	-.80**	.38	.26	-11.61	.76	242	525
	(.66)	(.23)	(.70)	(.00)	(.26)	(.80)	(.92)	(25.25)			
	-3.49**	.15	7.43**	.15**	-.79**	.38	.29		.76	283	525
	(.62)	(.22)	(.70)	(.00)	(.26)	(.80)	(.91)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Dipyridamole	-.89	-.62*	7.39**	.09**	-.60*	-.52	-.02	-1.98	.49	63	463
	(.82)	(.32)	(1.05)	(.01)	(.40)	(1.35)	(1.64)	(11.64)			
	-.98	-.63*	7.41**	.09**	-.59	-.53	.00		.48	73	463
	(.75)	(.32)	(1.06)	(.01)	(.40)	(1.35)	(1.64)				
Brompheniramine/ Phenylephrine/ Pseudoephedrine	-.26*	.05	2.57**	.12**	-.38**	-.19	.11	5.93	.65	186	688
	(.18)	(.08)	(.24)	(.00)	(.11)	(.32)	(.42)	(64.00)			
	-.25	.05	2.58**	.12**	-.38**	-.19	.11		.65	217	688
	(.16)	(.08)	(.24)	(.00)	(.11)	(.32)	(.42)				
Ampicillin	.16	-.10	3.26**	.07**	-.77**	-.50*	-.01	-.12	.42	91	885
	(.19)	(.14)	(.25)	(.01)	(.11)	(.29)	(.35)	(.13)			
	.11	-.15	3.28**	.07**	-.76**	-.50*	.00	.42	106	889	
	(.18)	(.13)	(.25)	(.01)	(.11)	(.29)	(.35)				
Chlordiazepoxide/ Clidinium bromide	-1.20**	-.05	4.37**	.12**	-.74**	.19	-.47	-39.15	.74	259	650
	(.37)	(.14)	(.47)	(.00)	(.18)	(.57)	(.67)	(30.82)			
	-1.38**	-.07	4.31**	.12**	-.75**	.17	-.50		.74	301	650
	(.35)	(.14)	(.47)	(.00)	(.18)	(.57)	(.67)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Tolbutamide	-.78	.01	4.20**	.10**	-1.42**	.59	.40	-12.33*	.71	129	367
	(.61)	(.21)	(.70)	(.00)	(.26)	(.77)	(.95)	(5.80)			
	-1.14*	-.01	4.07**	.10**	-1.44**	.54	.41		.71	151	367
	(.51)	(.21)	(.68)	(.00)	(.26)	(.78)	(.97)				
Conjugated estrogens	-3.87**	.06	6.39**	.09**	-.96**	.48	.42	-3.11	.83	343	502
	(.46)	(.10)	(.46)	(.00)	(.15)	(.43)	(.48)	(5.32)			
	-3.89**	.05	6.35**	.09**	-.96**	.47	.43		.83	400	502
	(.44)	(.10)	(.45)	(.00)	(.15)	(.43)	(.48)				
Chlorthalidone	-6.17**	.02	8.86**	.13**	-.47**	.88*	-.12	-4.12	.81	342	546
	(.69)	(.16)	(.65)	(.00)	(.20)	(.55)	(.59)	(11.27)			
	-6.43**	.01	8.99**	.13**	-.45*	-.88	-.25		.82	402	546
	(.68)	(.15)	(.65)	(.00)	(.20)	(.55)	(.58)				
Acetaminophen/ Chlorzaxazone	-1.26**	-.03	4.58**	.13**	-.17	-.49	-.94*	-53.26	.71	214	606
	(.39)	(.11)	(.45)	(.00)	(.15)	(.45)	(.53)	(127.72)			
	-1.34**	-.03	4.62**	.13**	-.17	-.48	-.98*		.71	249	606
	(.39)	(.11)	(.45)	(.00)	(.15)	(.45)	(.52)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Tetracycline	-.06	.11	3.27**	.03**	-.48**	-.11	.37	-.33**	.40	84	882
	(.19)	(.14)	(.22)	(.00)	(.10)	(.28)	(.33)	(.15)			
	-.16	-.02	3.28**	.03**	-.48**	-.12	.44		.40	98	882
	(.17)	(.13)	(.21)	(.00)	(.10)	(.28)	(.34)				
Spironolactone	-3.33**	-.15	7.49**	.14**	-.72*	-.50	1.52		.75	165	330
	(.85)	(.27)	(.96)	(.00)	(.32)	(1.05)	(1.20)				
	-3.33**	-.15	7.49**	.14**	-.72*	-.50	1.52		.75	165	330
	(.85)	(.27)	(.96)	(.00)	(.32)	(1.05)	(1.20)				
Phenytoin sodium	-1.37**	.03	4.60**	.04**	-1.23**	.05	1.47**	-9.82*	.50	89	615
	(.42)	(.11)	(.43)	(.00)	(.16)	(.41)	(.51)	(6.39)			
	-1.33**	.02	4.39**	.04**	-1.24**	.03	1.48**		.51	106	615
	(.37)	(.11)	(.42)	(.00)	(.16)	(.41)	(.52)				
Allopurinol	-7.18**	-.21	11.53**	.22**	-.17	-3.29**	-.42	-1.27	.88	494	471
	(.29)	(.23)	(.95)	(.00)	(.29)	(.94)	(.98)	(1.93			
	-7.70**	-.22	11.80**	.22**	-.14	-3.31**	-.40		.88	580	471
	(.94)	(.23)	(.96)	(.00)	(.29)	(.93)	(.96)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Dexbrompheniramine/ Pseudoephedrine	-.53** (.16)	.09 (.07)	2.86** (.23)	.16** (.00)	-.27** (.09)	.22 (.29)	-.21 (.34)		.79	409	665
	-.53** (.16)	.09 (.07)	2.86** (.23)	.16** (.00)	-.27** (.09)	.22 (.29)	-.21 (.34)		.79	409	665
Triamcinolone	-1.14 (.96)	-.03 (.19)	5.15** (.87)	.26** (.02)	.53** (.24)	1.84* (.92)	.40 (.81)	-8.89* (10.73)	.37	24	269
	-1.27 (.96)	-.07 (.19)	5.13** (.87)	.26** (.02)	.52* (.24)	1.85* (.92)	.36 (.81)		.37	28	269
Chlorpropamide	-6.98** (1.01)	.10 (.22)	10.61** (.93)	.16** (.00)	-.67** (.28)	-1.51** (.72)	-.60 (.86)	-22.27 (24.85)	.74	227	553
5	-7.09** (1.00)	-.12 (.22)	10.52** (.92)	.16** (.00)	-.67** (.28)	-1.53** (.72)	-.55 (.85)		.74	265	553
Hydroxysine	-1.67** (.36)	.06 (.11)	4.40** (.42)	.17** (.01)	.40** (.14)	.78* (.45)	-.01 (.55)	-8.56 (20.64)	.76	209	469
	-1.75** (.35)	.06 (.11)	4.41** (.41)	.17** (.01)	.41** (.14)	.77* (.45)	-.01 (.55)		.76	243	469

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Sulfamethoxazole/ Trimethoprim	-1.29**	.16*	4.64**	.36**	-.32**	-.19	.02	-164.58	.68	254	828
	(.26)	(.10)	(.31)	(.01)	(.12)	(.34)	(.41)	(252.07)			
	-1.31**	.16*	4.65**	.36**	-.32**	-.20	.04		.68	294	828
	(.27)	(.10)	(.31)	(.01)	(.12)	(.34)	(.40)				
Theophylline[5]	-1.73**	.02	4.07**	.12**	-.54**	.42	.75	3.69	.81	214	351
	(.81)	(.17)	(.77)	(.00)	(.21)	(.72)	(.75)	(83.00)			
	-1.73**	.03	4.07**	.12**	-.54**	.43	.75		.81	251	351
	(.80)	(.16)	(.76)	(.00)	(.21)	(.72)	(.75)				
Terbutaline sulfate[5]	-3.69**	.05	5.63**	.10**	-.11	-1.95**	-.22	3.90**	.85	289	364
	(.66)	(.14)	(.60)	(.00)	(.17)	(.54)	(.58)	(1.73)			
	-3.39**	.15	5.68**	.10**	-.11	-1.82**	-.42		.85	333	364
	(.65)	(.14)	(.60)	(.00)	(.17)	(.54)	(.57)				
Nitroglycerin	-.20	-.02	3.02**	.00**	.38**	.76**	1.28**	.05	.33	44	628
	(.18)	(.07)	(.25)	(.00)	(.10)	(.29)	(.38)	(.17)			
	-.17	-.02	3.03**	.00**	-.38**	.77**	1.28**		.33	51	628
	(.16)	(.07)	(.25)	(.00)	(.10)	(.29)	(.38)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Metronidazole	-3.06**	-.11	5.94**	.49**	-.63**	-1.19	-.07	156.42**	.78	288	580
	(.70)	(.20)	(.70)	(.01)	(.24)	(.72)	(.85)	(76.04)			
	-2.07**	-.06	5.51**	.49**	-.68**	-1.23*	-.20		.78	339	580
	(.60)	(.20)	(.66)	(.01)	(.24)	(.72)	(.86)				
Diethylpropion	-2.22**	.18*	4.56**	.26**	-.25*	-.27	-.47	65.83	.77	284	581
	(.39)	(.11)	(.42)	(.01)	(.15)	(.47)	(.49)	(137.40)			
	-2.22**	.19*	4.59**	.26**	-.25**	-.26	-.44		.77	330	581
	(.37)	(.11)	(.42)	(.01)	(.15)	(.47)	(.49)				
Phentermine	-.59**	.09	2.58**	.25**	-.06	-.02	-.93*	-1.25	.81	250	413
	(.30)	(.14)	(.38)	(.01)	(.14)	(.44)	(.56)	(3.77)			
	-.62**	.09	2.56**	.25**	-.07	-.02	-.94*		.81	292	413
	(.28)	(.13)	(.37)	(.01)	(.14)	(.44)	(.56)				
Minocycline	-6.25**	-.62*	9.81**	.44**	.42	-1.01	2.12	3.92	.79	161	299
	(1.56)	(.37)	(1.53)	(.01)	(.42)	(1.82)	(1.57)	(9.51)			
	-6.48**	-.58	10.11**	.44**	.46**	-.89	2.04**		.79	190	299
	(1.56)	(.36)	(1.53)	(.01)	(.41)	(1.81)	(1.55)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Furosemide	-.50**	.08	3.30**	.11**	-.94**	.18	.56*	-35.93	.85	653	820
	(.15)	(.07)	(.19)	(.00)	(.09)	(.25)	(.31)	(31.61)			
	-.58**	.07	3.28**	.11**	-.95**	.18	.57*		.85	761	820
	(.13)	(.07)	(.19)	(.00)	(.09)	(.25)	(.31)				
Erythromycin base	-.13	.00	3.29**	.12**	-.26**	-.21	.72*	-1.01**	.50	112	768
	(.19)	(.08)	(.26)	(.01)	(.11)	(.32)	(.38)	(.39)			
	-.31*	-.05	3.24**	.12**	-.26*	-.24	.74*		.50	131	768
	(.16)	(.08)	(.26)	(.01)	(.11)	(.33)	(.38)				
Hydrochlorothiazide/ Triamterene	-1.99**	.04	5.02**	.11**	-.93**	.09	.16		.81	594	834
	(.27)	(.08)	(.30)	(.00)	(.12)	(.30)	(.36)				
	-1.99**	.04	5.02**	.11**	-.93**	.09	.16		.81	594	834
	(.27)	(.08)	(.30)	(.00)	(.12)	(.30)	(.36)				
Amitriptyline/ Perphenazine	-5.60**	-.09	9.22**	.16**	-.02	-2.27**	.35		.82	306	405
	(.91)	(.19)	(.88)	(.00)	(.25)	(.77)	(.86)				
	-5.60**	-.09	9.22**	.16**	-.02	-2.27**	.35		.82	306	405
	(.91)	(.19)	(.88)	(.00)	(.25)	(.77)	(.86)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Cephalexin	-3.13**	.10	6.59**	.39**	-.45**	-.06	-1.29**	-57.97	.70	272	828
	(.48)	(.10)	(.41)	(.01)	(.14)	(.39)	(.41)	(81.52)			
	-3.16**	-.11	6.57**	.39**	-.45**	-.05	-1.28**		.70	317	828
	(.47)	(.10)	(.41)	(.01)	(.14)	(.39)	(.41)				
Erythromycin ethylsuccinate	-.33*	.04	3.31**	.17**	-.17*	-.27	-.34	-1.36	.64	183	716
	(.20)	(.08)	(.26)	(.01)	(.11)	(.33)	(.42)	(5.20)			
	-.36*	.04	3.30**	.17**	-.17	-.27	-.35		.64	213	716
	(.18)	(.08)	(.26)	(.01)	(.11)	(.33)	(.42)				
Ibuprofen	.62*	.13	4.03**	.14**	.95**	1.02*	.33		.81	550	779
	(.27)	(.12)	(.37)	(.00)	(.16)	(.45)	(.56)				
	.62**	.13	4.03**	.14**	-.95**	1.02**	.33		.81	550	779
	(.27)	(.12)	(.37)	(.00)	(.16)	(.45)	(.56)				
Mestranol/ Norethindrone/Placebo	-.72	.25	.79	.21**	-.57**	.95*	.02		.87	476	428
	(.48)	(.17)	(.58)	(.00)	(.18)	(.52)	(.67)				
	-.72	.25	.79	.21**	-.57**	.95*	.02		.87	476	428
	(.48)	(.17)	(.58)	(.00)	(.18)	(.52)	(.67)				

TABLE 8-1, continued

DRUG NAME[1]	CON-STANT	DPS	QUAN	SS-INDEX	CHAIN	MED	PRIV	GEN[2]	Adj. R^2	F	N
Hydrogenated ergot alkaloids	-4.69** (1.22)	.11 (.28)	9.30** (1.21)	.18** (.01)	.02 (.36)	-3.52** (1.13)	.26 (1.31)		.77	151	277
	-4.69** (1.22)	.11 (.28)	9.30** (1.21)	.18** (.01)	.02 (.36)	-3.52** (1.13)	.26 (1.32)		.77	151	277
Quinidine sulfate	-5.40** (1.25)	.01 (.38)	6.87** (1.19)	.09** (.00)	-.64* (.32)	1.74* (1.04)	1.61* (1.07)	.64* (.42)	.60	71	325
	-5.20** (1.24)	.23 (.35)	7.14** (1.17)	.09** (.00)	-.61* (.32)	1.80* (1.04)	1.43 (1.07)		.60	82	329

TABLE 8-2

Summary of Coefficient Signs
in Average Price Regressions

Variable	No. of Drugs	(+)	(+) and Signi-ficant[1]	(-)	(-) and Signi-ficant	Overall Effect
DPS	10[2]	0/0[3]	0/0	10/10	5/5	-
	45	24/19	2/2	21/26	7/6	No
QUAN	10	10/10	10/10	0/0	0/0	+
	45	45/45	45/45	0/0	0/0	+
SS-INDEX	10	10/10	10/10	0/0	0/0	+
	45	45/45	44/44	0/0	0/0	+
CHAIN	10	0/1	0/1	10/9	7/5	-
	45	6/7	4/4	39/38	31/29	-
MED	10	4/3	2/1	6/7	4/4	No
	45	18/18	7/7	27/27	12/12	No
PRIV	10	10/9	6/4	0/1	0/1	+
	45	30/32	11/9	15/13	3/3	+
GEN[4]	9	2	0	7	5	No
	37	10	3	27	10	-

1/ Statistical significance measured at the 10 percent level.
2/ Regressions for the 10 top substitution drugs.
3/ The number before the slash is for the model including GEN; the number after the slash is for the model excluding GEN.
4/ In 8 drugs there was no generic prescribing, so the variable GEN was omitted.

SOURCE: Table 8-1.

regressions a weighted sum of the coefficients on the *DPS* variable is statistically significant at better than the 5 percent level of significance.[5] (As discussed in Appendix 7, the assumption necessary for this test -- that the individual drug regressions are independent of one another -- is not strictly appropriate. Nevertheless, we believe that if it were possible to take fully into account any interdependence, the results would not differ by much.)

These regressions provide us with our best estimates of the magnitude of the price effect of a DPS law. In the regressions with *GEN* included, the weighted average coefficient on *DPS* is -$.059. When *GEN* is excluded, the weighted average coefficient is -$.103.[6]

In many ways, the results from the two models are very similar. While the law is shown to have a larger effect in decreasing average prescription prices paid when the effects of variations in generic prescribing are attributed to the DPS law, in only 10 of 37 drugs does *GEN* have a significant negative effect on average price and in 3 regressions the *GEN* coefficient was positive and significant.[7] However, 27 of the 37 coefficients are negative, which is statistically significant.[8] A comparison by drug of the results shown in Table 8-1 shows that the exclusion of the *GEN* variable changed the sign on the *DPS* coefficient in only 2 drugs, in both instances changing it from positive to negative. For most drugs, the size of the *DPS* coefficient was changed very little in the second regression model; in 23 of the 37 regressions which included *GEN* the difference was no greater than .02. In the 13 regressions where *GEN* was statistically significant, the weighted average change in the *DPS* coefficient was -$.096; more frequent generic prescribing lowered average prescription prices, as expected. As shown in Table 8-3, the drugs for which *GEN* has a significant negative effect almost all have

---

5/ In the with-GEN regressions, t = 2.31. In the without-GEN regressions, t = 4.10.

6/ The (weighted) average of only the 9 significant coefficients is -$.42 for the with-GEN regressions and -$.48 for the without-GEN regressions.

7/ In 8 drugs there was no generic prescribing at all, so the with-GEN model was not applicable.

8/ See footnote 4.

TABLE 8-3

Drugs for which the Generic Prescribing Variable has a Significant Effect in the Average Price Regression

Drug	Proportion of All Prescriptions Written Generically	Brand-Generic Price Differential
Negative Significant Coefficient on GEN:		
Hydrochlorothiazide	45.4%	$2.63
Chlordiazepoxide	10.2	3.83
Amitriptyline	16.0	2.44
Penicillin VK	51.6	1.09
Hydralazine/Hydrochlorothiazide/Reserpine	.3	4.98
Tolbutamide	5.2	2.69
Tetracycline	69.6	.45
Phenytoin	2.5	2.00
Triamcinolone	2.7	4.30
Erythromycin base	28.4	.18
Positive Significant Coefficient on GEN:		
Metronidazole	.3	4.01
Terbutaline	10.9	1.37
Quinidine sulfate	99.2	N/A[1]
45-Drug Average	20.1	
37-Drug Average		2.00

1/ While there are many brands of quinidine sulfate, sold at different prices, all were classified as generics by our definition, so no brand-generic price differential can be computed.

SOURCES: Tables 8-1 and A5-1.

either high average generic prescribing or a large brand-generic price differential (or both) such that variations around the average level of generic prescribing may be significant in size and a shift in generic market share will have a noticeable effect on average price.[9]

The results on the other variables are generally as hypothesized. The coefficients on *SSINDEX* and *QUAN* are all positive and all significant (with the exception of one *SSINDEX* coefficient.) Nearly all of the *CHAIN* coefficients are negative and most are significant.

The coefficients on insurance type are sometimes but by no means always significant. Two-thirds of the coefficients on *PRIV* are positive, significantly so in 11 drugs in the with-*GEN* model and 9 in the without-*GEN* model, indicating that for many drugs customers with private prescription drug insurance pay more than cash customers.[10] The results for *MED* are even more mixed and support no conclusion about the relative prices paid for Medicaid prescriptions.[11] This is surprising given the consistent pattern of higher substitution rates for people with Medicaid coverage, but of course even those rates were often low. On the 7 MAC drugs in the sample, Medicaid prescriptions were significantly less expensive in 4, significantly more expensive in 1; the remaining 2 had negative signs which were not significant.

It is apparent from these results that the effects of the law on prescription prices differ from drug to drug and are important for some drugs and unimportant for others. Even among the 10 top-substitution drugs the reduction in price varied considerably from drug to drug, ranging from 2 cents (penicillin VK) to 70 cents (isosorbide dinitrate) (using the with-*GEN* regressions.) Four of the decreases were about 50 cents per prescription. Table 8-4 shows the estimated price

---

9/ Of the 3 significant positive coefficients on GEN, 2 occur in drugs where there is very slight state-to-state variation in GEN since nearly all prescriptions (quinidine sulfate) or almost none (metronidazole) are written generically. We therefore do not place great reliance on the significance of these GEN coefficients (nor in the GEN coefficient for hydrochlorothiazide/hydralazine/reserpine, for the same reason.) We have no explanation for the third drug, terbutaline.

10/ The sign pattern on PRIV is statistically significant. See footnote 4.

11/ The sign pattern on MED is not statistically significant. See footnote 4.

change due to the law for each of the ten drugs analyzed, both in dollar terms and in percent of average prescription price. In percentage terms, the price declines ranged from 1.2 percent to 9.4 percent. Variations among drugs reflect differences in the brand-generic price differential, determining the potential savings from an increase in the generic market share; the extent of substitution; and, in the without-*GEN* model, the prevalence of generic prescribing.[12]

III. ESTIMATE OF OVERALL SAVINGS

We have estimated the dollar difference in total retail expenditures for prescription drugs between two sets of comparable prescriptions, differing by the permissibility or prohibition of substitution. The estimates are rough, intended to provide a sense of the general magnitude of the effects of the DPS laws, for 1980 and, by extrapolation, also for 1984.

Based on our average-price regressions, our rough estimate of the savings due to a drug product selection law for the 45 drugs we studied was between $21 and 38 million per year in 1980. The $21 million estimate utilizes the per-prescription price difference estimated for each drug based on the regressions which held constant the proportion of prescriptions written generically, multiplied by the number of prescriptions for that drug (all dosage forms) which were eligible for substitution in 1980.[13] The $38 million estimate allows for

---

12/ See Appendix Table A5 for data by drug.

13/ The number of new prescriptions (all dosage forms) in each of the 45 drug entities in IMS' 1980 NPA sample was taken from IMS' 1980 Basic Data Report and was expanded to an estimate of a national total for the drug entity by using the ratio of the whole NPA sample (1,113,486, as reported in the Basic Data Report) to the IMS estimate of the universe of U.S. new prescriptions in 1980 (750.289 million (Pharmacy Times, April 1982, p. 25)), a ratio of 674.114. The national estimate of new prescriptions for the drug was then adjusted by an estimate of the drug's refill rate, based on unpublished (1983) data provided by IMS on new and refill prescriptions by drug product, to produce a figure for total (new plus refill) prescriptions for that drug in 1980.

TABLE 8-4

Changes in Average Prescription Price Due to a DPS Law for the 10 Top-Substitution Drugs, 1980[1]

Drug	Average Prescription Price	with-GEN		without-GEN	
		Change in Price	Change as a Percent	Change in Price	Change as a Percent
Hydrochloro-thiazide	$4.71	-$.06	-1.3%	-$.21	-4.5%
Chlordiazepoxide	7.13	- .50	-7.0	- .65	-9.1
Amitriptyline	7.08	- .45	-6.4	- .62	-8.8
Penicillin VK	4.48	- .02	- .4	- .15	-3.3
Amoxicillin	6.56	- .13	-2.0	- .12	-1.8
Atropine sulfate/ Diphenoxylate	6.41	- .50	-7.8		
Meclizine	6.90	- .48	-7.0	- .55	-8.0
Isosorbide dinitrate	8.21	- .70	-8.5	- .70	-8.
Hydralazine/ Hydrochloro-thiazide/ Reserpine	10.58	- .26	-2.4	- .32	-3.0
Doxycycline	8.21	- .10	-1.2	- .10	-1.5

1/ The ten drugs are listed in descending order by substitution rate.

SOURCES: Tables 8-1 and A5-1.

both estimates, the per-prescription price differences estimated for solid oral dosage form products were extended to prescriptions for other dosage form products as well.

Extrapolating from these 45 drugs, which accounted for a little less than half (333.0 million) of all multi-source prescriptions eligible for substitution (696.9 million) in 1980,[14] we estimate that total retail expenditures on multi-source drugs were $44 to $80 million less in 1980 (in 1980 dollars) than they would have been had all substitution been prohibited. While substantial in absolute terms, this is about half of 1 percent of total purchases of prescription drugs through retail outlets, estimated to be $12 billion in 1980.[15] This simple extrapolation from the top-selling drugs to all prescriptions is probably an underestimate of the total effect for all drugs. By definition, the other one-third of prescriptions occur in less frequently prescribed drugs. Based on our sample of 45 drug entities, price effects and indeed substitution itself appear to be higher for less common drug entities. The weighted average substitution rate (on eligible prescriptions) was 6.1 percent for the 22 drugs in our sample with U.S. sales ranks in 1980 above 50 and 9.0 percent for the 23 drugs ranked between 51 and 100. Similarly, the weighted average coefficient from the average price regressions was -$.038 in the with-*GEN* regressions (-$.065 in the without-*GEN* regressions) for the higher-ranked drugs and more than twice that, -$.084 (-$.139), for the lower-ranked drugs. Our

---

14/ Of the total number of prescriptions dispensed in 1980 of 1,394.308 million, new prescriptions were 53.9 percent, or 750.289 million (Pharmacy Times, April 1982, p. 25). According to IMS, 69 percent of new prescriptions in 1980 were multi-source (IMS Research Group, 1981, p. 21); thus there were 517.699 million new multi-source prescriptions in 1980. Based on refill ratios computed from unpublished (1983) data provided by IMS, new prescriptions accounted for 54.66 percent of all prescriptions for our 45 drugs; assuming the same refill ratio for all other multi-source drugs, we multiplied the 517.699 by 1.829 (= 1/.5466). We thus arrived at an estimate of all multi-source prescriptions in the U.S. in 1980 of 946.871 million. Finally, we multiplied by the fraction of prescriptions for our 45 drugs which were eligible for substitution, 73.6 percent, for our estimate of the number of multi-source prescriptions eligible for substitution in 1980: of 696.897 million. Dollar savings for all multi-source drugs are, then, a multiple, 696.9/333.0 = 2.093, of the savings for the 45 drugs alone.

15/ Trapnell et al. (1983, p. 8).

estimate of the effects of DPS laws in 1980 is therefore probably conservative.

Since 1980 consumer savings due to the drug product selection laws have substantially increased. Since we had neither retail price nor substitution data on a drug-by-drug basis for more recent years, we combined aggregate data with several simplifying assumptions, discussed below, to project our 1980 estimates forward to 1984. Four factors have clearly worked to increase the savings from substitution: the addition of 9.5 percent more prescriptions to the pool of those eligible for substitution because of the passage of DPS laws in the holdout states;[16] a 5.3 percent increase in the number of multi-source prescriptions written,[17] a near doubling (86 percent increase) in the percentage of brand-written prescriptions on which substitutions were made,[18] and inflation in prescription drug prices of 38 percent from 1980 to 1984.[19] If the prices of branded and generic drugs are assumed to have risen at the same rate, the differential between brand and generic prices has also risen by 38 percent. If also the pattern of substitution across drugs is assumed not to have changed significantly, the average saving per substitution has increased by 38 percent as well. Combining the increased number of substitutions with the increased savings per substitution, we project that savings from substitution may have tripled, in nominal terms, to a

---

16/ In 1980, states allowing substitution accounted for 91.3 percent of the prescriptions in our sample.

17/ 996.8 million is our estimate of the number of all multi-source prescriptions dispensed in 1984. This is 65 percent of the total number of prescriptions dispensed in 1984; according to IMS' NPA, 1,533.6 million prescriptions were sold in 1984, an increase of 11 percent since 1980. "Top 200 Drugs of 1984," Pharmacy Times (April, 1985, p. 25). The multi-source share used is 65 percent, a rough correction to reflect the continuing trend towards a larger single-source share, from 31 percent of new prescriptions in 1980 to 33 percent in 1983; see footnote 11 in Chapter 2.

18/ As a percent of potentially substitutable prescriptions, substitution increased from 5.1 percent in 1980 to 9.5 percent in 1984, according to IMS. Chappell (Oct. 1984).

19/ The prescription drug component of the Consumer Price Index rose from 154.8 in 1980 to 213.8 in 1984, an increase of 38.1 percent. U.S. Department of Commerce, Bureau of Labor Statistics, "Consumer Price Indexes, Detailed Report" (monthly issues, 1980 and 1984). This reflects in part an increase in the size of the average prescription.

range of $130 to $236 million in 1984;[20] in constant dollars, this is more than a doubling.

The first assumption is that the prices of brands and generics rose at the same rate. Suppose instead, for example, that brand prices rose less than generic prices. Then the price differential would have shrunk and our estimate of 1984 savings would be upwardly biased. We believe that if there is any bias, it is in the other direction: that our estimates may be low. Limited data indicate that neither broad changes in the relative prices of brands and generics at the manufacturer level nor changes in retail dollar gross margins, which together make up retail price changes, have led to a diminution in the brand-generic price differential, and indeed that differential may well have widened.

We checked on the assumption that manufacturer-level brand and generic prices rose at the same rate by comparing 1980 and 1984 invoice data for individual drug products.[21] For the 45 drugs studied in this report, brand prices typically rose by about the same amount as retail prescription drug prices overall, while generic prices often fell, even in absolute terms. As to changes in retail dollar gross margins, our regression results in Chapter 7 suggest that an increase in substitution does not have any significant effect on the dollar gross margin at retail of brands but does depress prices of

---

20/ 1.15 (increase in number of prescriptions) X 1.86 (increase in substitution rate on eligible prescriptions) X 1.38 (increase in prices) = 2.95. Formulary coverage is assumed to remain the same on average.

21/ The compilations, based on IMS' U.S. Drugstore Audit data, were obtained from the U.S. Department of Health and Human Services, Health and Human Services, which they had purchased under their contract number 500-81-0057. The data were for October/November 1980 and August 1984. The 1980-1984 change in the price for the leading brand(s) could be computed for 42 of the 45 entities studied. The sales-weighted average of these changes was 35.5 percent. This was little different from the 37.5 percent increase in the producer price index for drugs and pharmaceuticals. U.S. Department of Commerce, Bureau of Labor Statistics, "Producer Price Indexes," (1980 and 1984). For generic prices, the comparison was between simple averages of all prices in 1980 and in 1984, since we did not have market shares to use for weighted averages. A sales-weighted average of the 29 entity averages available was -10.8 percent.

generics, thereby widening the brand-generic price differential.[22] Both of these patterns imply an *increase* in the brand-generic price differential over 1980, which is also the result generated by the application of a single rate of price increase to both brand and generic prices, although we do not know the accuracy of our simple 38 percent estimate.

The second assumption is that the pattern of substitutions across drugs in 1984 was essentially unchanged from 1980. However, if, for example, a larger proportion of substitutions now take place in drugs where the saving per substituted prescription is larger than average, the average saving, on all prescriptions whether substituted or not, would be greater than if the 1980 distribution of substitutions across drugs had been maintained.

We suggest that the increase in substitution has probably occurred primarily in two types of drugs: those in which substitution was already frequent, and those which have recently moved from single-source to multi-source status. If much of the substitution occurred in 1984 in the very drugs identified as top-substitution drugs in 1980, our use of the 1980 estimates is appropriate. Newly multi-source drugs are likely to have an even larger price differential, since there has been little time for competition at the manufacturer level to bring down the price of the leading brand. We infer that the average saving, as measured by the brand-generic price differential for substitutions, is likely to be at least as large (in constant dollars) in 1984 as in 1980.

Thus it seems that if our assumptions bias our projections, we probably *understate* the increase in consumer savings since 1980. Moreover, the 1984 estimates leave out some additional possibilities of saving. If manufacturers have responded to the growth of substitution by lowering prices or by entering

---

22/ In fact, increased levels of substitution may have produced larger per-prescription price effects, regardless of changes in the brand-generic price differential, because of downward pressure on the prices of individual brands and generics as well as the direct price effect of the switch from brand to generic: the regressions reported in Tables 7-1 and 7-2 show that for both brands and generics the price decreases associated with a DPS law were much larger for the top-substitution drugs than for other drugs.

the generic segment more aggressively, consumers may be enjoying additional savings.

An annual decrease in consumers' retail expenditures for prescription drugs due to the DPS laws of between $130 and $236 million, as of 1984, is still only about 1 percent of all retail sales of prescription drugs through drugstores.[23] Of course, a large share of total sales cannot be reduced by DPS laws -- not only the single-source share but also the necessary costs of producing and marketing multi-source drugs.

IV. CONCLUSION

On average, the price per prescription was 6 to 10 cents lower for multi-source prescriptions on which substitution was permitted in 1980 than on prescriptions where substitution was forbidden. This range reflects our uncertainty as to how much of observed differences in generic prescribing should be attributed to the workings of a drug product selection law. For consumers as a group, average multi-source prescription prices were less than 1 percent lower in 1980 because of the law. On prescriptions for some drugs, consumers saved little while for other drugs consumers saved considerably, 50 cents or more per prescription.

Total savings due to the DPS laws is estimated to have been $44 to $80 million in 1980 (in 1980 dollars.) Given the increase in substitution and the expansion of the prescription market in both numbers of prescriptions and price increases, the savings for 1984 are believed to be between $130 and $236 million per year (in 1984 dollars.)

23/ A rough estimate of 1984 retail sales of prescription drugs is $18 billion, based on an IMS estimate of the average retail prescription price ($11.99) multiplied by the total number of prescriptions dispensed. "Top 200 Drugs for 1984", Pharmacy Times (April 1985). We have not attempted to refine estimates of total retail sales since we want only to suggest that, relative to total retail prescription drug sales, the savings from substitution are very small.

CHAPTER 9

CONCLUSION

Drug product selection laws promoted a modest shift from leading brands to lower-priced generics. The total reduction in consumer expenditures was $44 to $80 million in 1980 and perhaps three times that in 1984.

In 1980 substitution occurred on 7.3 percent of all prescriptions for 45 leading multi-source drugs on which substitution was legally permissible.[1] This was 5.5 percent of all multi-source brand-written prescriptions. Substitution alone accounted for slightly more than 4 percentage points of generic market share. The drug product selection laws may have increased the generic market share indirectly as well; the proportion of generically written prescriptions on which a generic product was dispensed was perhaps 1-1.5 percentage points higher where substitution was permitted, and more prescriptions may have been written generically. The average retail price of a prescription ($8.10 in 1980) was at least $.059 lower in 1980 where substitution was permitted, and lower by more (between $.059 and $.109) if some of the increase in generic prescribing is attributed to the effects of the law.

All our 1980 results are based upon nationwide retail price data for 45 leading multi-source drugs, drawn from IMS' National Prescription Audit. Because our savings estimates are based on retail price data, they take into account the fact that while manufacturer-level prices are typically lower for generics than for brands, retailer dollar gross margins are higher for generics than for brands.[2] Because individual drug

---

1/ Prescriptions on which the prescriber prohibited substitution could not be excluded from the data. If physicians prohibited substitution on 10 percent of the multi-source brand-written prescriptions, the 7.3 percent figure would be raised to 8.1 percent of eligible prescriptions.

2/ An estimate (inappropriately) based on comparing manufacturers' or wholesale prices for brands and generics would overstate the savings since it would fail to take into account the higher retailer margins on generics.

entities are analyzed separately and then summarized, the estimates reflect differences in both substitution rates and brand-generic price differentials, and therefore savings, across drugs.

By combining aggregate data with several simplifying assumptions[3] we projected our 1980 estimates of consumer savings forward to 1984. We estimate that these savings have more than doubled in real terms to a range of about $130 to $236 million in 1984 dollars. The growth in savings reflects an increase in the number of multi-source prescriptions (about 5 percent), a near doubling of the percentage of brand-written prescriptions on which substitutions were made (from 5.1 percent to 9.3 percent of all brand-written multi-source prescriptions, according to IMS), the implementation of drug product selection laws in the remaining states, and general increases in drug prices (51 percent). We expect savings to continue to increase due to the continued spread of the acceptability of substitution and the entry of more generic products as a result of the 1984 Hatch/Waxman Act.

The incidence of substitution varies a great deal. In some drugs, there was essentially no substitution at all in 1980, while in others the rate was over 20 percent of eligible prescriptions. Substitution occurred more frequently on Medicaid prescriptions than on cash prescriptions and noticeably less frequently on privately insured prescriptions. Chain and independent stores, however, did not appear to differ significantly in their substitution behavior in 1980.

One source of variation from state to state was differences in the legal provisions of states' drug product selection laws. Of course, states with drug product selection laws had more substitution than states with antisubstitution laws. State formularies played a similar role on a drug-by-drug basis. On the four-fifths of all prescriptions for which a state formulary did not preclude brand interchange, the substitution rate was much higher than on the remaining one-

---

3/ For the purpose of the estimate, we assumed that there were no major changes in the pattern of substitutions across drugs nor in the response of generic prescribing to the laws. We assumed also that brand and generic prices rose at the same rate, in terms of both manufacturer-level prices and retail margins.

fifth. Three other provisions were also shown to have affected the rate of substitution significantly. First, a prescription pad format making it easy for physicians to prohibit substitution lowered substitution; second, a requirement that pharmacists consult or discuss with customers any substitutions increased substitution; and third, the presence of a formulary, especially a positive formulary, unexpectedly led to less substitution, even when substitution was permissible on prescriptions for a given drug. Mandatory substitution led to higher rates of substitution in some drugs but never as high as the mandate might suggest, and moreover did not even show a significant systematic effect of increasing substitution across the board. Finally, a requirement that consumers be given the difference in invoice cost between the prescribed brand and the substituted generic was not shown to deter substitution. Even the particular provisions which most promote substitution failed to push it to high levels. Of course, since the general grant of authority to substitute produced relatively weak results everywhere, small adjustments within the law were unlikely to cause the substitution rate to jump substantially. As substitution becomes more common, the consequences of differences in detailed provisions may increase.

Since both consumers and pharmacists have economic incentives that favor substitution, we regard the relative infrequency of substitution as somewhat of a puzzle; for consumers, a marked brand-generic differential in retail prices and, for pharmacists, a higher dollar gross margin on generics than on brands could be expected to encourage substitution. Part of the explanation is simply the newness of the institutional change. As consumers and health professionals continue to garner experience with generics they are likely to find substitution increasingly acceptable. Consumers or pharmacists appear to believe that the very fact that a prescription is written for a brand name, even when the physician has not explicitly prohibited substitution, means that the physician strongly prefers the branded product for the patient. Our inference comes from the strong contrast in 1980 between dispensing behavior on brand-written prescriptions eligible for substitution and on generically written prescriptions: while substitution on brand-written prescriptions was infrequent,

generically written prescriptions were almost always filled with generics. Most consumers probably do not know whether in the prescriber's expert opinion a substitution is acceptable; being unsure, they may not feel confident making the medical judgment on their own. We hypothesize that if consumers were to understand their physicians' considered opinions, they might choose substitution more frequently.

As the market share of generics increases, competitive pressures may depress manufacturers' prices, a potential effect of substitution and the DPS laws overall which goes beyond those measured in this study. While lower prices provide an immediate saving for consumers, inroads on the high market shares and (manufacturing-level) price premiums for leading brands diminish the incentives for research and development of new drugs.[4] In the long run these effects could be of greater importance than the direct savings from substitution. We therefore examine briefly some historical data on changes in manufacturers' prices as a guide to the future.

Dramatic declines in prices characterized the major antibiotics in the 1960s and 1970s; by 1980 manufacturers' prices in the four largest antibiotic entities[5] had fallen by three-quarters or more in nominal prices -- more in real terms -- since the 1960s.[6] During this time there was a large increase in the market share of generics and secondary brands. The increase in generic market share predated the introduction of DPS laws and was instead a response primarily to an upsurge in generic prescribing, now ranging above 50 percent in three of these drugs.[7]

4/ Although by extending the patent life of new drugs the 1984 Hatch/Waxman Act provides additional incentive for these activities.

5/ Tetracycline, ampicillin, penicillin VK, and erythromycin base. These four entities together accounted for 21 percent of all prescriptions in our 45 multi-source drugs in 1980.

6/ The information on drug price competition in the 1960s and 1970s used in this and the following paragraph is taken from Schwartzman (1976, pp. 255-292.).

7/ Generic prescribing rose between 1966 and 1973 from 8.9 percent to 17.4 percent on erythromycin base prescriptions; from 4.1 percent to 49.7 percent on ampicillin prescriptions; from none to 14.2 percent on penicillin VK prescriptions; and from 29.8 percent to 40.7 percent on tetracycline prescriptions

Can we predict a similar drop in prices due to the DPS laws' leading to a substantial increase in the use of generics? It is not clear, for three reasons. First, the price decline in antibiotics may have been caused by factors other than increases in generic market share. The early price decreases in antibiotics occurred in an environment which also included strong competition between different chemical compounds used for similar therapeutic purposes. There were substantial promotional efforts, often mounted in conjunction with entries of competing products by other major manufacturers, not just small "generic" producers. In fact, even during the patent period there were competing brands marketed by other large pharmaceutical firms which presumably inhibited the development of a deep-rooted brand loyalty to the first product. Additional factors (such as MAC regulations) have also affected the course of competition in these and other drugs. Second, some major non-antibiotic drugs showed no such dramatic price decline by 1977, despite substantial market share incursions by generics and secondary brands. Third, in the 10 top-substitution drugs in 1980 -- drugs in which substitution was causing a significant increase in the use of lower-price generic products -- manufacturers' prices of leading brands did not fall between 1980 and 1984. Instead, they rose by about the same amount (36.2 percent) as the average across all drugs.[8] Thus, whether an increase in generic market share in itself can force down the manufacturer's price of the leading brand and whether the increase in generic market shares in individual drug entities brought about by substitution will be enough to accomplish this is still an open question.

Finally, whether substitution is the most useful vehicle for lowering the prescription drug prices paid by consumers (and the goal itself is controversial) is a question which reaches much further than the bounds of this study. We point out two

---

(Schwartzman (1976, p. 269).) In 1980, generically written prescriptions were 28.4 percent of all erythromycin base prescriptions; 84.2 percent of ampicillin prescriptions; 51.6 percent of ampicillin prescriptions; and 69.6 percent of tetracycline prescriptions.

8/ See footnote 21 in Chapter 8 for the methodology. On the other hand, prices of generics in the 10 top-substitution drugs fell more (-18.9 percent) between 1980 and 1984 than the average across all drugs (-10.8 percent).

other mechanisms. One, generic prescribing, stands out in our data. In 1980 generic prescribing accounted for about two-thirds of the overall generic market share. Although in many drugs substitutions account for most of the generic dispensing, in others nearly all prescriptions are written generically and thereupon dispensed generically. Moreover, there is striking variation from state to state in the incidence of generic prescribing: the range is from 15 to 30 percent of multi-source prescriptions. In most drugs, generically written prescriptions are almost always filled with generics. Since a change in the amount of generic prescribing translates almost directly into generic market share, whatever determines differences in generic prescribing is responsible for a good portion of any differences in average retail prescription drug prices. A second price-reducing mechanism is the often over-looked arena of competition among retailers,[9] of considerable importance in that retail gross margins constituted 40 percent, on average, of the retail prices of the 45 leading multi-source drugs we studied. The recent trend toward more aggressive retailer advertising of generic lines is a development that tends to invigorate inter-pharmacy competition. So too, would the introduction of consumer advertising by drug manufacturers, whatever its other implications.[10] If retail competition is sharpened, the search for competitive advantage may lead to greater efficiency and lower consumer prices.

We conclude that drug product selection laws have reduced retail prescription prices by increasing the market share of generics, but not at the scale hoped for by some advocates of the laws. While differences among state laws did affect rates of substitution in 1980, the more vivid result is the very modest amount of substitution occurring in most states and most drugs. In the past four years, however, substitution has become much more frequent, and there is good reason to expect it to play an even larger role in prescription drug markets in the future.

9/ For a general discussion of the relationships between retailers' and manufacturers' margins, including evidence that they tend to be inversely correlated, see Steiner (1973, 1978, 1984).

10/ See Masson and Rubin (1985).

APPENDIX A1

THE PROVISIONS OF THE STATE LAWS

Table A1-1 shows for each state the individual provisions of its drug product selection law. Because our data are for 1980, we concentrated on the coding of the law and formulary in effect in 1980. The primary provisions used in the analysis are shown in Columns 2 through 7. Columns 8 through 12 contain information on other regulations which may less directly have affected substitution decisions. (Because these provisions were not as central to our analysis, we were not as thorough in reviewing our information. Our tabulation should therefore not be considered definitive.) Column 13 shows which states regulated the choice of products to dispense on generically written prescriptions. In addition, we show pre-1980 provisions and some, but not all, post-1980 amendments. We do not show post-1980 changes in the formularies. The recommendations of the FTC/FDA Model Act are shown at the bottom of the table.

In the text following the table, we provide a key to the classifications of the provisions, with explanations where necessary.

We recognize that a statute may be open to several interpretations. Therefore, our classification of the provisions may appear to have greater precision than is true. Even the employees of state Boards of Pharmacy had some difficulties specifying the exact meaning of some provisions, since in many instances there have been no challenges which would have led to legal clarification. While we have been diligent in our attempt to understand the statutes and have sought interpretations from every state's Board of Pharmacy (or equivalent agency), errors in classification (or differences in judgment) may remain.

APPENDIX A1

TABLE A1-1*

Taxonomy of State Regulations, 1980[1]

State	(1) Effective Date Mo/Day/Yr	(2) Mandatory or Permissive Substit.	(3) Format of Dr's Rx Pad	(4) Formulary Type and Extensiveness in 1980 a	b[2]	(5) Pharmacist Liability	(6) Cost Pass-through
Alabama	1/1/80	PERM	N2	X	100%	HI	NO
Alaska[3]							
Arizona	1/1/79	PERM	P2	+	36%	LO-STAT	NO
(Amnd)	8/1/79[4]						
Arkansas	8/14/75	PERM	P1-a	-	84%	LO-FORM	UC-3
Calif.	5/1/76	PERM	N1-b	X[5]	100%	LO-STAT	YES-3
(Amnd)	1/1/80						
(Amnd)	1/1/81						NO-3
Colorado	4/26/76	PERM	N1-b	-	81%	LO-STAT	YES-3
Connect.	10/1/76	PERM	P1-b	X	100%	HI	YES-3
(Amnd)	12/7/77						
Delaware	12/20/76	PERM	N2	-	89%	HI	YES
(Amnd)	7/1/81						
D.C.	9/10/76	PERM	P1-a	+	37%	LO-STAT	NO-3
Florida	5/31/74	PERM	N1-a	TT	91%[6]	HI	NO
(Amnd)	6/3/76	MAND-LO	P1-b			LO-STAT	UC
Georgia	1/1/78	PERM-LO	A2	X	100%	HI	UC

* See footnotes at end of table.

TABLE A1-1--Continued

(7) Notification							(8)	(9)	(10)		(11)		(12)	(13)
a	b	c	d	e	f	g	Advertising	Prescriber Liability	Pharmacy Ownership a	b	Price Posting and Signs a	b	Mail Order	Generically Written Rx's
-	-	-	-	-	-	-	-	HI	-	-	-	-	+	ANY
+	-	+	-	+	-	-	-	LO	+	-	-	-	-	ANY
+	-	-	-	+	-	-	-	HI	-	-	-	-	-	ANY
-	-	-	-	-	+	-	-	LO	+	-	+	-	-	ANY
									+					
+	-	-	-	-	+	-	+	HI	+	-	-	-	-	ANY
+	+	+	-	+	-	-	-	HI	-	-	-	+	-	ANY
											+			
+	-	+	-	+	-	-	-	HI	-	-	-	-	-	ANY
-	-	-	-	-	-	-	-	LO	-	-	+	+	-	LO
-	-	-	-	-	-	+	-	HI	-	-	-	+	-	ANY
-	-	+	+	-	-	-	-	LO	-	-	-		-	ANY
-	-	-	-	-	-	-	-	HI	-	-	-	-	+	LO

TABLE A1-1, continued

State	(1) Effective Date Mo/Day/Yr	(2) Mandatory or Permissive Substit.	(3) Format of Dr's Rx Pad	(4) Formulary Type and Extensiveness in 1980 a	b[2]	(5) Pharmacist Liability	(6) Cost Pass-through
Hawaii[7]							
Idaho	7/1/78	PERM	N2	X	100%	HI	YES
Illinois	10/1/77	PERM	N2	+	42%	LO-STAT	NO
(Amnd)	8/19/81		N1-a				
Indiana	7/1/84						
Iowa	7/1/76	PERM	N1-I	X	100%	HI	YES
Kansas	7/1/78	PERM	N1,2	-	81%	HI	UC
Kentucky	6/15/72	MAND-LO	P1-a	+	46%[8]	MAND-FORM	NO
Louisiana	9/14/80	PERM	NN	-	0/81%	HI	UC
Maine	1/1/76	PERM	N1-a	X	100%	HI	NO
(Amnd)	1/1/79						
Maryland	5/1/73	PERM	N1-b	+		LO-FORM	YES
(Amnd)	1/1/78		P1-c	-		LO-FORM	YES-3
(Amnd)	1/1/79			-/+	75%		NO-3
Mass.	1/20/77	MAND	N2	+	41%	MAND-FORM	NO
Michigan	4/1/75	PERM	P1-a	X	100%	HI	YES-3
Minnesota	8/1/75	PERM	P1-a	X	100%	HI	YES
Miss.	7/1/79	PERM	P2	-	94%	LO-STAT	NO
Missouri	1/1/79	PERM	A2	-	84%	LO-STAT	NO
Montana	4/18/77	PERM	N1-b	X	100%	LO-STAT	YES
Nebraska	9/2/77	PERM	P1-a	-	81%	LO-STAT	NO

TABLE A1-1--Continued

(7) Notification							(8)	(9)	(10)		(11)		(12)	(13)
a	b	c	d	e	f	g	Advertising	Prescriber Liability	Pharmacy Ownership a	b	Price Posting and Signs a	b	Mail Order	Generically Written Rx's
+	-	-	-	-	-	-	-	HI	+	-	-	+	-	ANY
-	-	+	-	+	-	-	-	LO	+	-	-	-	-	ANY
														ANY
-	+	+	-	+	-	-	-	HI	+	-	-	-	+	ANY
-	-	-	-	-	-	-	-	HI	-	-	-	-	-	ANY
+	-	-	-	-	-	-	+	HI	-	-	-	+	-	ANY
-	-	-	-	-	+	-	+	HI	-	-	-	-	+	ANY
+	-	-	-	-	+	-	-	HI	-	-	+	-	-	ANY
				+	-	-								
-	-	-	-	-	-	+	+	HI	+	-	-	-	-	ANY
+							-				+			
						-								
+	-	-	-	-	-	-	-	HI	-	-	-	-	-	ANY
+	-	-	-	-	+	-	+	HI	+	+	+	-	+	ANY
+	-	-	+	-	-	-	-	HI	-	-	-	-	-	ANY
+	-	-	-	+	-	-	-	LO	-	-	-	-	-	ANY
+	-	-	-	-	-	-	-	HI	-	-	-	-	-	ANY
-	-	-	+	-	-	-	-	LO	+	-	-	+	-	LO
-	-	-	-	-	-	-	-	LO	-	-	-	+	-	LO

TABLE A1-1, Continued

State	(1) Effective Date Mo/Day/Yr	(2) Mandatory or Permissive Substit.	(3) Format of Dr's Rx Pad	(4) Formulary Type and Extensiveness in 1980 a	b[2]	(5) Pharmacist Liability	(6) Cost Pass-through
Nevada	1/17/79	PERM	A2	+	49%	LO-STAT	NO
(Amnd)	10/1/79						
New Hamp.	8/27/73	PERM	A1-b	+	98%	LO-STAT	NO
(Amnd)	7/1/81		P1-b				
New Jer.	9/29/77	MAND	N1-a	M	100%[9]	MAND-FORM	UC
New Mex.	5/14/76	PERM	P1-b	+	29%	LO-FORM	NO
(Amnd)	1/1/82						
New York	4/1/78	MAND-ELSE	P2	M	100%[9]	MAND-FORM	NO
N.C.	1/1/80	PERM	A2	X	100%	LO-STAT	NO
N.D.	7/1/79	PERM	A2	X	100%	LO-STAT	NO
(Amnd)	1/1/80						
Ohio	1/1/78	PERM	P1-a	TT	81%[10]	HI	YES-3
Oklahoma	4/1/61	PERM	NN	X	100%	HI	NO
Oregon	9/12/75	PERM	P1-a	X	100%	LO-STAT	NO
Penn.	6/25/77	MAND	P2	+	49%	LO-STAT	UC-3
R.I.	7/1/76	PERM	P2	+	43%	LO-STAT	NO
(Amnd)	1/1/79	MAND-ELSE					YES
(Amnd)	7/1/81						
S.C.	1/1/79	PERM	P2	X	100%	HI	NO

TABLE A1-1--Continued

(7) Notification a	b	c	d	e	f	g	(8) Advertising	(9) Prescriber Liability	(10) Pharmacy Ownership a	b	(11) Price Posting and Signs a	b	(12) Mail Order	(13) Generically Written Rx's
+	-	+	-	+	-	-	-	HI	+	-	+	+	-	ANY
-	-	-	-	-	+	-	-	HI	-	-	+	-	-	ANY
-	+	-	+	-	-	-	+	HI	-	-	-	+	-	ANY
+	-	-	-	-	-	-	-	HI	-	-	-	-	-	ANY
+	-	-	-	-	-	-	+	HI	-	-	+	+	-	ANY
-	-	-	-	-	-	-	-	LO	-	-	-	-	+	ANY
-	-	-	+	-	-	-	-	HI	-	-	-	-	+	ANY
										+				
+	-	+	-	+	-	-	+	LO	-	-	-	-	-	ANY
-	-	-	-	-	-	-	-	HI	-	-	-	-	-	ANY
+	-	-	-	-	-	-	-	LO	-	-	-	+	-	LO
+	+	+	+	-	-	-	-	LO	-	-	+	+	-	ANY
-	-	-	-	-	-	-	-	LO	+	-	+	-	-	ANY
+	-	+	+	-	-	-	+	HI	-	-	-	-	-	ANY

TABLE A1-1, Continued

State	(1) Effective Date Mo/Day/Yr	(2) Mandatory or Permissive Substit.	(3) Format of Dr's Rx Pad	(4) Formulary Type and Extensiveness in 1980 a	b[2]	(5) Pharmacist Liability	(6) Cost Pass-through
S.D.	7/1/78	PERM	A2	X	100%	HI	NO
Tenn.	6/1/77	PERM	N2	+	29%	LO-STAT	YES
Texas	1/1/82	PERM	N2		0	LO-STAT	NO
Utah	5/10/77	PERM	N1-b	-	84%	LO-FORM	YES
Vermont	2/23/78	MAND-LO	P1-b	+	49%	MAND-FORM	UC
Virginia	7/1/76	PERM	A1-a	+	47%	LO-FORM	YES
(Amnd)	7/1/77						
(Amnd)	1/1/79		A2				
(Amnd)	7/1/81						NO
Wash.	9/19/77	MAND	A2	X	100%	LO-STAT	YES
W. Va	7/1/78	MAND-LO	P2	-	86%	LO-STAT	YES
Wisconsin	3/20/76	PERM	P1-a	+	37%	LO-FORM	YES
Wyoming	7/1/79	PERM	A2	-	81%	LO-STAT	UC
FTC/FDA Model		PERM	P1-b	+	49%	LO-STAT (Optional)	NO

TABLE A1-1--Continued

(7) Notification							(8)	(9)	(10)		(11)		(12)	(13)
a	b	c	d	e	f	g	Advertising	Prescriber Liability	Pharmacy Ownership a	b	Price Posting and Signs a	b	Mail Order	Generically Written Rx's
-	-	-	-	-	-	-	-	HI	-	-	-	-	-	ANY
-	-	-	-	-	-	-	-	HI	-	-	-	-	+	ANY
+	+	-	-	+	-	-	-	LO	-	-	-	+	-	ANY
-	-	-	-	-	+	-	-	LO	-	-	-	-	-	ANY
+	-	-	+	-	-	-	-	HI	+	-	+	+	-	LO
+	-	-	-	-	-	-	-	HI	+	-	-	-	-	ANY
					+			LO						
-	+	-	-	-	-	-	-	LO	-	-	-	+	-	ANY
+	-	-	-	+	-	-	-	LO	-	-	+	+	+	LO
-	-	-	-	+	-	-	-	HI	-	-	-	+	+	LO-ELSE
-	-	-	-	-	-	-	-	HI	-	-	-	-	-	LO
-	-	-	+	-	-	-								

Footnotes to Table A1-1

1/ Some amendments after 1980 are shown but not necessarily all.

2/ Percentage of prescriptions, for 45 leading multi-source drugs, on which substitution was permitted in 1980.

3/ Laws for Alaska and Hawaii were not researched because the IMS data used do not include those two states.

4/ Where an amendment did not change the code, the column is left blank. (Details of other provisions or other aspects of the law may have been changed.)

5/ California nominally has a negative formulary but there were not drugs listed on it.

6/ Florida and Ohio have negative state formularies but require each pharmacy to establish its own positive formulary. The percentages given are for the state formulary.

While the provision for pharmacy formularies would not appear to constrain pharmacists' choices, a study done in Florida showed that the application of pharmacy formularies removed from possible substitution an additional 25 percent of all prescriptions written. Vuturo, Krischer and McCormick (1980).

7/ See footnote 3.

8/ Kentucky's law is ambiguous as to whether it controls all substitution or only mandatory substitution. We use the interpretation provided by state officials: that it controls all substitution.

9/ New Jersey and New York have positive formularies listing drugs for which substitution is mandatory; substitution is permitted, however, in all other drugs, making these states in one sense "no formulary" states; the extensiveness of permissible substitution is therefore given as 100 percent. (New Jersey mandates substitution on about 39 percent of multi-source prescriptions and New York 76 percent.)

In the other states with mandatory substitution, the formulary controls all substitution, not just mandatory substitution.

10/ See footnote 6.

SOURCE: Compiled by the Bureau of Economics, Federal Trade Commission.

COLUMN 1: EFFECTIVE DATE OF DPS STATUTE OR AMENDMENT

The first column in Table A1-1 gives the date on which the state's initial DPS law, or subsequent amendment, became effective. The effective date is typically some months after the date it became law. However, not every provision of the law may have become effective on that date. For instance, physicians often were given a grace period to change over to a new type of prescription pad. Also, it sometimes takes months before a formulary is published. And, of course, actual conduct adapts gradually after the introduction of the law, especially when the statute mandates a radical departure from previous behavior.

COLUMN 2: MANDATORY OR PERMISSIVE SUBSTITUTION ("MAND")

PERM: The pharmacist is permitted to substitute, once the physician has allowed it.

PERM-LO: *PERM* condition plus the pharmacist must use the least expensive generic in stock or one with a below-average wholesale cost when substituting.

MAND: The pharmacist must substitute, once the physician has allowed, if the pharmacy has a lower-price generic equivalent in stock.

MAND-LO: *MAND* condition plus the pharmacist must use the least expensive generic in stock or one with a below-average wholesale cost when substituting.

MAND-ELSE: The pharmacist must substitute, once the physician has allowed it but if a lower-price generic equivalent is not in stock may not fill prescription.

Most of the states left the substitution decision to the pharmacist (and consumer) (*PERM and PERM-LO*).

There are two basic classifications for states requiring that, in the absence of a prohibition by the prescribing physician, a pharmacist must substitute an equivalent, less expensive drug product for the prescribed brand. In some states the pharmacist had to substitute a less expensive product only if there was one in inventory (*MAND*). Other states not only mandated substitution but also required that if the pharmacy did not stock a less expensive generic equivalent (New York) or a less than average wholesale cost equivalent (Wisconsin) the pharmacist could not fill the prescription at all (*MAND-ELSE*).

Some states, such as Iowa, made substitution mandatory if public funds were used to pay for the prescription. We believe this requirement to be relatively common; we have not coded it. On MAC drugs the reimbursement formula provides a powerful incentive for the pharmacist to substitute a below-MAC drug.

States which both mandated substitution and had a positive formulary used the formulary in two different ways. Most required substitution for drugs on the formulary and forbade all other substitution. Two states (New Jersey and New York) required substitution for formulary drugs but left substitution to the discretion of the pharmacist for all other drugs.

In 4 states (Florida, Georgia, Kentucky and West Virginia) the pharmacist when substituting was required to dispense the least expensive generic equivalent in stock. This is designated *PERM-LO* or *MAND-LO* on the table.

The variable *MAND* in the regressions is coded 1 for the MAND codes and 0 for the *PERM* codes.

COLUMN 3: FORMAT OF PHYSICIAN'S PRESCRIPTION PAD ("RXPRO," "RXANTI," AND "RXNEUT")

RXPRO formats:

P1-a : Single signature line. A handwritten abbreviation is required to prevent substitution.

P1-b : Single signature line. A handwritten designation of two or more words is required to prevent substitution.

P2 : Two signature lines. The bottom right line denotes "substitution permitted".

RXNEUT formats:

N1-a : Single signature line. A handwritten designation is required to prevent substitution. A preprinted line(s) or box(es) is (are) required.

N1-b : Single signature line. A handwritten designation is required to prevent substitution. A preprinted line(s) or box(es) is (are) permitted.

N1-I : Single signature line with physician's choice as to presumption (substitution permitted or prohibited.) (Iowa only.)

N2 : Two signature lines. Physician's option as to whether to designate right or left line as substitution permitted.

N1,2 : Physician's choice of single or double signature line. (Kansas only.)

NN : No regulations dealing with format, with respect to substitution.

RXANTI formats:

A1-a : Single signature line. A handwritten abbreviation is required to permit substitution. (No longer used; formerly used in Virginia.)

A1-b : Single signature line. A handwritten designation of two or more words is required to permit substitution. (In New Hampshire only, formerly; replaced in 1981.)

A2 : Two signature lines. The bottom left line denotes "substitution permitted".

We categorized physicians' prescription pad formats as to the likelihood that the physician would permit or, alternatively, prohibit substitution. Accordingly, they are labeled *RXPRO*, *RXNEUT*, and *RXANTI*. Table A4-4 in Appendix A4 indicates that while most of our *a priori* judgments about likely effects appear to be borne out, some were not.

The DPS literature has generally characterized physicians' prescription pads as "single-" or "double- [signature] line". In the first case, the doctor merely signs the prescription

and, in the absence of any designation to the contrary on the prescription, substitution is permitted. (Prior to 1981, one state's single-line pad carried the opposite presumption, that without special instructions substitution was prohibited.) With the second format, one signature line bears a printed annotation that substitution is permitted, the other line that substitution is not permitted, and the physician designates a preference by choosing which line to sign. We chose an alternate categorization in order to summarize the effects of the many variants mandated or permitted by the state laws and to incorporate our belief that some double-line formats are much less conducive to physician prohibition of substitution than others.

Some states left to the physician's option features which make it either difficult or easy to permit or prohibit substitution. Without knowing the proportions of physicians in a state who exercise each option, we cannot know the overall effect of the prescription pads chosen. Several such states are assigned to the *RXNEUT* category.

A. RXPRO FORMATS

Two of the three prescription pad formats in the *RXPRO* category are single-line pads. On these, either a handwritten abbreviation (P1-a) or two or more words (P1-b) are necessary for the physician to prohibit substitution. Examples of the first are the initials "DAW" (meaning "Dispense as Written") in Minnesota and "B.N." (meaning "Brand Necessary") in the District of Columbia. The second type of prescription pad requires that the phrase be written out in full. States with either of these two formats did not allow a preprinted box to be checked or a line to be initialed for the purpose of preventing substitution. One of the two-signature line pads is classified as *RXPRO*. On P2 pads, the "substitution permitted" signature line is on the right, the place where physicians are accustomed to signing the prescription. It has been suggested that physicians would continue to sign in that location simply out of habit. Therefore, if the "substitution permitted"

signature line is in the bottom right corner, most prescriptions would allow substitution, while if the "substitution prohibited" line is there, more prescriptions would disallow substitution. The latter formats are classified as *RXANTI.*

B. RXANTI FORMATS

The "most anti" *RXANTI* pad is a single-line format with the presumption that substitution is prohibited unless the physician has written out a statement that substitution is permitted (A1-a). The New Hampshire law prior to its amendment in 1981 made it especially difficult for the physician desiring to permit substitution by specifying that the following phrase had to be written out: "or its generic equivalent drug listed in the New Hampshire Drug Formulary." Somewhat less of a burden is the requirement that an abbreviation be written on a single-line prescription pad if substitution is to be permitted (A1-b).

The third *RXANTI* format is the two-line pad with the "substitution permitted" line on the left, leaving the "substitution prohibited" line in the location where physicians may be accustomed to signing automatically (A2).

C. RXNEUT FORMATS

Finally, there are six categories of *RXNEUT* prescription pad formats, several of which leave major elements of the design to the physician's own option. Therefore, both the physician who generally opposes substitution and the physician who generally allows it can have a prescription form printed in such a way that it is simple to designate the usual decision.

Several states required two signature lines but left to the physician the decision of which instruction was to appear on the right (N2). We have included with the N2 pads the Massachusetts format that required the "substitution permitted" line to be on the lower left if a left-right format was used but also permitted an alternative arrangement of both signature lines in the lower right corner whereby the "substitution permitted" line had to be printed above the other line.

Some states with single-line pads and the presumption that substitution was permitted unless the physician indicated otherwise required the form to contain preprinted line(s) or box(es) which the physician could check or initial, thus facilitating a physician's designation for overriding the presumption (N1-a).

Another category, N1-b, also contains single-line formats where the presumption is that substitution is permitted, but the states with this format permitted (but did not mandate) the pre-printing of a box to be initialed by hand to prohibit substitution. Physicians who elect to print such a box may be expected to forbid substitution more frequently than in the absence of the preprinted reminder; even when the box is not initialed, their selection of that format may suggest a disapproval of substitution. These formats are considered "neutral" because the convenience with which most prescribers can prohibit substitution is determined by the formats they choose. In a state permitting such a choice, the proportion of "pro" and "anti" pads depends on the proportions of physicians with predispositions for or against substitution in general.

Two other regulations, each unique to a single state, also allowed physicians to choose a format in accord with a preformed opinion about the general desirability of substitution. The Iowa statute (N1-I) was one such example, permitting a physician to have the form preprinted with either the words "substitution permitted" or "do not substitute," depending upon usual prescribing preferences. Kansas allowed physicians to use either a single-line or a double-line form (N1,2). If a single-line form was used, substitution was permitted unless "dispense as written" was handwritten on the prescription. On a double-line form, the "first line" had to be labeled "dispense as written."

Finally, the two states with no regulations as to prescription pad format (NN) obviously allowed physicians to use whatever design made their usual decisions easiest to communicate.

D. TELEPHONE PRESCRIPTIONS

Our coding classifies states according to their statutory provisions for written prescriptions. However, more than a quarter of all prescriptions are conveyed by telephone.[1] In general, we would expect that when the physician (or someone in the physician's office) speaks with the pharmacist there is established a clear understanding of what will be dispensed. That is, the pharmacist can inquire as to whether a specified version of the drug will be acceptable to the physician. If so, the prescription as recorded will match the brand dispensed and no substitution need be recorded.

However, in some states telephoned prescriptions were treated by the law differently from written prescriptions. In Louisiana and New York, for example, while the presumption on written prescriptions was that substitution was permitted, the presumption was the opposite for telephoned prescriptions: unless the physician explicitly stated that substitution was permitted, the pharmacist could not substitute. To the extent that pharmacists typically mention a proposed substitution anyway, in the course of receiving a telephoned prescription, such a law would not have much force.

COLUMN 4: TYPE AND EXTENSIVENESS OF FORMULARY IN 1980 ("POS," "NEG," AND "NO FORM")

4(a) Type:

+ : Positive formulary. Substitution is permitted if the drug is on the formulary. (Positive formularies used to regulate mandatory substitution are coded M, rather than +.)

1/ See footnote 9 in Chapter 6.

M : Mandatory formulary. A positive formulary controlling mandatory substitution only. Substitution is permitted (but not mandated) on non-formulary drugs.

- : Negative formulary. Substitution is permitted if drug is *not* on the formulary.

-/+ : Negative formulary at beginning of 1980, changed to positive formulary in mid-1980.

TT : Two-tier. Negative state formulary and positive individual pharmacy formularies.

X : No formulary. Pharmacist makes independent judgments regarding substitution.

4(b) Extensiveness: The extensiveness of the opportunity to substitute is measured by the proportion of prescriptions in 45 leading multisource drugs on which substitution was permitted (by formulary) in 1980. The computation was based upon state formularies and information obtained from state Boards of Pharmacy. Each drug (in the specified dosage form) was coded, by state and month, as to whether substitution was permitted or not. Both the proportion of the year during which substitution was permitted on the drug in the state (since some formularies were changed during 1980) and each drug's share of the total number of prescriptions dispensed in the U.S. in 1980 (for the 45 drugs studied) were taken into account. (Data for the 45 drugs were weighted by the scheme discussed in Appendix A6, Section V.)

Because a number of state formularies have been amended since 1980, the table should not be read to reflect the current extensiveness of the state formularies.

In the regressions, *POS* is coded 1 for + and *M* states. *NEG* is coded 1 for - and *TT* states. Both *POS* and *NEG* are coded 0 for *X* states.

COLUMN 5: PHARMACIST LIABILITY ("LIAB")

HI: By engaging in substitution, a pharmacist is exposed to a potential increase in professional liability.

LO-STAT: The statute expressly protects a pharmacist from increased liability when substituting.

LO-FORM: The pharmacist is impliedly protected when selecting from drug products on a positive formulary (or, by interpretation in a few states, by avoiding those on a negative formulary.)

MAND-FORM: The pharmacist is impliedly protected when substituting as required in accord with a formulary established for the purpose of regulating the mandatory substitution.

Some states have decided that a pharmacist should not face a more stringent standard of liability when substituting than when filling a generically written prescription, when by definition one or another brand must be selected. There are three forms of protection against added liability: first, an express statutory provision (*LO-STAT*); second, an implicit protection as long as substitutions are made in accord with the state's formulary (*LO-FORM*); and third, an enhanced form of the second, in states where substitution is mandated according to a formulary. (In some mandatory states, the statute

itself provided protection.) In a few (non-mandatory) states with a formulary, the Board of Pharmacy did not confirm that the formulary provided such protection. These few states are coded as having no protection against added liability (*HI*), as are no-formulary states which had no express statutory language to limit liability on substitutions.

The variable used in the regressions, *LIAB*, is coded 1 if there was statutory protection (*LO-STAT*) and 0 otherwise.

Some state officials expressed the view that no extra liability is incurred when a pharmacist substitutes within a generic class as long as the drug dispensed has an FDA approval. We know of no judicial test of this view. Were it true, the state-to-state differences in liability provisions would have little effect.

COLUMN 6: COST PASS-THROUGH ("PASS")

NO: A substituted product need only have a retail price lower than the prescribed brand's.

UC: *NO* provision plus the restriction that the substituted product be sold at a price no higher than the usual and customary retail price.

YES: The pharmacist must pass through into the substituted item's retail price most or all of the difference between its wholesale cost and that of the prescribed item.

. . .-3: The state statute or regulation includes a provision that 3rd party payers must receive the same savings as uninsured private consumers.

If a state did not regulate the retail price or the pharmacist's margin on substituted products, the state was coded *NO*. The same code is used when the state required that the retail price of the substituted product simply be less than the price of the originally prescribed product. This requirement is unlikely to be restrictive, for pharmacists nearly always charge somewhat less for generic equivalents of branded drugs even when they are not legally obliged to do so. A different code (*UC*) is used if the state required not only that the substituted product be sold at a price lower than the one prescribed but also that its price when substituted not be higher than its usual and customary price, that is, the price charged when it was dispensed to fill a generically written prescription or a prescription on which the item itself was prescribed.

The code *YES* is used when the state had a pass-through requirement, as described in Chapter 5. Most of these states required that the full cost savings be passed through. The state of Washington is an exception in that pharmacists were required to pass through only 60 percent of the difference between the wholesale prices of the prescribed and the substituted products. Our conversations with state officials indicated that there is wide variation in the enforcement of pass-through provisions across states, but we did not incorporate these differences in our coding scheme.

The addition of a *3* to any of the codes in Column 6 indicates that the state statute or regulation specifically provides that third-party payers (both private and governmental) receive the same savings as cash-paying customers.

The variable *PASS* used in the regressions is coded 0 (i.e., no pass-through requirement) for either of the two codes *NO* and *UC*, and is coded 1 only when column 6 is coded *YES*.

COLUMN 7: NOTIFICATION ("INFO")

7(a): + Extra labeling is required.

7(b): + Extra recordkeeping is required.

7(c): + The pharmacist is required to make an oral comparative price disclosure.

7(d): + The pharmacist must receive advance consent or orally notify consumer of the right to refuse.

7(e): + The pharmacist must orally inform the consumer in advance.

7(f): + The pharmacist must orally notify the consumer that a substitution was made.

7(g): + Notification of the physician is required.

The coding of the notification provisions was particularly difficult. Even after discussions with Boards of Pharmacy officials, it was not always clear what the state statutes or regulations meant, for example, whether the information had to be given when the prescription was presented or after it was filled (when it was picked up.) Moreover, in order to designate a provision as requiring an extra procedure, we had to understand what types of information pharmacists in a state were required to provide on non-substituted prescriptions.

We have classified requirements for providing extra information when substituting into seven types.

1. Extra Labeling (Column 7(a)).

For many years all states have required the pharmacy to label a prescription drug container with certain information. Typically the label includes the prescriber's name, the name of the pharmacy, the name of the product dispensed, the patient's name, dosage instructions, and (more recently and not necessarily by requirement) drug and food interaction warnings. Pharmacists may not routinely indicate on the label that a substitution has taken place, nor generally record on the label the name of the manufacturer of a generic drug they are dispensing.

Extra labeling requirements when a substitution is made are of several sorts. For example, Wisconsin specified that both the generic name and the manufacturer's name of the dispensed product be listed, and the name of the prescribed brand as well. In Vermont pharmacists had to note on the label that a substitution was made. Missouri required that the pharmacist print the product code of the substituted product on the label.

2. Extra Recordkeeping (Column 7(b)).

Similarly, every state has some form of recordkeeping requirement that antedates its drug product selection statute. Even in the absence of statutory provisions, good pharmacy practice obliges the pharmacist, either on the original prescription or elsewhere, to record the name of the brand prescribed and the name and manufacturer of the brand dispensed. Provisions which do no more than require that the foregoing procedures be followed when the pharmacist substitutes are not considered to be extra recordkeeping requirements. But certain jurisdictions required that additional (and sometimes redundant) information be recorded, for instance, a separate notation that a substitution was made.

3. Disclosures to the Consumer (Column 7(c) - (f)).

There are several variants on what a pharmacist is required to say to a consumer whenever a substitution is being made.

The most extensive notification is the requirement to inform the customer, in advance, of the difference in retail price between the prescribed branded product and the generic equivalent that the pharmacist is preparing to substitute *(Column 7(c))*. This provision is likely to be the most costly to the pharmacy of any of the information provisions since calculating and explaining the price comparison is time consuming. On the other hand, the information provided is arguably the most useful to the consumer.

In some states the pharmacist had to, before filling the prescription, notify the customer of the right to refuse a substitution or get consent for the substitution *(7(d))*. Although not all statutes coded with a check in *Column 7(d)*

were explict about "in advance", we were told that these conversations were held in advance because it would be too costly for the pharmacist to risk a refusal after already incurring the expense of filling the bottle and labeling the prescription.

A similar but slightly weaker requirement is to inform the customer, in advance, that substitution will occur but without necessarily acquiring the customer's explicit concurrence *(Column 7(e))*. States with this requirement include those that mandated oral price disclosure (see discussion of *7(c))* but without requiring consent or notification of right to refuse.

A yet weaker version *(Column 7(f))* is the requirement that the pharmacist orally inform the customer at the time the prescription is picked up that a substitution has been made.

4. Notification of the Physician (Column 7(g)).

No state any longer requires the pharmacist to notify the prescribing physician that a substitution has taken place.

5. Definition of the INFO Variable in the Regressions

The definition of the variable *INFO* used in the regressions was coded 1 if any one of the following four provisions was in effect:

(7(c)), the pharmacist was required to make a comparative price disclosure, OR

(7(d)), the pharmacist was required to receive advance consent or to notify the consumer of the right to refuse substitution, OR

(7(e)), the pharmacist was required to inform the consumer orally in advance, OR

(7(f)), the pharmacist was required to notify the consumer whenever a substitution was made.

Column 8: ADVERTISING RESTRICTIONS

+ : There are significant restrictions on the pharmacy's ability freely to advertise prices.

While retail advertising of prescription drugs is permitted in all states, some states impose some restrictions. Restrictions on advertising are varied. For example, New York and New Jersey do not permit the use of a coupon with an amount off the regular price of a drug. Colorado requires that the product's generic name be displayed in any ad that contains the product's brand name. Ohio requires that information concerning the drug's usage and counterindications be published in the ad. Louisiana had not repealed its provisions on price advertising, and, although it was not enforcing its statute, a Board of Pharmacy official advised us that druggists had hesitated to advertise prescription drug prices. Some types of regulations may affect the profitability and likelihood of substitution more than others.

COLUMN 9: PRESCRIBER LIABILITY

HI: The statute exposes the physician to a potential increase in professional liability when the physician permits substitution.

LO: The statute expressly protects the physician from increased liability when the physician permits substitution.

COLUMN 10: PHARMACY OWNERSHIP

10(a): + There are regulations prohibiting physicians from having a controlling ownership in a pharmacy.

10(b): + Statutory restrictions bar ownership of drug stores by partnerships or corporations unless a minimum specified percent of the interest or stock is held by registered pharmacists.

Included among states which had some provision restricting a physician from acquiring a controlling interest in a pharmacy (a + in *Column 10(a)*) are states which do not have a specific provision regarding prescription drugs, physicians and pharmacists but which do have a general conflict of interest law enforced by the attorney general's office. It has been suggested that physician ownership of a pharmacy sets up a potential conflict of interest. This is particularly evident if the physician can direct patients to a pharmacy located in the same building as the physician's office.

The second type of restriction on pharmacist ownership (a + in *Column 10(b)*) apparently still exists in only two states, North Dakota and Michigan, the North Dakota statute being far more restrictive. Laws in these two states bar ownership of a drugstore by a partnership or corporation unless a certain percentage is held by pharmacists. These statutes could clearly interfere with entry of chain outlets.

COLUMN 11: PRICE POSTING REQUIREMENTS

11(a): + The pharmacy must post prices of top-selling (100 or so) drugs.

11(b): + The pharmacy must post general information about the availability of generic drugs. As an example: "Pennsylvania law permits pharmacists to substitute a less expensive generically equivalent drug for a brand name drug unless you or your physician direct otherwise."

Such displays are likely to increase the demand for lower-price drugs generally, whether these are dispensed on generically written prescriptions or as substitutes for branded prescriptions. Neither posting requirement imposes a special cost in conjunction with a substitution and therefore is unlikely to be any deterrent to substitution. The posting of prices, in particular, may increase interpharmacy competition.

COLUMN 12: MAIL ORDER

+ : There are regulations restricting pharmaceutical houses from operating a mail order prescription drug business within the state.

Those states having an outright ban or significant restrictions on mail order dispensing by firms located within the state are checked in *Column 12.* However, the restrictions do not prevent out-of-state mail order firms from shipping prescription drugs into the state, although there is ongoing controversy about the role of interstate mail order shipments of prescription drugs.

COLUMN 13: GENERICALLY WRITTEN PRESCRIPTIONS

ANY : The pharmacist may fill a generically written prescription with any generically equivalent product.

LO : The pharmacist must fill a generically written prescription with the lowest-price generically equivalent product that he has in stock.

LO-ELSE : The pharmacist must dispense a product of below-average wholesale cost of the items in formulary or forgo filling the prescription.

About three-quarters of the states left the decision as to what to dispense on generically written prescriptions entirely to the pharmacist *(NO)*. In the remaining states, the pharmacist had to fill the prescription with "the lowest price generic product that the pharmacy has in stock" or with a below-average-cost product defined in some other way *(LO)*.[2] In D.C. and Vermont, the pharmacist was required to dispense the least expensive product in inventory which is listed in the formulary. Wisconsin required that the drug product chosen when filling a generically written prescription be one whose cost (to the pharmacist) was below the average for those listed in the formulary. Wisconsin's provision implies that if the pharmacy did not carry in inventory a product meeting this cost criterion, it had to forgo filling the prescription *(LO-ELSE)*.

2/ Some of the officials contacted in these states said that they considered the "in stock" language to be a large loop-hole which allowed pharmacists to carry only relatively expensive branded products in a multi-source entity. Only if competition among retail pharmacies is weak would this occur.

APPENDIX A2

THE FTC/FDA MODEL STATE ACT

Section 1. [DEFINITIONS.]

(a) "Established name" has the meaning given in section 502(e)(3) of the federal food, drug and cosmetic act (21 U.S.C. 352(e)(3)).

(b) "Equivalent drug product" means a drug product with the same established name, active ingredient strength, quantity and dosage form as the drug product identified in the prescription, and listed as therapeutically equivalent in the current [name of state] drug formulary.

(c) "Prescriber" means a person licensed by the state to prescribe drug products.

Section 2. [DRUG PRODUCT SELECTION.]

(a) Unless instructed otherwise by the person receiving the drug pursuant to the prescription, a pharmacist filling a prescription for a drug product prescribed by its trade or brand name may select an equivalent drug product listed in the current [name of state] drug formulary.

(b) The pharmacist shall not select an equivalent drug product if the prescriber handwrites "medically necessary" or words of the same meaning on the written prescription, or when ordering a prescription orally, the prescriber specifies that the prescribed drug product is medically necessary. The designation of medical necessity shall not be preprinted or stamped on the prescription. This subsection does not preclude a reminder of the procedure required to prohibit selection of an equivalent drug product from being preprinted on the prescription.

(c) The pharmacist shall not select an equivalent drug product unless its price to the purchaser is less than the price of the prescribed drug product.

(d) The pharmacist, or the pharmacist's agent, assistant or employee shall inform the person receiving the drug pursuant to the prescription of the selection of a lower-cost equivalent drug product and of the person's right to refuse the product selected.

Section 3. [PRESCRIPTION LABEL.]

Unless the prescriber instructs otherwise, the label for every drug product dispensed shall include the product's trade or brand name, if any, or its established name and the name of the manufacturer, packer or distributor, using abbreviations if necessary.

Section 4. [PRESCRIPTION RECORD.]

The pharmacy file copy of every prescription shall include the trade or brand name, if any, or the name ofthe manufacturer, packer or distributor of the drug product dispensed.

Section 5. [DRUG FORMULARY.]

(a) The [state health department, board of pharmacy or drug formulary commission] shall establish and maintain by regulation a [name of state] drug formulary of equivalent drug products. The formulary shall list all drug products that the commissioner of food and drugs, United States food and drug administration, has approved as safe and effective, and has determined to be therapeutically equivalent. The formulary shall list all drug products that were not subject to premarketing approval for safety and effectiveness under the federal food, drug and cosmetic act, that are manufactured by

firms meeting the requirements of that act, are subject to pharmacopeial standards adequate to assure product quality, and have been determined by the commissioner of food and drugs to meet any other requirements necessary to assure therapeutic equivalence. The formulary may list additional drug products that are determined by the [department, board or commission] to meet requirements adequate to assure product quality and therapeutic equivalence.

(b) The [department, board or commission] shall provide for revision of the formulary as necessary but not less than annually.

(c) The [department, board or commission] shall provide for distribution of the formulary and revisions to all pharmacies and prescribers licensed in this state and to other appropriate individuals.

(d) The [department, board or commission] shall assess the need and if appropriate provide for public education regarding the provisions of this act and from time to time shall monitor the effects of the act.

Section 6. [PHARMACIST LIABILITY.] (Optional)

A pharmacist who selects an equivalent drug product pursuant to this act assumes no greater liability for selecting the dispensed drug product than would be incurred in filling a prescription for a drug product prescribed by its established name.

Section 7. [ENFORCEMENT.]

Section 8. [EFFECTIVE DATE.]

APPENDIX A3

FORMULARIES: SOURCES AND COVERAGE

This appendix contains some additional material on formularies. Table A3-1 shows the sources relied upon by the states in developing their formularies. The frequency with which states' formularies were updated, as of 1980, is also shown in Table A3-1 by the dates of the formularies in effect during 1980. Table A3-2 gives the number of states for which substitution was permissible in each of the 45 multi-source entities used in this study. The precise coding of each state's formularies for 1980, by drug and month, is available upon request.

I. SOURCES OF FORMULARIES

Table A3-1 lists those states which, to the best of our knowledge, relied on some established listing for formularies in effect in 1980. In some instances this reliance is indicated in the statute but no listing is actually mailed to the state's pharmacists. Some states adopt a list but make minor modifications. Others perhaps rely on the list but publish what appears to be the state's own compilation. For this reason, the table underestimates the effect of the FDA's lists in that presumably even those states which produce a unique formulary look to the FDA's list for guidance. Further, it may well be that the FDA list is used as a basic guide even in states with no formulary. Finally, our list of sources is sure to contain errors, since neither we nor officials in the state were able to reconstruct some of the history.

TABLE A3-1

Sources for State Formularies, 1980

A. FDA list of "Therapeutic Equivalents", used as positive formulary. The first edition was published in October 1980 with monthly supplements and annual editions thereafter. However, a draft of the first list was in circulation from about January 1979.

Arizona (from 7/80)
Maryland (from 12/80)
Nevada

B. FDA list of "Therapeutic Equivalents" used but converted to negative formulary

Kansas
Louisiana (from 9/80)
Nebraska
Ohio
West Virginia (from 12/80) (modified)
Wyoming

C. FDA's earlier list (January 1977) of drugs with known or potential bioequivalency problems, used as a negative formulary

Arkansas
Colorado
Maryland (modified) (to 5/80)
Utah
West Virginia (modified)

TABLE A3-1, Continued

D. Maximum Allowable Cost list. The list applicable for most of 1980 was the October 1979 list; an update was issued in December 1980.

New Mexico
Tennessee

E. List of 200 Leading Products. This is based on an IMS compilation which is published annually in the April issue of *Pharmacy Times.*

New Hampshire

F. New York's formulary (precursor of FDA list)

Maryland (from 5/80 until adoption of the FDA list in 12/80)

G. State's own list

Arizona (5/79 list used until 7/80; FDA list used thereafter)
District of Columbia (7/79)
Delaware (2/79, 2/80, 6/80)
Florida (7/79)
Illinois (8/79, 12/80)
Kentucky (1/78, 2/80, 6/80)
Massachusetts (9/79)
Missouri (11/79, 10/80)
New Jersey (10/79, 11/79, 12/79, 2/80, 8/80)
New York (4/79, 4/80)
Pennsylvania (1/80)
Rhode Island (1/80, 7/80)
Vermont (3/79)
Virginia (7/79, 4/80)
Wisconsin (7/79)

II. PERMISSIBILITY OF SUBSTITUTION BY DRUG IN 1980

Table A3-2 shows, for each of the 45 multi-source drugs analyzed in this study, the number of states in which substitution was permitted in 1980. This is not the same as the number of states whose formularies listed the drug, since states with no formulary are included as permitting substitution in every drug. Where a mid-year formulary change caused a change in the classification of the drug in a state, that state is counted twice (once in each classification.)

TABLE A3-2

Number of States in Which Substitution was Permitted, by Drug, 1980[1]

Drug	Number of States Permitting Substitution	Number of States Prohibiting Substitution
Hydrochlorothiazide	45	3
Chlordiazepoxide	45	2
Amitriptyline	45	4
Penicillin VK	47	0
Amoxicillin	46	1
Atropine sulfate/ Diphenoxylate	45	2
Meclizine	44	3
Isosorbide dinitrate	37	11
Hydralazine/ Hydrochlorothiazide/ Reserpine	25	24
Doxycycline	43	6
Hydrochlorothiazide/ Spironolactone	37	13
Dipyridamole	34	14
Brompheniramine/ Phenylephrine/ Pseudoephedrine	27	20
Ampicillin	47	0
Chlordiazepoxide/ Clidinium bromide	32	16
Tolbutamide	35	17
Conjugated estrogens	24	24
Chlorthalidone	34	14
Acetaminophen/ Chlorzoxazone	34	14

1/ The base number of states, including D.C., is 47. There are no observations for Alaska and Hawaii. Indiana and Texas are not included because they

TABLE A3-2--Continued

Drug	Number of States Permitting Substitution	Number of States Prohibiting Substitution
Dexbrompheniramine/ Pseudoephedrine	27	21
Triamcinolone	26	21
Chlorpropamide	35	11
Hydroxyzine	34	13
Sulfamethoxazole/ Trimethoprim	41	8
Theophylline	26	22
Terbutaline	32	16
Nitroglycerin	34	14
Metronidazole	34	13
Diethylpropion	27	20
Phentermine	39	9
Minocycline	38	9
Furosemide	34	14
Erythromycin base	29	19
Hydrochlorothiazde/ Triamterene	33	14
Amitriptyline/ Perphenazine	27	21
Cephalexin	37	12
Erythromycin ethlylsuccinate	35	13
Ibuprofen	34	11
Mestranol/Norethindrone/ Placebo	42	6
Hydrogenated ergot alkaloids	34	13
Quinidine sulfate	45	6

1/ (continued)
are no-substitution states. Because some states changed formularies duriang 1980, those states are counted twice if part of the year belongs in the "Yes" column and part in the "No." The following states changed their formularies during 1980: Arizona, Maryland, Illinois, Kentucky, and Virginia.

APPENDIX A4

AVERAGE STATE SUBSTITUTION RATES BY INDIVIDUAL LEGAL PROVISION

One method of looking at the effects of each provision is the method used by previous researchers: computing the substitution rate by state and then comparing states. Starting with substitution rates by individual states, we have computed a simple average across those states in which the provision was in effect.

I. METHODOLOGICAL PROBLEMS

There are at least two serious drawbacks to this method. One is that the estimates of individual state averages made with our data set cannot be taken as statistically reliable measures. A second is that an individual provision of the law does not operate in isolation; other provisions and non-legal influences affect the measured substitution rate. For these reasons, we rely more heavily on the results of our logit regressions. In fact, however, the patterns which appear in the simple tabulations reported in this appendix are, for the most part, qualitatively borne out by the more elaborate statistical techniques.

A. The IMS Data Sample Is Not Random Within a State

As discussed in Appendix A6, the sample used by IMS for their National Prescription Audit is not designed to assure good estimates at the state level, since IMS stratifies their sample by region and by store ownership type, but not by state. Statistical tests based on these state averages are therefore not appropriate. (Some of the other studies have sought to design a sample appropriate at the state level and have therefore been more able to rely on state-level averages.)

Using the logit regression technique circumvents this sampling problem, since we take the sample as a whole to be representative of the United States as a whole. Also, we use the individual prescription as the unit of observation, making it possible to control for a number of other influences on substitution. (That the IMS sample has elements of a "sample of convenience," since non-cooperating stores must of necessity be excluded, introduces some non-randomness which is not removed by our statistical techniques.)

One obvious source of possible bias is oversampling, in a state, of one or another type of store. However, according to the logit regression analysis reported in the text, chains and independents do not appear to differ significantly in substitution behavior. Therefore a state's substitution rate is unlikely to be exaggerated due to a sampling imbalance of this sort.

While these data by state cannot support statistical tests, they do suggest wide interstate variation, on several measures. Moreover, averages across groups of states, whereby any bias in an individual state's estimate is diluted, provide a useful preliminary view of patterns according to individual provisions of the law.

B. Averages by Provision Reflect Other Influences As Well

Any inference that the presence or absence of a single provision is the cause of the difference in substitution rates may be incorrect if whenever that provision is included in a statute, some other selected provision tends also to be present. It could be, in such a case, that the first provision had no effect -- that it was instead the second provision which, even in the absence of the first, would have led to higher substitution rates. This was a second reason for our use of multivariate logit regressions, reported in the text.

II. SUBSTITUTION RATES AND OTHER CHARACTERISTICS BY STATE

Table A4-1 presents data on substitution rates, legal provisions, and other characteristics by individual state.

A comparison of the two (the second and fourth) columns giving substitution rates, one computed for the prescriptions for which the formulary permitted substitution and one for all prescriptions shows how the choice of definition affects not only the magnitude of the measures but also the ranking of the states. In general, the smaller the proportion of prescriptions for which the formulary permits substitution (% Rxs Eligible for Substitution), the higher is the formulary-restricted substitution rate (% Substit. on Form-Eligible Rxs) relative to the all-prescription rate (% Substit. on All Drugs).

Table A4-2 shows for a weighted average of our sample of 45 multi-source drugs, first for only those prescriptions on which the formulary permits substitution and then across all prescriptions, the simple average of state substitution rates for states with and without each of the broadly-defined provisions used in the logit regressions.

According to Table A4-2, formularies cut into the universe of substitution opportunities and therefore are associated with lower rates of substitution measured across all drugs, but given that substitution is permitted for a drug, a formulary leads to more substitution. That states with positive formularies typically allow substitution on fewer drugs than states with negative formularies is one reason that when substitution is measured across all drugs, the rate is higher in negative-formulary states than in positive-formulary states.

Mandatory substitution leads to higher substitution rates, although not as much higher as the outright mandate would lead many to expect. The cost pass-through, notification requirements, and a prescription pad format which is more conducive to permitting the pharmacist to substitute also are each shown to be associated with more substitution. Statutory protection against additional liability when substituting is not associated with higher substitution rates, but protection from

TABLE A4-1

Substitution Rates and Other Characteristics by State, 1980

State	DPS Law: Mo/Yr Effective	%Substit. on Form-Eligible Rxs	% Rxs Eligible for Substit.	% Substit. on All Drugs	Individual Provisions of DPS Law[1]							
					MAND	RX-PRO	RX-ANTI	POS	NEG	LIAB	PASS	INFO
Alabama	1/80	4.9	100.0	4.9	0	0	0	0	0	0	0	0
Alaska[2]												
Arizona	1/79	6.9	36.3	4.8	0	1	0	1	0	1	0	1
Arkansas	8/75	1.7	83.8	1.6	0	1	0	0	1	0	0	1
California	5/76	9.1	100.0	9.1	0	0	0	0	0	1	1	1
Colorado	4/76	7.0	81.2	6.5	0	0	0	0	1	1	1	1
Connecticut	10/76	9.3	100.0	9.3	0	1	0	0	0	0	1	1
Delaware	10/76	18.9	88.7	17.0	0	0	0	0	1	0	1	1
D.C.	9/76	10.2	37.2	2.6	0	1	0	1	0	1	0	0
Florida	5/74	11.3	90.7[3]	10.2	1	1	0	0	1	1	0	1
Georgia	1/78	3.3	100.0	3.3	0	0	1	0	0	0	0	0
Hawaii[2]												
Idaho	7/78	8.6	100.0	8.6	0	0	0	0	0	0	1	0
Illinois	10/77	7.8	42.1	3.4	0	0	0	1	0	1	0	1
Indiana	7/84	NA	0	.7	NA	NA	NA	NA	NA	NA	NA	NA
Iowa	1/77	6.6	100.0	6.6	0	0	0	0	0	0	1	1
Kansas	7/78	1.9	81.2	1.5	0	0	0	0	1	0	0	0
Kentucky	6/76	17.1	46.0	10.4	1	1	0	1	0[4]	0	0	0
Louisiana	1/81	3.0	33.3[5]	1.3[5]	0	0	0	0	1	0	0	1
Maine	1/76	15.4	100.0	15.4	0	0	0	0	0	0	0	1
Maryland	1/78	4.6	75.4	4.6	0	0	0	1[6]	1[6]	0	0	0
Massachusetts	1/77	24.0	41.2	8.0	1	0	0	1	0	0	0	0
Michigan	1/77	8.1	100.0	8.1	0	1	0	0	0	0	1	1

TABLE A4-1--Continued

State	DPS Law: Mo/Yr Effective	%Substit. on Form-Eligible Rxs	% Rxs Eligible for Substit.	% Substit. on All Drugs	Individual Provisions of DPS Law[1]							
					MAND	RX-PRO	RX-ANTI	POS	NEG	LIAB	PASS	INFO
Minnesota	8/75	7.1	100.0	7.1	0	1	0	0	0	0	1	1
Mississippi	7/79	7.7	94.0	7.3	0	1	0	0	1	1	0	1
Missouri	1/79	4.1	83.8	3.6	0	0	1	0	1	1	0	0
Montana	4/77	14.7	100.0	14.7	0	0	0	0	0	1	1	1
Nebraska	1/78	2.7	81.2	2.1	0	1	0	0	1	1	0	0
Nevada	1/79	0.3	49.4	.1	0	0	1	1	0	1	0	1[7]
New Hampshire	8/73	9.7	97.5	9.4	0	0	1	1	0	1	0	0[7]
New Jersey	9/77	9.9	100.0	9.2	1	0	0	1	0	0	0	1
New Mexico	5/76	18.2	28.8	2.4	0	1	0	1	0	0	0	0
New York	4/78	7.3	100.0	7.3	1	1	0	1	0	0	0	1
North Carolina	1/80	3.7	100.0	3.7	0	0	1	0	0	1	0	0
North Dakota	7/79	1.4	100.0	1.4	0	0	1	0	0	1	0	1
Ohio	1/78	7.3	81.2[3]	6.4	0	1	0	0	1	0	1	1
Oklahoma	7/75	0.2	100.0	.2	0	0	0	0	0	0	0	0
Oregon	9/75	8.0	100.0	8.0	0	1	0	0	0	1	0	0
Pennsylvania	8/77	8.5	49.1	4.3	1	1	0	1	0	1	0	1
Rhode Island	7/76	13.7	43.0	4.4	1	1	0	1	0	1	1	0
South Carolina	1/79	3.4	100.0	3.4	0	1	0	0	0	0	0	1
South Dakota	7/78	0.5	100.0	.5	0	0	1	0	0	0	0	0
Tennessee	6/77	7.9	28.8	1.9	0	0	0	1	0	1	1	0
Texas	1/82	NA	0	.3	NA	NA	NA	NA	NA	NA	NA	NA
Utah	5/77	2.6	83.8	2.4	0	0	0	0	1	0	0	1
Vermont	2/78	16.3	48.7	6.5	1	1	0	1	0	0	0	1
Virginia	7/76	8.6	46.5	3.8	0	0	1	1	0	0	1	1
Washington	9/77	1.6	100.0	1.6	1	0	1	0	0	1	1	0
West Virginia	7/78	14.3	85.7	12.3	1	1	0	0	1	1	1	1
Wisconsin	3/76	26.1	37.1	6.3	0	1	0	1	0	0	1	0
Wyoming	7/79	2.8	81.2	2.1	0	0	1	0	1	1	0	0
Ave. of State Averages		8.3		5.8								
Ave. Across All Prescriptions		7.3	73.6	5.5								

TABLE A4-1--Continued

	Insurance Coverage			Chain Share of Rxs		SS-INDEX[9]	%Rxs Prescribed Generically	% of Rxs Prescribed Generically which were Dispensed Generically	Generic Market Share[10]
	CASH%	MED%	PRIV%	NPA	Census[8]				
Alabama	83.6	15.3	1.1	40.0	35.3	.96	16.7	90.5	22.0
Alaska[2]									
Arizona	95.7	.1	4.2	77.3	61.6	.92	20.2	95.2	20.5
Arkansas	84.2	13.7	2.2	38.0	16.4	.97	16.9	88.3	16.9
California	74.2	19.7	6.2	33.8	39.0	1.13	26.7	82.0	27.8
Colorado	77.3	15.7	7.0	0	21.3	1.02	22.8	95.4	26.1
Connecticut	78.3	11.2	10.5	3.7	19.8	.92	23.8	89.1	26.7
Delaware	82.4	9.9	7.7	0	60.3	.92	21.9	98.9	27.5
D.C.	88.2	8.2	3.6	44.9	65.1	1.10	28.2	79.1	24.2
Florida	82.5	14.0	3.5	24.0	49.2	1.03	21.5	93.9	26.5
Georgia	80.8	16.9	2.3	25.3	41.4	1.01	13.9	89.0	18.5
Hawaii[2]									
Idaho	91.2	2.2	6.6	27.3	16.0	.80	21.1	86.1	25.3
Illinois	84.9	7.4	7.7	37.9	31.3	.97	17.8	86.7	19.4
Indiana	90.6	2.7	6.7	57.1	58.1		11.1	87.5	13.1
Iowa	79.0	8.4	12.6	10.8	22.2	1.04	21.1	86.4	25.2
Kansas	95.3	3.5	1.2	0	13.4	1.03	20.4	78.8	15.6
Kentucky	85.3	10.0	4.8	13.7	36.6	1.08	17.6	85.5	24.0
Louisiana	68.9	26.9	4.2	0	33.4	.99	10.3	75.1	12.1
Maine	56.5	41.1	2.4	0	44.3	1.01	26.2	91.9	37.5
Maryland	69.8	16.3	13.9	58.3	57.7	.98	24.2	83.5	25.1
Massachusetts	78.8	19.8	1.3	14.7	23.9	1.02	30.8	88.9	32.1
Michigan	56.9	12.5	30.6	18.4	33.2	.99	15.4	90.6	21.1

TABLE A4-1--Continued

	Insurance Coverage			Chain Share of Rxs		SS-INDEX[9]	%Rxs Prescribed Generically	% of Rxs Prescribed Generically which were Dispensed Generically	Generic Market Share[10]
	CASH%	MED%	PRIV%	NPA	Census[8]				
Minnesota	87.8	5.6	6.5	52.1	28.1	.89	23.1	83.3	24.3
Mississippi	41.6	57.6	.7	0	27.0	1.00	17.5	82.8	27.8
Missouri	85.1	9.8	5.0	27.9	32.6	.95	19.1	85.3	19.0
Montana	94.1	5.1	.7	79.1	20.9	.96	27.0	86.0	33.5
Nebraska	77.6	5.7	16.7	0	12.7	.99	18.6	74.9	18.5
Nevada	89.6	7.4	3.0	0	49.5	1.02	19.9	73.4	17.0
New Hampshire	87.5	10.8	1.7	0	18.4	1.02	29.9	68.1	26.6
New Jersey	77.7	6.4	15.9	13.6	26.7	.99	17.7	86.6	23.8
New Mexico	76.6	16.0	7.3	3.5	30.1	1.07	24.9	76.1	20.6
New York	71.5	10.7	17.8	23.9	28.6	.99	21.2	91.1	25.8
North Carolina	87.1	10.5	2.4	14.3	48.3	1.02	16.5	92.7	20.2
North Dakota	82.2	15.9	1.9	0	20.7	1.08	12.4	71.4	13.3
Ohio	73.2	6.5	20.3	46.2	50.8	.94	16.8	86.4	21.8
Oklahoma	92.1	5.5	2.4	14.8	21.3	1.03	13.0	80.1	14.3
Oregon	87.1	10.6	2.3	0	4.6	1.02	23.3	91.6	28.7
Pennsylvania	78.4	10.1	11.6	26.2	41.3	.95	17.4	81.8	19.3
Rhode Island	79.4	16.1	4.5	38.4	39.2	.90	23.7	90.5	24.8
South Carolina	73.3	24.1	2.6	0	45.9	1.00	15.8	89.7	21.7
South Dakota	88.5	9.1	2.5	0	12.7	.91	20.7	97.8	19.2
Tennessee	78.8	18.5	2.7	24.3	33.4	.99	18.0	88.4	19.4
Texas	86.4	10.4	3.1	54.3	38.5		14.1	85.5	14.7
Utah	95.7	2.0	2.3	42.7	27.0	.88	24.5	82.7	22.2
Vermont	81.2	17.3	1.4	15.9	16.4	.94	30.9	90.1	31.5
Virginia	90.2	7.4	2.4	59.2	58.4	.96	22.9	86.9	25.1
Washington	81.1	13.1	5.8	53.7	27.1	1.07	29.9	82.9	23.0
West Virginia	67.1	10.9	22.1	15.1	47.3	.92	17.1	91.4	25.4
Wisconsin	81.1	9.6	9.4	5.6	20.4	1.01	26.5	87.0	26.4
Wyoming	96.2	2.5	1.2	74.6	14.2	.99	22.0	81.4	21.3

Footnotes for Table A4-1

1/ As coded in the regressions. "1" means provision is present.

2/ IMS' NPA does not include data for Alaska or Hawaii.

3/ Each store's percentage varies according to its own formulary. This percentage reflects only the state negative formulary.

4/ Kentucky's formulary was ambiguous, containing both a positive mandatory formulary, implying that substitution on other prescriptions was forbidden, but also a negative formulary, suggesting that for drugs not on the negative formulary substitution was mandatory on some drugs, permitted on the rest. We accepted the interpretation of state officals: that where substitution was not mandatory, it was prohibited.

5/ For the 4 months when the DPS law was in effect, there was 3.0 percent substitution; 81 percent of prescriptions were eligible for substitution.

6/ Maryland's formulary was negative from January to May 1980, positive thereafter.

7/ New Hampshire was coded "0" on INFO in the regressions by error.

8/ The computation used data from IMS, from the 1981 Lilly and NACDS-Lilly Digests, and from the 1977 Census of Retail Trade. Details are available upon request.

9/ These state averages of the single-source price index used in the regressions are taken from the data set for the top substitution drug (hydrochlorothiazide).

10/ Generic market share is computed as the percentage of all prescriptions on which the identity of the product dispensed was given. The percentages would be 1 or 2 points higher, on average, if estimates were made also for prescriptions on which the product dispensed was not recorded. See footnote 1 in Table 6-3.

SOURCES: State statutes and formularies; computations with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit; the 1981 Lilly and NACDS-Lilly Digests; U.S. Department of Commerce, Census of Retail Trade, 1977.

liability is often conferred by a formulary (especially a mandatory formulary).

Most of the patterns shown in Table A4-2 are consistent with the results of the multivariate logit regressions reported in Chapter 5. Some differences stand out. In particular, the regressions show that, when other influences are taken into account, a formulary leads to *less*, not more substitution, and notification requirements to more. Also, some results which look quite clear from the cross-tabulations are not significant in the regressions, even when the sign patterns are consistent. This is true of *MAND* and *PASS*. The comparison of the two sets of results suggests that the specific legal provisions are correlated with other influences on substitution.

III. AVERAGE SUBSTITUTION RATES BY PROVISIONS IN DETAIL

Because the exact specification of some of the particular legal provisions have been the subject of controversy, we report the average state substitution rates by more detailed subcategories of the provisions. The data on the detailed provisions should be treated even more tentatively than the cross-tabulations of the more broadly defined provisions. Not only are there the methodological problems discussed above but also many of the detailed provisions were present in only a very few states. However, since more elaborate techniques tended to confirm most of the broad patterns seen in simple tabulations, these patterns too may be indicative, at least for provisions which are present across more than a few states.

A. Mandatory or Permissive Substitution

There are three ways in which statutes mandate substitution. In 4 states, the statute requires either that the pharmacist dispense the lowest cost version of the drug entity in inventory or that the product dispensed be one whose wholesale cost is below average. In two states, the pharmacy is held to a more stringent requirement: if the pharmacy does not have a lower cost version, the prescription cannot be

TABLE A4-2

Average Substitution Rates in States by Legal Provision, 1980[1]

Provision	Number of States	Average Substitution Rate[2]: Across drugs for which substitution is permitted	Average Substitution Rate[2]: Across all drugs
I. Mandatory or Permissive Substitution			
MAND[3]	10	12.4%	7.4
PERM	37	7.7	5.3
II. Format of Physician's Prescription Pad			
RXPRO	20	10.2	6.2
RXNEUT	17	9.0	6.7
RXANTI	10	3.6	.9
III. Formulary			
POS	17	11.6	5.3
NEG	13	6.6	5.7
NONE	17	6.2	6.2
IV. Pharmacist Liability			
LO-STAT	21	7.3	5.4
OTHER	26	9.1	6.0
V. Cost Pass-Through			
YES	17	10.1	7.4
NO	30	7.2	4.8
VI. Notification			
YES	28	7.9	6.6
NO	19	8.8	4.4
Average of State Averages	47	8.3	5.8
Average Across All Prescriptions		7.3	6.0

1/ There were in 1980 47 states plus the District of Columbia in which substitution was permitted at least part of the year.

2/ Averages are computed as simple averages across states, where each state's substitution rate is a weighted average across drugs.

3/ All row titles are explained in Chapter 5 and Appendix A1.

SOURCE: Substitution rates computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

filled, and the customer must go to another pharmacy. The remaining 4 states which mandate substitution impose neither of these specific requirements. (One of the states which does not mandate substitution nevertheless requires that any substitution made must be to a below-average-cost product. This state (Georgia) has a lower substitution rate (3.3 percent) than other "permissive" states.)

One might have expected the "substitute or else lose the prescription" regulation to lead to the most substitution. Instead, as Table A4-3 shows, it is associated with the least substitution of the three variants of the mandatory regulation (although the two states with this provision may be different in other ways as well.) The requirement that the lowest-cost-product-in-inventory be used led to somewhat more substitution than the general provision.

Mandating substitution may encourage substitution indirectly by making it less likely that pharmacists will be found liable for substitutions (in accord with any formulary restrictions) since the state has left them no option. It is difficult to separate any effect of liability protection from the direct mandate. We discuss this further in section D below, on Pharmacist Liability.

B. Format of the Physician's Prescription Pad

Table A4-4 gives, for 12 different formats of prescription pads, the simple average substitution rate across states for each format. For some formats there are very few states, or even only one, so it is very likely that other provisions in those states or other non-legal characteristics strongly color the substitution rates reported.

The format which stands out as being different is the two-line form on which a signature on the *left-hand* line permits substitution. This is one of those categorized as *RXANTI (A2)*. The 9 states with this format have a very low average substitution rate, under 3 percent. At the other extreme, among the *RXPRO*s, a presumption that substitution is permitted in the absence of a handwritten abbreviation *(P1-a)* is associated, across 9 states, with a high average substitution rate of 9.8 percent (for substitution-permitted

TABLE A4-3

Average State Substitution Rates by Type of Mandatory Provision, 1980

Provision	Number of States	Average Substitution Rate[1]: Across drugs for which substitution is permitted	Average Substitution Rate[1]: Across all drugs
MAND:			
Substitution is mandatory, in general terms	4	11.0%	5.8%
MAND-LO:			
Pharmacy must substitute lowest cost product in inventory	4	14.8	9.8
MAND-ELSE:			
If pharmacy does not have lower cost product in inventory, prescription cannot be filled	2	10.5	5.9
Any Mandatory Provision	10	12.4	7.4
ALL DPS STATES	47	8.1	5.8

1/ Averages are computed as simple averages across states, where each state's substitution rate is a weighted average across drugs.

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

TABLE A4-4

Average State Substitution Rates by Format of Physician's Prescription Pad, 1980

Format	Number of States	Number of Signature Lines	Presumption Subst. OK or not OK	Required to Override Presumption or Side for OK signature	Average Substitution Rate: Across drugs for which substitution is permitted	Average Substitution Rate: Across all drugs
RXPRO:	20				10.2%	6.7%
P1-a	9	1	OK	abbreviation	9.8	5.8
P1-b	4	1	OK	word	13.8	7.1
P2[1]	7	2	N/A	right	8.8	6.2
RXNEUT:	17				9.0	6.7
N1-a	3	1	Not OK	req. line or box	11.0	9.3
N1-b	5	1	OK	opt. line or box	8.7	7.4
N1-I	1	1	opt.[2]	opt.	6.6	6.6
N2[1]	5	2	N/A	opt.	12.8	8.1
N1,2	1	1 or 2	opt.	opt.	1.9	1.5
NN	2		no regulations		2.0	.8
RXANTI:	10				3.6	3.2
A1-b[1]	1	1	Not OK	word	9.7	9.4
A2[1]	9	2	N/A	left	2.4	2.2
ALL DPS STATES	47				5.8	8.3

1/ Physician made explicit decision that substitution is allowed.
2/ "Opt." means at the physician's option.

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

drugs), and when one or more words must be written out instead of an abbreviation *(P1-b)*, the 3-state average rate is even higher, 13.8 percent (7.1 percent across all drugs). Another of the formats included in *RXPRO* also yields a higher-than-average substitution rate, 8.8 percent, in the 7 states whose double-line formats reserve the right-side signature line for "substitution permitted" *(P2)*.

The *RXNEUT* formats, with an average state rate of 9 percent on substitution-permitted prescriptions, included some with rates well above some of the *RXPRO* pads. For example, the most frequently adopted *RXNEUT* format had an average state substitution rate of 12.8 percent in the 5 states which allowed the physician to decide whether to put the "substitution permitted" signature line on the right or the left *(N2)*. Where a line or box was required for any handwritten prohibition of substitution *(N1-a)*, making it easy to countermand the presumption that substitution was permissible, the 3-state average was 11 percent. A third *RXNEUT* format used the opposite presumption, that substitution was not permitted but a box for checking permission was allowed to be pre-printed *(N1-b)*; the average substitution rate for 5 states with this format was also above average, 8.7 percent. Two of the other 3 "neutral" prescription pad formats had very low substitution rates but they occurred in only one or two states so it is even less appropriate to infer any association between any of those formats and the observed substitution rate. It is difficult to know what to infer from the results on the "neutral" pads, since the choice of prescription pad format is itself is a matter of choice for the physician and must therefore reflect any underlying predilection towards or against substitution.

The remaining *RXANTI* format *(A1-b)* had an above-average substitution rate but it was present in only one state.

Other analysts have labeled prescription pads as "one-line" or "two-line." It is interesting to note that the two two-line pads perform very differently, depending on whether the substitution-permitted signature is on the right (*P2*, with 8.8 percent) or on the left (*A2*, with 2.9 percent.) We sought to make a similar comparison within the one-line forms which differ as to the presumption about the permissibility of substitution. Where the physician must take an active role to

prohibit substitution *(P1-a* and *P1-b)*, the rate of substitution is high, 9 percent or above. However, although the substitution rate was also high (9.7 percent) where a handwritten designation was required to overcome the presumption of prohibition, the fact that there was only one state means we cannot infer much from the high rate.

Another way of categorizing prescription pads is as to whether the physician's intent is expressed explicitly. A pharmacist may be more likely to substitute if the physician has taken some action on the prescription to indicate that substitution is appropriate, than if the prescription implicitly permits substitution in the absence of physician override. We cannot test this proposition directly since we cannot disentangle the physician's and the pharmacist's decisions. We can look only at the first condition (the prescription pad) and the final result (the substitution rate.) Only if "explicitness" were to have a stronger effect than "convenience" would the connection be clear.

Our data do not confirm the hypothesis that explicit physician approval is associated with more frequent substitution, a result shown by Gurley and Gagnon, although our data cannot be understood to refute the hypothesis, either.[1] The formats identified by an asterisk in the table above convey to the pharmacist that an explicit decision was made by the physician. Explicit indications are absent when the presumption is that substitution is permitted, that is, on prescription forms where the physician must exert additional effort to prohibit substitution *(P1-a and P1-b)*, and these formats are associated with higher substitution rates (on formulary drugs, 9.8 and 13.8 percent) than when explicit permission is given, as by format *P2* (8.8 percent). The first two formats are, after all, the ones which make it most inconvenient for the physician to prohibit substitution. Format *P2* is more convenient for prohibitions as well as more explicit for pharmacists; the two characteristics must be somewhat offsetting in their

---

1/ Gurley and Gagnon (1981). See the summary of their results in conjunction with the discussion of the pharmacist's interpretation of the physician's wishes in Chapter 3.

effect on the final substitution rate. Also, although two-line formats are equally explicit regardless of the side on which the "substitution-permitted" signature line appears, that detail appears to make a substantial difference, reflecting the customary physician behavior of signing on the right. While ease and custom seem to make a difference in physician prescription writing and therefore in the incidence of substitution, our data give no support to the contention that physicians' explicit permission to substitute makes it more likely that a substitution will occur given that it is permitted. On the other hand, our evidence cannot be taken to refute that hypothesis, either, in that the appropriate interpretation of these figures is that explicitness is not *more* important than convenience, a much less likely proposition.

C. Formulary

A formulary cuts into the universe of prescriptions on which substitution is permitted. Therefore the substitution rate on formulary-eligible prescriptions is higher than on all prescriptions in part simply because the denominator is smaller. Similarly, states with a formulary have a lower substitution rate on all drugs (5.5 percent) than states with no formulary (6.2 percent.) Negative formularies prohibit substitution on prescriptions in relatively few drugs and therefore tend to permits substitution on a larger proportion of prescriptions (85 percent, on average) than do positive formularies (45 percent, on average).[2] It is therefore not surprising that states with negative formularies have a higher average substitution rate across all drugs (5.7 percent) than states with positive formularies (5.3 percent.)

2/ These averages omit New Jersey and New York, where the formularies regulate only mandatory substitution, and Maryland, since the "% Rxs Eligible for Substitution" reported in Table A4-1 is based on both negative and positive formularies.

Given that substitution is permitted on a prescription, the presence of a formulary of any kind is associated with more substitution (on average, 9.4 percent) than states with no formulary (6.2 percent.) Positive formulary states have higher average substitution rates (11.6 percent) than negative formulary states (6.6 percent.)

However, these cross-tabulation results are not borne out by the regressions which take into account other influences on substitution. The logit regressions show that the presence of a formulary is associatcd with lower rates of substitution. It is still true, in the regressions, that a positive formulary encourages substitution more than does a negative formulary; the coefficients on *POS* are less negative than those on *NEG.*

This seeming contradiction between the two methods of analysis impies that the presence of a formulary is correlated with some other conditions which encourage substitution. One obvious complication is the fact that states which mandate substitution use a formulary (with one exception), and the mandate itself leads to more substitution. (On the other hand, if high average state substitution rates in formulary states are due in part to a formulary's providing some protection against liability when substituting, this effect is not separated out in the regressions.) Table A7-1 shows the correlations between *POS* and *NEG* and other variables used in the regression.

D. Pharmacist Liability

Explicit statutory protection from additional liability when substituting is associated with somewhat higher average rates of substitution than the absence of any protection (7.3 percent vs. 6.6 percent, for formulary-eligible prescriptions.) However, other forms of liability protection may be equally as effective or even superior, as suggested by the 9.1 percent average substitution rate for alls tates without express statutory protection on liability. Where there is no statutory provision but substitution is mandatory, rates are double (14.9 percent), and when there is a formulary guiding (permissive) substitution the rate is also higher (10.3 percent.) It is especially difficult to make a strong inference about the role

of liability protection, however, since states in these last two categories have, by definition, other provisions which seem to encourage substitution.

E. Cost Pass-Through

The average substitution rate in states requiring a cost pass-through (10.1 percent on formulary-eligible prescriptions) was higher than in states with no pass-through requirement (7.2 percent).

Some states (9) did not require a cost pass-through but did insist that the price charged on a substitution be the "usual and customary" price (as when it is dispensed on a generically written prescription.) Substitution in these 9 states was somewhat lower (6.6 percent on formulary-eligible prescriptions) than in the 21 states which had no price or margin regulation whatever (7.5 percent.)

Not all of the 17 states which require that the pharmacy's acquisition cost savings on a generic substitute be passed through to the consumer require that the *full* savings be passed on. Washington state specifies that 60 percent be passed on. Its substitution rate was very low, under 2 percent, but this single observation is not sufficient reason to believe that a full pass-through leads to more substitution than a partial pass-through.

F. Notification

Based on the cross-tabulation data in Table A4-5, one might conclude that some of the information provisions increased substitution and some diminished it, although not by much. Obtaining a customer's consent in advance of the transaction was associated with an average substitution rate a bit above average (9.1 percent on formulary-eligible prescriptions) but providing a price comparison was not (8.0). A general provision about advance notification, which may impose somewhat less cost on pharmacists than the first two while still providing information to consumers directly, is associated with a higher average level of substitution (10.2 percent) but an

TABLE A4-5

Average State Substitution Rates by
Type of Notification Requirement, 1980

Type of Notification	Number of States	Average Substitution Rate[1]	
		Across drugs for which substitution is permitted	Across all drugs
a. Extra labeling required	24	9.7%	6.9%
b. Extra recordkeeping required	5	7.2	6.2
c. Pharmacist required to make oral comparative price disclosure	10	8.0	6.5
d. Pharmacist must receive advance consent or orally notify customer of right to refuse	8	9.1	7.1
e. Pharmacist must orally inform customer in advance	12	10.2	7.5
f. Pharmacist must orally inform customer that substitution was made	7	7.0	5.8
INFO=1: At least one of (c) through (f)	28	9.0	7.0
INFO=0: None of (c) through (f)	19	7.3	4.1
ALL DPS STATES	47	8.1	5.8

1/ Averages are computed as simple averages across states, where each state's substitution rate is a weighted average across drugs.

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

even more general notification requirement, not specifying advance notification, has a below-average level of substitution (7.0 percent.) Additional labeling requirements, which may usefully inform consumers, does have an above-average rate (9.7 percent.) The additional recordkeeping requirement, which imposes costs but does not convey information to consumers, has a lower average substitution rate (7.2 percent.) The presence of at least one direct notification provision is shown to lead to an above-average level of substitution (9.0 percent), and the logit regression confirm this.

G. Collateral Provisions

Table A4-6 provides substitution data on other regulations not included in the logit regression analysis. Based on these data, advertising restrictions do not appear to discourage substitution, nor do restrictions on physician ownership of pharmacies have any apparent effect on substitution. The 2 states which in 1980 required some form of pharmacist ownership of drugstores had a lower substitution rate than other states. Both sign requirements, for prices and to inform consumers that substitution was possible, were associated with higher levels of substitution. This is consistent with an active role by the consumer in determining the extent of substitution activity. Finally, restrictions on mail order activity within a state seemed to have no effect on substitution rates.

TABLE A4-6

Average State Substitution Rates by Collateral Provisions, 1980

Provision		Number of States	Average Substitution Rate[1]: Across drugs for which substitution is permitted	Average Substitution Rate[1]: Across all drugs
I. Advertising Restrictions				
	Yes	8	8.0%	6.6%
	No	39	8.3	5.6
II. Pharmacy Ownership Restrictions				
A. Physician Ownership	Yes	13	8.6	6.2
	No	34	8.1	5.5
B. Pharmacist Ownership	Yes	2	4.7	4.7
	No	45	8.4	5.8
III. Prescriber Liability				
	Low	17	8.1	5.9
	High	30	8.3	5.6
IV. Posting of Signs				
A. Prices	Yes	10	12.1	7.1
	No	37	7.2	5.4
B. Availability of Generics/ Substitution	Yes	16	10.4	7.1
	No	31	7.2	5.0
V. Mail Order Restrictions				
	Yes	10	8.0	5.0
	No	37	8.3	5.9

1/ Averages are computed as simple averages across states, where each state's substitution rate is a weighted average across drugs.

SOURCE: Computed with data for 45 leading multi-source drugs from the 1980 IMS National Prescription Audit.

APPENDIX A5

DATA ON 45 LEADING MULTI-SOURCE DRUGS

Appendix A5 consists of a single table showing, for each of the 45 leading multi-source drugs analyzed in this study, price, cost, and gross margin data, for leading brands, generics, and the drug entity as a whole. Also shown are the proportions of all prescriptions written for the leading brand, written generically, and dispensed generically. Some additional data are included as well.

Definitions, data sources and methods of computation are described in Appendix A6. Computations are across all U.S. prescriptions in 1980. The source of the data is IMS' 1980 National Prescription Audit.

TABLE A5-1

Leading Multi-Source Drugs: Characteristics, and Prescribing and Dispensing Patterns, by Type of Brand, 1980

Generic Name	Ibuprofen	Cephalexin	Furosemide	Isosorbide dinitrate	Chlorpropamide
Rank*	3	6	9	12	14
Therapeutic Category	Antiarthritic	Antibiotic	Diuretic	Cardiovascular	Antidiabetic
Refill Rate	50.0%	16.0%	66.0%	78.0%	69.0%
Leading Brands	Motrin	Keflex	Lasix	Isordil, Sorbitrate	Diabinese
Number of Manufacturers	2	2	7	34	8
% Rxs Prescribed for Leading Brands	100.0%	99.9%	99.7%	91.8%	98.8%
% Rxs Prescribed Generically	0.0%	0.1%	0.3%	8.1%	1.2%
% Rxs Dispensed with Generics of Those Prescribed Generically	--	0.0%	13.6%	92.7%	75.0%
% Rxs Substituted	0.0%	0.0%	0.4%	12.6%	2.2%
% Rxs Dispensed with Generics	0.0%	0.0%	0.4%	18.4%	3.0%
Cost per Rx					
Average	$8.16	$9.29	$4.54	$5.08	$10.67
Leading Brand(s) (LB)	$8.16	$9.29	$4.55	$6.05	$10.87
Generics (G)	--	--	$2.81	$1.06	$4.94
Cost Difference per Rx					
LB-G	--	--	$1.74	$4.99	$5.93
(LB-G)/G	--	--	61.9%	470.8%	120.0%
Price per Rx					
Average	$11.71	$13.27	$7.42	$8.21	$14.06
LB	$11.71	$13.27	$7.43	$9.01	$14.25
G	--	--	$5.97	$4.92	$8.57
Price Difference per Rx					
LB-G	--	--	$1.46	$4.09	$5.68
(LB-G)/G	--	--	24.5%	83.1%	66.3%

TABLE A5-1--Continued

Generic Name	Ibuprofen	Cephalexin	Furosemide	Isosorbide dinitrate	Chlorpropamide
Gross Margin per Rx ($)					
Average	$3.55	$3.98	$2.88	$3.14	$3.39
LB	$3.55	$3.98	$2.88	$2.97	$3.38
G	--	--	$3.16	$3.87	$3.63
Gross Margin Difference per Rx ($)					
G-LB	--	--	$0.28	$0.90	$0.25
(G-LB)/G	--	--	8.9%	23.3%	6.9%
% Gross Margin					
Average	30.3%	30.0%	38.8%	38.3%	24.1%
LB	30.3%	30.0%	38.8%	33.0%	23.7%
G	--	--	52.9%	78.7%	42.4%
Number of Observations	5,326	6,843	7,358	1,144	2,346
Proportion of Prescriptions on Which Substitution was Permitted in 1980	66.3%	63.7%	66.5%	78.8%	70.1%
Proportion of Prescriptions by Customer Payment Type:					
Cash	74.9%	84.9%	71.9%	72.5%	64.7%
Medicaid	13.6%	6.5%	19.3%	15.7%	23.2%
Private Insurance	11.5%	8.5%	8.8%	11.8%	12.1%

* Rank is determined by dollar sales to drugstores based on data from IMS' U.S. Drugstore Audit for 1980. The list of top entities was provided by the Health Care Financing Administration.

TABLE A5-1--Continued

Generic Name	Hydrochloro-thiazide/ triamterene	Sulfamethoxazole/ trimethoprim	Doxycycline	Theophylline	Amitriptyline/ Perphenazine
Rank*	16	19	20	21	22
Therapeutic Category	Diuretic	Antibiotic	Antibiotic	Bronchodilator	Antidepressant
Refill Rate	71.0%	21.0%	17.0%	62.0%	62.0%
Leading Brands	Dyazide	Septra DS, Bactrim DS	Vibramycin	Theo-Dur	Triavil
Number of Manufacturers	4	5	26	4	3
% Rxs Prescribed for Leading Brands	100.0%	100.0%	94.9%	85.1%	81.4%
% Rxs Prescribed Generically	0.0%	0.0%	4.8%	0.2%	0.0%
% Rxs Dispensed with Generics of Those Prescribed Generically	--	--	73.0%	0.0%	--
% Rxs Substituted	0.4%	1.7%	8.9%	1.1%	0.1%
% Rxs Dispensed with Generics	0.4%	0.3%	12.0%	14.0%	18.7%
Cost per Rx					
Average	$6.21	$6.64	$7.05	$6.44	$9.96
Leading Brand(s) (LB)	$6.21	$6.65	$7.50	$6.31	$9.80
Generics (G)	--	$3.25	$3.93	$7.42	$10.65
Cost Difference per Rx					
LB-G	--	$3.40	$3.57	-$1.11	-$0.85
(LB-G)/G	--	104.6%	90.8%	-15.0%	-8.0%
Price per Rx					
Average	$8.87	$10.39	$11.05	$10.05	$14.17
LB	$8.87	$10.39	$11.27	$9.78	$14.02
G	--	$8.60	$9.49	$12.14	$14.82
Price Difference per Rx					
LB-G	--	$1.79	$1.78	-$2.36	-$0.80
(LB-G)/G	--	20.8%	18.8%	-19.4%	-5.4%

TABLE A5-1--Continued

Generic Name	Hydrochloro-thiazide/ triamterene	Sulfamethoxazole/ trimethoprim	Doxycycline	Theophylline	Amitriptyline/ Perphenazine
Gross Margin per Rx ($)					
Average	$2.66	$3.75	$4.00	$3.61	$4.21
LB	$2.66	$3.74	$3.78	$3.47	$4.21
G	--	$5.36	$5.56	$4.72	$4.17
Gross Margin Difference per Rx ($)					
G-LB	--	$1.62	$1.78	$1.25	-$0.04
(G-LB)/G	--	30.2%	32.0%	26.5%	-1.0%
% Gross Margin					
Average	30.0%	36.1%	36.2%	35.9%	29.7%
LB	30.0%	36.0%	33.5%	35.5%	30.0%
G	--	62.3%	58.6%	38.9%	28.1%
Number of Observations	8,998	6,425	4,065	825	964
Proportion of Prescriptions on Which Substitution was Permitted in 1980	58.1%	73.8%	84.5%	57.7%	54.7%
Proportion of Prescriptions by Customer Payment Type:					
Cash	78.1%	84.4%	86.3%	79.2%	75.8%
Medicaid	12.3%	8.7%	5.1%	12.4%	14.4%
Private Insurance	9.6%	6.8%	8.6%	8.5%	9.8%

TABLE A5-1--Continued

Generic Name	Allopurinol	Chlorthalidone	Dipyridamole	Erythromycin ethylsuccinate	Amoxicillin
Rank*	25	28	29	30	35
Therapeutic Category	Antigout	Diuretic	Cardiovascular	Antibiotic	Antibiotic
Refill Rate	72.0%	71.0%	74.0%	12.0%	9.0%
Leading Brands	Zyloprim	Hygroton	Persantine	E.E.S.	Amoxil, Larotid
Number of Manufacturers	6	27	21	2	29
% Rxs Prescribed for Leading Brands	83.1%	98.1%	96.1%	97.9%	41.6%
% Rxs Prescribed Generically	16.7%	1.9%	3.9%	2.1%	50.0%
% Rxs Dispensed with Generics of Those Prescribed Generically	16.6%	36.8%	90.7%	0.0%	51.2%
% Rxs Substituted	2.8%	4.3%	7.1%	0.0%	10.1%
% Rxs Dispensed with Generics	5.2%	4.9%	9.4%	0.0%	36.8%
Cost per Rx					
Average	$12.84	$6.43	$10.36	$3.62	$2.32
Leading Brand(s) (LB)	$12.93	$6.60	$11.20	$3.62	$2.29
Generics (G)	$11.27	$3.35	$2.90	--	$2.38
Cost Difference per Rx					
LB-G	$1.66	$3.25	$8.30	--	-$0.09
(LB-G)/G	14.7%	97.0%	286.2%	--	-3.8%
Price per Rx					
Average	$16.64	$9.42	$14.70	$7.42	$6.56
LB	$16.85	$9.55	$15.37	$7.42	$6.55
G	$13.29	$7.08	$8.81	--	$6.57
Price Difference per Rx					
LB-G	$3.56	$2.47	$6.56	--	-$0.02
(LB-G)/G	26.8%	34.9%	74.5%	--	-0.03%

TABLE A5-1--Continued

Generic Name	Allopurinol	Chlorthalidone	Dipyridamole	Erythromycin ethylsuccinate	Amoxicillin
Gross Margin per Rx ($)					
Average	$3.80	$2.99	$4.37	$3.80	$4.24
LB	$3.91	$2.95	$4.20	$3.80	$4.27
G	$2.02	$3.74	$5.95	--	$4.19
Gross Margin Difference per Rx ($)					
G-LB	-$1.89	$0.79	$1.75	--	-$0.08
(G-LB)/G	-93.6%	21.1%	29.4%	--	-1.9%
% Gross Margin					
Average	22.8%	31.7%	29.7%	51.2%	64.6%
LB	23.2%	30.9%	27.3%	51.2%	65.2%
G	15.2%	52.8%	67.5%	--	63.8%
Number of Observations	1,345	2,250	1,630	5,997	5,690
Proportion of Prescriptions on Which Substitution was Permitted in 1980	66.5%	66.8%	62.0%	68.7%	87.5%
Proportion of Prescriptions by Customer Payment Type:					
Cash	75.6%	76.4%	76.6%	83.3%	87.9%
Medicaid	11.1%	11.3%	12.0%	5.1%	4.8%
Private Insurance	13.3%	12.3%	11.3%	7.7%	7.3%

TABLE A5-1--Continued

Generic Name	Conjugated estrogens	Nitroglycerin	Metronidazole	Mestranol/ Norethindrone/ Placebo	Hydrochloro-thiazide
Rank*	36	39	41	42	44
Therapeutic Category	Estrogen	Cardiovascular	Trichomonacide	Oral Contraceptive	Diuretic
Refill Rate	62.0%	49.0%	6.0%	78.0%	73.0%
Leading Brands	Premarin	Nitrostat	Flagyl	Ortho-Novum, Norinyl	Hydro-Diuril, Esidrix
Number of Manufacturers	51	10	6	2	52
% Rxs Prescribed for Leading Brands	97.1%	39.2%	99.7%	100.0%	53.3%
% Rxs Prescribed Generically	2.7%	60.1%	0.3%	0.0%	45.4%
% Rxs Dispensed with Generics of Those Prescribed Generically	84.8%	73.8%	14.3%	--	96.5%
% Rxs Substituted	4.2%	0.9%	0.9%	0.0%	22.2%
% Rxs Dispensed with Generics	6.5%	40.1%	1.0%	0.0%	55.0%
Cost per Rx					
Average	$6.11	$1.39	$9.29	$8.16	$1.68
Leading Brand(s) (LB)	$6.24	$1.41	$9.30	$8.16	$3.31
Generics (G)	$4.19	$1.35	$7.75	--	$0.51
Cost Difference per Rx					
LB-G	$2.05	$0.06	$1.55	--	$2.80
(LB-G)/G	48.9%	4.4%	20.0%	--	549.0%
Price per Rx					
Average	$8.30	$3.10	$13.52	$7.99	$4.71
LB	$8.39	$3.39	$13.56	$7.99	$6.24
G	$7.09	$2.71	$9.55	--	$3.61
Price Difference/Rx					
LB-G	$1.30	$0.68	$4.01	--	$2.63
(LB-G)/G	18.3%	25.1%	42.0%	--	72.9%

TABLE A5-1--Continued

Generic Name	Conjugated estrogens	Nitroglycerin	Metronidasole	Mestranol/ Norethindrone/ Placebo	Hydrochloro-thiazide
Gross Margin per Rx ($)					
Average	$2.20	$1.73	$4.23	-$0.17	$3.04
LB	$2.15	$2.00	$4.26	-$0.17	$2.94
G	$2.90	$1.37	$1.81	--	$3.11
Gross Margin Difference per Rx ($)					
G-LB	$0.75	-$0.63	-$2.45	--	$0.17
(G-LB)/G	25.9%	-46.0%	-135.4%	--	5.5%
% Gross Margin					
Average	26.5%	55.8%	31.3%	-1.9%	64.5%
LB	25.6%	59.0%	31.4%	-1.9%	47.1%
G	40.9%	50.6%	19.0%	--	86.2%
Number of Observations	1,751	2,657	2,836	1,559	8,140
Proportion of Prescriptions on Which Substitution was Permitted in 1980	51.9%	68.7%	68.2%	76.9%	92.5%
Proportion of Prescriptions by Customer Payment Type:					
Cash	85.3%	80.3%	81.8%	83.0%	76.9%
Medicaid	5.9%	12.8%	11.0%	14.1%	12.9%
Private Insurance	8.8%	6.9%	7.1%	2.9%	10.1%

TABLE A5-1--Continued

Generic Name	Phenytoin	Erythromycin base	Amitriptyline	Ampicillin	Penicillin VK
Rank*	47	48	54	55	56
Therapeutic Category	Anticonvulsant	Antibiotic	Antidepressant	Antibiotic	Antibiotic
Refill Rate	74.0%	13.0%	62.0%	13.0%	12.0%
Leading Brands	Dilantin	E-Mycin	Elavil	(none)	V-Cillin K, Pen-VEE-K
Number of Manufacturers	26	7	36	62	59
% Rxs Prescribed for Leading Brands	97.5%	69.4%	80.0%	0.0%	41.3%
% Rxs Prescribed Generically	2.5%	28.4%	16.0%	84.2%	51.6%
% Rxs Dispensed with Generics of Those Prescribed Generically	84.8%	12.7%	89.8%	100.0%	91.1%
% Rxs Substituted	2.8%	0.2%	15.9%	7.2%	15.2%
% Rxs Dispensed with Generics	4.6%	4.4%	30.3%	100.0%	58.0%
Cost per Rx					
Average	$3.70	$1.89	$1.74	$1.26	$1.16
Leading Brand(s) (LB)	$3.82	$1.88	$1.72	--	$1.68
Generics (G)	$1.12	$1.97	$1.78	$1.26	$0.80
Cost Difference per Rx					
LB-G	$2.70	-$0.09	-$0.06	--	$0.88
(LB-G)/G	241.1%	-4.6%	-3.4%	--	110.0%
Price per Rx					
Average	$6.57	$5.96	$7.08	$4.92	$4.48
LB	$6.66	$5.97	$7.85	--	$5.13
G	$4.66	$5.79	$5.41	4.92	$4.04
Price Difference per Rx					
LB-G	$2.00	$0.18	$2.44	--	$1.09
(LB-G)/G	42.9%	3.1%	45.1%	--	27.0%

TABLE A5-1--Continued

Generic Name	Phenytoin	Erythromycin base	Amitriptyline	Ampicillin	Penicillin VK
Gross Margin per Rx ($)					
Average	$2.87	$4.10	$5.36	$3.67	$3.33
LB	$2.84	$4.11	$6.16	--	$3.46
G	$3.54	$3.83	$3.64	$3.67	$3.24
Gross Margin Difference per Rx ($)					
G-LB	$0.70	-$0.28	-$2.52	--	-$0.22
(G-LB)/G	19.8%	-7.3%	-69.2%	--	-6.8%
% Gross Margin					
Average	43.7%	68.8%	75.7%	74.6%	74.3%
LB	42.6%	68.8%	78.5%	--	67.5%
G	76.0%	66.2%	67.3%	74.6%	80.2%
Number of Observations	2,683	7,123	1,866	11,862	18,214
Proportion of Prescriptions on Which Substitution was Permitted in 1980	58.6%	67.2%	86.7%	93.0%	92.0%
Proportion of Prescriptions by Customer Payment Type:					
Cash	66.9%	85.1%	78.2%	83.5%	86.3%
Medicaid	25.2%	5.9%	11.7%	8.9%	6.2%
Private Insurance	7.9%	9.1%	10.1%	7.7%	7.5%

TABLE A5-1--Continued

Generic Name	Hydrochloro-thiaside/ Spironolactone	Hydrogenated ergot alkaloids	Terbutaline	Minocycline	Quinidine sulfate
Rank*	57	58	60	61	62
Therapeutic Category	Diuretic	Cardiovascular	Bronchodilator	Antibiotic	Cardiovascular
Refill Rate	77.0%	73.0%	69.0%	40.0%	79.0%
Leading Brands	Aldactaside	Hydergine	Brethine	Minocin	(none)
Number of Manufacturers	21	3	2	2	59
% Rxs Prescribed for Leading Brands	98.8%	100.0%	83.9%	92.9%	0.0%
% Rxs Prescribed Generically	1.2%	0.0%	10.9%	5.5%	99.2%
% Rxs Dispensed with Generics of Those Prescribed Generically	100.0%	--	23.5%	0.0%	100.0%
% Rxs Substituted	7.8%	0.0%	0.7%	0.3%	0.0%
% Rxs Dispensed with Generics	8.9%	0.0%	8.1%	1.4%	100.0%
Cost per Rx					
Average	$9.29	$14.37	$6.38	$12.94	$6.96
Leading Brand(s) (LB)	$9.75	$14.37	$6.41	$12.99	--
Generics (G)	$5.05	--	$5.96	$9.06	$6.96
Cost Difference per Rx					
LB-G	$4.70	--	$0.45	$3.93	--
(LB-G)/G	93.1%	--	7.6%	43.4%	--
Price per Rx					
Average	$12.50	$18.86	$9.72	$17.33	$10.93
LB	$12.83	$18.86	$9.84	$17.37	--
G	$9.44	--	$8.47	$14.16	$10.93
Price Difference per Rx					
LB-G	$3.39	--	$1.37	$3.21	--
(LB-G)/G	35.9%	--	16.2%	22.7%	--

TABLE A5-1--Continued

Generic Name	Hydrochloro-thiazide/ Spironolactone	Hydrogenated ergot alkaloids	Terbutaline	Minocycline	Quinidine sulfate
Gross Margin per Rx ($)					
Average	$3.21	$4.49	$3.35	$4.39	$3.95
LB	$3.08	$4.49	$3.42	$4.38	--
G	$4.39	--	$2.50	$5.11	$3.95
Gross Margin Difference per Rx ($)					
G-LB	$1.31	--	-$0.92	$0.73	--
(G-LB)/G	29.8%	--	-36.8%	14.3%	--
% Gross Margin					
Average	25.7%	23.8%	34.5%	25.3%	36.1%
LB	24.0%	23.8%	34.8%	25.2%	--
G	46.5%	--	29.5%	36.1%	36.1%
Number of Observations	1,915	592	800	770	777
Proportion of Prescriptions on Which Substitution was Permitted in 1980	74.5%	57.9%	67.9%	77.5%	89.6%
Proportion of Prescriptions by Customer Payment Type:					
Cash	75.9%	69.1%	71.9%	83.8%	77.2%
Medicaid	12.3%	25.0%	17.7%	4.7%	12.9%
Private Insurance	11.8%	5.9%	10.4%	11.6%	9.9%

TABLE A5-1--Continued

Generic Name	Hydralazine/ Hydrochlorothiazide/ Reserpine	Brompheniramine/ Phenylephrine/ Pseudoephedrine	Chlordiazepoxide	Chlordiazepoxide/ Clidinium bromide	Hydroxyzine
Rank*	65	66	67	71	73
Therapeutic Category	Cardiovascular	Cold preparation	Tranquilizer, minor	Antispasmodic	Tranquilizer
Refill Rate	79.0%	38.0%	52.0%	55.0%	40.0%
Leading Brands	Ser-Ap-Es	Dimetapp	Librium	Librax	Atarax, Vistaril
Number of Manufacturers	22	26	41	20	21
% Rxs Prescribed for Leading Brands	94.8%	98.5%	88.8%	98.6%	99.3%
% Rxs Prescribed Generically	0.3%	0.2%	10.2%	0.6%	0.7%
% Rxs Dispensed with Generics of Those Prescribed Generically	75.0%	100.0%	97.0%	100.0%	30.0%
% Rxs Substituted	8.9%	6.6%	17.3%	6.8%	1.6%
% Rxs Dispensed with Generics	14.0%	8.1%	25.6%	8.0%	1.8%
Cost per Rx					
Average	$7.88	$2.61	$4.26	$5.86	$4.99
Leading Brand(s) (LB)	$8.58	$2.82	$5.53	$6.27	$5.04
Generics (G)	$3.88	$0.43	$0.83	$1.61	$1.98
Cost Difference per Rx					
LB-G	$4.70	$2.39	$4.70	$4.66	$3.06
(LB-G)/G	121.1%	557.8%	566.3%	289.4%	155.6%
Price per Rx					
Average	$10.58	$5.18	$7.13	$8.81	$8.57
LB	$11.32	$5.33	$8.16	$9.10	$8.61
G	$6.34	$3.67	$4.33	$5.82	$6.83
Price Difference per Rx					
LB-G	$4.98	$1.66	$3.83	$3.28	$1.78
(LB-G)/G	78.6%	45.2%	88.5%	56.4%	26.1%

TABLE A5-1--Continued

Generic Name	Hydralazine/ Hydrochlorothiazide/ Reserpine	Brompheniramine/ Phenylephrine/ Pseudoephedrine	Chlordiazepoxide	Chlordiazepoxide/ Clidinium bromide	Hydroxyzine
Gross Margin per Rx ($)					
Average	$2.70	$2.57	$2.87	$2.95	$3.58
LB	$2.74	$2.51	$2.64	$2.83	$3.56
G	$2.47	$3.24	$3.51	$4.21	$4.85
Gross Margin Difference per Rx ($)					
G-LB	-$0.27	$0.73	$0.87	$1.38	$1.29
(G-LB)/G	10.9%	22.5%	24.8%	32.8%	26.6%
% Gross Margin					
Ave	25.5%	49.6%	40.3%	33.5%	41.8%
LB	24.2%	47.1%	32.4%	31.1%	41.4%
G	39.0%	88.3%	81.1%	72.3%	71.0%
Number of Observations	1,583	4,079	2,964	2,904	1,354
Proportion of Prescriptions on Which Substitution was Permitted in 1980	48.5%	52.2%	88.9%	59.2%	61.7%
Proportion of Prescriptions by Customer Payment Type:					
Cash	74.4%	82.2%	83.5%	83.4%	80.1%
Medicaid	17.0%	7.2%	7.6%	7.1%	8.6%
Private Insurance	8.7%	10.7%	8.9%	9.5%	11.2%

TABLE A5-1--Continued

Generic Name	Triamcinolone	Phentermine	Meclizine	Tetracycline	Spironolactone
Rank*	80	82	83	86	87
Therapeutic Category	Corticosteroid	Anti-Obesity	Antinauseant	Antibiotic	Diuretic
Refill Rate	19.0%	26.0%	53.0%	26.0%	77.0%
Leading Brands	Aristocort**	Fastin	Antivert	Achromycin-V	Aldactone
Number of Manufacturers	21	11	31	135	18
% Rxs Prescribed for Leading Brands	97.1%	95.1%	90.6%	23.1%	100.0%
% Rxs Prescribed Generically	2.7%	4.3%	9.4%	69.6%	0.0%
% Rxs Dispensed with Generics of Those Prescribed Generically	61.5%	97.7%	93.4%	99.9%	--
% Rxs Substituted	1.7%	0.3%	14.2%	5.0%	3.7%
% Rxs Dispensed with Generics	3.3%	3.6%	20.8%	77.8%	3.7%
Cost per Rx					
Average	$4.88	$5.22	$3.50	$0.73	$9.96
Leading Brand(s) (LB)	$5.05	$5.38	$4.40	$0.79	$10.15
Generics (G)	$1.04	$1.16	$0.68	$0.71	$4.96
Cost Difference per Rx					
LB-G	$4.01	$4.22	$3.72	$0.08	$5.19
(LB-G)/G	385.6%	363.1%	547.1%	11.3%	104.6%
Price per Rx					
Average	$8.70	$9.03	$6.90	$3.76	$13.52
LB	$8.87	$9.22	$7.78	$4.12	$13.66
G	$4.57	$5.14	$4.12	$3.67	$9.91
Price Difference per Rx					
LB-G	$4.30	$4.08	$3.66	$0.45	$3.75
(LB-G)/G	94.1%	79.4%	88.3%	12.3%	37.8%

TABLE A5-1--Continued

Generic Name	Triamcinolone	Phentermine	Meclizine	Tetracycline	Spironolactone
Gross Margin per Rx ($)					
Average	$3.81	$3.82	$3.39	$3.03	$3.56
LB	$3.82	$3.84	$3.37	$3.33	$3.51
G	$3.53	$3.98	$3.44	$2.95	$4.95
Gross Margin Difference per Rx ($)					
G-LB	-$0.29	$0.14	$0.07	-$0.38	$1.44
(G-LB)/G	-8.2%	3.4%	2.0%	-12.9%	29.1%
% Gross Margin					
Ave	43.8%	42.2%	49.1%	80.6%	26.3%
LB	43.1%	41.2%	43.3%	80.8%	25.7%
G	77.2%	77.5%	83.5%	80.4%	50.0%
Number of Observations	551	1,590	1,666	13,104	811
Proportion of Prescriptions on Which Substitution was Permitted in 1980	48.5%	74.2%	87.3%	93.0%	64.5%
Proportion of Prescriptions by Customer Payment Type:					
Cash	89.8%	91.3%	79.2%	85.5%	75.3%
Medicaid	2.4%	1.8%	12.4%	7.3%	15.9%
Private Insurance	7.8%	6.9%	8.3%	7.2%	8.8%

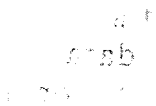
** Not among 200 leading brands prescribed, but has high proportion of prescriptions in this entity.

TABLE A5-1--Continued

Generic Name	Dexbrompheni-ramine/ Pseudoephedrine	Atropine sulfate/ Diphenoxylate	Diethylpropion	Acetaminophen/ Chlorzoxazone	Tolbutamide
Rank*	88	93	95	96	98
Therapeutic Category	Cold Preparation	Antidiarrheal	Anti-Obesity	Muscle Relaxant	Antidiabetic
Refill Rate	47.0%	25.0%	33.0%	36.0%	78.0%
Leading Brands	Drixoral	Lomotil	Tenuate	Parafon Forte	Orinase
Number of Manufacturers	13	40	6	16	25
% Rxs Prescribed for Leading Brands	94.3%	98.9%	83.7%	99.8%	94.8%
% Rxs Prescribed Generically	0.0%	0.0%	0.1%	0.1%	5.2%
% Rxs Dispensed with Generics of Those Prescribed Generically	--	--	0.0%	50.0%	76.2%
% Rxs Substituted	2.4%	15.6%	1.0%	3.8%	5.7%
% Rxs Dispensed with Generics	8.1%	16.6%	17.0%	4.0%	8.7%
Cost per Rx					
Average	$3.44	$3.34	$6.42	$5.07	$6.11
Leading Brand(s) (LB)	$3.43	$3.93	$6.31	$5.25	$6.47
Generics (G)	$3.60	$0.80	$6.95	$0.88	$2.75
Cost Difference per Rx					
LB-G	-$0.17	$3.13	-$0.64	$4.37	$3.72
(LB-G)/G	-4.7%	391.3%	-9.2%	485.2%	135.3%
Price per Rx					
Average	$6.31	$6.41	$10.15	$8.54	$9.65
LB	$6.31	$6.95	$10.14	$8.67	$9.91
G	$6.30	$4.12	$10.19	$5.52	$7.22
Price Difference per Rx					
LB-G	$0.01	$2.83	-$0.05	$3.15	$2.69
(LB-G)/G	0.2%	68.7%	-0.5%	57.1%	37.3%

TABLE A5-1--Continued

Generic Name	Dexbrompheni-ramine/ Pseudoephedrine	Atropine sulfate/ Diphenoxylate	Diethylpropion	Acetaminophen/ Chlorsoxazone	Tolbutamide
Gross Margin per Rx ($)					
Average	$2.87	$3.08	$3.73	$3.47	$3.55
LB	$2.88	$3.02	$3.83	$3.42	$3.45
G	$2.70	$3.32	$3.24	$4.64	$4.49
Gross Margin Difference per Rx ($)					
G-LB	-$0.18	$0.30	-$0.59	$1.22	$1.04
(G-LB)/G	-6.6%	9.0%	-18.2%	26.3%	23.2%
% Gross Margin					
Average	45.5%	48.1%	36.8%	40.6%	36.8%
LB	54.6%	43.5%	37.8%	39.5%	34.8%
G	42.9%	80.6%	31.8%	84.1%	62.2%
Number of Observations	3,424	4,211	2,420	2,636	1,015
Proportion of Prescriptions on Which Substitution was Permitted in 1980	52.3%	88.8%	56.6%	54.6%	59.8%
Proportion of Prescriptions by Customer Payment Type:					
Cash	83.7%	86.4%	89.1%	80.1%	72.3%
Medicaid	4.9%	5.5%	1.0%	6.8%	18.8%
Private Insurance	11.4%	8.1%	9.9%	13.2%	8.9%



APPENDIX A6

DESCRIPTION OF THE DATA

Two kinds of data were necessary for this analysis: first, a compilation of the provisions of the state laws, including formulary restrictions; and second, data on prescription transactions, as to the brand prescribed, the brand dispensed, the cost to the pharmacy, and the retail price. In this appendix, these data are described and problems noted.

Most of the analysis utilized data for 45 leading multi-source drug entities. The criteria for the selection of the data are specified.

I. STATE LAWS AND FORMULARIES

In addition to collecting the state statutes and amendments pertaining to drug product selection and all formularies in effect in 1980, we sought out compilations of statutory provisions already prepared by other researchers and trade organizations. We consulted by telephone with Board of Pharmacy or other officials in each state to confirm our understanding of the statute and to seek clarification when statutes or formularies appeared ambiguous or were silent on some important issue. In some instances, state officials themselves expressed uncertainty as to the most appropriate interpretation of an ambiguous provision.

The results of our compilations are summarized in several tables. Table A1-1 in Appendix A1 shows the statutory provisions in effect in each state in 1980. Information on formularies is given in Appendix Tables A1-1, A3-1 and A3-2.

II. DATA ON DRUG TRANSACTIONS, PRICES AND COSTS

The Federal Trade Commission purchased from IMS America, Ltd. data from two of its services. The National Prescription Audit (NPA) gathers data on the nature and prices of prescriptions dispensed through retail drugstores. The U.S. Drugstore Audit (USD) compiles data on the quantities and costs of prescription drugs purchased by drugstores for resale to consumers. The data used in this analysis are from the 1980 audits.

A. National Prescription Audit (NPA)

The NPA uses a panel of about 800 retail drugstores in which, on two days each month, each prescription transaction is recorded. In 1980, the NPA included over one million prescription transactions.

1. Sample Design

The sample of stores is selected to be representative of both region of the country and type of store within each region. Stores are classified as having independent or chain ownership, by whether the chain has eleven or more units, and by the volume of the individual outlet. In the end, the sample must be based to some extent on convenience, since some stores decline to participate.

Since the NPA sample is balanced across each of five regions of the continental United States rather than across individual states, the data may over-represent some states within a region and under-represent others. State shares of all U.S. prescriptions as measured by the NPA are often quite different from shares based on Census data, although positively correlated.[1]

Similarly, the NPA sample is not designed to provide a random sample of chains and of independents within each state, nor even to reflect the chain and independent market shares within an individual state. A comparison of NPA chain market

---

1/ A comparative tabulation is available upon request.

shares by state with market shares as measured by Census and other data show marked discrepancies in many states.[2] Were chains and independents to respond differently to drug product selection laws, inferences about differences between states' laws might be clouded by this sampling problem. However, our results show no strong difference in the behavior of chains and independents.

Because most of the analysis uses data for a group of states at a time, rather than each state singly, the problem of inappropriate samples in individual states may be alleviated to some extent, as, for example, oversampling of chains in one state in the group is balanced by undersampling of chains in another state. Estimates for individual states are less reliable.

2. *Data on Individual Prescriptions*

The information recorded for each prescription includes, for both the drug product prescribed and the drug product dispensed, the name of the brand or drug entity, the manufacturer's name where specified, and the dosage form and strength; the number of units (e.g., tablets); the type of prescriber; whether payment is through Medicaid, other insurance, or cash; and the retail price. Retailers are instructed to record the full price received for a prescription. For insured prescriptions, including Medicaid, this price is the sum of any copayment paid by the customer plus the amount the pharmacy is reimbursed directly by the state or insurer. However, we observed in the NPA data prices of $.50 or $1.00, common amounts for a copayment, suggesting that in some instances only the copayment was recorded. Observations with a price of $.50 or $1.00 were omitted from the regressions.[3] Other extreme prices were judged to be coding errors and were excluded as well.[4]

2/ See Table A4-1.

3/ All observations were included in the computation of the descriptive cross-tabulation statistics.

4/ Details are available upon request.

We also reviewed IMS' coding on dosage form and strength, filling it in where missing, correcting it where necessary, and making the coding consistent within a drug entity. Our analysis required using a generic entity as the unit of analysis and this information was added wherever missing or incorrect in the IMS data. Observations where the product dispensed did not match the product prescribed in terms of generic entity, dosage form, strength, or number of tablets were excluded from the analysis.

A major deficiency in the data for our purposes is that the record does *not* show whether the physician permitted or prohibited substitution. We therefore cannot wholly distinguish between physician and pharmacist behavior on substitution.

B. U.S. Drugstore Audit (USD)

IMS' U.S. Drugstore Audit (USD) gathers data from pharmacy invoices as to the quantities purchased from and prices paid to manufacturers and wholesalers. Each month IMS collects data on purchases by the 1600 drugstores which participate in this audit.[5] IMS either microfilms all invoices received in a drugstore or, for outlets of large chains, accepts computer tapes covering warehouse withdrawals for specified outlets.

For the purposes of our analysis, the methodology used in collecting the USD cost data has two major drawbacks: there was no adjustment for discounts based on overall volume, and chain costs were not recorded in a way appropriate for our use. In addition, costs were unavailable for many of the products in our study, even for some leading brands. Cost data for comparable brands in the same entity were used for interpolation of costs where missing.

Only a single national average cost was computed for each drug. The cost estimate for any individual brand is therefore the same for states permitting and states prohibiting substitution.

5/ The USD and NPA panels have little overlap.

1. Not All Discounts Subtracted

The USD fails to capture all discounts, especially total volume discounts. If the manufacturer or wholesaler gives a discount on the particular product and if that discount is recorded in the invoice line pertaining to the product, then the USD cost reflects the discount. In contrast, if a discount is given for the total purchase, across many products, and is not tied to a particular product, then the discount is not allocated among the purchases and is in fact not recorded at all. There are many discounts of the latter type. For example, a discount may be granted on the basis of total purchases for the quarter or for the year. Purchasers of larger quantities effectively pay lower prices than those described in the USD.

The result of this omission is that the prices paid by pharmacies shown in the USD are higher than the actual transactions prices.

2. Treatment of Chain Purchases

The cost data reported for chains do not measure what the chain as a large buying organization actually paid. The costs reported are those which the chain warehouse charges to the chain's individual outlets. If the chain has its own warehouses, it may add to the price it paid the manufacturer or wholesaler a warehousing fee. Of course, this might restore comparability of chain costs to independents' costs where wholesalers have performed the warehousing function. However, we do not know what a chain actually adds to its own purchase costs. A chain may even add a non-uniform up-charge if it wishes to juggle its retail outlets' incentives to sell various products. We do know that, for a few drug products, the cost reported in the USD was substantially (and unbelievably) higher for chains than for independents.

Because of these problems, and the fact that data are collected from only a few of the major chains, we eliminated the chain observations altogether. We estimated only a single average cost for each drug product, using data from independent stores only.

3. *Greater Overstatement of Generic Costs Than of Brand Costs*

We believe that firms marketing generics are more likely than sellers of leading brands to grant large across-the-line discounts in order to secure a sale, but because bottom-line discounts are not recorded in this audit, comparisons of brand and generic costs are biased. In addition, the generic cost estimates we use are overstated relative to brand costs because we excluded from the computations all observations from large chains. Bias in the brand-generic comparison exists if chains purchase leading brands at lower costs than independents but receive even greater discounts on generics, relative to independents.[6]

Overall, while the USD cost data have some deficiencies, they do support broad conclusions about the relative costs and retail gross margins of leading brands and generics. Indeed, the identifiable biases imply that some results would be even stronger with data better suited to our purposes.

III. SAMPLE OF GENERIC ENTITIES

A. Leading Entities in Terms of Dollar Sales

For much of the analysis, we used 45 multi-source entities found among the top 100 entities ranked in order of total dollar sales to retail drugstores in 1980. The ranking of generic entities was provided by the Health Care Financing Administration and was based on IMS' USD data. The top 100 entities accounted for about 900,000 of the million and a half prescriptions in the 1980 NPA. Of the 100 top entities, 41 were single-source and 59 multi-source.

6/ The trade press reports that chains purchase generics at especially advantageous prices. Drug Store News, July 21, 1980.

At our request, an executive of a large drug chain checked the prices his firm had paid in 1980 for several pairs of products for which our data showed the cost of the generic to be higher than the cost of the brand or the retail gross margin of the generic to be lower. He found the cost to his chain to be lower on all the drugs discussed and the cost of the generic, in particular, to be much lower than our data showed.

The products actually analyzed in this study are not the 100 most frequently dispensed drug products in terms of numbers of prescriptions. Relatively low-cost prescriptions appear in the list ranked by dollar sales only if they are high in number of prescriptions.

B. Solid Oral Dosage Forms

We restricted the sample to tablets and capsules only. These dosage forms constitute about three-quarters of all prescriptions.[7] Of the top 100 drug entities, 6 were not sold in tablet or capsule form.

C. Most Frequent Dosage Form/Strength Combination

The data for each drug entity were further broken down into unique dosage form/strength combinations, e.g., 100 milligram tablets, 50 milligram time-release capsules. In 11 entities there was no single oral dosage form/strength combination with at least 500 observations, an arbitrarily set minimum. Of these 11, 8 were single-source drugs. The most frequently dispensed single oral dosage form/strength combination for the sample as a whole was selected.

D. Modal Prescription Sizes

Finally, only those prescriptions which were among the five most frequently dispensed prescription sizes within that dosage form/strength combination (again, for the U.S. as a whole) were retained (e.g., 20, 30, 50, 60 and 100 capsules). Our reason was that price information spreads more readily on purchases of typical size than on odd sizes.

7/ De Nuzzo (1981).

E. Multi-source and Single-source Entities

We next identified which of these entities were single-source and which multi-source. If the IMS coding system identified two or more suppliers, or if either of two FDA listings did, the drug was classified as multi-source.[8] Otherwise, the drug was listed as available from a single source only.

This criterion produced some anomalies. For 4 drug entities,[9] despite the apparent availability of alternatives to the leading brand, on none of the prescriptions in our sample was anything other than the single leading brand dispensed. Indeed, several drugs which we classified as multi-source appear to be have been still under patent protection in 1980. By our criterion, ibuprofen was a multi-source drug (although our sample of prescriptions showed only Motrin dispensed), whereas in 1980 the Boots brand Rufen had not yet been introduced in competition with the leading brand Motrin. Although the patent on Dyazide did not expire until 1981, .4 percent of our sample prescriptions of triamterene/hydrocholorothiazide from the 1980 NPA were filled with some other product, as were 3 percent of the prescriptions for chlorpropamide although the Diabinese patent remained in force until 1984. Whether these oddities in the data were due to recording or processing errors, or whether there were sales of products by firms other than the patent holder, we cannot say. Reverse classification errors may also exist. Because we did not study patents or patent licenses, our definition makes possible the listing of a drug entity as multi-source when the second seller shares a patent or is licensed by the first and therefore may not set prices independently.

Of the 83 drug entities meeting the other criteria, 50 were multi-source. Of these, one was dropped because by 1980 it was

---

8/ The two FDA listings were the list of "Approved Prescription Drug Products" and a listing by ingredients provided by the Drug Listing Branch ("Ingredient Search").

9/ Ibuprofen, cephalexin, erythromycin ethylsuccinate, and hydrogenated ergot alkaloids, in the dosage forms and strengths specified for this study.

(in this dosage form) an over-the-counter drug and 4 others because of data problems. Most of our analysis, therefore, is based on 45 multi-source drugs.

In some of the analysis we use only 37 of the 45 entities. The 8 entities excluded are those in which either only leading brands or only generics were in fact dispensed on prescriptions in our sample. Only brands were dispensed for the 4 listed in footnote 8, although generics appeared to be available. For 2 entities (ampicillin and quinidine sulfate) all products were classified as generics, while for norethindrone/mestranol/placebo both products were classified as leading brands. Finally, for triamterene/hydrocholorothiazide we were missing some of the data necessary for making comparisons between Dyazide and the rarely dispensed alternative.

F. List of Drugs Studied

Table A6-1 lists the top 100 entities, the exact specification of the observations selected, and the number of observations for these.

G. The Representativeness of the 45 Drugs Studied

The 45 drugs studied cannot be taken as the "45 most frequently prescribed drugs." Two reasons have been given already. Single-source drugs are necessarily excluded, and the ranking by dollar sales to drugstores probably does not match a ranking by numbers of prescriptions sold. In addition, some of the drugs which we excluded because of too few observations in a selected dosage form/strength combination were sold most frequently in non-oral dosage forms. In others, sales were spread over many dosage form/strength combinations rather than concentrated in one or a few; the entity as a whole was large even though no specification was appropriate for our analysis. Finally, a few large drug entities were excluded because of data problems.

Nor are these 45 drugs strictly representative of the whole set of multi-source drugs. Less frequently sold drugs may well be less frequently substituted, both because pharmacies may find it unprofitable to stock multiple brands and because

TABLE A6-1

100 Top Generic Entities and the Specification of the Drug Products Selected for this Study

Rank	Generic Entity	Multi- or Single Source	Dosage Form Selected
1	Cimetidine	S	tab
2	Diazepam	S	tab
3	Ibuprofen	M	tab
4	Propranolol	S	tab
5	Methyldopa	S	tab
6	Cephalexin	M	cap
7	Sulindac	S	tab
8	Potassium Chloride	M	Data problems; not used
9	Furosemide	M	tab
10	Metoprolol	S	tab
11	Ethinyl Estradiol/ Norgestrel	S	tab
12	Isosorbide Dinitrate	M	tab
13	Naproxen	S	tab
14	Chlorpropamide	M	tab
15	Indomethacin	S	cap
16	Hydrochlorothiazide/ Triamterene	M	cap
17	Mestranol/ Norethindrone	M	Data problems; not used
18	Acetaminophen/ Codeine	M	Data problems; not used
19	Sulfamethoxazole/ Trimethoprim	M	tab
20	Doxycycline	M	cap

TABLE A6-1, Continued

Strength Selected	Prescription Sizes Selected	Number of Prescriptions in Sample
300 mg	100,60,30,50,40	6,688
5 mg	30,100,50,60,20	12,913
400 mg	100,30,60,50,40	5,326
40 mg	100,60,120,50,30	3,288
250 mg	100,60,30,50,90	3,980
250 mg	20,30,28,40,24	6,843
200 mg	60,30,20,100,50	2,339
40 mg	30,100,60,50,20	7,358
50 mg	100,60,30,50,40	1,974
500 UGM/ 50/UGM	21/63/42/126/147	2,135
10 mg	100,120,60,200,50	1,144
250 mg	60,30,100,50,20	3,090
250 mg	100,30,60,50,90	2,347
25 mg	30,100,50,60,40	3,437
25 mg/ 50 mg	100,30,60,50,20	8,998
16 mg/ 800 mg	20,30,14,10,28	6,425
100 mg	10,8,12,7,20	4,065

TABLE A6-1, Continued

Rank	Generic Entity	Multi- or Single Source	Dosage Form Selected
21	Theophylline	M	time-release tab
22	Amitriptyline/ Perphenazine	M	tab
23	Hydrochlorothiazide/ Methylodopa	S	Not used
24	Timolol Maleate		No solid oral dosage forms
25	Allopurinol	M	tab
26	Clorazepae Dipotass.	S	cap
27	Prazosin	S	Not used
28	Chlorthalidone	M	tab
29	Dipyridamole	M	tab
30	Erythromcin Ethyl-succinate	M	tab
31	Zomepirac	S	Not used
32	Acetaminophen/ Propoxyphene Napsylate	S	tab
33	Thioridazine	S	Not used
34	Flurazepam	S	cap
35	Amoxicillin	M	cap
36	Conjugated Estrogens	M	tab
37	Fenoprofen	S	Not used
38	Nadolol	S	
39	Nitroglycerin	M	sub-lingual tab
40	Doxepin	M	Data problems; not used
41	Metronidazole	M	tab

TABLE A6-1, Continued

Strength Selected	Prescription Sizes Selected	Number of Prescriptions in Sample
300	100,60,30,50,20	825
25 mg/ 2 mg	100,30,60,50,90	964
300 mg	100,30,50,60,34	1,345
7.5 mg	30,50,100,60,40	2,203
50 mg	30,100,50,60,40	2,250
25 mg	100,120,200,60,90	1,630
400 mg	20,30,40,24,28	5,997
100 mg	30,20,50,100,24	6,739
30 mg	30,20,15,50,10	5,596
250 mg	30,15,21,20,18	5,690
125 mg	100,30,50,21,60	1,751
.3/.4 mg	100,25,30,50,200	2,657
250 mg	21,30,8,42,16	2,836

TABLE A6-1, Continued

Rank	Generic Entity	Multi- or Single Source	Dosage Form Selected
42	Mestranol/ Norethindrone/ Placebo	M	tab
43	Lorazepam	S	tab
44	Hydrochlorothiazide	M	tab
45	Disopyramide	S	Fewer than 500 obs.; not used
46	Ethinyl Estradiol/ Norgestrel/Placebo	S	tab
47	Phenytoin Sodium	M	cap
48	Erythromycin Base	M	tab
49	Carbidopa/Levodopa	M	Fewer than 500 obs.; not used
50	Tolazamide	S	Not used
51	Ethinyl Estradiol/ Norethindrone Acetate	S	Fewer than 500 obs.; not used
52	Quinidine Gluconta	M	Fewer than 500 obs.; not used
53	Tolmetin	S	Not used
54	Amitriptyline	M	tab
55	Ampicillin	M	cap
56	Penicillin VK	M	tab
57	Hydrochlorotiazide/ Spironolactone	M	tab
58	Hydrogenated Ergot Alkaloids	M	tab

TABLE A6-1, Continued

Strength Selected	Prescription Sizes Selected	Number of Prescriptions in Sample
1 mg/ 40 UGM	28,84,56,112,168	1,559
1 mg	30,60,50,100,20	1,856
50 mg	100,30,60,50,20	8,140
300 UGM/ 30 UGM	28,84,56,168,112	799
100 mg	100,90,60,120,200	2,683
250 mg	20,40,30,28,24	7,123
25 mg	30,100,50,60,20	1,866
250 mg	20,40,30,28,24	11,962
250 mg	40,20,30,28,34	18,214
25 mg/ 25 mg	100,30,60,50,40	1,915
1 mg	100,90,60,50,340	592

TABLE A6-1, Continued

Rank	Generic Entity	Multi- or Single Source	Dosage Form Selected
59	Cefaclor	S	Not used
60	Terbutaline Sulfate	M	tab
61	Minocycline	M	cap
62	Quinidine Sulfate	M	tab
63	Tamoxifen	S	Fewer than 500 obs.; not used
64	Fluocinonide		No solid oral dosage form
65	Hydralazine/ Hydrochlorothiazide/ Reserpine	M	tab
66	Brompheniramine/ Phenylephrine/ Pseudoephedrine	M	time-release tab
67	Chlordiazepoxide	M	cap
68	Miconazole		Not solid oral dosage form
69	Haloperidol	S	Not used
70	Nystatin	M	Fewer than 500 obs.; not used
71	Chlordiazepoxide/ Clidinium Bromide	M	cap
72	Clotrimazole		No solid oral dosage form
73	Hydroxyzine	M	tab
74	Beclomethasone Dipropionate		No solid oral dosage form

TABLE A6-1, Continued

Strength Selected	Prescription Sizes Selected	Number of Prescriptions in Sample
2.5 mg	100,30,60,50,90	800
50 mg	30,20,60,24,50	770
200 mg	100,120,200,60,50	777
100 UGM/ 25 mg/ 25 mg	100,30,60,50,90	1,583
12 mg/ 15 mg/ 15 mg	20,30,12,60,50	4,079
10 mg	100,30,50,60,40	2,964
5 mg/ 2.5 mg	100,30,50,60,40	2,905
25 mg	30,20,50,60,40	1,354

TABLE A6-1, Continued

Rank	Generic Entity	Multi- or Single Source	Dosage Form Selected
75	Nitrofurantoin Macrocrystalline	S	cap
76	Potasium Bicarbonate	S	tab
77	Procainamide	M	Fewer than 500 obs.; not used
78	Oxycodone/APC	S	tab
79	Ethinyl Estradiol/ Acetate/ Placebo	S	Fewer than 500 obs.; not used
80	Triamcinolone	M	tab
81	Gramicidin/Neomycin/ Nystatin/Trimcinolone		Not solid oral dosage form
82	Phentermine	M	cap
83	Meclizine	M	tab
84	Carbamazepine	S	Not used
85	Ethynodiol Diacetate/ Ethyinyl Estradiol	S	tab
86	Tetracycline	M	cap
87	Spironolactone	M	tap
88	Dexbrompheniramine/ Pseudoephedrine	M	time-release tab
89	Danazol	S	Fewer than 500 obs.; not used
90	Pseudoephedrine	M	OTC in this dosage form; not used
91	Amitriptyline/ Chlordiazepoxide	S	Not used

TABLE A6-1, Continued

Strength Selected	Prescription Sizes Selected	Number of Prescriptions in Sample
50 mg	40,30,28,60,20	1,796
25 mg	30,60,90,100,50	1,022
5 mg	30,20,12,100,50	4,546
4 mg	16,30,20,12,15	551
30 mg	30,60,20,15,14	1,590
25 mg	30,50,100,20,60	1,666
1 mg/ 50 UGM	21,63,42,126,84	1,093
250 mg	30,20,100,40,24	13,105
25 mg	100,60,30,40,120	811
20 mg	20,30,12,60,50	3,424

TABLE A6-1, Continued

Rank	Generic Entity	Multi- or Single Source	Dosage Form Selected
92	Hydrochlorothiazide/ Propranolol	S	Fewer than 500 obs.; not used
93	Atropine Sulfate/ Diphenoxylate	M	tab
94	Cyclobenzaprine	S	Not used
95	Diethylpropion	M	time-released tab
96	Acetaminophen/ Chlorzoxazone	M	tab
97	Meclofenamic Acid	S	Fewer than 500 obs.; not used
98	Tolbutamide	M	tab
99	Oxazepam	S	Not used
100	Hydralazine/ Hydrochlorothiazide	S	Not used

TABLE A6-1, Continued

Strength Selected	Prescription Sizes Selected	Number of Prescriptions in Sample
2.50 mg/ 25 UGM	30,20,50,24,100	4,211
715 mg	30,60,50,15,20	2,420
250 mg/ 300 mg	40,30,50,60,100	2,636
500 mg	100,60,30,50,120	1,015

consumers may not learn comparative price information as easily. Therefore our quantitative estimates of substitution and price effects may be somewhat higher than would be true for all multi-source drugs (and are certainly higher than the appropriate figures for the entire universe of drugs including single-source drugs.)

IV. CLASSIFICATION BY TYPE OF BRAND

While the terms "brand" and "generic" may seem to be clear without further definition, they are in fact subject to considerable ambiguity. For example, many products of small, non-research-intensive firms (commonly labeled as "generic firms") are marketed with unique names, not just the names of the generic entities. For this study we have used definitions of brand type intended to capture the functional distinction associated with physician, pharmacist and consumer familiarity with and loyalty to a brand, to distinguish between a brand which can command a premium price because of strong loyalty, especially among prescribing physicians, and an alternative product which relies on low prices as its primary selling feature.

A. Definitions

The definitions are as follows:

Leading Brand. A leading brand is defined in terms of the number of prescriptions as written (not as dispensed) and is any brand either a) included in the list of the 200 products most frequently prescribed, or b) named by the physician on at least 20 percent of all prescriptions in its entity.

We used the list for 1980 compiled (annually) by IMS from its National Prescription Audit and published in the April 1981 issue of *Pharmacy Times*. Among the 200 leaders are a number of

generic names, reflecting the high incidence of generically written prescriptions in some large entities; these are excluded from our definition of leading brand. We added the second criterion because even the dominant brand in a small drug entity may not appear on the list of the top 200 leading brands.[10]

In most but not all instances a leading brand was marketed by one of the pharmaceutical firms characterized by large size and a strategy of heavy investment in research and development and in marketing. Of the 49 leading brands found in the 45 multi-source entities selected for analysis, 43 were marketed by one of the top 30 firms, ranked by dollar sales in 1980.[11] For these firms, a premier strategy is the discovery of a new chemical entity. The newly discovered drug is typically marketed intensively; "detail men" visit physicians to describe the new drug and to try to persuade them to prescribe it. During the period of patent protection the firm is free from competition from other versions of the same drug entity and usually strong physician loyalty to the pioneer brand is developed which continues even after the expiration of the patent.

Generic. All non-leading brands are termed "generics," whether or not the product is marketed solely under the generic name.

The term "generic" as applied to a particular version of a drug entity, sold by an identified firm, can be -- and has been -- defined in several different ways. One definition is whether the product is sold under the name of the generic entity only, without any proprietary name. Another is whether the product is sold by one of the so-called "generic firms," i.e., a firm other than one of those characterized as a large research-intensive firm. These firms typically avoid the

---

10/ In only one of the 45 multi-source entities selected for analysis did this supplementary criterion lead to the reclassification of a drug product as a leading brand (the Aristocort brand of trimcinolone.)

11/ The IMS Research Group (1981) ranked companies in order of 1980 dollar purchases by drugstores of ethical pharmaceutical products.

expenses of research and development and of brand-name marketing and specialize instead in offering low-price versions of drugs whose patents have expired.

There is, of course, some overlap in firms' marketing and research strategies. Small firms specializing in generics may also market one or a few leading brands. Also, as mentioned above, many of the non-leading brands sold by generic houses carry proprietary names, even though few prescriptions are written for these products by name. Similarly, some research-intensive firms have complemented their leading-brand offerings by selling other products either under the generic name alone or with a name which combines a part of the firm's name with the generic name, e.g., SmithKline French's SK-Ampicillin. If a firm sells a line of generics under this type of naming system the products are called "branded generics."

For some purposes we wish to distinguish "branded generics" from other "generics." The criterion is simply the identity of the firm marketing the product. Non-leading brands sold by the 30 largest pharmaceutical firms are classified as branded generics, and non-leading brands sold by all other (smaller) firms are classifed as generics. This definition accords with the characterization of a branded generic as a product without strong brand loyalty marketed under the reputational umbrella of a major research firm.

In summary, it is not accurate to describe a drug entity as typically containing one brand and one or more products sold only under the generic name. For the purpose of this study, the two-part classification of "leading brand" and "generic" captures the distinction in function between a high-price frequently prescribed brand and all others. The term "generics" will be used interchangeably with "all other brands", as distinguished from "leading brands."

B. The Effect of Alternative Definitions

Some of our results would probably be altered if different definitions were used. Generic market share, for example, is wholly dependent upon this definition. Categorizing products which command perhaps 8 or 15 percent but fewer than 20 percent of the prescriptions in an entity (our cutoff) as "brands"

would substantially reduce our measures of the generic market share in a number of drugs. The largest reductions would occur for several older antibiotics in which a handful of brands each have a significant but small market share. One example will illustrate this. In ampicillin there are three brands which each account for over 10 percent of prescriptions dispensed and another three with over 5 percent apiece. Together these 6 account for 70 percent of all prescriptions dispensed, and all but SK-Ampicillin carry recognizable brand names that do not include the generic term "ampicillin." Because none of them commands more than 5 percent of prescriptions *written* for ampicillin, we infer that pharmacies may not feel constrained to carry them in inventory for the purpose of filling "dispense as written" brand-written prescriptions. For other purposes, however, these products might better be categorized "brands", rather than "generics." If that were done, the share of ampicillin prescriptions dispensed with a generic (as redefined) would fall from 100 percent to 26 percent. Since antibiotics account for about half of *all* generic prescribing, our numbers are very dependent on the definition of "brand" and "generic" for antibiotics.[12]

C. Anomalies in Brand-Generic Classification: Retail Price of Generic Higher Than Price Of Brand

Three drugs failed to follow the pattern of the brand selling for a higher retail price than the generic. The three exceptions were theophylline sustained-release tablets, perphenazine and amoxicillin. These exceptions illustrate two difficulties in finding a single coding system for brand type which captures the functional meaning of "leading brand" versus "generic". First, some of the "generics" are brands with small market shares which nevertheless are preferred to the leading brand by some consumers or physicians, as is apparently the case for theophylline and perphenazine. Second, some of our

12/ See Chapter 6 for discussion of choice of product to be dispensed on generically-written prescriptions and generic market share in general.

"leading brands" belong to a generic entity for which consumers and physicians apparently believe all brands are essentially the same; amoxicillin is an example. The three drugs are discussed in turn.

1. Theophylline, a bronchodilator

We have identified only Theodur as a leading brand.[13] It accounts for 85.1 percent of prescriptions written and about the same (85.9 percent) of prescriptions dispensed. A secondary brand, Sustaire accounts for essentially all the rest of the prescribing (14.7 percent) and dispensing (13.9 percent.) (For .1 percent of theophylline prescriptions dispensed the brand or manufacturer was not recorded. There is little substitution (1.09 percent) and almost no generic prescribing (.24 percent).) Sustaire sold at higher prices; the retail price per prescription, averaged across all states, was $9.78 for Theodur and $12.14 for Sustaire. (This price disparity is more striking because the size of the average Theodur prescription was one-quarter larger.) The higher retail price of Sustaire is consistent with the higher pharmacy-level cost shown in our data, $.0956 per tablet for Theodur, $.1123 for Sustaire.

2. Perphenazine, an antidepressant

The leading brand, Triavil, accounts for about 81 percent of all prescriptions, both as written and as dispensed. A second brand Etrafon accounts for essentially all the rest (.1 percent of prescriptions dispensed do not have the manufacturer recorded.) The retail prices, across all states,

---

13/ Slophyllin Gyro-caps is also listed among the top 200 prescribed drugs in 1980, which would classify it as a leading brand. However, no prescriptions for this brand in the 300 mg. strength we had selected appeared in our data. Products named Theodur obviously confront stronger competition, as with Slophyllin, in related dosage forms and strengths, and it may be that the overall competition faced by a brand-name product is reflected in a price schedule which appears to have some internal consistency, and that the relatively low price seen in this dosage form and strength is due to the wider picture.

were $9.80 for Triavil and $10.65 for Etrafon (same sized prescriptions); the wholesale costs were ordered consistently, $.1468 and $.1595 per tablet.

3. Amoxicillin, an anti-infective (antibiotic)

This is an entity where there are several brands with nearly the same market shares, nearly the same prices, and nearly the same costs to pharmacies. There are two leading brands, Amoxil and Larotid, but the two together account for only 42 percent of all prescriptions written but 63 percent of all prescriptions dispensed. There are several other brands with 5 percent to 10 percent of the market. The prices of these two leading brands are slightly lower than the prices of other brands, $6.55 compared with $6.57 per prescription. However, the fact that the average prescription sold for the leading brand is one capsule smaller than the average for other brands is enough to reverse this result. The cost per tablet of the leading brands ($.1004) is slightly higher than the average cost for other products (products of other large manufacturers, $.1032; products of small manufacturers, $.0980.)

V. METHODS OF GENERALIZING ACROSS DRUGS[14]

In order to isolate the effects of the substitution laws by minimizing variation due to other causes, the analysis proceeded drug by drug. But patterns of substitution are very different from drug to drug, as are costs, prices, gross margins, refill rates, the incidence of generic prescribing -- all important variables. Any answers to questions about the overall effects of the laws require a method of generalizing across drugs.

14/ The way in which differences in formulary restrictions makes comparisons more difficult for data aggregated across drugs is discussed in Chapter 2.

We have used different methods for different purposes. The methods discussed here apply to cross-tabulations of data. For generalizing across regressions run for each drug separately, other techniques were used.[15]

One natural way of summing up effects across different drugs is to take a simple average of the averages for the individual drugs. This is used in Chapter 3 to summarize brand-generic price, cost and gross margin differences. This method, however, weights drugs with small sales too heavily relative to their actual importance in the economy.

Another way to aggregate across drugs is to weight each drug by the number of prescriptions. This is the method used most frequently in reporting results of cross-tabulations about prescribing and dispensing patterns. Any estimates of proportions of prescriptions thus reflect a proportion of all transactions, or of all decisions.

Where not otherwise indicated, the weights used are shares of total (new and refill) prescriptions for solid oral dosage forms. While we used only data for new prescriptions in our analysis, for purposes of generalizing across drugs we wanted to take into account the fact that prescriptions for some drugs are refilled far more frequently than for other drugs. We assumed that the substitution rate for a drug would be the same for refills as for new prescriptions; we are told that it is usual for a pharmacist to dispense on a refill the same product dispensed on the new prescription and there is sometimes even a requirement to that effect. We therefore incorporated refill ratios in the weights:[16] each drug entity's weight was its share in the total number (new plus refill) of prescriptions for the 45 leading multi-source drugs studied. The total number of new (but not refill) prescriptions in each drug entity was calculated by summing the numbers of prescriptions for each brand and generic version within the drug entity given in the 1980 Basic Data Report published by IMS, based on its National Prescription Audit. After computing a refill rate for each entity using unpublished materials from IMS, we were able to

---

15/ See Chapter 5 and Appendix A7.

16/ Refill rates vary widely from drug to drug, as shown in Appendix Table A5-1.

estimate the total number of prescriptions for each entity in 1980.

An alternative set of weights is the share of dollar sales, useful in that it reflects the fact that a substitution on an expensive prescription is likely to save consumers more than a substitution in a low-priced entity. This weighting scheme was computed in an analogous manner from the same data sources. In general, the results from the two weighting schemes were similar.

Another issue in designing a weighting system is the selection of prescriptions to be included in the universe. Because this study uses data for solid oral dosage forms, the weights are based on a total for only these dosage forms. An alternative would be each drug's share of all prescriptions regardless of dosage form. This would be appropriate if brand choice and pricing behavior is indeed the same across dosage forms. Estimates using this alternative weighting scheme were computed by an analogous method. This yielded, for example, a slightly higher substitution rate, implying that drugs which are sold also in other forms are substituted slightly more frequently (when in tablet or capsule form) than other drugs. However, since we lack estimates of actual substitution rates for liquids or ointments, for example, using all-form weights assumes that the substitution rate is the same across all dosage forms. While there is no obvious reason to doubt the appropriateness of this assumption, weights which are defined in the same terms as the underlying data eliminate a possible source of unreliability, and the weights which match the data most closely are used throughout most of the report. We believe our estimates to be reasonably accurate measures of the whole universe of (multi-source) prescriptions. In any case, tablets and capsules constitute 75 percent of all prescriptions.

The estimation of total dollar savings due to the DPS laws required somewhat different treatment. Instead of using data only for solid oral dosage form prescriptions, we used data for all prescriptions (all dosage forms). The methodology and numbers used are presented in section III of Chapter 8.

APPENDIX A7

ECONOMETRIC ISSUES

This appendix supplements the discussions in Chapters 5, 7 and 8 about the econometric models estimated. The models are presented in greater detail than in the text and modeling choices are explained. In particular, the choices made about the level of aggregation have statistical consequences for which in some cases we are able to make adjustments.

I. STATEMENT OF THE MODELS

A. The Logit Model for Brand Choice

The logit model for the substitution choice is:

$$\text{Prob}\,(S_r) = \frac{e^{F(Z_r)}}{1 + e^{F(Z_r)}}$$

where Prob(S_r) is the probability that a substitution is made on the r^{th} prescription and Z_r represents the values of a set of independent variables, defined below, for the r^{th} prescription.

When natural logarithms are taken on both sides of the equation,

$$\log\left(\frac{\text{Prob}\,(S_r)}{1 - \text{Prob}\,(S_r)}\right) = F(Z_r)$$

$$a_1 + a_2 MAND_t + a_3 RXPRO_t$$

$$+ a_4 RXANTI_t + a_5 POS + a_6 NEG$$

$$+ a_7 LIAB_t + a_8 PASS_t + a_9 INFO_t$$

$$+ a_{10} QUAN_r + a_{11} SSINDEX_{it}\ a_{12} CHAIN_{it}$$

$$+ a_{13} MED_r + a_{14} PRIV_r + a_{15} GEN_t$$

$$+ a_{16} TIME_t + ERROR_{rit}$$

where t = 1, 2, . . ., 47 indexes the state; for each t, i = 1, 2, . . ., N_t indexes the stores within that state; and for each i and t, r = 1, 2, . . ., R_{it} indexes the prescriptions dispensed by that store.

The choice of a brand -- the dependent variable -- is coded as 0 if the prescription was dispensed as written and as a 1 if instead a substitution was made.

The first 8 variables, representing provisions of the state's drug product selection law, are dummy variables, coded 1 if the provision is present and 0 if not. They are discussed in Chapter 5 and Appendix A1. The remaining variables are discussed at greater length in this appendix.

MAND

Mandatory substitution (on all prescriptions, regardless of insurance type.)

RXPRO, *RXANTI*, and *RXNEUT*

"Pro-substitution", "anti-substitution" , or "neutral" physicians' prescription pad, respectively. (*RXNEUT* is the omitted category.)

POS, *NEG*, and *NO FORM*

Positive formulary, negative formulary, or no formulary, respectively. (*NO FORM* is the omitted category.)

LIAB

Express statutory protection of the pharmacist from greater liability when substituting than when filling a generically written prescription.

PASS

Cost pass-through.

INFO

Notification.

QUAN

The number of tablets/capsules in the prescription.

SSINDEX

An index of the store's average price of 18 single-source drugs, relative to the average price across all stores.

CHAIN

CHAIN = 1 if the store is a member of a chain with more than 10 outlets; *CHAIN* = 0 if the store is independently owned or part of a small chain.

MED, *PRIV*, and *CASH*

Mode of payment for the prescription: Medicaid, private insurance, and out-of-pocket. (*CASH* is the omitted category.)

GEN

The proportion of prescriptions written generically in the state, computed across 45 drugs.

TIME

The number of months from first implementation of the state's drug product selection law to the month of the prescription transaction.

B. The Generalized Least Squares Model for Prices

For explaining (brand, generic and average) prices we used an error components model estimated with a generalized least squares procedure:

$$P_{it} = b_1 + b_2 DPS_t + b_3 QUAN_{it} + b_4 SSINDEX_{it} + b_5 CHAIN_{it} + b_6 MED_{it} + b_7 PRIV_{it} + b_8 GEN_t + ERROR_{it}$$

where t = 1, 2, . . ., 49 indexes the state; for each t, i = 1, 2, . . ., N_t indexes the stores within that state; and for each i and t, r = 1, 2, . . ., R_{it} indexes the prescriptions dispensed by that store.

The price is a store average. There are three regressions run for each drug. In one, the only observations included are those for prescriptions on which a leading brand was dispensed. In the second, only generically-dispensed prescriptions are used. The third uses all observations for prescriptions in the drug entity, regardless of whether a brand or a generic was dispensed. Thus, both intercepts and slopes can vary both with the drug entity and with the type of drug product (brand or generic) being analyzed.

The non-legal variables are defined as in the logit regressions except that, like the price, several are store-level averages instead of pertaining to an individual prescription. The *DPS* variable is a dummy indicating whether substitution

was permitted by statute and formulary ($DPS = 1$) or not ($DPS = 0$). Of the right-hand variables, only $QUAN$ varies by drug entity and by type of product dispensed.

II. ECONOMETRIC STRATEGY

A. Reduced Form of a Simultaneous System

The models are essentially in reduced form and contain determinants of both costs and demand. We are not attempting to estimate the demand and cost functions which form the underlying structural system.

A pharmacy's decisions on choice of brand to dispense and on prices for brands and generics are made simultaneously. For example, whatever influences pricing decisions affects also dispensing decisions, since the prices determine the gross margins and therefore the pharmacy's incentive to dispense one product rather than another product. Thus, the statistical analysis of one decision must include the determinants of all decisions. Each of the regressions contains the same set of independent variables, although the level of aggregation varies to match that of the dependent variable.

Not only are the several decisions made simultaneously within a single pharmacy; those decisions are made at the same time as, and with an eye to, the comparable decisions in every other pharmacy in the market. There is, then, (conceptually) a system of simultaneous equations of multiple decisions made by each individual pharmacy, which in turn reflect its underlying cost and demand functions, and this system is embedded in the larger system which includes the same set of decision problems for each competitor in the market. Each store includes in its calculus the probable effects of its prices, for example, on the decisions of the other stores with which it competes. Each pharmacy's decisions therefore depend not only on its own cost and demand conditions but on those of its rivals as well.

The model of monopolistic competition offers a useful paradigm for describing the operation of a local prescription drug market. Typically there are many sellers (at least in an urban area) and entry into retailing is not difficult.

Retailers are differentiated from one another in the eyes of consumers by location, services, and selection of other merchandise offered. Because stores are differentiated in these ways, a retailer has some discretion over the price in that a price set slightly higher than a nearby competitor's will not lead to the loss of all customers to that rival; some consumers will prefer to stay even if they must pay a slight premium.

Other models are also plausible. Differences among consumers might be emphasized; some consumers find it worthwhile to seek comparative price information and thereupon find their way to the lowest-price stores, while others find it too costly to search, and purchase at the most convenient store without knowing how its prices compare to those elsewhere. Yet a third description is that of local oligopolies, linked in a chain through space.[1] That is, each retailer takes into account the response of only a few other retailers located nearest, but each of these competitors competes not only with the first retailer but with a few others located at a slightly greater distance from the first retailer.

The general result of any of these plausible models is that a store need not simply accept some price dictated by the market but instead knows that a slight price increase will cause it to lose some (but not all) of its customers, while a slight decrease will bring some but not all customers in the market. In other words, each store faces a downward sloping demand curve and all sellers determine their prices simultaneously, taking into account the probable response of at least some of the other competitors in the market. We envision this model as approximately applicable in each of the local markets in our sample.

B. Short-Run Analysis

We also recognize that we are analyzing the short run, not the long run. That is, we are not testing the hypotheses that drug product selection laws lead to changes in the retail

---

1/ See also Rossiter (1982) for a duopoly model.

market structure nor that manufacturers will lower their prices.

C. Separate Regression for Each Drug

In every case (logit and GLS), the regression is run for each drug entity separately, allowing both intercept and slopes to vary from drug to drug. Drugs differ greatly not only as to wholesale cost but also in demand patterns. The number of people afflicted with a disease for which the drug is useful directly affects the level of demand for the drug. Also, drug products differ as to the intensity of competition with other drugs used for the same therapeutic purpose and, even more immediately, with other brands of the same drug. The level of confidence about bioequivalence and the (related) incidence of generically written prescriptions affect the likelihood that pharmacies will dispense generic versions of the drug. All of these factors affect consumers' interest in shopping around for a good price and their willingness to accept generics.

Within each entity the five leading prescription sizes were selected and observations on all five included in a single regression. This was done in order to obtain enough observations but to restrict the selection to the sizes on which consumers were likely to have the most price information.

The pharmacy is modeled as seeking to maximize profit in each drug entity. That is, each entity is treated as independent of every other entity and of other non-prescription drug products sold by the store. This simplification is reasonable in that prescriptions for different drug entities are not interchangeable. Of course, interrelationships on both the demand and the cost sides surely exist. It is likely that a consumer's choice of store depends in part on the prices paid in the past for an array of prescriptions, and it is obvious that prescription department costs and store overhead are shared by all drugs.

Some have argued that prices on single-source drugs -- where no substitutions are possible -- would be higher where substitution on multi-source drugs is permitted, that pharmacies will "make up" on single-source drugs for lower prices charged on multi-source drugs. This seems unlikely for at least two

reasons: if higher prices on single-source drugs were more profitable, the pharmacy would have charged those higher prices regardless of substitution possibilities. Moreover, the margin on substituted generics is *higher*, meaning that there are no lost profits to make up.

A second possibility for higher single-source prices depends on a longer term response. That is, if the opportunity to substitute were to lead to lower profits for the pharmacy as a whole, some stores would exit. Especially if too many stores exited, the movement towards a new equilibrium might involve some increases in all prices, including those of single-source drugs.

A contrary prediction -- that single-source prices will be lower where substitution is encouraged -- also depends on a longer-run story. That is, if competition were generally enhanced by substitution opportunities, such that price information on prescription drugs circulates more actively than before, the new environment might spur increased competition on single-source drugs as well. Further, if substitution opportunities led to a more rapid increase in the market share of low-cost retailers, more consumers would be paying lower prices on single-source drugs.

We have tested whether prices of single-source drugs are affected by the drug product selection laws. For 19 single-source drugs[2] we ran GLS regressions with the following model:

$$P_{it} = b_1 + b_2 DPS_t + b_3 QUAN_{it} + b_4 CHAIN_{it} + b_5 MED_{it} + b_6 PRIV_t + ERROR_{it}$$

where i indexes the store and t indexes the state. This model is identical to the one used for the multi-source prices except for the omission of the single-source price index *(SSINDEX)*, of which the price being estimated is a part, and the variable for generic prescribing (*GEN*), since generic prescribing of a

2/ The 19 entities used are given in the list of the top 100 entities in Table A6-1.

single-source drug cannot in fact affect stocking or dispensing decisions. The same GLS procedure used for the multi-source drug regressions was used for the single-source drug regressions.[3]

The results of the 19 single-source price regressions do not show that the laws have any systematic effect on the prices of single-source drugs. Of the 19 coefficients on *DPS*, 12 were positive and 7 negative but none were significant even at the 10 percent level. (The 12:7 split is not significant at the 10 percent level by a binomial signs test.)

That the laws appear not to lead to substantial complementary or offsetting price changes in single-source drugs means that any estimate of consumer savings in multi-source drugs alone can be taken as an estimate of the total savings associated with the law. Had single-source prices risen a great deal, as a result of the law, consumers might have been worse off even if prices paid for multi-source drugs fell. Alternatively, the estimate would have been understated had single-source prices fallen alongside multi-source prices. The independence of the single- and multi-source drug markets precludes the need for any such adjustment.

III. THE INDEPENDENT VARIABLES

A. Detailed Definitions

1. The Laws

The inclusion of the dummy variables for the laws (*DPS*) or provisions of the laws (*MAND, RXANTI, RXPRO, POS, NEG, PASS, LIAB, INFO*) represents another way in which we are exploring only part of a system. That is, we do not attempt to explain why certain states adopted certain laws. In fact, we (implicitly) assume that the nature of the law is not causally related to any of the variables we also use to explain price

3/ See Section IV below. The specification of the single-source drug price data is described below.

and brand choice differences. This implies, for example, that states where chains have an especially high market share are not more likely to have very liberal (or very conservative) drug product selection laws than other states.[4]

Suppose instead that the laws are endogenous, that both the nature of the law and market behavior could be explained by some third set of (state) characteristics. If so, the performance of the retail prescription drug market is not a direct response to the specific provisions of the DPS law but rather reflects some underlying environment in the state which colored the drafting of the law as well as subsequent market behavior. That is, both the nature of the law and market behavior may be explained by some third set of state characteristics. In Chapter 6, we made a similar argument: that the prevailing attitude towards generic drugs among physicians in a state might explain the correlation between early adoption of a DPS law and a higher incidence of generic prescribing.

We did not seek to model or test hypotheses about the law-making process. While an analysis of the actual evolution of each state's law would be valuable, it lies beyond this study.

Our codification of the laws is described in Appendix A1 and discussed further in Chapter 5.

2. Quantity

Because the ingredient cost to the pharmacy is higher with larger prescriptions and because prices for the five most popular quantities dispensed are all included in the same regression, the quantity (*QUAN*) variable is included in the

---

4/ Oster (1980) analyzed the patterns of adoption of several types of state consumer protection laws including the permissibility of retail advertising of prescription drugs.) The determinants of the nature of state drug product selection laws might be expected to be similar. However, the signs on the explanatory variables used in Oster's analysis (intended to measure consumer pressure, industry pressure, and ease of coordination among pharmacies) were as predicted but the coefficients were insignificant.

price regressions. (The price per tablet declines with prescription size, presumably reflecting the fixed cost of dispensing.) *QUAN* also picks up part of the differential cost of carrying inventory which is, or course, higher for higher-cost drugs; part is picked up by the constant term.

It is possible that there is some interaction between the size of the prescription and the effect of drug product selection laws; this argues for the inclusion of *QUAN* in the substitution regressions as well. If large dollar expenditures cause buyers to search more, those with larger prescriptions may have more price-elastic demands. There are other demand-related factors associated with prescription size, too. Medicaid purchases are on average for larger quantities than cash purchases. This may reflect Medicaid regulations which in some states limit the number of prescriptions which may be purchased per month. Also, in many entities prescriptions on which a generic is dispensed are on average larger than those on which a leading brand is dispensed. And these, then, are also correlated: the generic market share is larger for Medicaid buyers than for others. These factors suggest that *QUAN* could have been included as a slope shifter on the *DPS* law variables (with an interaction term) as well as included to shift the intercept. We chose to avoid this additional complexity.

3. *Index of Single-Source Drug Prices*

The single-source index (*SSINDEX*) is an index of the average price, over 18 single-source drugs (on which no substitution is possible), relative to all stores in the sample. This index captures both demand and cost elements which are common to both single-source and multi-source drugs.

On the cost side, differences in costs other than the acquisition cost and extra inventory costs of the drug are reflected in the single-source price index. The cost of dispensing a prescription, including overhead, is essentially the same regardless of the brand name on the tablet and therefore does not affect a pharmacist's choice of brand to

dispense.[5] However, differences in local retailing costs must be taken into account when comparing prices across locations. Store economies of scale in operating costs and in quantity discounts on purchases are also reflected, as are any chain-wide economies of scale.

The level of demand is set primarily by the number and distribution of prescriptions written by physicians and disease patterns, other determinants of demand for physician services (such as incomes and extent of insurance), the availability and price of physician services, and factors affecting physician prescribing choices which vary from place to place.[6] The extent of Medicaid or private drug insurance coverage affects not only overall demand but demand for particular drugs.

The willingness of consumers to accept or seek substitutions varies. Some types of consumers may simply find generics more acceptable than others. The age and income of the population, as well as the prevalence of insurance, affect the propensity to search. In markets with more price dispersion search is more valuable to consumers. Information is more readily available where there is newspaper advertising of retail prescription drug prices or ads featuring generics generally, and where populations are more homogeneous.

Finally, while the nature of competition in each local market can be generally characterized as monopolistically competitive, the actual market structure varies in terms of numbers and types of competitors. A large store is further encouraged to keep prices low because of complementarities on the demand side, since the attraction (by low price) of an

---

5/ Recordkeeping costs and delay in payment make the cost per prescription higher for insured prescriptions than for others. Therefore, the proportion of a store's customers whose insurance (private or Medicaid) covers prescription drugs will also affect the average cost of dispensing. These cost differences are picked up by the variables for customer payment type, MED and PRIV.

Some drug product selection laws impose a special cost if a substitution is made. This is discussed in Chapter 5.

6/ Some prescriptions written by physicians are not filled. All that is necessary to eliminate this problem from a single pharmacy's decision problem is that it is the average price in the market that determines how many prescriptions are left unfilled and that each store believes itself too small to have any significant effect on the overall price level in the market.

additional prescription customer will result in greater sales of non-drug items.

The *SSINDEX* variable was constructed in the following way. Of the original list of the top 100 drug entities, 33 had only one provider. For each of these 33 single-source drug entities we selected the dosage form/strength combination with the largest number of prescriptions in our data, and within this specification the quantity (e.g., number of tablets) most frequently dispensed. We then used the 18 with the largest number of prescriptions to form the single-source price index. These are listed in Table A6-1. For each store, an annual average price for each of the 18 drugs was calculated. An index was formed by the ratio of this price to the mean store price of that drug, across all stores. Finally, for each store an unweighted mean of the 18 indices for the store was calculated. Each store, therefore, has one summary single-source price index. If for any of the single-source drugs included in the index the data set contained no observations for a store, the store's index was composed of an unweighted average of its indices on the remaining drugs.

We believe that it is appropriate to use the *SSINDEX* variable in the regression since the drug product selection laws do not seem to affect the prices of single-source drugs; see section II.C above. (If instead the law in fact did affect single-source drug prices, the inclusion of both *SSINDEX* and dummies for the law would still not bias the coefficients. The multicollinearity might make it difficult to establish statistical significance, however.)

4. Store Type

While the single-source price index reflects most economies of scale enjoyed by large chains, we posit additional chain economies specific to the sale of multi-source drugs. Two are the possibility of especially favorable quantity discounts in buying generic drugs, or special contracting, and economies of scale in advertising a generics program or prices of specific generics. We therefore also include a dummy variable for type of ownership of the store (*CHAIN*). Chain market share is

treated as exogenous in this model; this choice would be less appropriate in a longer-run model.

5. Customer Payment Type

As discussed in Chapter 4, differences in insurance coverage affect the propensity of consumers to seek out the lowest price among stores or among brands. Also, reimbursement regulations, including MAC ceilings, influence pharmacists' brand choices and therefore pricing decisions. Differences in the proportion of the population covered by Medicaid (*MED*) and private insurance (*PRIV*), rather than paying out-of-pocket (*CASH*) will, then, cause differences in the numbers and types of prescriptions written, in the propensity of consumers to search out the lowest price and, for MAC drugs, the pharmacy's incentive to dispense low-cost products. Like the effects of chain ownership, some of the effects of insurance are picked up by the *SSINDEX*. However, the *SSINDEX* is a very summary and therefore imprecise measure of any single aspect of demand. Inclusion of the payment-type variables highlights this specific influence, especially for drugs where insurance could be expected to play a particularly important role.

The variables representing customer payment type are treated somewhat differently in the brand-choice and price regressions, reflecting different choices as to the appropriate level of aggregation in the two models. The aggregation choices are discussed in Section IV below. In both models, the omitted category, incorporated in the constant term, is *CASH*.

6. The Incidence of Generic Prescribing

The effect of generic prescribing (*GEN*) on substitution in particular and on generic market share and prices in general was discussed in Chapter 6. As explained in Chapter 8, the average price regressions were run twice, once with and once without the *GEN* variable.

The best measure would be the incidence of generic prescribing in each store for the individual drug entity which is the subject of the regression. However, there are many instances when there were so few observations of a drug even in

a whole state that the measured incidence of generic prescribing was zero, even though the national incidence was moderately high. Ratios specific to both drug and state therefore seemed prone to substantial misestimation. We used instead the incidence of generic prescribing measured across a weighted average of 45 drugs in the state. A similar sparseness of data at the store level led us to use a single state average rather than store averages. Therefore, the measure of generic prescribing varies only by state but not by store. This average is adjusted for each drug by multiplying it by a ratio of that drug's U.S.-wide proportion of generically written prescriptions to the same proportion computed across all 45 drugs. This adjustment makes no statistical difference in the regressions but puts the magnitude of the coefficient on the variable into a more appropriate range.

7. Pharmacy Cost of the Drug

There is one variable, the cost of the drug product, which is present in a theoretical model but which is not included in the regression. Because a pharmacy's choice as to whether or not to substitute will depend largely on a comparison of the gross margins, the theoretical model clearly includes the costs of both brand and generic as explanatory variables. However, the cost data available did not allow this, and cost is not included in the regression analysis. For the reasons discussed in Appendix 4, we have a single per-tablet cost estimate for all stores for each drug product. Therefore the inclusion of cost as an independent variable would simply be the introduction of a constant.[7]

The price regressions are, for this analysis, essentially equivalent to regressions with dollar gross margin as the dependent variable, since invoice cost is constant across states and thus gross margin would equal the price less a constant. This is a result of our method of computation but is probably true in actuality as well. That is, manufacturers

---

7/ Insofar as a generic entity includes several generic versions at varying costs, the cost measure would not be a constant in the regressions on generic prices.

probably do not vary their prices according to the nature of a state's drug product selection law; it would be impossible to do so in selling to a multi-state chain. We reiterate that the single-period analysis cannot capture the effects of changes over time in manufacturers' prices on gross margin or price.

8. Constant

The constant can be interpreted as a measure of both the average acquisition cost of the drug plus the average dispensing cost.

B. Correlations Among Variables

An individual provision occurs sometimes in conjunction with another (or other) provision(s), and other characteristics of the retail prescription drug market are also intercorrelated. Whether this reflects some underlying structure which led to the passage of certain laws or whether it is simply a random pattern, it causes multicollinearity which in turn makes the estimation inefficient. That is, multicollinearity increases the difficulty of statistically identifying the effects of individual provisions or, indeed, of any independent variable which is correlated with others in the regression; when two influences (for example) typically occur in tandem neither can be identified as the one with greater force. Specifically, multicollinearity causes the estimates of the standard errors of the coefficients to be large, making it difficult to find statistical significance even where there is economic significance.

Table A7-1 shows pair-wise correlations among the eight individual statutory provisions. The correlations are based on the states as the units of observations. The correlations for prescription-level data used in the logit regressions or for store-level data used for the brand-choice regressions would be similar although not exactly the same due to the fact that there might be relatively many or few observations in those states whose statutes contain any pair of provisions. (In addition to pair-wise correlations there may also be more

TABLE A7-1

Correlations among Statutory Provisions

	MAND	RX-PRO	RX-ANTI	POS	NEG	LIAB	PASS	INFO
MAND	1	+.191	-.011	+.371	-.081	+.061	-.058	+.017
RXPRO		1	-.434	+.169	+.151	+.021	+.258	+.114
RXANTI			1	-.058	+.034	+.375	-.165	-.087
POS				1	-.451	+.049	-.184	-.081
NEG					1	+.124	+.039	+.135
LIAB						1	-.038	-.021
PASS							1	+.184
INFO								1

complex patterns among several provisions which would give rise to the same type of statistical problem.)

RXPRO and *RXANTI* are of course highly correlated; if the prescription pad is not *RXPRO*, it can only be *RXNEUT* or *RXANTI*. For similar reasons, *POS* and *NEG* are correlated. The correlation between *MAND* and *FORM* reflects the fact that most states which mandate substitution have a formulary, typically a positive formulary. Other combinations also happen to occur. *LIAB* and *RXANTI* occur together more than one-third of the time, and *PASS* and *RXPRO* about one-fourth of the time.

There are also correlations between other economic measures and the presence or absence of a DPS law in 1980. Table A7-2 shows these for store-level data for the drug tetracycline

TABLE A7-2

Correlations between Non-Legal and Legal Variables

	MED	PRIV	GEN	CHAIN
DPS	+.056	+.084	+.408	-.063

(picked because of the large number of observations.) As discussed in Chapter 6, generic prescribing is much more frequent where DPS laws were in place.

IV. AGGREGATION

Whether to use the individual prescription as the unit of observation, or instead an average, was a major issue. Several types of averages were possible: store level, chain (within or across states), state, and any of these could be monthly or annual averages. We elected to use the individual prescription data for the brand-choice (logit) regressions and to use an annual store average (with a single state average across outlets for each chain) for the price regressions. The reasons for and implications of these choices are discussed in the context of each of the two types of models.

A. Aggregation Levels Chosen

1. The Logit Models: Individual Prescription Data

The unit of observation used in the logit regressions is the individual prescription. The pharmacy may not adhere to a uniform policy of substituting either always or never. The decision may reflect individual consumers' willingness to accept a generic, or, alternatively, resistance to a higher-priced brand. In particular, the probability of substitution will reflect whether the customer pays with cash or is covered

by either Medicaid or some other form of insurance. For example, in some states the law requires substitution for Medicaid customers. (We include in the logit regressions dummy variables for the customer's insurance type.)

An alternative specification would be the proportion of prescriptions on which substitutions were made by a store (over some specified time period.) However, because of the fewness of observations in many stores, the sample proportion for many stores would have been 100 percent (e.g., substitution occurred on the only prescription in the sample) and for others 0 percent (e.g., no substitution was made on the one or two prescriptions in the sample), even though those stores might well have substituted, on average, some intermediate percent of the time. Technically, the logit program cannot use observations with 100 percent substitution because the denominator of the fraction is then zero, and zero cannot be used as the divisor. Even had the store-level aggregation been feasible, it would have wasted the information as to the insurance coverage of the specific prescription.

We rejected also the state level of aggregation. To use state averages would have meant that a great deal of information about the variation in the data, due to differences among stores and among prescriptions within the store, would be lost. Less of the overall variance could be explained, making it more difficult to achieve statistically significant results.

2. *The Price Regressions: Annual Store Averages*

Rather than the price for each individual prescription, an average price is used for each store or for each chain within a state.[8] There are several reasons for this choice.

8/ Price-per-tablet was also rejected as the unit of observation. A consumer makes a single decision as to what and where to buy for the prescription as a unit and presumably compares prices for the prescription rather than the price per tablet. Moreover, most of the pharmacy's costs excluding the cost of the drug itself are per-prescription costs. The paperwork for reimbursement on an insured prescription, for example, or the time needed to discuss substitution with a customer does not vary with the size of the prescription.

A store is modeled as setting a single price (or at least establishing a pricing policy) for a drug product (specific as to brand, dosage form, strength and quantity) rather than varying the price from customer to customer. One reason to believe that a pharmacy would set a single price is simplicity and avoidance of recomputation.

Similarly, there is likely to be a chain-wide pricing policy which makes the prices of the different outlets more similar to each other than to prices at other chains or independents. A chain's prices are averaged but only within a single state since laws vary from state to state.

An alternative would have been to use three separate prices for the three insurance types, in recognition of the cost and demand differences among the three. However, even a single price set by a store reflects the mix of its customer types. For example, a store with a high proportion of privately insured customers may set a higher price than a store with mostly cash customers who are more attuned to price comparisons. Our regression model controls for customer mix through the two independent variables measuring the proportions of the store's sales which are Medicaid and other private insurance (with cash payment the omitted type). Because there are few observations per drug per store, this proportion would be poorly estimated if the proportion were computed over a single drug. Therefore, the payment-type proportions were calculated for each store or chain over all multi-source drugs together.

The time period selected for the aggregation is the entire year 1980, except where the state's formulary (or, for Louisiana, the law) changed mid-year. In such instances the two portions of the year are kept separate and there are two "store averages" for a single store.

The alternative to the formulary-period average is a monthly average. The primary benefit of using monthly data would be to correct for shifts in demand or in costs. While demand is not likely to have varied from month to month,[9] costs may well have. However, inflation does not confound the results as to

---

9/ Certain drugs may have seasonal patterns, for example, heavy use of cough and cold medications in winter.

the effects of the drug product selection laws as long as the samples of observations is balanced across the year in the same way across states, and this is very likely. Moreover, we found that month dummies included in some early regressions showed no consistent significant patterns, and the coefficients on month dummies bore little relationship to changes in invoice costs, the largest element of the prescription's cost.

As in the logits, we rejected further aggregation, to state averages, because of the loss of store-specific information useful in explaining the overall variation in prices and therefore in isolating significant influences.

Because aggregate data are used for the price variables, independent variables are aggregated also for the price regressions. For example, *QUAN*tity is the average number of tablets or capsules per prescription for the store or chain.[10] For chains, *SSINDEX* is averaged over that chain's outlets in the state, with each outlet's index weighted by the number of transactions for the selected drug. The payment-type variables are the proportion of the store's or chain's multi-source prescriptions paid for by Medicaid or other third-party insurance, respectively.

B. Correlated Error Terms Within Regressions

While we have taken into account both the laws and other major cost and demand influences, it is possible that there are other conditions which affect pharmacist response to the opportunity to substitute and which vary by store or by state. If this is so, the error terms in the regression are correlated and the estimation is inefficient. The extent of the problem is different for the brand-choice regressions and for the price regressions because the level of aggregation of the variables differs. Our options for making corrections to the estimation procedure also differ because the logit regressions are

---

10/ For the selected drug and time period. For regressions involving a single brand or brand type, the average quantity is for that brand or brand type only. The SSINDEX is averaged in the same way.

estimated by a maximum likelihood procedure while the price regressions employ least squares.

1. Store-Level Correlated Errors

At the store level, despite some intrastore price variability due to price discimination or accident or reporting error, there is likely to be a strong commonality among a single store's prices, stronger than any similarity of prices among stores. The data confirmed that there were many stores in which several observations were identical, and the same was true across units of the same chain. Even when store-specific influences (such as local cost conditions) have been controlled for in the model, some store-level idiosyncracy in pricing or brand-choice behavior may prevent the observations from being truly independent of one another. An example of an omitted store characteristic which might lead to such behavior is a personal commitment, on the part of an owner-pharmacist, either for or against substitution. The existence of store idiosyncracies means that when a substitution is made on one transaction in a store, substitution is more (or less) likely on a second prescription in the same store than in another otherwise identical store.

2. Statistical Implications of Correlated Errors

In technical terms, the errors -- the portion of the dependent variable not explained by the model -- would be correlated for observations from a single store, that is, would be more similar among observations from a single store than across stores. The statistical implication of correlated error terms is that the estimates of the standard errors of the coefficients are not unbiased and the tests of statistical significance are not entirely reliable. In a sense, the inclusion in the regression of several observations from a single store gives the false appearance of a larger number of independent observations than is really true; a second observation from a store gives less "real" new information than an observation from a different store. Therefore it is likely that the standard errors of the coefficients are understated, making

it possible that statistical tests of significance show more coefficients to be significant than would be true if the data had been drawn from a sample designed differently.

3. State-Level Correlated Errors

Similarly, the many stores within a single state might share some characteristic not captured by the regression's independent variables. For example, there may be differences in the training of pharmacists or physicians. If most pharmacists in a state are trained at a single school of pharmacy, they may all have learned a particular approach to certain decisions. If, for example, in one school certain drug entities are held up as examples of potential bioequivalence problems, pharmacist graduates of that school may decline to substitute in those entities more frequently than pharmacy graduates whose attention was drawn to a different set of entities.

If there is some such omitted state-wide characteristic (or a complex of them), when substitutions are made frequently by one store (or when prices are high), then substitutions are more likely (or prices higher) in other stores of the same state. This would cause correlation among the error terms within each state with the attendant statistical problems.

4. Types of Problems Present in Price and Brand-Choice Regressions

Correlated error terms are a potential problem in both types of regressions. In the price regressions, while the possibility of within-store correlations is eliminated by using store averages, correlations seem likely between stores within a single state. In the logit regressions, both sources of possible error correlation exist since there may be several observations in a single store.

5. Results Using Alternative Levels of Aggregation

a. Price Regressions. To check the effects of different levels of aggregation in the price regressions, we ran a number

of models with individual prescription data, monthly store averages, and state averages by month and year. The results of regressions run with aggregated data were not much different from those for disaggregated data. As expected, fewer coefficients were significant when aggregated data were used. An occasional (insignificant) sign was switched but never when the coefficient was significant in either the aggregated or disaggregated regression.

b. Brand-Choice Regressions. In order to see whether the results were very sensitive, we ran an alternative specification of the brand-choice regressions for one drug and compared the results with those of the individual-prescription logit regression. We ran OLS regressions using state-level data, with the "log-odds" of substitution as the dependent variable, ln [(p/(1-p)], where p is the proportion of prescriptions on which a substitution was made.

In the regression for hydrochlorothiazide, the top-substitution drug, the signs on 7 of the 8 legal dummies were the same as in the individual-prescription logit regression; *LIAB* became negative instead of positive. None of the coefficients were significant, while in the individual-prescription logit regression 6 of the 8 were significant.

While this loss of statistical significance may have been due partly to the disappearance of false significance attributable to the correlated error terms, aggregation to the state level also removes a great deal of valuable information which is useful in explaining variation and therefore in determining appropriately significant relationships. For example, no longer is a particular prescription identified as being a Medicaid prescription. "True" significance lies somewhere between the results of the individual-prescription logits and the state aggregate "log-odds" OLS regressions.

We ran two other such experimental "log-odds" regressions, one for a weighted average of all 45 drugs where substitution was permitted on the specific drug and one for a weighted average of the 45 drugs disregarding formulary restrictions. Again, none of the coefficients were statistically significant. The signs corresponded to the general sign patterns

reported across the individual logit regressions for 24 drugs (except for *RXPRO*, which showed no pattern.)

6. *Error Components Model*

For the price regressions, we used a generalized least squares (GLS) procedure, based on an error component model designed to capture the presence of state-by-state influences, since ordinary least squares (OLS) is inappropriate when error terms are correlated. Specifically, we assume that the error term is composed of two parts:

$$ERROR_{it} = m_i + e_{it}$$

where m_i is the state component and e_{it} is the random component. We assume that the state component shifts the intercept but not the slopes. We assume that m_i is a random variable rather than being fixed. We therefore rule out using dummy variables for each state. In fact, use of state dummy variables would not have been feasible since the variables in which we are most interested also are state-level variables and the inclusion of both sets of dummies would have produced a singular matrix, making estimation mathematically impossible.

The model we use is that described in Judge et al.[11] The resulting variance-covariance matrix is block-diagonal in form.

The GLS procedure based on this model adjusts each observation for the fact that any observation (more accurately, the error term) is more similar to other observations in the same state than to observations in other states. (Whatever "average state component" exists is added into the *CONSTANT* term.) This reduces the importance, in the estimation procedure, of the extreme observations which a large state with an above-average state error component would contribute to the pool of all observations. The GLS correction, then, improves the validity of the statistical tests on the coefficients.

11/ Judge et al. (1980).

The GLS procedure used in the price regressions is not applicable in the logit regressions because they use a maximum likelihood estimation technique, not ordinary least squares (OLS).

V. ESTIMATION PROCEDURES

A. Logit Estimation Procedures

We use a logit model to explain or predict the pharmacy's choice of brand to use in filling a prescription, or rather the probability of a given brand choice. We cast the choice on brand-written prescriptions as binary: whether a substitution is made, or not. (For generically written prescriptions, the choice is also treated as binary: whether a generic is dispensed or not (i.e., a brand is dispensed), where generic and brand are defined as explained in Appendix 6.) The logistic function used in the logit model keeps the predicted probabilities between 0 and 1, as is appropriate; a linear probability model, for which OLS could be used, does not.

One drawback of the logit model for our problem is that the model works best when the sample observations are split relatively evenly between the 0 and 1 choices, whereas substitution rates tend to be quite low, so that for a number of the drugs the split is 90 percent/10 percent or even more extreme. To provide a better fit on the tails of the distribution it would be necessary to use a model based on a different distribution of the error terms, such as the Poisson distribution. In the absence of computer software available for this alternative model, we used the logit.

B. GLS Estimation Procedure

The GLS estimation procedure was adapted by Gerard Butters from Fuller and Battese.[12] Two alterations were needed. Our model has only one component instead of two, and instead of a

12/ Fuller and Battese (1974).

fixed number of observations for each state (component), the number was variable. Three regressions are run: first, a regression in which each observation is the difference from the respective state mean; second, the ordinary least squares regression with uncorrected data; and third, a regression in which each observation is adjusted by subtracting some fraction of the appropriate state mean, where the proportion depends on the amount of variation within a state.

The procedure is as follows:

1. Using ordinary least squares (OLS), regress the dependent variable on the k-1 (here, 6) independent variables plus a constant, using the original (untransformed) data. Retain the sum of squared residuals (SSR) from this regression. Compute an adjusted mean square error:

$$s^{**2} = \frac{SSR - s^{*2}(N - k)}{N - tr\left(\frac{V(X^{*\prime}X^{*})}{SSR/(N - k)}\right)}$$

where V is the variance-covariance matrix from the OLS regression using original values, and tr is the trace of the matrix.

2. Run a regression where the value of each variable, dependent and independent, is the difference between the original value and the mean for that variable in the appropriate state. Independent variables which are state-level dummies (*DPS*) or state-level averages (*GEN*) fall out of this regression, since the difference from the state mean is zero for each observation. The constant term is also omitted.

Let k^* be the number of independent variables in this regression (4). This number k^* is smaller than k in the original regression, by the number of state dummies plus one (the constant.)

Compute the sum of squared residuals from this second regression, SSR^*, and calculate an estimated mean square error:

$$s^{*2} = \frac{SSR^*}{N_t - T - k^*}$$

where N_t is the number of observations in the t^{th} state and T is the number of states, here 49.

Retain the $(X'X)^*$ matrix from this regression, to be used below.

4. Transform each dependent variable by replacing the original value P_{it} with:

$$P^{**}_{it} = P_{it} - \left(1 - \frac{s^*}{\sqrt{s^{*2} + N_t s^{**2}}}\right)\left(\frac{\sum_{n=1}^{N_t} P_{it}}{N_t}\right)$$

Transform each independent variable similarly.

5. Regress the transformed dependent variable on the transformed independent variables. This regression provides the final results.

In some regressions the calculations produced a negative estimate of the variance in step 2. In those instances, OLS was used in place of GLS.

VI. INDEPENDENCE ACROSS REGRESSIONS

An assumption underlying the running of separate regressions for each drug is that the error terms in each regressions are independent of those in all other regressions. We recognize that this assumption is probably over-strong for our analysis; there is in fact probably some interdependence. The same panel

of pharmacies is represented in each of the regressions, and even when most store-level influences are held constant by the inclusion of the *SSINDEX* and other variables, there may be idiosyncratic behavior consistent across a store's decisions on all multi-source drugs, not just across all prescriptions of a single drug. A pharmacy which prices high on one multi-source drug may well price high on another multi-source drug. To run each drug separately, as we have done, is to ignore some store-specific information that is available, that is, pricing (or brand-choice) decisions on other drugs.

A. Seemingly Unrelated Regressions

A procedure superior to ordinary least squares is the estimation of the system of seemingly unrelated regressions, using GLS with estimates of the components of the variance-covariance matrix. The processing requirements for our price analysis, given a system of 45 equations (or rather 45 times 2, if both brand and generic prices are included), ruled this out. Also, it was unclear as to how -- or whether -- the GLS correction in the price regressions could be incorporated along with the seemingly unrelated system.

Under certain conditions, OLS results are the same as those from the estimation of seemingly unrelated regressions. If all the independent variables are the same in all the equations, OLS is efficient. In our regressions, all regressions have the same set of *named* variables, of which only one (*QUAN*) varies by drug. If all regressions had observations from exactly the same set of stores, therefore, there would be only one variable which differed from equation to equation, and the gain from moving from OLS to GLS estimation of seemingly unrelated regressions would be slight.

In fact, the subset of stores represented in one drug regression is not exactly the same as in all other drug regressions, since observations were missing for some stores in some drugs. The tables in Chapters 7 and 8 show the number of observations in each regression. For example, the average price regression for meclizine has 548 observations, while that for isosorbide dinitrate has 409. The total number of stores in the panel was much greater, as indicated by the fact that

the penicillin VK regression has 959 observations. This makes it quite likely that the stores represented in the meclizine and isosorbide dinitrate regressions do not wholly overlap.

B. Binomial Tests of Sign Patterns Across Regressions

Our ability to generalize across drugs by summarizing sign patterns in the regressions is also conditional on the independence of the individual drug regressions. In the text we report, for example, that in the logit regressions on substitution 21 of 24 coefficients on *RXANTI* were negative and that by a binomial test (based on a .5 probability of a positive sign) this is a significant pattern. This test applies only if the observations counted up are independent. If instead all 24 regressions represent essentially the same information, little is gained and a count of signs is meaningless. We believe that the problem of correlated error terms among regression equations is probably not extreme and that therefore the binomial signs test is useful in summarizing the regression results.

VIII. TRANSFORMATION OF LOGIT COEFFICIENTS INTO ESTIMATED CHANGES IN PROBABILITY OF SUBSTITUTION

The coefficients estimated by the logit regressions are not estimates of the changes in the probability of substitution associated with each independent variable since the dependent variable is the logarithm of the odds of choice, not the actual probability. To state the effects of the independent variables in terms of changes in the probability of substitution, the coefficients must be transformed.

Our method of transforming the logit coefficients is as follows.[13] What we are seeking is the change in probability due to a move from the absence of a legal provision (dummy equal to zero) to the presence of the provision (dummy equal to

---

13/ See also Pindyck and Rubinfeld (1981, pp. 299-300).

one.) For each drug, we evaluated the estimated equation using the mean values of the independent variables; let us term the value obtained A. We computed an average probability of substitution

$$P = \frac{e^A}{1 + e^A}$$

Since the estimated equation included all dummies equal to one, this probability corresponds to the presence of each provision (P^1). To find the probability of substitution when a particular provision was absent, it was necessary to subtract from A its contribution, which is its estimated coefficient, and calculate the resulting P ($_iP^0$ where i indexes the provisions). We then took the difference in the two probabilities ($P^1 - {}_iP^0$) as the estimate of the provision's effect on the probability of substitution.[14]

14/ The computation of differences in probability associated with RXNEUT required removing the effects of both RXPRO and RXANTI from the equation, to find the probability of substitution when the prescription pad had a "neutral" format. The same was true for differences involving no formulary.

BIBLIOGRAPHY

Act of 1984, U.S. Pub. L. No. 98-417, Sept. 24, 1984.

Albion, Mark S. **Advertising's Hidden Effects: Manufacturers' Advertising and Retail Pricing.** Boston: Auburn House Publishing Company, 1983.

Bond, Ronald S. and Lean, David F. **Sales, Promotion and Product Differentiation in Two Prescription Drug Markets**, Staff Report to the Federal Trade Commission, February 1977.

Brook, Robert H.; Lohr, Kathleen; Chassin, Mark; Kosecoff, Jacqueline; Find, Arlene; and Solomon, David. "Geographic Variations in the Use of Services: Do They Have Any Clinical Significance?" **Health Affairs**, Vol. 3, No. 2, Summer 1984.

CBS Television Network Sales/Marketing Services, **The CBS Consumer Model: A Study of Attitudes, Concerns and Information Needs for Prescription Drugs and Related Illnesses**, 1984.

Chappell, Stephen C. "1st 6 Months of '84: Independents & Drug Chains Dispensed 775.7 Million Prescriptions." **Pharmacy Times**, October 1984, pp. 25-31.

Colford, Steven W. and Giges, Nancy. "Drug Makers Seek Generic Cure." **Advertising Age**, October 1, 1984, pp. 10-11.

Darby, Michael and Karni, Edi. "Free Competition and the Optimal Amount of Fraud." **The Journal of Law and Economics**, April 1973.

De Nuzzo, Rinaldo V. "25th Annual Prescription Survey, Albany School of Pharmacy" (for 1980). **Medical Marketing and Media**, April 1981.

DeVito, Carolee A. **Economic Impact of the State of Kentucky's Generic Drug Substitution Legislation,** Final Report on Contract NO. 233-81-3034 to U.S. Department of Health and Human Services, Public Health Service, National Center for Health Services Research, October 18, 1982.

Drug Store News, various issues.

Drug Topics, various issues.

44 **Federal Register** 2942, January 12, 1979.

Federal Trade Commission, Bureau of Consumer Protection, Staff Report to the Federal Trade Commission. **Drug Product Selection,** 1979. Cited in the text as FTC Staff Report, 1979.

Fuller, W.A. and Battese, G.E. "Estimation of Linear Models with Crossed-Error Structure." **Journal of Econometrics,** April 2, 1974, pp. 67-78.

Gardner, David M. "Is There a Generalized Price-Quality Relationship?" **Journal of Marketing Research,** Vol. 8, May 1971, pp. 241-243.

Glaser, Martha. "New competitors intensify race for Rx drug sales." **Drug Topics,** March 18, 1985.

Goldberg, Theodore; DeVito, Carolee A.; Dickson, W.M., et al., Series of papers on the effects of drug substitution legislation, project supported by U.S. Department of Health and Human Services, Public Health Service, Office of the Assistant Secretary for Health, National Center for Health Services Research, grant number R01 HS 02134.

Goldberg, Theodore and DeVito, Carolee A. "The Impact of State Generic Drug Substitution Laws." **Drug Therapy,** December 1981.

Goldberg, Theodore and Raskin, Ira, eds. **State Drug Product Selection Laws.** U.S. Department of Health and Human Services, Public Health Service, Office of the Assistant Secretary for Health, National Center for Health Services Research and Health Care Technology Assessment, forthcoming.

Grabowski, Henry G. and Vernon, John M. "Substitution Laws and Innovation in the Pharmaceutical Industry." **Law and Contemporary Problems,** Duke University School of Law, Winter - Spring 1979.

Gurley, Tony and Gagnon, Jean Paul. **Drug Product Selection, Pharmacy Laws of North Carolina, GS 96-76, Drug Product Selection.** An evaluation performed for the North Carolina Governmental Evaluation Commission. Unpublished manuscript, March, 1981.

Hatch/Waxman Drug Price Competition and Patent Term Restoration Act of 1984. See Act of 1984.

Holton, R. H. "Price Discrimination at Retail: The Supermarket Case." Journal of Industrial Economics, October 1957.

IMS America, Ltd. **National Prescription Audit,** 1980.

IMS America, Ltd. **1982, The Year in Review, Prescription Purchase and Promotional Trends,** 1983.

IMS America, Ltd. **1983, The Year in Review, Prescription Purchase and Promotional Trends,** 1984, pp. 43-45.

IMS America, Ltd. **U.S. Drugstore Audit,** 1980.

IMS America, Ltd., IMS Research Group, **The U.S. Pharmaceutical Market 1980, A Review.** Ambler, Pa., 1981.

Judge, George G.; Griffiths, William E.; Hill, R. Carter; and Lee, Tsoung Chao. **The Theory and Practice of Econometrics.** New York: John Wiley and Sons, 1980.

Klein, Benjamin and Leffler, Keith B. "Non-Governmental Enforcement of Contracts: The Role of Market Forces in Assuring Quality." **Journal of Political Economy**, Vol. 89, 1981, pp. 615-641.

Kralewski, John E.; Pitt, Laura; and Dowd, Bryan. "The Effects of Competition on Prescription-Drug-Product Substitution." **The New England Journal of Medicine**, Vol. 309, No. 4, July July 28, 1983, pp. 213-216.

Leffler, Keith B. "Persuasion or Information? The Economics of Prescription Drug Advertising." **The Journal of Law and Economics**, Vol. XXIV(1), April 1981, pp. 45-74.

The '80 Lilly Digest. Indianapolis: Eli Lilly and Company, 1981.

Lynch, Michael. **A Dual Stage Model of Retailing and Manufacturing.** Unpublished manuscript, January 1983.

_____. **A Formal Model of Steiner's Dual Stage Model: Application to the Drug Product Selection Laws.** Unpublished manuscript, September 1983.

Masson, Alison and Rubin, Paul H. "Matching Prescription Drugs and Consumers." **New England Journal of Medicine**, August 22, 1985.

McKercher, P.L. and Grasela, J. "Impact of Michigan's generic drug law." Testimony before the Michigan House of Representatives, Feb. 25, 1980.

Miller, Russell R. "Prescribing Habits of Physicians: A Review of Studies on Prescribing of Drugs, Parts I-VIII." **Drug Intelligence and Clinical Pharmacy**, (November 1973-February 1974):492-500, 557-564 (vol. 7), 81-91 (vol. 8).

Morgan, John P. and Kagan, Doreen V. **Substitution for Branded Drugs in the Real World: A Brief Report of a Retail Shopping Survey in New York and New Jersey.** Unpublished manuscript, 1984.

Morris, L. A.; Grossman, R.; Gordon, E.; and Soveiro, C. **Patient Sources of Prescription Drug Information.** Unpublished manuscript, Food and Drug Administration, Rockville, Maryland, 1983. Also published in a longer form by National Technical Information Service, Springfield, Va., 1983, 83-10031.

National Association of Chain Stores, **1981 NACDS - Lilly Digest: A Survey of Chain Store Pharmacy Operations.** Indianapolis: Eli Lilly and Company, 1981.

Nelson, Phillip. "Information and Consumer Behavior." **Journal of Political Economy**, Vol. 78, 1970, pp. 311-329.

New York State Department of Health. **Safe Effective and Therapeutically Equivalent Prescription Drugs.** April 1, 1980.

Norwood, G. Joseph; Lipson, David P.; Temple, Thomas; Hadsall, Ronald S.; and Freeman, Robert A. **Policy Implications of MAC: AWP-AAC and EAC-AAC Differentials Among Pharmacies and Pharmaceuticals.** Final Report submitted to Social Security Administration, May 31, 1977.

Oster, Sharon. "An Analysis of Some Causes of Interstate Differences in Consumer Regulations." **Economic Inquiry**, Vol. XVIII, January 1980, pp. 39-54.

Phalon, Richard. "Life on the Fast Track." **Forbes**, August 13, 1984, pp. 62-63.

"Pillbox War: Drug Battle Heats Up Between Brand-Name and Generic Makers." **Wall Street Journal**, August 13, 1984, p. 1.

Pindyck, Robert S. and Rubinfeld, Daniel. **Econometric Models and Economic Forecasts.** New York: McGraw-Hill Book Company, 1981.

"Prescription Drugmakers Try to Cope With a Dose of Adversity." **Business Week**, September 17, 1984, pp. 132-140.

Robinson, Bill. "Generic Drug patent bill spells Change for Industry." **Drug Topics**, October 1, 1984.

Rossiter, Louis F. **The Market for Retail Pharmacies: A Duopoly Model.** in Richard M. Scheffler and Louis F. Rossiter, eds., **Advances in Health Economics and Health Services Research**, Vol. 3, JAI Press Inc., Greenwich, Conn, 1982.

Schwartzman, David. **Innovation in the Pharmaceutical Market.** Baltimore: The Johns Hopkins University Press, 1976.

Shapiro, Carl. "Premiums for High Quality as Returns to Reputations." **Quarterly Journal of Economics**, Vol. 98, 1983.

"The Shift to Generic Drugs." **New York Times**, July 23, 1984, pp. D5.

Sinclair, Molly. "Generic Drug Laws - A Boon - But not to Consumers." **Washington Post**, July 28, 1980.

Statman, Meir and Tyebjee, Tyzoon G. "Trademarks, Patents, and Innovation in the Ethical Drug Industry." **Journal of Marketing**, Vol. 45, Summer 1981, pp. 71-81.

Steiner, Robert L. "A Dual Stage Approach to the Effects of Brand Advertising on Competition and Price." in **Marketing and the Public Interest**, John Cady, ed. Boston: Marketing Science Institute, July 1978, pp. 78-105, 127-150.

_____. "Basic Relationships in Consumer Goods Industries." **Research in Marketing**, Vol. 7, JAI Press Inc., 1984, pp. 165-208.

_____. "Does Advertising Lower Consumer Prices?" **Journal of Marketing**, Vol. 37, October 1973, pp. 19-26.

Temin, Peter. **Taking Your Medicine, Drug Regulation in the United States.** Cambridge, Mass.: Harvard University Press, 1980.

Trapnell, Gordon R.; Genuardi, James S.; and O'Brien, Joan. **Consumer Expenditures For Ethical Drugs.** The Actuarial Research Corporation, Falls Church, Va, September 9, 1983.

Traxler, Herbert G.; and Siegenthaler, Linda A. "Summary of Selected State Experiences with Drug Product Selection Laws." Draft chapter prepared for Goldberg and Raskin, forthcoming book.

"200 Most Frequently Prescribed Products." **Pharmacy Times**, April issue, annually.

U.S. Department of Commerce, Bureau of the Census. **1977 Census of Retail Trade**, Subject Series, Drug Stores, Table 22.

U.S. Department of Commerce, Bureau of Labor Statistics. **Consumer Price Indexes, Detailed Report**, Prescription Drugs, 1980 and 1984.

U.S. Department of Commerce, Bureau of Labor Statistics. **Producer Price Indexes, Detailed Report**, Drugs and Pharmaceuticals, 1980 and 1984.

U.S. Department of Health and Human Services, Health Care Financing Administration, Bureau of Program Policy, **Price Information for Drug Products, Invoice Level Prices**, Data for October/November 1980 and August 1984.

U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, National Center for Drugs and Biologics, **Approved Prescription Drug Products with Therapeutic Equivalence Evaluations**, annual editions with monthly supplements.

☆U.S. GOVERNMENT PRINTING OFFICE: 1985 494 329 42211

U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Bureau of Drugs, Drug Listing Branch. **Ingredient Search; Multiple Ingredients for Study of Effects of States' Drug Product Selection Laws.** April 1982.

U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Bureau of Drugs, Drug Listing Branch, **National Drug Code Directory 1980,** 1981. HHS Publication No. (FDA) 81-1077.

U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration, Bureau of Drugs, Drug Use Analysis Branch, Division of Drug Experience, **Drug Utilization in the U.S. 1980, Second Annual Review,** December 1981.

U.S. Department of Health and Human Services, Public Health Service, Office of the Assistant Secretary for Health, National Center for Health Services Research, see Goldberg and Raskin.

Vuturo, George J.; Krischer, Jeffrey P.; and McCormick, William C. "Drug Product Selection: The Florida Experience." **Journal of the American Pharmaceutical Association,** May 1980, Vol. 70, No. 5, pp. 479-484.

Washington Post, advertisement, July 17, 1984, p. A-11.

Wennberg, J. and Gittelsohn, A. "Variations in Medical Care Among Small Areas." **Scientific American,** Vol. 246, 1982, pp. 120-133.

Zeich, Richard C. "One-line Rx Forms Boost Drug Substitution." **Drug Topics,** January 16, 1984, pp. 37-38.

_____. "Substitution audit cites six-year gains." **Drug Topics,** November 7, 1983.