

AD-A032 244

RAND CORP SANTA MONICA CALIF

F/G 5/3

THE LEGAL AND ILLEGAL MARKETS FOR TAXED GOODS: PURE THEORY AND --ETC(U)

UNCLASSIFIED

MAY 76 R T SMITH

P-5639

NL

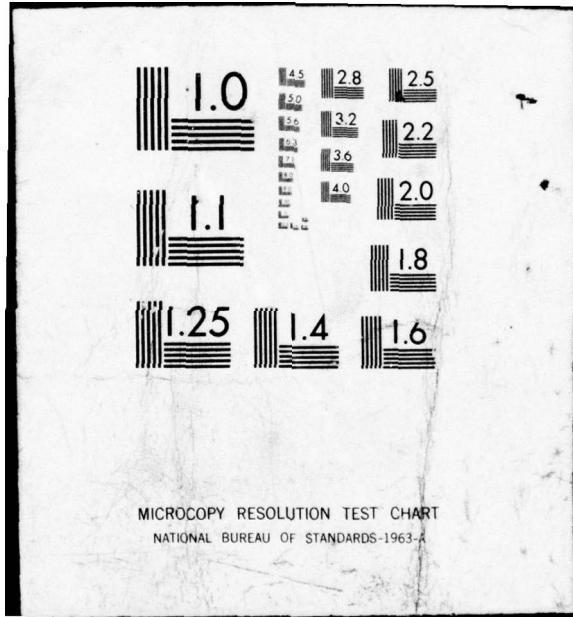
| OF |

AD
A032244



END

DATE
FILMED
1-77



16

(2)

AD A 032244

(6)

THE LEGAL AND ILLEGAL MARKETS FOR TAXED GOODS: PURE THEORY AND AN APPLICATION TO STATE GOVERNMENT TAXATION OF DISTILLED SPIRITS

(10)

Rodney T. Smith

(11)

May 76

(12)

6 pp.

DDC
RECEIVED
NOV 18 1976
RECEIVED

AR B

(14)

P-5639

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

296600

JP

ACCESSION for		
NTIS	White Section	<input checked="" type="checkbox"/>
ONC	Buff Section	<input type="checkbox"/>
UNANNOUNCED		<input type="checkbox"/>
JUSTIFICATION		
BY		
DISTRIBUTION/AVAILABILITY CODES		
Dist:	AVAIL and/or	SECRETAL
A		

The Rand Paper Series

Papers are issued by The Rand Corporation as a service to its professional staff. Their purpose is to facilitate the exchange of ideas among those who share the author's research interests; Papers are not reports prepared in fulfillment of Rand's contracts or grants. Views expressed in a Paper are the author's own, and are not necessarily shared by Rand or its research sponsors.

The Rand Corporation
 Santa Monica, California 90406

THE LEGAL AND ILLEGAL MARKETS FOR TAXED GOODS: PURE
THEORY AND AN APPLICATION TO STATE GOVERNMENT TAXATION OF DISTILLED SPIRITS

Rodney T. Smith*

Economists have expanded their study of the legal system, with special attention to ascertaining the effects and understanding the motivation for the regulation of markets. The study of the effects of regulation has concentrated on the impact of regulation on market price, output, product quality, distribution of income, and social welfare. The study of the motivation for regulation has attempted to discover the determinants of the observed pattern of regulation among markets and legal jurisdictions.

The measurement of the stringency of regulation has been the salient characteristic of both inquiries. Researchers have aspired to quantify the central features of regulations that create the effects on markets sought by the proponents of regulation. Studies of taxation and tariffs have measured this stringency by tax and tariff rates,¹ while studies of other forms of regulation have measured regulatory stringency by the

^(which) → * This paper is based upon the author's Ph.D. dissertation ^(cont on p 5) for the Economics Department, University of Chicago. The author is particularly indebted to Gary Becker, the chairman of the dissertation committee, and George Stigler, a diligent member of that committee, for useful suggestions and guidance during the numerous drafts of this paper. The author also benefited from advice provided by Charles E. Phelps of The Rand Corporation. John Hause and Tom Savings offered helpful comments and suggestions during the conference presentation of an earlier draft of this paper. All of these individuals are absolved from responsibility for the remaining errors.

¹ See Niskanen, William, "The Demand for Alcoholic Beverages: An Experiment in Econometric Method," The Rand Corporation, P-2583, May 1962, and the import demand studies cited infra, note 71.

presence or absence of regulation.² Using such measures analyses of regulation estimate the relationship between the stringency and the effects of regulation by deriving the implications of regulation-induced shifts in the demand and supply for goods. The determinants of regulatory policy have been studied by examining how the observed measure of regulatory stringency varies in response to variables believed to measure the demand and supply for regulation.³

Such analyses have, in general, neglected the conflict between the incentive for individuals to evade regulations and the effort of governments to enforce regulations. As emphasized in the economic analyses of crime, laws impose costs on individuals that provide the incentive for the evasion of the law. In response, the government engages in law enforcement to discourage criminal activity and thereby alter behavior as intended by the law. The Becker⁴ discussion of the evasion and enforcement of felony laws provided the basic analytical framework for this economic analysis of criminal activity. Ehrlich⁵ has extended the theory and provided extensive empirical tests of the

²Stigler, George and Claire Friedland, "What Can Regulations Regulate? The Case of Electricity," *Journal of Law and Economics*, October 1962, estimated the impact of the presence of a state electricity commission on electricity prices. Peltzman, Sam, "Entry into Commercial Banking," *Journal of Law and Economics*, October 1965, estimated the impact of Federal control of entry on the rate of entry into commercial banking. Landes, William, "The Economics of Fair Employment Laws," *Journal of Political Economy*, July/August 1968, estimated the impact of the presence of a state Fair Employment Commission on state black-white earnings and unemployment rate differentials. Landes also considered continuous measures of regulatory stringency: the budget of the commission and the number of years the commissions had been in existence.

³See Stigler, George, "The Theory of Economic Regulation," *Bell Journal of Economics and Management Science* (Spring 1971).

⁴Becker, Gary, "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, March/April 1968.

⁵Ehrlich, Issas, "Participation in Illegitimate Activity: A Theoretical and Empirical Investigation," *Journal of Political Economy*, May/June 1973.

theory of felony crimes. Stigler⁶ further developed the theory of law enforcement by examining the relationship between the optimal level of law enforcement and the damage the government suffers from criminal activity.

(cont fr p. 1) → This essay integrates the theory of illegal behavior into the economic analysis of regulation, developing implications for both the measurement of regulatory stringency and the determination of the economic effects of regulation. The discussion shows that measures of regulatory stringency must consider the level of law enforcement resources in addition to the statutory provisions in regulations. A more important conclusion is that an analysis of regulation that ignores the prospect of illegal behavior incorrectly analyzes the economic effects of changes in the statutory provisions of regulations. → (cont on p. 4)

While these conclusions are believed to apply to all forms of regulation, the discussion concentrates on the analysis of excise taxation for four reasons. First, the size of the tax appears to be the obvious measure of the stringency of regulation. Second, there exists a well-known traditional analysis of the economic effects of taxation that neglects the presence of tax evasion. Third, analyses of non-tax regulation attempt to derive an equivalent tax to summarize the effects of the regulation.⁷ Fourth, state government taxation of distilled

⁶Stigler, George, "The Optimum Enforcement of Laws, *Journal of Political Economy*, March/April 1970:

⁷Bhagwati, Jagdish, "On the Equivalence of Tariffs and Quotas," *Trade, Tariffs, and Growth: Essays in International Economics*, 1969, presents a theoretical discussion concerning the equivalence between tariffs and quotas. Peltzman, Sam, "An Evaluation of Consumer Protection Legislation: 1962 Drug Admendements," *Journal of Political Economy*, September/October 1973, derives a tax on new drugs that is equivalent to the control exerted on the rate of introduction of new drugs by the Federal Drug Administration.

cont'd
p. 3

spirits provides data concerning legal consumption, prices, tax rates, and tax enforcement budgets. With these data statistical tests can distinguish between the traditional and the alternative theories of the economic effects of taxation. The empirical results from the study of state taxation of liquor suggest replacing the traditional analysis by the proposed alternative analysis that emphasizes the importance of tax evasion.

The Traditional Analysis

The taxed good may be either a final or intermediate product, although the present discussion offers no distinction between the taxation of final and intermediate products. The discussion refers to the market for the taxed good as a product market, and the markets for the factors of production that produce the taxed good as factor markets. The distinctive feature of the traditional analysis is that it ignores the presence of tax evasion.

Suppose that the pre-tax demand and supply of a good are represented by the curves D_x and S_x^0 in Figure 1. The height of the demand curve depends upon income and the prices of other goods that are assumed constant in the analysis. The supply curve is upward sloping, reflecting the presence of resources specialized to firms (creating firm level decreasing returns to scale in output) and resources specialized to the industry (creating upward-sloping factor supply curves). The initial equilibrium is at price P_0 and quantity x_0 .

Suppose that a per unit tax is levied on the producers of the taxed good. By neglecting the presence of tax evasion, the traditional analysis derives the consequence of shifting the supply curve by the amount

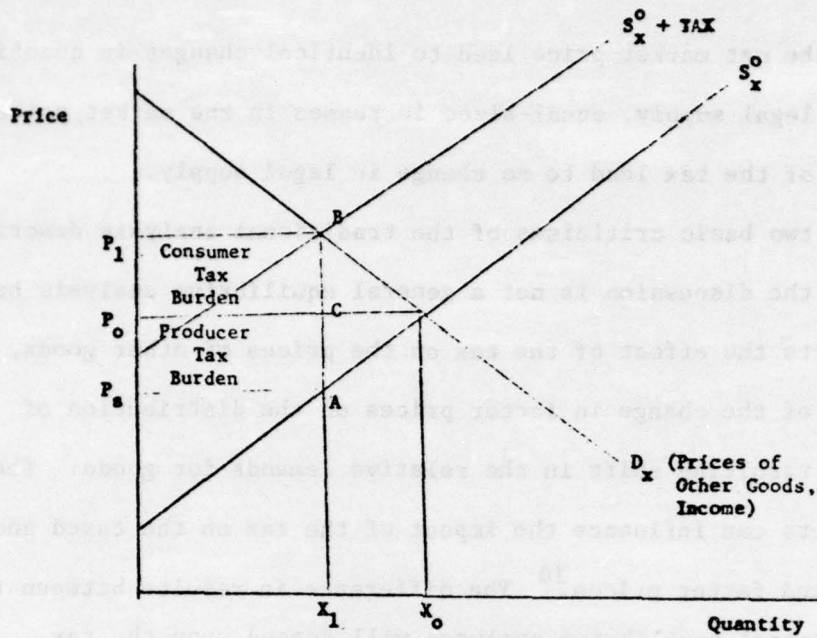


Figure 1. The Traditional Analysis of Taxation

of the tax.⁸ Taxation is seen to increase market price, from P_0 to P_1 , and decrease market quantity, from x_0 to x_1 . The increase in market price is less than the amount of the tax, implying that there is a decrease in the net price (market price less the amount of tax). The tax generates revenue $P_1 B A P_s$, the consumer share of the tax burden is $P_1 P_0 C B / P_1 B A P_s$. It is well known that the quantitative magnitude of these changes depend upon the elasticities of demand and supply.

The analysis places restrictions on the properties of the demand and supply curves.⁹ For legal demand, equal-sized changes in the amount

⁸ Taxation does not affect the tax exclusive supply conditions because taxation does not influence the cost minimizing factor proportions to produce a given level of output at specified factor prices. Compare this result with the conclusions below wherein the presence of tax enforcement alters the optimal factor proportions.

⁹ The restrictions follow from the assumption that quantity demanded depends only on market price (and not to be decomposition of market price into the net price and the tax rate) and that quantity supplied depends solely on the net price.

of the tax or the net market price lead to identical changes in quantity demanded. For legal supply, equal-sized increases in the market price and the amount of the tax lead to no change in legal supply.

There are two basic criticisms of the traditional analysis described above. First, the discussion is not a general equilibrium analysis because it neglects the effect of the tax on the prices of other goods, and the impact of the change in factor prices on the distribution of income and the resulting shift in the relative demands for goods. These neglected effects can influence the impact of the tax on the taxed good's output, price and factor prices.¹⁰ The difference in results between the partial and general equilibrium analyses will depend upon the tax studied. The differences in results are expected to be small whenever both the taxed good's budget share and industry's factor market shares are small. The difference between such partial and general equilibrium analyses shall not be pursued in the remainder of the discussion.

The second criticism pertains to the traditional analysis' failure to consider the presence of tax evasion. The difference between consumer and producer prices, P_1 and P_g in Figure 1, provide an incentive for tax evasion. To counter this incentive, the taxing government engages in tax enforcement. When the analysis is modified to include these considerations, there are substitutions in legal and illegal consumption and production that are ignored by the traditional analysis. These substitutions will be present in either the partial or general equilibrium analyses.

¹⁰ See Mieszowski, Peter, "On the Theory of Tax Incidence," *Journal of Political Economy*, June 1967.

The Alternative Analysis of Taxation

The alternative analysis uses a two-market model to study the relationship between the legal and illegal markets. The legal market refers to transactions that pay the excise tax, the illegal market refers to transactions that do not pay the tax. The analysis considers the properties of the product demand and supply curves for the legal and illegal markets, then proceeds to study how the market equilibria are influenced by changes in the tax rate and tax enforcement. The discussion is an exercise in pure theory, and shall not speculate about the ways in which tax evasion occurs in actual market situations. An application of the theory is presented in the study of state government taxation of distilled spirits.

The Legal and Illegal Demand for the Taxed Good¹¹

Since the legal and illegal markets are alternative sources for the taxed good, legal and illegal consumption are assumed to be substitutes.

The degree of substitutability between legal and illegal consumption depends upon the presence of psychic and monetary costs from tax evasion. The psychic costs arise from consumer tastes against engaging in illegal activity. The monetary costs arise from the apprehension and punishment of consumers of illegal goods, and any higher product and price information costs in the illegal market resulting from the attempt to conceal tax evasion from tax enforcement officers.

Ignoring potential differences in product quality, the absence of psychic and monetary costs from tax evasion implies that the procure-

¹¹The discussion assumes that consumers do not generate their own illegal supply of the taxed good. Otherwise, illegal product demand would not be independent of illegal product supply.

ment of product services is the only utility flow associated with consumer participation in the legal and illegal markets. Under such circumstances substituting one unit of legal for one unit of illegal quantity leaves the total amount of product services unchanged; legal and illegal quantities are perfect one-for-one substitutes in consumption for individual consumers or firms.

With psychic and monetary costs from tax evasion, the consumer balances these costs and the product services from illegal consumption against the product services from legal consumption. When the marginal costs from tax evasion are constant, legal and illegal consumption are still perfect substitutes for individuals or firms, but not one-for-one. Alternatively, when the marginal costs depend upon the level of illegal consumption, legal and illegal consumption are imperfect substitutes; they are assumed to display a declining marginal rate of substitution.

Legal and illegal consumption can be imperfect substitutes at the market level, even if they are perfect substitutes for each individual. Suppose that individual consumers or firms differ in the levels of their constant marginal costs of evasion. Such differences result from individuals possessing different attitudes toward tax evasion, different probabilities of being caught, and different vulnerabilities to punishment (for example, a prison sentence of given length is more onerous to people with higher values of time). The differences in the marginal cost of evasion lead individuals to require different price differentials between legal and illegal consumption to induce them to leave one market and to enter the other. For a given legal market price, a reduction in the illegal market price leads some, but not all, consumers to substitute illegal consumption.¹²

¹²The restriction that own price effects dominate cross-price effects is placed on the demand functions. This assumption allows the dismissal of the possibility of Edgeworth's Taxation Paradox. See *infra*, page 25.

The Legal and Illegal Supply for the Taxed Good

Suppliers have the options of specializing in either legal or illegal production, or non-specializing by producing for both markets. Legal sales are the firm's sales that are reported to the government, and illegal sales are the firm's unreported sales. The model of these supply decisions is based upon the hypothesis that suppliers maximize the expected profits from legal and illegal production. The discussion explicitly ignores entrepreneur attitudes toward risk, and how risk preferences influence the choice between legal and illegal production. This omission is noteworthy because legal production is riskless, while illegal production is subject to the uncertainty of apprehension, conviction, and punishment.¹³ The production technology, the expected punishment function, and factor supply conditions are important elements of the theory of product supply. The theory of product supply is developed to emphasize that the presence of specialized factors generates the supply side substitution between legal and illegal markets. Individual firms are assumed to be price-takers in all product and factor markets.

A. Production Technology. Each firm is assumed to be a potentially multi-product firm that produces both legal and illegal goods. The level of legal and illegal production depends upon the quantities of hired factors, L and L_2 , and resources, R , that are specialized to the firm. Assuming that legal and illegal production is non-joint,¹⁴ the production functions are:

¹³ Ehrlich, supra note 5, argues that risk preferers are more likely to specialize in illegal activity, while risk-avoiders are more likely to diversify their risks by participating in both legal and illegal activities, or to specialize in legal activities.

¹⁴ The non-jointness assumption emphasizes that the substitution between legal and illegal production results from specialized resources to the firm or to the industry.

$$x_L = f_L(L_1^l, L_2^l, R^l)$$

$$x_I = f_I(L_1^i, L_2^i, R^i)$$

where the superscripts for the factors refer to participation in legal "l" and illegal "i" production. The assumption of non-jointness allows the unique allocation of factors to outputs.

Both production functions are assumed to be constant returns to scale in the hired factors and the firm's specialized factor. Since the level of the firm's specialized factor is constant, there can only be variations in the quantities of the hired factors of production; suggesting that there are decreasing returns to scale in the hired factors.

B. Expected Punishment. Expected punishment (EP) measures the costs tax violators suffer from the apprehension, conviction, and punishment for tax evasion. The probability of apprehension and conviction, P_a , reflects the likelihood of apprehension, and depends upon the number of units supplied to the illegal market, x_I , and the level and productivity of resources devoted to the apprehension of tax violators, α_p .^{15,16} Once apprehended and convicted, there are two forms of punishment: fines and imprisonments levied on the hired factors of production and the firm's specialized resources engaged in illegal activity, and the confiscation of apprehended illegal production. The fines and

¹⁵ See Smith, Rodney, "The Legal and Illegal Markets for Taxed Goods and Taxation Policy: Pure Theory and an Application to State Government Taxation of Distilled Spirits," Chapter 3 for a discussion of the determination of the level of resources allocated to tax enforcement. The characteristics of markets and jurisdictions believed to influence the productivity of these resources in the apprehension of violators of the state liquor tax is discussed infra, pp. 49-50.

¹⁶ The discussion abstracts from the ability of tax violators to protect themselves from apprehension by investing resources that obscure their illegal activity from tax enforcement authorities. Such self-protection by violators could include participation in the legal market so that detection of the firm's existence by tax authorities does not necessarily imply detection of the firm's tax violations.

imprisonments meted out on convicted entrepreneurs and factors, FI , depend on the level of illegal production, the quantity of factors allocated to illegal production, and the severity of this form of punishment, α_F .^{17,18} The severity of punishment by confiscation of apprehended illegal transactions is equal to the expected value of apprehended illegal units, $P_a P_I x_I$, multiplied by the conditional probability of confiscation given apprehension and conviction (that is assumed to be unity). Consequently, expected punishment is described by the following equation:

$$EP = P_a(x_I, \alpha_p) \{FI(L_1^i, L_2^i, x_I, \alpha_F) + P_I x_I\}$$

or

$$EP = EP(x_I, L_1^i, L_2^i, \alpha_p, \alpha_F, P_I) .$$

The theory of rational law enforcement, as developed by Becker¹⁹ and Stigler,²⁰ can be used to infer properties of the expected punishment function.

Rational law enforcement dictates that the government construct the expected punishment function so that prospective violators consider the damage their violations inflict on society when determining the level

¹⁷Fines and imprisonments can be measured in the same units by using monetary equivalents for imprisonments (based upon foregone earnings while in prison, reduced future earnings, and the monetary value of the disutility of imprisonment).

¹⁸This specification of the fines and imprisonment function assumes that the tax enforcement authorities distinguish between hired factors used for legal and illegal production by the same firm. If this distinction is not made, then the level of hired factors used in legal production, L_1^l and L_2^l , should be introduced into the FI function for firms engaging in tax evasion.

¹⁹Supra note 4.

²⁰Supra note 6.

of illegal production. Since it is costly to apprehend, convict, and punish tax violators, it does not pay for the government to deter all violations. However, the larger the damage from tax violations, the larger the optimal expected punishment. The properties of the expected punishment schedule depend upon the relationship between the amount of tax evasion and the damage the government suffers from tax evasion.

Tax evasion is assumed to inflict damage on the government, regardless of the political motivation for taxation. Tax evasion represents uncollected revenue and the ability of the market to partially circumvent the government's intention to reduce the total consumption of the taxed good. Given rational tax enforcement, there is a positive marginal expected punishment from illegal production. Furthermore, the larger the amount of tax evasion, the larger the marginal damage from additional tax evasion.²¹ Rational tax enforcement also implies that the marginal expected punishments for illegal production and hired factors increase with the level of tax evasion.

The marginal expected punishments also increase when there is an increase in the stringency of tax enforcement and punishment: a_p and a_F . The stringency of enforcement and punishment, while unobservable variables, may be related to a variety of observable variables, as seen in the analysis of state taxation of liquor.

²¹The existence of taxation implies that the generated tax revenue and the reduced consumption of the taxed goods are economic goods. A downward-sloping demand for these goods imply that the marginal evaluation of generating additional tax revenues is inversely related to the level of revenue already generated. A similar statement is true for taxation objectives related to reducing the consumption of the taxed good. See Smith, *supra* note 15, Chapter 3.

C. Factor Supply Conditions. The supplies of hired factors to the taxed industry are increasing functions in factor prices, reflecting the specificity of resources to the taxed industry. The relevant factor prices are the factor market prices adjusted for the occupational hazard of incurring expected punishment for participating in tax evasion. While these adjusted factor prices are identical among firms (due to firms being price-takers in factor markets), observed factor prices that are unadjusted for expected punishment vary among firms because firms differ in their levels of illegal production. Firms specializing in legal production do not need to compensate hired factors for the occupational hazards of illegal activity, and therefore pay hired factors their opportunity costs. Firms that produce some illegal production pay higher factor prices to compensate the factors for their expected punishment from participating in tax evasion.²²

D. Firm Supply Behavior. Entrepreneur supply decisions are determined by the maximization of expected profit, π , subject to the constraint of the firm's production functions and the supply of resources that are specialized to the firm. Expected profit is the receipts from legal and illegal production less factor costs, tax payments, and expected punishment:

²²This statement does not imply that firms bear the entire burden of expected punishment imposed on hired factors. The expected punishment imposed on hired factors reduces the demand for the factors of production, thereby reducing factor prices.

$$\pi = P_L x_L + P_I x_I - w_1(L_1^l + L_1^i) - w_2(L_2^l + L_2^i) - x_L T - EP(x_I, L_1^i, L_2^i, \alpha_P, \alpha_F, P_I)$$

where w_1 and w_2 are factor market prices adjusted for the expected punishment suffered by hired factors.

The constraints are:

$$x_L = f_L(L_1^l, L_2^l, R^l)$$

$$x_I = f_I(L_1^i, L_2^i, R^i)$$

$$R^l + R^i = R .$$

By substituting the production functions into the expected profit function, the optimization problem reduces to selecting the levels of hired factors for legal and illegal production, and allocating the firm's specialized resource between legal and illegal production.

The first order equilibrium conditions are:

Legal Production

$$(P_L - T) \frac{\partial f_L}{\partial L_1} = w_1 \quad (2)$$

$$(P_L - T) \frac{\partial f_L}{\partial L_2} = w_2 \quad (3)$$

$$(P_L - T) \frac{\partial f_L}{\partial R^l} = \lambda \quad (4)$$

Illegal Production

$$(P_I - \frac{\partial EP}{\partial x_I}) \frac{\partial f_I}{\partial L_1} = w_1 + \frac{\partial EP}{\partial L_1} \quad (5)$$

$$(P_I - \frac{\partial EP}{\partial x_I}) \frac{\partial f_I}{\partial L_2} = w_2 + \frac{\partial EP}{\partial L_2} \quad (6)$$

$$(P_I - \frac{\partial EP}{\partial x_I}) \frac{\partial f_I}{\partial R^i} = \lambda \quad (7)$$

Employment of the Firm's Specialized Resource

$$R^l + R^i = R \quad (8)$$

where λ is the La Grangean multiplier measuring the marginal expected profit of the firm's specialized resource. The equilibrium conditions state that the optimal level of each factor equates the value of its marginal product to its factor price, inclusive of its marginal expected punishment.

The equilibrium conditions show that the imposition of expected punishment on hired factors influences optimal factor proportions. Equations (5) and (6) show that the optimal factor proportions for

illegal production equate the marginal rate of substitution to the ratio of the sum of real factor prices and the marginal expected punishment of factors. But without taxation and tax enforcement, this marginal rate of substitution would be equated to real factor prices.²³

Illegal production selects different factor proportions than production before taxation; illegal production being less intensive in the factor with the proportionately largest marginal expected punishment component. Equations (2) and (3) show that the presence of tax enforcement does not influence factor proportions for legal production because the optimal factor proportions equate the marginal rate of substitution to the ratio of real factor prices.²⁴

Equilibrium conditions (4), (7), and (8) represent an implicit market within the firm for the firm's specialized factor of production. Legal and illegal production compete for the specialized factor, the optimal allocation of that factor equating the specialized factor's marginal expected profit from legal and illegal production. An alternative formulation of the optimization problem would be to treat the shadow price of the specialized resource as a factor price, and formulate separate profit maximizing problems for legal and illegal production. The equilibrium conditions for legal and illegal production would be equations (2)-(4) and (5)-(7), respectively. The equilibrium shadow

²³ See Wisecarver, Dan, "The Social Costs of Input-Market Distortions," *American Economic Review*, June 1974, for a presentation of the conventional tax analysis wherein taxation of inputs, but *not* output, leads to the distortion of factor proportions. The results in the text show that taxation of output also leads to the distortion of factor proportions, thereby inducing society to operate within its production possibility frontier.

²⁴ If the tax enforcement authorities punish all hired factors employed by the firm, instead of only the factors devoted to illegal production, then tax enforcement influences legal production factor proportions for firms producing for both the legal and illegal markets. Equations (2) and (3) would include the marginal expected punishment of hired factors as an additional cost of factor employment.

price for the specialized factor would be determined by the supply condition in equation (8) and the factor demands for the specialized factor in legal and illegal production. The specialized factor captures the firm's expected profit, by virtue of the assumption that the legal and illegal production functions are linear homogenous in the hired and specialized factors.²⁵ The firm's expected profit becomes the economic rent of the firm's specialized factor. For firms producing for both the legal and illegal markets, the shadow price of the specialized resource influences the allocation of the specialized resource between legal and illegal production.²⁶ The opportunity cost of the firm's specialized resource is reflected in the firm's legal and illegal supply curves.

Equations (9) present the supply curves for firms producing for both legal and illegal markets:²⁷

$$x_L = x_L(P_L - T, P_I, \alpha_p, \alpha_F) \quad (9)$$

$$x_I = x_I(P_I, P_L - T, \alpha_p, \alpha_F) .$$

²⁵ See Smith, supra note 15, where it is shown that the equilibrium marginal expected profit, λ , is equal to a first-order approximation to expected profit, divided by the quantity of the specialized resource:

$$\lambda \approx \frac{\pi}{(R^l + R^i)}$$

²⁶ See Pfouts, Ralph, "The Theory of Cost and Production in the Multi-Product Firm," *Econometrica*, 1961, for a fuller discussion of how a firm's specialized resource becomes unspecialized within the multi-product firm.

²⁷ See Smith, supra note 15 for a formal derivation of the properties.

Both supplies are increasing functions of their own prices because of the inelastic supply of the firm's specialized factor.^{28,29} Legal and illegal production are substitutes because, for example, an increase in the legal price leads to an expansion of legal production that bids up the shadow price of the specialized factor, leading to a reduction in illegal production.³⁰ This substitution between markets would not occur if there were no resources that are specialized to the firm. This implied substitutability in production also suggests that an increase in tax enforcement (by increasing the probability of apprehension, α_p , or the severity of punishment, α_F) leads to a reduction in illegal and an increase in legal production.³¹ Firms producing for only one market

²⁸ See Muth, Richard, "The Derived Demand Curve for a Production Factor and the Industry Supply Curve," *Oxford Economic Papers* (new Series), July 1964, for a discussion of how a linear homogeneous production function leads to a finite industry supply elasticity when industry factor supplies are not perfectly elastic. It is straightforward to extend the result to firm supply when there are resources specialized to the firm.

²⁹ An increase in the illegal market price also increases the costs of illegal production because the higher price intensifies the severity of punishment by the confiscation of apprehended illegal units. However, higher illegal prices leads to a larger increase in the return than the cost of illegal production because the expected punishment from confiscation represents only a fraction of the total costs of illegal production.

³⁰ Restrictions can be placed on the supply curves that are similar to the restrictions placed on the demand elasticities: in particular, direct-price effects are assumed to dominate cross-price effects.

³¹ The assumption of risk neutrality implies that an equal percentage change in the probability of apprehension or the severity of punishment leads to identical percentage changes in legal and illegal production. If entrepreneurs are risk-averse, then legal and illegal production would be more responsive to proportionate changes in the severity of punishment than the probability of apprehension. See Becker, supra note 4.

do not display the substitutability between legal and illegal production. Evidence showing that enforcement efforts influence firm legal supply would reject the hypothesis that firms only participate in one market.

The profitability of firms depends upon market prices, taxation, tax enforcement, and factor prices.³² For firms producing for both markets, their profitability is directly related to legal and illegal market prices because higher market prices increase the revenue obtained from production. These firms' profitability is diminished by more taxation, tax enforcement, and higher factor prices because these variables increase the operating costs of the firms. The profitability of firms producing solely for the legal market is insensitive to tax enforcement and the illegal market price because these firms' costs and revenues depend solely on the legal market price, the tax rate, and factor prices. The profitability of firms producing solely for the illegal market is insensitive to taxation and the legal market price.

E. Market Supply. Industry supply is obtained by aggregating over firm supply curves. The industry supply response to product prices, taxation, and tax enforcement differ from the firm supply response for two reasons. First, the supply of hired factors to the industry is not infinitely elastic; reflecting the specificity of factors to the industry. Second, changes in market price and taxation policy can lead to the entry and exit of firms between the legal and illegal markets. Both effects

³²See Smith, supra note 15, for a formal discussion of profitability. Note that the discussion in the text is a partial analysis because changes in the tax rate and tax enforcement are studied independently of changes in product and factor prices. See infra, pages 23-26 for the relationship between legal and illegal market prices, taxation, and tax enforcement.

lead to substitution between legal and illegal production at the market level of aggregation, even if such substitution is absent within individual firms.

The specificity of hired factors to the taxed industry influences legal and illegal market supply by making the supply of firms producing for one market depend upon the product price in the other market. An increase in the illegal product price bids up hired factor prices, that in turn reduce legal production. This conclusion suggests that illegal market supply also depends on taxation and the legal market price, while legal market supply also depends on tax enforcement; even if the firm supply curves do not.

The entry and exit of firms between the legal and illegal markets leads to additional substitution between legal and illegal production when firms produce solely for one market. Increases in tax enforcement induce firms to exit from the illegal market, and leads to a reduction in factor prices because of the decline in factor demand by firms exiting from the illegal market. The lower factor prices increase the profitability of legal production, implying that tax enforcement leads to an entry of firms into the legal market.³³ Similarly, taxation induces firms to exit from the legal market and enter the illegal market.

Market Equilibrium

The legal and illegal market prices and quantities are determined by the demand and supply conditions for both markets. The markets are inter-related because both markets display substitution in both consumption and

³³ Note that if it is optimal for firms to produce for both markets, then tax enforcement leads to a *reduction* of firms (and therefore legal firms) because there is a decline in firm profitability.

production. Taxation policy changes the relative price of legal and illegal goods thereby creating shifts in legal demand and supply that are ignored by the traditional analysis.

Increased Taxation.³⁴ Figures 2 and 3 depict each market's demand and supply before and after the increase in the tax rate. The before curves, denoted by the superscript B, are evaluated at the initial equilibrium's relative prices: $(P_x^i/P_x^l)_0$ and $(P_x^i/P_n)_0$.³⁵ The after curves, denoted by the superscript A, are evaluated at the new equilibrium's relative prices: $(P_x^i/P_x^l)_1$ and $(P_x^i/P_n)_1$. The adjustment from the initial to the new equilibrium is not described.

In Figure 2 the curves $D^B(P_x^i/P_x^l)$ and $S^B(P_x^i/P_n) + \text{tax}^B$ represent the legal market's pre-tax change demand and supply curves. The initial equilibrium quantity, price, and net price are x_1^0 , p_x^1 , and P_n^0 . Holding constant at their initial levels the ratios of the illegal price to both the legal and net legal prices, increasing the tax rate from tax^B to tax^A shifts the supply curve to $S^B(P_x^i/P_n) + \text{tax}^A$ (the broken line in the figure). This is the shift discussed by the traditional analysis, that predicts that the new equilibrium quantity, price, and net price are x_L^T , P_L^T , P_N^T . However, these prices and quantity are not an equilibrium position because the demand for the legal market good declines to $D^A(\frac{P_I}{P_L})$ in response to the increase in the price of legal relative to illegal consumption; while the legal supply shifts to $S^A(\frac{P_I}{P_N})$ in response to the decline in the net legal price relative to the illegal market

³⁴See the Appendix for an algebraic derivation of the results. The Appendix shows that taxation increases the price of legal relative to illegal consumption, and reduces the net legal price relative to the illegal market price. Both results are used in the following discussion.

³⁵The demand and supply curves were written in terms of our price and relative legal and illegal price to facilitate the graphical presentation.

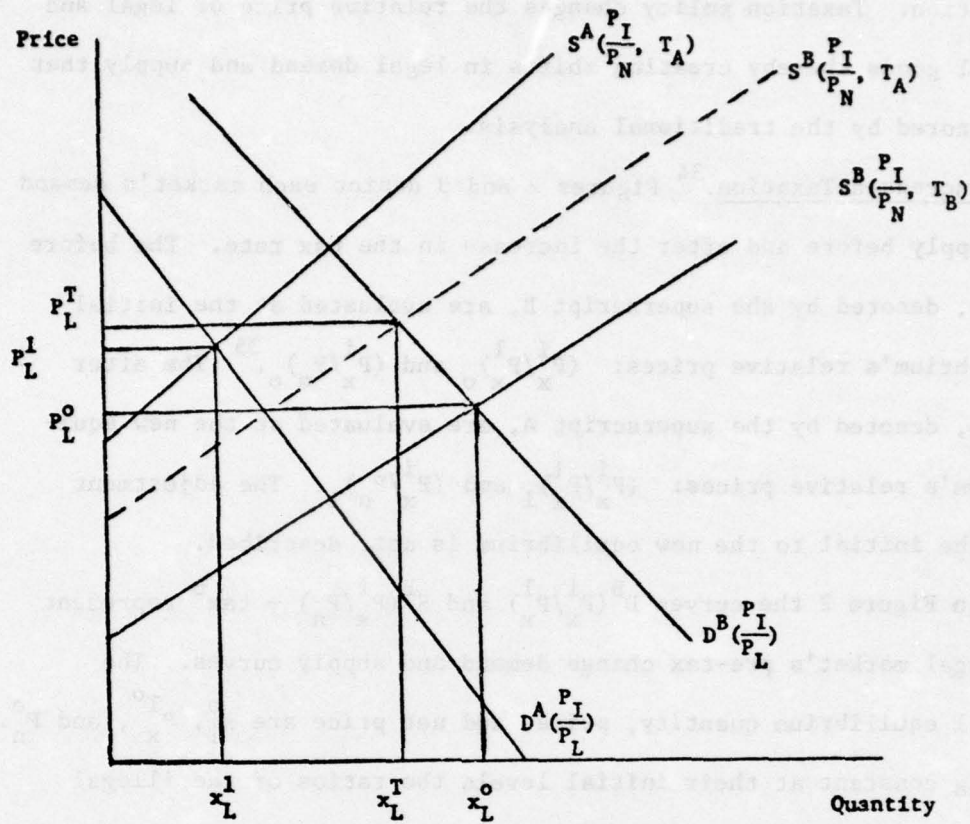


Fig. 2--The Legal Market

price. These subsequent shifts imply that the new equilibrium quantity is less than x_L^T . The traditional analysis understates the decline in equilibrium legal quantity.

The subsequent shifts in legal market demand and supply curves have conflicting effects for determining how the equilibrium legal market and legal net prices differ from the predictions of the traditional analysis. The decline in demand suggests that the legal market and legal net prices are lower than predicted by the traditional analysis. The shift in supply suggests that the price is higher. If the demand shift dominates, then the traditional analysis overstates the increase

in the legal price, and understates the decrease in the legal net price; thereby understating the producer tax burden. The Appendix shows that the demand shift dominates whenever taxation decreases the illegal market price.

If direct price effects were not assumed to dominate cross-price effects in demand and supply, then the subsequent shift in legal demand could be sufficiently large to reduce the equilibrium legal price (implying that producers bear the entire tax burden).³⁶ In this case the traditional analysis' conclusion that taxation increases market prices is invalid once the taxed market is allowed to interact with the illegal market. This conclusion is a re-statement of Edgeworth's Taxation Paradox.

Edgeworth believed that his paradox was a consequence of monopoly.³⁷ Hotelling showed that the Taxation Paradox can occur under competition; the necessary conditions for the paradox being that the two goods under analysis be substitutes in both consumption and production. While Hotelling concluded that these necessary conditions would not be satisfied in all cases, *every* taxed good satisfies the necessary conditions for Edgeworth's Taxation Paradox because legal and illegal markets are substitutes in both consumption and production. However, the present analysis dismisses the possibility of the Edgeworth Taxation Paradox by assuming that direct price effects dominate cross-price effects.

If the subsequent supply shift dominates the subsequent demand shift in Figure 2, the traditional analysis understates the increase

³⁶ See Appendix.

³⁷ See Hotelling, Harold, "Edgeworth's Taxation Paradox and the Nature of Demand and Supply Functions," *Journal of Political Economy*, October 1932.

in the legal market price; thereby overstating the producer tax burden. The Appendix shows that this occurs if the taxation increases the equilibrium illegal price of the taxed good, but taxation can never increase the net legal price.³⁸

In Figure 3, the curves $D_B(P_L/P_I)$ and $S_B(P_N/P_I)$ represent the pre-tax change demand and supply curve for the illegal market. Increased taxation shifts these curves by altering the relative prices of legal and illegal consumption. The increase in the price of legal relative to the price of illegal consumption causes an increased demand for the illegal market quantity as consumers substitute away from legal consumption. The decrease in the ratio of the net legal price to the illegal market price causes an increase in illegal supply as producers substitute away from the legal market. These shifts in demand and supply

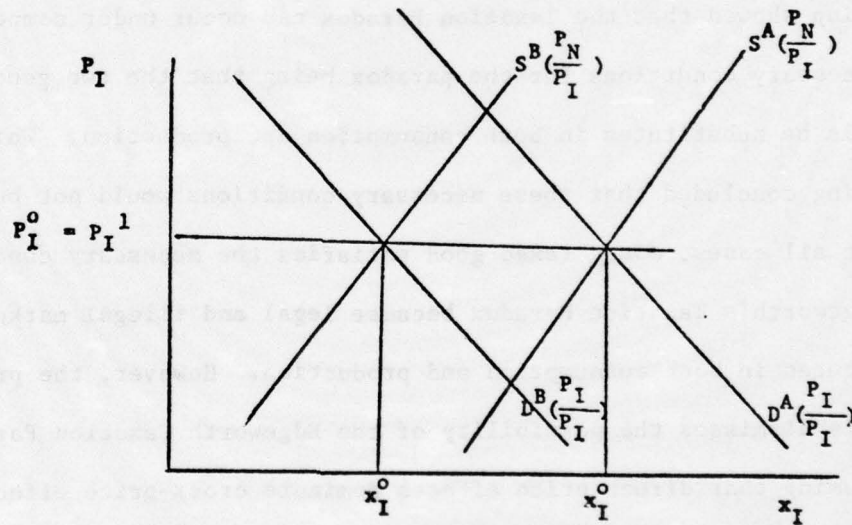


Fig. 3--The Illegal Market

³⁸ If Edgeworth's Taxation Paradox was not excluded, then taxation could increase the net legal price. See Appendix. Hotelling, page 603, also concluded that taxation could increase the net legal price if the two markets satisfied the necessary conditions for Edgeworth's Taxation Paradox.

imply that there is an increase in the illegal quantity, while the change in the illegal price depends on two conflicting effects whose relative magnitude are not known in general. Figure 3 depicts the case where the demand and supply shifts offset each other, implying that the illegal price is unaffected by taxation.

Taxation and Firm Profitability. The impact of increased taxation on firm profitability depends upon each firm's participation in the legal and illegal markets, and whether additional taxation increases or decreases the equilibrium illegal market price. Additional taxation unambiguously reduces the profitability of firms producing exclusively for the legal market because additional taxation reduces the legal market price net of the tax. Additional taxation has an ambiguous effect on the profitability of firms producing exclusively for the illegal market because the illegal market price can either rise or fall. Similarly, additional taxation has an ambiguous impact on the profitability of firms producing for both the legal and illegal markets. The change in the profitability of these firms depends upon the changes in the profitability of legal and illegal production and each firm's volume of sales to each market.

The Impact of Increased Tax Enforcement. The impact of increased tax enforcement is qualitatively symmetric to an increase in the tax rate; detailed analysis is not presented. Increased tax enforcement would decrease the size of the illegal market, increase the size of the legal market, and increase the ratio of the illegal to the legal market prices. While the change in the level of the legal market price is *a priori* indeterminate, additional tax enforcement increases the illegal market price. Firms specializing in illegal production suffer losses, while firms specializing in legal production may enjoy gains.

Firms producing for both markets may either gain or lose from additional tax enforcement.

Empirical Tests to Distinguish Between the Traditional and Alternative Analysis

The presence of interaction between legal and illegal demand and supply, the distinguishing feature between the traditional and alternative models, can be empirically verified by testing propositions concerning the performance of market price, tax rate, and tax enforcement variables in legal demand and supply equations. According to the traditional model, equal-sized increases in the tax rate and the net legal price lead to equal-sized reductions in the quantity demanded for the legal market's good. Similarly, legal supply depends upon the net legal price, so that equal-sized increases in the tax rate and the legal price lead to no change in the quantity supplied to the legal market. The alternative model concludes that such restrictions on legal demand and supply should not be observed empirically because these restrictions ignore the substitution between legal and illegal markets.

Consider legal market demand. Increases in the tax rate, holding constant the net legal price, increase the price of the legal market good and reduces the legal quantity demanded. Since additional taxation also increases the price of legal relative to illegal consumption, there is an additional decline in the legal quantity demanded as consumers substitute between the legal and illegal markets. Similarly, increases in the net legal price, holding constant the tax rate, also increase the price of the legal good and reduces the legal quantity demanded. However, if the forces that increased the net legal price,

such as higher factor prices, increases the costs of legal and illegal production, then the change in the net legal price has no direct effect on the relative price of legal and illegal consumption, and does not lead consumers to substitute between the legal and illegal markets. Consequently, increases in the tax rate reduce legal quantity demanded more than equal-sized increases in the net legal price.^{39,40}

The performance of the tax enforcement variable also tests the hypothesis that there is significant substitution between the illegal and legal consumption and production. In the demand equation, the tax enforcement variable measures the impact of changes in enforcement on the relative price between legal and illegal consumption, and the resulting substitution undertaken by consumers. In the supply equation, the tax enforcement variable measures the impact of changes in tax enforcement on the relative price between legal and illegal production, and the resulting substitution undertaken by producers.

³⁹Algebraically, the partial differentials of legal quantity demanded with respect to the tax rate and net legal price are:

$$(*) \quad \left. \frac{\partial X_L}{\partial T} \right|_{P_N} = \frac{\partial X_L}{\partial P_L} + \frac{\partial X_L}{\partial (P_I/P_L)} \frac{\partial (P_I/P_L)}{\partial T}$$

$$(**) \quad \left. \frac{\partial X_L}{\partial P_N} \right|_{T} = \frac{\partial X_L}{\partial P_L} + \frac{\partial X_L}{\partial (P_I/P_L)} \frac{\partial (P_I/P_L)}{\partial P_N} = \frac{\partial X_L}{\partial P_L}$$

$$\left. \frac{\partial X_L}{\partial T} \right|_{P_N} - \left. \frac{\partial X_L}{\partial P_N} \right|_{T} = \frac{\partial X_L}{\partial (P_I/P_L)} \frac{\partial (P_I/P_L)}{\partial T} < 0$$

because $\frac{\partial X_L}{\partial (P_I/P_L)} > 0$ and $\frac{\partial (P_I/P_L)}{\partial T} < 0$.

⁴⁰An analogous discussion of legal supply leads to the conclusion that equal-sized increases in the tax rate and the legal price *reduce* the quantity supplied to the legal market.

An Empirical Study of State Taxation of Distilled Spirits

The study of state taxation of distilled spirits provides evidence supporting the alternative analysis of excise taxation. Using data from a 1970 cross-section of states, analysis of the legal market for distilled spirits provides evidence of substitution between the legal and illegal markets, as shown by the significant impact of tax enforcement on legal demand and supply, and the differential responsiveness of legal demand and supply to changes in the tax rate and market price. Variables believed to influence the ability to enforce its tax are seen to reduce legal supply. These empirical results are used for a variety of issues: the comparison of the traditional and the alternative analyses' predictions of a consumer tax burden, the relationship between tax enforcement and legal market price, and the impact of state versus private ownership of retail outlets on the legal market price.

State Government Taxation and Regulation of Distilled Spirits⁴¹

State governments administer their taxation and regulation of distilled spirits by two methods: *monopoly control* where bottled distilled spirits are sold in state-owned stores, and *license control* where distilled spirits are sold in privately-owned stores that are licensed by the state. The systems differ in their methods of taxation and licensing, but are similar in their regulation of other elements of the sale of

⁴¹ See the Distilled Spirits Institute, *Summary of State and Local Laws and Regulations Relating to Distilled Spirits*, Washington, D.C. (1972) for a summary of state laws and regulations governing the sale of distilled spirits. See the Joint Committee of the States to Study Alcoholic Beverage Laws, *Alcoholic Beverage Control* (1960), for a discussion of the licensing procedures and enforcement commissions used by the state governments.

distilled spirits. Both systems restrict the hours of business, place minimum ages for legal customers, limit the choice of bottle size, and restrict the advertising of alcoholic beverages.

In monopoly states,⁴² taxes are levied by the legislation specifying the state stores' pricing policy. The pricing legislation determines the stores' percentage mark-ups and allowable discounts. Some monopoly states also levy explicit *ad valorem* or per gallon taxes. Since the state owns all outlets selling distilled spirits for off-premise consumption, monopoly states only issue licenses for privately-owned establishments that sell distilled spirits for on-premise consumption. The government allocates licenses according to non-monetary criteria (such as integrity) in addition to the collection of license fees. Some states place statutory limitations on the number of licenses issued by the state government.

In license states, per gallon taxes are levied on wholesalers. Many license states also have retail price maintenance, but differ on whether the price guidelines are mandatory, or binding for non-signers of the retail price maintenance agreements. The license states issue licenses for privately-owned, on- and off-premise, consumption establishments. As with monopoly states, the government allocates licenses according to non-monetary criteria as well as fees, with some states placing statutory limitations on the number of licenses issued.

⁴² The monopoly states are Alabama, Idaho, Iowa, Maine, Michigan, Mississippi, Montana, New Hampshire, Ohio, Oregon, Pennsylvania, Utah, Vermont, Virginia, Washington, West Virginia, and Wyoming. In 1970 these states accounted for approximately 25 percent of the United States consumption of distilled spirits.

Monopoly and license states have created Alcoholic Beverage Control Commissions to enforce the taxation and regulation of distilled spirits. In many monopoly and license states, special tax agencies collect taxes levied on alcoholic beverages. The collected revenue is distributed among states' general revenue funds, local governments by tax revenue-sharing, and earmarked projects ranging from public schooling to the rehabilitation of alcoholics.⁴³

In many states, local governments also possess the power to license retail outlets. The power to license can include the approval of applicants for state licenses. The license fees collected are retained by the local governments.

Evasion of Distilled Spirits Taxation

There are three distinct forms of illegal behavior associated with federal and state taxation of distilled spirits, only one form of behavior being considered in this study. The first form pertains to the evasion of production taxes levied on distilled spirits as they are produced domestically. The federal production tax has been \$10.50 per gallon since 1951. Evasion of this tax takes either the form of legally licensed manufacturers under-reporting their output to the Federal Government, or the manufacture of distilled spirits by unlicensed distillers (the latter are popularly known as "moonshiners"). Evasion of

⁴³In 1970, 13 percent of total tax revenue (taxes plus state store profits) were given to local governments. This transfer amounted to about \$250 million. In the same year, 21 percent of state tax revenue was allocated to earmarked projects.

production taxes is not considered in this study because states do not levy production taxes (the sole exception being Kentucky). Furthermore, any gains from evading production taxes will be distributed beyond an individual state's boundary because the production of hard liquor is a national industry. In fact, foreign competition is visibly important in this market, with imports accounting for approximately twenty-five percent of all distilled spirits entering domestic trade channels in 1970.⁴⁴

The second form of illegal behavior relates to consumers purchasing distilled spirits outside their state of residence, the incentive for this purchase being that their own state's regulation and taxation policy raises prices in their own state above prices prevailing in neighboring states. This consumer activity shall be called the border phenomenon. While illegal, the border phenomenon is not considered to be state tax evasion by this study. The government of the neighboring state may collect its tax on the purchases generated by the border phenomenon, so that these purchases appear in the neighboring state's legal market.⁴⁵

The final form of illegal behavior pertains to the evasion of the state tax levied on wholesalers. Evasion of this tax involves the under-reporting of sales by the state's wholesalers, and may involve distilled spirits that have paid the federal tax and any applicable import duties. This evasion is the subject of this study.

⁴⁴*Distilled Spirits Annual Statistical Review*, published by The Distilled Spirits Institute, Washington, D.C., 1970. The United States also levies import duties that in 1970 ranged from 80¢ to \$1.50 per gallon, depending upon the type of distilled spirit. This study shall also ignore the presence of smuggling of foreign produced liquor into the United States.

⁴⁵See *infra*, pages 56-58, for a discussion of how the presence of the border phenomenon affects the empirical analysis.

Measuring the Ability of State Governments to Enforce Their Tax

As discussed by the theory of supply, legal supply is affected by the ability of the state government to enforce its tax, as well as state taxation, regulation, and enforcement activities. The analysis attempts to measure state differences in this ability by variables related to the number of transactors in the taxed market and the relationship between state and local governments. While the identification of such variables is an important element in the empirical implementation of the theory presented in this essay, the current investigation has not concentrated on this area of research.

Markets with numerous transactors are expected to be more difficult to police than markets with few transactors, because there are more potential violators to monitor. The number of taxed firms (wholesalers) and the size of the state's drinking age population are used as measures of the number of transactors.

As emphasized by The Joint Committee of The States to Study Alcoholic Beverage Laws,⁴⁶ local government cooperation with state authorities is an important element in the enforcement of distilled spirits legislation. The presence of revenue sharing and local licensing confront local governments with conflicting incentives to cooperate with state tax enforcement.

When there is revenue sharing, local governments benefit from aiding state tax enforcement because local cooperation increases the tax revenue transferred from the state to the local governments. However, there is a common resource problem because the enforcement efforts by one local government increases the revenue obtained by all

⁴⁶Supra note 41.

other local governments in the state. Since states usually distribute the shared revenue in proportion to local population, the presence of revenue sharing is expected to primarily induce the large cities to aid in the enforcement of the state tax.⁴⁷

Alternatively, local government power to license retail outlets discourages local government cooperation with state tax authorities. For firms participating in both the legal and illegal markets, local cooperation with state tax enforcement reduces the gains from tax evasion, and thereby reduces the value of the local license.⁴⁸ Consequently, the variable measuring the incentive for local government cooperation with the state tax authorities must balance the effect of tax revenue sharing against the effect of local licensing of retail outlets. The selected variable is the fraction of local government alcoholic beverage revenue that originates from local licensing. The larger this fraction, the *less* incentive for local cooperation with state tax authorities.

Data Sources and Data Problems

The testing of the hypotheses discussed above utilizes data primarily collected by the Distilled Spirits Institute (DSI). Each year the DSI

⁴⁷ According to a marketing survey by *Time*, *Top 50 Metro Areas for 10 Types of Distilled Spirits* (1971), the fifty largest metropolitan areas accounted for approximately two-thirds of the 1970 national consumption of distilled spirits.

⁴⁸ The text assumes that additional tax enforcement reduces the profitability of firms producing for both the legal and illegal markets. The assumption is correct whenever tax enforcement does not influence market prices, but may be false once market prices change in response to additional tax enforcement, *supra* page 27. It seems appropriate to assume that a particular local government's decision to cooperate with state tax authorities will not affect market prices because most metropolitan areas can be considered price-takers in their regional markets for distilled spirits.

collects data concerning legal consumption,⁴⁹ tax rates, tax collections, state store revenues and operating expenses, state and local licensing revenues, number and type of retail outlets, and state government enforcement and administration expenditures.⁵⁰ Sources for other variables include the U.S. Treasury, for the number of wholesalers, the 1970 U.S. Census, for each state's drinking age population, age distribution, and mean income, and Clark Gavin-Jobsen Incorporated for market prices. All variables in dollar units are deflated by a state cost-of-living index constructed by Anderson.⁵¹ Tables 1 and 2 present summary statistics and simple correlations for the important variables. The study of state taxation of distilled spirits seems conducive to examining the relationship among the size of the legal market, the tax rate and the tax enforcement budget, as evidenced by the variability (as measured by the coefficient of variation) across states in these variables.

Unfortunately, there are difficulties with the quality of data for the tax rates, market prices, and enforcement expenditures. For states with license control, the tax rates were taken directly from the

⁴⁹ The legal consumption data is obtained from data on wholesalers' volume reported to the state governments.

⁵⁰ The consumption and retail outlet data are published in the *Distilled Spirits Industry Annual Statistical Review* (1970). Other DSI data are published in *Public Revenues from Alcoholic Beverages* (1970).

⁵¹ Anderson, Kent, "Residential Energy Use: An Econometric Analysis," The Rand Corporation, R-1297-NSF, October 1973.

Table 1

SUMMARY STATISTICS FOR IMPORTANT VARIABLES

<u>Variable</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Coefficient of Variation</u>
Consumption/1000 Adults	3329.78 (gallons)	1887.12	.57
Consumption/Retail Outlets	2437.14 (gallons)	1991.96	.82
Market Price	\$27.07 (per gallon)	3.1100	.11
Net Legal Price	\$22.98 (per gallon)	3.7922	.17
Tax Rate	\$4.0908 (per gallon)	2.8257	.69
Enforcement Budget/ 1000 Adults	\$606.896 (per 1000 adults)	492.948	.81
Lowest Tax Rate of Adjacent State	\$2.3200 (per gallon)	1.44	.62
Retail Licenses/ 1000 Adults	1,9635 (per 1000 adults)	1.2286	.63
Wholesalers/1000 Adults	.0612 (per 1000 adults)	.0279	.46

Table 2
SIMPLE CORRELATIONS

	Consumption/ 1000 Adults	Consumption/ Retail Outlet	Market Price	Net Market Price	Tax Rate	Enforcement Budget/1000 Adults	Lowest Tax of Adjacent State	Retail Licenses 1000 Adults	Wholesalers/ 1000 Adults
Consumption/ 1000 Adults	1.00								
Consumption/ Retail Outlet	.141	1.00							
Market Price	-.387	.264	1.00						
Net Market Price	-.11	.106	.681	1.00					
Tax Rate	-.277	.148	.186	-.592	1.00				
Enforcement Budget / 1000 Adults	-.032	.371	.040	-.414	.600	1.00			
Lowest Tax of Adjacent State	.041	.212	.270	-.126	.465	.250	1.00		
Retail Licenses/ 1000 Adults	.393	-.608	-.564	-.181	-.378	-.208	-.206	1.00	1.00
Wholesalers/ 1000 Adults	-.038	-.405	-.133	-.224	.155	.139	-.090	.475	1.00
Real Personal Income Per Capita	.569	-.072	-.203	.038	-.275	-.138	-.066	.254	-.138

legislation. For states with monopoly control, an implicit tax was calculated on the basis of states store profits.⁵² If the monopoly states also levied an explicit tax, then the explicit tax was added to the calculated shadow tax. Undoubtedly, this procedure is a rough approximation that introduces an error in variable problem into the tax rate variable. The direction of bias in the calculated tax rates cannot be determined *a priori*. The calculation procedure assumes that private retail outlets earn zero economic rent (imparting an upward bias)⁵³, alternatively the "non-profit" status of monopoly store entrepreneurs leads them to take more of their profits in non-pecuniary forms than private entrepreneurs (imparting a downward bias).

The Gavin-Jobson market price data are producer-suggested retail prices, and certainly introduce an error in variable problem. Transaction prices will differ from the suggested-price because of the presence

⁵²If state stores earned no monopoly profits, then the ratio of total revenue less operating costs to the value of capital assets would equal the competitive rate of return. Actual rates of return were calculated for each monopoly state's system of retail outlets, and the difference between the calculated rate and 10 percent (the assumed competitive rate of return) was interpreted as return from monopoly profits (*m*). This calculated return is a rough calculation because (1) the value of capital assets data was unattainable, and was approximated by operating expenses, (2) the opportunity cost of funds invested in inventories was not included because of the absence of inventory data. Using the calculated monopoly return, *M*, the implicit tax, *T*, was calculated by the following mark-up equation

$$P = (P - T)(1 + m) \quad (*)$$

Equation (*) says that the market price, *P*, is equal to the market price net of the tax, (*P-T*), multiplied by the one plus the monopoly return. Equation (*) can be solved for the implicit tax: $T = P \cdot m / (1+m)$. The average value for *m* was 38 percent. The average of the statutory mark-ups is 65 percent, see Distilled Spirits Institute (1972), but the base for the statutory mark-up is delivered cost of goods and does not include operating expenses.

⁵³If private firms earn economic rent, then state store profits would include economic rent as well as monopoly profits. By using state store profits as an estimate of monopoly profits, the calculation procedure estimates the shadow tax equivalent to both the economic rent and monopoly profits.

of discounts and off-list price changes. Furthermore, a complete price series was only available for blended distilled spirits, which is a popular type of distilled spirits but accounted for only twenty percent of total United States consumption of distilled spirits in 1970.⁵⁴

The enforcement expenditure variable also presents potential problems for the interpretation of the statistical results. First, the reported expenditures are for the enforcement of all alcoholic beverage legislation, not simply tax enforcement. If states differ in the fraction of their resources devoted to total alcoholic beverage legislative enforcement, an error in variable problem is created. Second, the expenditure variable neglects the presence of tax enforcement by the Federal Government. If federal and state enforcement efforts are substitutable, then higher state enforcement expenditures may represent offsets for lower federal tax enforcement, and, if true, lead to a downward bias in the estimated impact of additional state tax enforcement expenditures on legal demand and supply. Furthermore, since data on actual punishments meted out on convicted violators was not attainable, the exclusion of punishment data imparts an unknown bias for the estimated co-efficient of the enforcement variable.⁵⁵

Problems Confronting the Application of the Pure Theory of Tax Evasion to State Taxation of Distilled Spirits

The empirical testing of the hypotheses developed by the pure theory of tax evasion must consider the following potential modeling problems: the illegal behavior associated with the border phenomenon, the presence

⁵⁴ See Time Marketing Survey, supra page 50, note 1. See the following section for another problem associated with the price data.

⁵⁵ See Becker, supra note 4, and Stigler, supra note 6 for discussions on why increased demand for law enforcement lead to both more resources devoted to apprehending violators and more onerous punishment meted out on convicted violators: imparting an upward bias. Alternatively, if there is inter-state variation in the relative cost of apprehending violators and meting out punishment, such variation could lead to an inverse relationship between resources devoted to apprehending violators and punishments: imparting a downward bias.

of non-tax regulation by state governments, and the problem that state taxation occurs at the wholesale level, but the price data pertains to the retail market.

The presence of the border phenomenon leads the price elasticity of state market demand for distilled spirits to differ from the price elasticity of demand for distilled spirits by that state's resident population. When there is an increase in the market price in a low-priced state, the demand for distilled spirits in that state's market declines because the resident population consumes less distilled spirits by substituting to other goods, and fewer out-of-state residents cross-over the border to purchase distilled spirits. When there is an increase in the market price in a high-priced state, the demand for distilled spirits in that state's market also declines because residents purchase less distilled spirits by substituting to other goods, and more frequently cross-over to neighboring low-priced states to purchase their distilled spirits. For either type of state, the state's market demand curve is more elastic than the aggregation of the individual demands for distilled spirits by the state's resident population.

Wales has attempted to estimate the difference between the elasticity of market demand and the elasticity of the aggregate demand for distilled spirits by the state's resident population.⁵⁶ He concludes that virtually *all* of the observed price responsiveness of the state market's demand curve is associated with the border phenomenon. While thought-provoking, the Wales' conclusion relies upon an estimation technique that

⁵⁶ See Wales, Terence, "Distilled Spirits and Interstate Consumption Effects," *American Economic Review*, September 1968.

guarantees a biased estimate of the price elasticity of the aggregate demand for distilled spirits by the state's resident population,⁵⁷ suggesting that future research is required on this issue. Furthermore, Wales concludes that the difference between the elasticities of the state market demand and the resident's demand represents the estimation bias created by ignoring the border phenomenon.⁵⁸ However, this difference does not represent a bias if the analysis seeks to estimate the price elasticity of demand in the state market for distilled spirits.

⁵⁷ Wales' solution to the decomposition of the price elasticity for market demand can be illustrated by the following:

Let the demand in a state's market, C , depend upon market price, P , income, I , and a random disturbance term, μ .

$$(*) \quad C = a_0 + B_p P + B_I I + \mu$$

Assuming that μ is uncorrelated with market price and income, unbiased estimates of the price coefficient can be obtained by the use of ordinary least square. However, $(**)$ $B_p = B_T + B_s$

where

B_T is the price coefficient for the demand for distilled spirits by the state's resident population.

B_s is the price coefficient of out-of-state purchases. There is an identification problem; B_p cannot be decomposed into B_T and B_s . Wales pursues an interesting model that leads to the following equation:

$$(***) \quad C = a_1 + B_T \tilde{P} + B_I \tilde{I} + \tilde{\mu}$$

where \sim over the variables denotes that the variable is a function of the stated variable, and other independent variables measuring population density of adjacent states near the common border, and the adjacent state's price and income. Wales uses ordinary least squares to estimate the equation. However, the disturbance term in the equation depends upon *all* the "independent" variables included in the equation (see Wales, page 857). Since all the "independent" variables are correlated with the disturbance term, the use of ordinary least squares produces a biased estimate of the price coefficient. Thus, Wales' modeling solves the problem of decomposing B_p into B_T and B_s , but presents the problem, unsolved, of obtaining an unbiased estimate of B_T .

⁵⁸

See Wales, page 862.

While the border phenomenon is important for understanding the magnitude of the price elasticity of demand for a state market, the model estimated in this paper did not attempt to control for the border phenomenon. Fortunately, this model design decision does not bias the primary tests of the theory because the theory concerns the behavior of market curves, and the theory emphasizes the differential responsiveness of market demand to changes in the tax rate and the market price net of the tax. The price response of out-of-state purchases would pertain to increases in market price created by either an increase in the tax rate or an increase in the market price net of the tax.

The use of non-tax regulation by state governments, as described above, implies that the study of taxation policy may not capture all the ways in which state governments influence the market for distilled spirits. The low simple correlation between the market price and the tax rate illustrates that the interstate variation in the tax rate is not the dominant source of interstate variability in the price for distilled spirits. The model presented below does not explicitly consider non-tax regulation, but assumes that the primary effects of the regulations on legal supply operate through the effects of the regulations on the market price for distilled spirits.⁵⁹

⁵⁹See infra note 68 for how the estimated model relates increases in the number of retail licenses to reductions in the retail price for distilled spirits.

The final modeling difficulty pertains to the problem that state taxation occurs in the wholesale market, but the price data is for the retail market. According to the pure theory the substitution between legal and illegal markets should be observed in the taxed, wholesale market, but data availability requires that these substitutions be observed indirectly in the retail market. This modeling constraint suggests the following stylization of the model developed by the pure theory.

Substitutions between legal and illegal consumption may be unknown to consumers in the retail market. Consumers search among retailers to obtain distilled spirits at the lowest price, purchasing the quantity they demand at that price. The division of these sales between the legal (reported) and illegal (unreported) markets depends upon the profit-maximizing behavior of the suppliers, as described by the theory.

Both consumer demand and supplier decisions about tax evasion generate the apparent legal demand for distilled spirits.⁶⁰

The apparent legal demand curve for the retail market should display the differential responsiveness to changes in the tax rate and the net legal price. When the tax rate increases by a dollar, and the net legal price remains constant, consumers reduce their consumption of distilled spirits, and suppliers reduce the fraction of total sales reported to government. Alternatively, when the net legal price increases, but

⁶⁰In this model, the legal demand is the excess of total consumer demand for distilled spirits over illegal supply. The substitution between legal and illegal markets originates from illegal supply.

the tax rate remains constant, consumers reduce their total consumption, but suppliers have no direct incentive to reduce the fraction of total sales reported to the government. Since in both cases the impact on total consumption is the same, the differential responsiveness of legal demand to changes in the tax rate and the net legal price represents the hypothesis that higher tax rates reduce the fraction of total consumption reported to the government, while higher net legal prices do not alter the reporting decisions.⁶¹

Empirical Results

Table 3 presents the estimated equations for legal demand and legal supply. The equations were estimated by the seemingly unrelated regression technique that was developed by Zellner.⁶²

Legal demand is inversely related to the net legal price and the tax rate, and directly related to income, the tax enforcement budget,

⁶¹Corden, W. M., *Trade Policy and Economic Welfare*, Clarendon Press, Oxford, 1974, uses the same argument when considering why legal import demand is more elastic than total import demand when there is an increase in the tariff rate. However, Corden does not note that legal import demand need not be more elastic than total import demand when there is an increase in the world market price, the tariff rate being held constant.

⁶²The equations reported in Table 3 are part of a larger model that included equations explaining the tax enforcement budget and the tax rate. Smith, supra note 15, presents the complete model and discusses more fully the estimation issue.

The estimation issue considers the correlation among the endogenous explanatory variables (consumption, market price, tax enforcement, tax rate) and each equation's error term. Analytically, one selects the estimator that minimizes the mean squared error of the parameter estimates (the sum of the variance of the estimates and the square of the bias). In practice, the choice is between a single equation estimation technique, such as ordinary least squares (OLS) and a simultaneous equation estimation technique, such as two stage least squares (TSLS). Both estimators are biased in small samples.

The bias of OLS is a priori indeterminate. The sign of the bias depends upon the size and sign of the endogenous variables' coefficients, the covariance of the equations' error terms, and the covariance among the explanatory variables. There is not sufficient a priori information to sign the bias because each equation includes more than one endogenous variable as explanatory variables. The two and three stage least squares estimates increased, in absolute value, the magnitude of the coefficients

and the lowest tax rate of adjacent states. The income elasticity of demand is large, 1.75, suggesting that the distilled spirits tax is progressive.⁶³ The price elasticity of demand is also high, -1.5, suggesting that the state market demand curve is price elastic.⁶⁴

The age distribution variable was included, though insignificant, because consumer surveys reported by Gavin-Jobsen show that the 25-45 age group contains the most enthusiastic consumers of distilled spirits. While the demand equation does not consider cross-price effects with beer and wine, this omission need not lead to specification error because Niskannen reports the absence of significant cross-price effects in his time series analysis of the demand for alcoholic beverages.⁶⁵

for the price, tax rate, and enforcement budget variables in directions that were favorable for the alternative analysis of taxation. The simultaneity problem appears to bias the parameter estimates in favor of the traditional analysis of taxation.

DeMin Wu, "Alternative Tests of Independence Between Stochastic Regressors and Disturbances," *Econometrica*, July 1973, has formulated F-tests to determine whether the single and simultaneous equation estimators are identical. If so, then the endogenous, explanatory variables are uncorrelated with the equations' error terms, suggesting that the simultaneity problem is not particularly important in the model under study. Wu's tests were not calculated because of the absence of the appropriate computer software. However, separate T-tests accepted the null hypothesis (T-statistics were generally below .5) that the OLS and TSLS estimates were identical for each variable in the equations. The distributions were non-distinct because of the large standard errors associated with the TSLS estimates. Consequently, I conclude that OLS were preferable because of the greater precision of the parameter estimates. The seemingly unrelated regression technique was used to gain efficiency in parameter estimates by utilizing the non-zero covariances among the equations' error terms.

⁶³ Testing the null hypothesis of a unit income elastic legal demand yields a t-statistics of 1.55. The betting odds are about eleven to one that the income elasticity exceeds unity.

⁶⁴ Testing the null hypothesis that legal demand is unitary price elastic yields a t-statistic of 0.76. The betting odds are about four to one that the demand curve is price-elastic. Note that the price elasticity of demand is *not* the elasticity of the net legal price variable in the legal demand equation reported in Table 3. The -1.5 estimate price elasticity is consistent with the -2.0 elasticity estimated by Niskannen, *supra* note 1, and the -.8 elasticity estimated by Simon, Julian, "The Demand for Liquor in the U.S. and a Simple Method of Determination," *Econometrica*, January 1966.

⁶⁵ See Niskannen, *supra* note 1.

Legal supply per retail outlet is directly related to the legal market price and the tax enforcement budget, and inversely related to the tax rate, the number of wholesalers per 1000 adults, the drinking age population, and the fraction of local government alcoholic beverage that originates from local licensing. The dependent variable was deflated by the number of retail outlets by virtue of the hypothesis that the empirical analysis was estimating the supply curve of the representative firm. More formally, the estimated equation assumes that that all firms possess the same production functions, and all states pay the same real factor prices to mobile factors; so that variations in product price, taxation and tax enforcement, and non-tax regulation, are the source of state variation in legal supply.⁶⁶ The supply equation captures the effect of restrictive licensing by hypothesizing that licensing policy affects per firm legal supply via the policy's influence on legal market price.⁶⁷ Nonetheless, the specification of the dependent variable may be criticized for ignoring potential state differences in average firm size due to state differences in economies of scale.⁶⁸

The legal demand and supply equations provide empirical support for replacing the traditional with the alternative analysis of taxation.

⁶⁶ The price of non-mobile factors, such as land, is another source of state variation in per firm legal supply. Such variables were not included in the study.

⁶⁷ For a given per firm legal supply, reducing the number of retail outlets by restrictive licensing reduces legal market supply. This leads to a simultaneous increase in both the legal market price and the per firm legal supply for the retail outlets that remain in the market. Using the demand and supply equation in Table 3, the elasticity of legal market price with respect to the number of retail outlets is $-.35$. That is, a ten percent decrease in the number of retail outlets leads to a three and one half percent increase in legal market price and, by the elasticity of supply, a four and one half percent increase in per firm legal supply.

⁶⁸ To test the hypothesis, state differences in economies of scale were postulated to be related to state differences in population density. However, a variable measuring the fraction of the state's population residing in urban areas was statistically insignificant, with a t-statistic below $.5$. Similarly, urbanization was found to have no impact on the tax enforcement budget and the tax rate.

Table 3

THE LEGAL MARKET FOR DISTILLED SPIRITS AND STATE GOVERNMENT
TAXATION OF DISTILLED SPIRITS*

Equation Dependent Variable	Legal Demand Consumption/ 1000 Adults	Legal Supply Sales/Retail Outlet
Explanatory Variables		
Tax Rate (\$/gallon)	-505.89 (-3.8498) [-.6215]	-298.28 (-1.7515) [-.5007]
Legal Market Price (\$/gallon)		114.52 (1.1794) [1.2723]
Net Legal price (\$/gallon)	-184.00 (-2.2865) [-1.2700]	
Real Per Capita State Income	1.7186 (3.5303) [1.7809]	
Enforcement Budget Per 1000 adults	1.2774 (2.3366) [.2328]	2.3153 (3.0335) [.5766]
Lowest Adjacent State Tax Rate	297.20 (1.7428) [.2071]	
Fraction of State Adult Population Between 25 and 45	2232.7 (.4716) [.1200]	
Fraction of Local Government Alcoholic Beverage Revenue that Originates from Local Licensing		-1054.5 (-1.8424) [-.2730]
Fraction of Retail Outlets that are for on-Premise Consumption		2162.3 (1.0904) [.5831]
The Presence of State Monopoly Control		1012.3 (.9880) [.1445]
Wholesalers per 1000 Adults		-28703.00 (-2.6618) [-.7207]
Drinking Age Population (1000 adults)		-.1623 (-1.5983) [-.1610]
South		1415.1 (1.9769) [.1262]
Constant Term	1800.7 (.5166) [-]	-115.23 (-.0425) [-]
R ² Adjusted for Degrees of Freedom	.4269	.4415
F-Statistic/Level of Significance	F(6,39) = 6.5864/ .000	F(9,36) = 4.9530/ .0002

* Co-efficient estimates, T-statistic in parenthesis, elasticity in bracket.

First, both legal demand and supply are more responsive to changes in the tax rate than changes in the market price. Formally, F-tests reject the traditional analysis' hypothesis that the net legal price and the tax rate have identical coefficients in the legal demand equation, and that the market price and tax rate have identical coefficients, in absolute value, in the legal supply equation.^{69,70} Second, larger enforcement expenditures are seen to increase both legal demand and supply, as predicted by the alternative analysis. The most comprehensive test between the traditional and alternative models is an F-test that simultaneously tests the traditional analysis' restrictions on

⁶⁹ For the demand equation, the null hypothesis for the F-test is that the coefficient for the tax variable is less than (in absolute value) the coefficient for the net legal price variable. While this specification of the null hypothesis is a weaker statement than the restriction given by the traditional analysis, the null hypothesis provides a strong test of the alternative hypothesis. The null hypothesis for the F-test of the supply equation has a similar specification. The F-tests of the restrictions were:

<u>Equation</u>	<u>F-statistic</u>	<u>Level of Significance</u>	<u>Betting Odds in Favor of Alternative Analysis</u>
Legal Demand	F(1,149)=11.421	.0005	2000/1
Legal Supply	F(1,149)=1.8229	.0895	10/1

⁷⁰ Krause, Lawrence, "United States Imports, 1947-1958," *Econometrica*, April 1962, found that United States' imports are more responsive to changes in ad valorem tariffs than changes in market prices. According to the traditional analysis, the elasticity of demand with respect to the market price should equal the elasticity of demand with respect to one plus the ad valorem tariff. However, Krause found that the ad valorem tariff elasticity was larger, in absolute value, than the price elasticity; this finding being consistent with the alternative analysis of taxation. The Krause study examined changes in import market shares for products for 1947 to 1958. Other samples examined changes in market shares for shorter periods, 1954-58, and 1957-58, but did not find empirical support for the alternative theory of taxation. However, Krause argues that the minor changes in tariffs during these years are responsible for the absence of significant coefficients for the tariff variables.

Mordechai Kreinin, "Price Vs. Tariff Elasticities in International Trade -- A Suggested Reconciliation," *American Economic Review*, September 1967, cites numerous import demand studies that consistently show that import demand is more responsive to changes in the ad valorem tariff than to changes in the world price. This "puzzling phenomenon" has been observed for many

the tax and price coefficients, and the assumption that enforcement expenditures have a zero impact on legal demand and supply. This joint test rejects the specification of the traditional analysis, suggesting that both consumers and producers substitute between the legal and illegal markets.⁷¹

An alternative interpretation of the differential responsiveness of legal demand and supply to changes in tax rates and market prices is that the empirical results are the consequence of errors in the explanatory variables. For example, it is well known that measurement error in an explanatory variable will bias toward zero the estimate of the variable's coefficient. Consequently, the errors present in the market price variable, as discussed above could explain the smaller coefficients for the market price variables.

This alternative interpretation of the results seems dubious for two reasons that result from the Cooper-Newhouse discussion of the errors in variable problem.⁷² First, the correlation between the market price and tax variables would transfer bias to the tax rate's estimated coefficient,

countries and over different time periods. Kreinin attempts to explain the results by arguing that the tariff rates on products understate the true change in the effective rate of protection because factor and product tariffs are positively correlated, but factor tariffs change by less than product tariffs.

Donald Wood, "Price vs. Tariff Elasticities: Comment," *American Economic Review*, March 1969, shows that the Kreinin reconciliation is without theoretical foundation, even if the relation between factor and product tariffs is as Kreinin postulates. Kreinin's reply to Wood, *American Economic Review*, March 1969, concluded that the difference between price and tariff elasticities remains unreconciled. The theory of tax evasion presents one reconciliation.

⁷¹The F-statistic for the joint test of all the hypotheses of the traditional analysis is $F(4,149)=5.4487$, the level of significance being .0002.

⁷²Cooper, Richard and Joseph Newhouse, "Further Results on the Errors in the Variables Problem," The Rand Corporation, P-4715, October 1971.

also biasing toward zero the estimated tax coefficient.⁷³ More importantly, the tax rate and tax enforcement variables are also subject to measurement error, as discussed above, so that the direction of bias for any of the coefficients cannot be predicted *a priori*.

Table 4

Comparison of the Traditional and Alternative Models'
Analysis of Changes in Taxation Policy

Variable	Tax Rate		Tax Enforcement Budget	
	Alternative	Traditional	Alternative	Traditional
Legal Consumption				
Slope	-440.60	-101.19	2.75	0.0
Elasticity	-000.54	-000.12	.50	0.0
Market Price				
Slope	.65	.55	-.008	0.0
Elasticity	.0053	.0007	-.002	0.0

Table 4 presents the traditional and alternative analyses' predictions of the impact of changes in taxation policy. The calculations are derived

⁷³ Cooper-Newhouse show that if only one variable in a regression is subject to measurement error, then the coefficients for the variables measured without error are biased upward (downward) if the coefficient of the variable measured with error has the same (opposite) sign as the correlation between the variable measured with error and the variables measured without error. For the legal demand equation, both the coefficient for the net legal price and the correlation between the net price and the tax rate are negative, suggesting that the tax rate coefficient is biased upwards; that is, biased towards zero (and possibly a positive number) because the tax rate coefficient is expected to be negative. An identical conclusion can be reached for the bias in the tax rate's coefficient: in the legal supply equation, because both the price coefficient and the correlation between the market price and the tax rate are expected to be positive.

by simultaneously solving the legal demand and supply equations; obtaining consumption and market price as a function of the tax rate and tax enforcement budget. By ignoring the substitution between illegal consumption and production, the traditional analysis understates the decline in legal consumption by 77.1 percent, and understates the increase in market price by 15.4 percent, and thereby under-predicts the consumer tax burden.⁷⁴ Recall that the traditional analysis understates the price increase if higher tax rates cause an increase in the illegal market price; thus the evidence suggests that higher tax rates lead to higher prices in the illegal market. Finally, additional tax enforcement is seen to reduce the legal market prices implying that additional tax enforcement reduces the consumer tax burden.

Returning to the estimated equations, legal supply provides support for the hypotheses that the ability of state governments to enforce the tax depends upon the number of taxed wholesalers, the size of the state's drinking age population, and the fraction of local government alcoholic beverage revenue that originates from local licensing. All these variables illustrate that states with less ability to enforce the tax rate have smaller legal markets.⁷⁵

⁷⁴ Burreight, Burke, "An Aggregate Urban Transportation Model," Dissertation in Progress, University of California at Los Angeles, study of retail gasoline prices finds that a one cent increase in the wholesale price leads to a .45 of a cent increase in retail prices, while a one cent increase in the sales tax leads to a .75 of a cent increase in retail prices. By not distinguishing between price and tax rate changes, the traditional analysis would understate the consumer's burden of the gasoline tax.

⁷⁵ Smith, *supra* note 15, develops a model of taxation policy, showing that as markets become more difficult to police, tax rates decline and tax enforcement budgets increase. All three variables influencing legal supply possess consistent signs in equations explaining the tax rate and tax enforcement budget.

Table 3 provides other results. First, the fraction of retail outlets that are for on-premise consumption is introduced as a control variable in legal supply to determine if on- and off-premise establishments have different optimal firm sizes: a hypothesis that is rejected by the legal supply equation. Second, the presence of state monopoly control has no direct impact on legal supply, once the tax rate and tax enforcement budget are held constant. Third, southern states have larger legal sales per retail outlet.

Monopoly Versus License Control and the Legal Market Price

There has been discussion among economists concerning whether state or private ownership of liquor stores should lead to lower prices for distilled spirits. Simon found that the price of distilled spirits was lower in monopoly than license states by \$2.45 per gallon, even though monopoly states generated \$3.55 per gallon more revenue than license states.⁷⁶ Simon reconciled the apparent paradox, monopoly states had higher taxes but lower prices, by any of the following three reasons: monopoly states had more efficient marketing systems than license states, monopoly states exercised monopsony power while license states did not, or monopoly state stores offered fewer services than license state stores. However, Simon did not offer evidence supporting any of these hypotheses.⁷⁷

Whalen argued that such analysis must distinguish between license states with and without retail price maintenance.⁷⁸ Classifying three license states as without retail price maintenance, these states had lower prices than monopoly states, while monopoly states continued to have lower prices than license states with retail price maintenance.

⁷⁶Simon, Julian, "Economic Effects of State Monopoly of Packaged-Liquor Retailing," *Journal of Political Economy*, April 1966.

⁷⁷The monopsony hypothesis seems doubtful because the monopoly state with the largest consumption, Pennsylvania, represents less than five percent of total United States consumption, while all monopoly states represent about 25 percent of total consumption.

⁷⁸Whalen, T. J., "State Monopoly of Package-Liquor Retailing," *Journal of Political Economy*, April 1967.

Unfortunately, Whalen's analysis does not explain why monopoly states generate more revenue per gallon than license states. Similarly, the Peltzman⁷⁹ discussion of pricing decisions by privately and publicly owned firms provides an explanation for monopoly states having lower prices, but does not explain why monopoly states generate more revenue per gallon of distilled spirits consumed by the state's population.

The empirical model of the legal market for distilled spirits provides another interpretation of the price differential between monopoly and license states. Table 5 presents the average market price, tax rate, and enforcement budget for monopoly and license states. As found by Simon monopoly states have lower prices but higher tax rates than license states, although the price difference is smaller in my sample. This apparent paradox is explained, however, by noting that monopoly states have larger enforcement budgets, that drive prices lower in the monopoly states. Using the relationship between market price and the taxation policy variables that are reported in Table 4, monopoly states

⁷⁹ Peltzman, Sam, "Pricing in Public and Private Enterprises: Electric Utilities in the United States," *Journal of Law and Economics*, April 1971.

should have prices that are \$2.00 per gallon lower than license states.⁸⁰

Controlling for the differences in taxation policy, monopoly states have higher prices than license states. Enforcement policy seems to be the mechanism that leads to lower observed prices in monopoly than license states. Why monopoly states choose larger budgets and higher tax rates than license states must await explanations from the economic theory of politics.

Table 5

Monopoly and License State Taxation Policy and Legal Price of Distilled Spirits

<u>Method of Control</u>	<u>Market Price</u>	<u>Tax Rate</u>	<u>Tax Enforcement Budget</u>
Monopoly	\$26.80/gallon	\$7.35/gallon	\$1035/1000 adults
License	\$27.21/gallon	\$2.35/gallon	\$ 378/1000 adults

Concluding Remarks

The relationship between taxes and tax evasion has been understood in policy circles for centuries, and certainly has been understood by

⁸⁰The price differential accounted for by differences in taxation policy was determined by the following equation:

$$\begin{aligned}
 \text{price}_{\text{monopoly}} - \text{price}_{\text{license}} &= .65 (\text{tax}_{\text{monopoly}} - \text{tax}_{\text{license}}) \\
 &\quad - .008 \left(\begin{array}{l} \text{enforcement} \\ \text{budget}_{\text{monopoly}} \end{array} - \begin{array}{l} \text{enforcement} \\ \text{budget}_{\text{license}} \end{array} \right) \\
 &= .65(5.00) - .008(656.71) = -\$2.00/\text{gal}
 \end{aligned}$$

A full analysis of the price differential would include differences between monopoly and license states in licensing policy, state populations, number of wholesalers, and fraction of local government alcoholic beverage revenue that is due to local licensing.

81
economists. Nonetheless, tax evasion has been ignored by the traditional analysis of the economic effects of taxation. This essay has attempted to explore the implications of introducing tax evasion into the economic analysis of taxed markets.

The substitution between legal and illegal markets appears to be empirically important, as evidenced by the study of state taxation of distilled spirits and numerous empirical studies of import demand. Unlike the traditional analysis, economic analyses of the effects of taxation must consider the presence of tax evasion. Otherwise, taxation analysis understates the decline in the legal consumption of the taxed good, and incorrectly predicts the tax burden of consumers and producers. The study of liquor taxation suggests that the traditional analysis understates the consumer tax burden, implying that the illegal market price appears to be directly related to the tax rate.

The government response to tax evasion, enforcement, is important because it influences legal and illegal consumption and the consumer tax burden. For the state liquor tax, additional tax enforcement reduces the legal market price. Additional research could improve taxation analysis by identifying the characteristics of markets and political jurisdictions that influence the ability of state governments to enforce the tax.

⁸¹ See Alexander Hamilton's discussion in *The Federalist*, Number 35. Hamilton argues that one reason for modest tariffs in imports is to control the volume of smuggling. Economists' appreciation of the evasion problem can be found in Corden, supra note 62, and Break, G. F. and E. R. Rolph, *Public Finance*, New York, 1971, pp. 309-310.

Appendix

TAXATION AND THE LEGAL AND ILLEGAL MARKETS

Alternative Analysis

The legal market is described by the equations:

$$X_L^D = X_L^D (P_L, P_I)$$

$$X_L^S = X_L^S (P_N, P_I, \alpha_P, \alpha_F)$$

The illegal market is described by equations:

$$X_I^D = X_I^D (P_L, P_I)$$

$$X_I^S = X_I^S (P_N, P_I, \alpha_P, \alpha_F) .$$

Logarithmically differentiating the legal market equations yields:

$$X_L^{*D} = \eta_{LL} P_L^* + \eta_{LI} P_I^* = (\eta_{LL} + \eta_{LI}) P_L^* + \eta_{LI} (P_I^* - P_L^*)$$

$$X_L^{*S} = \epsilon_{LL} (a_P P_L^* - a_T T^*) + \epsilon_{LI} P_I^* = (\epsilon_{LL} + \epsilon_{LI}) (a_P P_L^* - a_T T^*) + \epsilon_{LI} \{ P_I^* - (a_P P_L^* - a_T T^*) \}$$

Similarly, the logarithmic differentiation of the illegal market equations yields:

$$X_I^{*D} = (\eta_{II} + \eta_{IL}) P_I^* + \eta_{IL} (P_L^* - P_I^*)$$

$$X_I^{*S} = (\epsilon_{II} + \epsilon_{IL}) P_I^* + \epsilon_{IL} \{ (a_P P_L^* - a_T T^*) - P_I^* \}$$

where $a_P = \frac{P_L}{P_N}$, $a_T = \frac{T}{P_N}$, and "*" is the percentage change operator.

Note that the demand and supply curves are written as functions of the own-price and the ratio of own price to the other market's price. Recall that the restrictions placed on the elasticities implied that $(\eta_{II} + \eta_{IL})$, $(\eta_{LL} + \eta_{LI}) < 0$, and $(\epsilon_{II} + \epsilon_{IL})$, $(\epsilon_{LL} + \epsilon_{LI}) > 0$. Solving these equations for the percentage change in prices and quantities yields:

$$\frac{X_L^*}{T^*} = \frac{a_t}{\Delta} \left\{ \eta_{LL} E - \epsilon_{LL} a_P N \right\} < 0$$

$$\frac{X_I^*}{T^*} = \frac{a_t}{\Delta} \left\{ \eta_{IL} E - \epsilon_{IL} N \right\} > 0$$

$$\frac{P_L^*}{T^*} = \frac{a_t}{\Delta} \left\{ E - \epsilon_{LL} \eta_{II} + \eta_{IL} \epsilon_{LI} \right\} > 0$$

$$\frac{P_I^*}{T^*} = \frac{a_t}{\Delta} \left\{ \epsilon_{LL} \eta_{LI} - \epsilon_{IL} \eta_{LL} \right\} > 0$$

Using these results, it follows that

$$\frac{P_N^*}{T^*} = \frac{-a_t}{\Delta} \left\{ N + \eta_{LI} \epsilon_{IL} - \epsilon_{II} \eta_{LL} \right\} < 0$$

$$\frac{P_L^*/P_I^*}{T^*} = \frac{a_t}{\Delta} \left\{ E - \epsilon_{LL} (\eta_I + \eta_{IL}) + \epsilon_{IL} (\eta_{LL} + \eta_{LI}) \right\} > 0$$

$$\frac{P_N^*/P_I^*}{T^*} = \frac{-a_t}{\Delta} \left\{ N - \eta_{LL} (\epsilon_I + \epsilon_{IL}) + \eta_{IL} (\epsilon_{LL} + \epsilon_{LI}) \right\} < 0$$

where $E = (\epsilon_{LL} \epsilon_{II} a_P - \epsilon_{IL} \epsilon_{LI} a_P) > 0$ by second order conditions of profit maximization.

$N = (\eta_{LL} \eta_{II} - \eta_{IL} \eta_{LI}) > 0$ by second order conditions of utility maximization.

Δ is the determinate of the Hessian of the legal and illegal markets' excess demand functions, and is positive for the markets that satisfy Hicksian perfect stability. For the expressions for the legal and net legal price, note that the assumption that direct-price-effects dominate cross-price effects guarantees that $-\epsilon_{LL} \eta_{II} + \eta_{IL} \epsilon_{LI} > 0$. This restriction rules out Edgeworth's Taxation Paradox.

Comparison of the Alternative and Traditional Analyses

For legal quantity, the traditional analysis concludes that:

$$\frac{X_L^*}{T^*} = \frac{-\eta_{LL} a_T \epsilon_{LL}}{(\eta_{LL} - a_P \epsilon_{LL})} \quad (*)$$

Subtracting the alternative analysis' prediction from (*) yields,

$$\frac{X_L^*}{T^*} \Big|_{\text{Traditional}} - \frac{X_L^*}{T^*} \Big|_{\text{Alternative}} = \frac{a_T}{(\eta_{LF} - a_P \epsilon_{LL}) \Delta} \left\{ \eta_{LL} \epsilon_{LL} \left[\epsilon_{IL} \eta_{LI} - \epsilon_{II} \eta_{LL} + \epsilon_{LI} \eta_{IL} - \epsilon_{LL} \eta_{II} \right] - a_P (\epsilon_{LL})^2 N - (\eta_{LL})^2 E \right\} > 0$$

That is, the traditional analysis underpredicts the decline in the legal market.

For legal market price, the traditional analysis includes:

$$\frac{P_L^*}{T^*} = \frac{-\epsilon_{LL} a_T}{(\eta_{LL} - a_P \epsilon_{LL})} \quad (**)$$

Subtracting the alternative analysis' prediction from (**) yields:

$$\frac{P_L^*}{T^*} \Big|_{\text{Traditional}} - \frac{P_L^*}{T^*} \Big|_{\text{Alternative}} =$$

$$\frac{a_T}{(\eta_{LL} - a_P \epsilon_{LL}) \Delta} \left\{ (\eta_{LI} - \epsilon_{LI}) (\epsilon_{LL} \eta_{IL} - \epsilon_{IL} \eta_{LL}) \left(\frac{S_L}{(1-S_L)} \right) \right\} \begin{matrix} > \\ < \end{matrix} 0$$

where $S_L = \frac{X_L}{X_L + X_I}$.

Note that the expression with the ambiguous sign, $\epsilon_{LL} \eta_{IL} - \epsilon_{IL} \eta_{LL}$, also appears in the expression for the change in the equilibrium illegal market price. If taxation increases the illegal market price, then the traditional analysis understates the increase in the legal market price.