Regulatory Restrictions on Vertical Integration and Control: The Competitive Impact of Gasoline Divorcement Policies

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Gasoline "divorcement" regulations restrict the integration of gasoline refiners and retailers. Theoretically, vertical integration can harm competition, making it possible that divorcement policies could increase welfare; alternatively, these policies may reduce welfare by sacrificing efficiencies. This paper attempts to differentiate between these possibilities by estimating a reduced form equation for the real retail price of unleaded regular gasoline. I find that divorcement regulations raise the price of

[1] The views expressed in this paper are the author's, not those of the Federal Trade Commission or any individual Commissioner. I thank Denis Breen, Jeffrey Fischer, Dan Hosken, Pauline Ippolito, Paul Pautler, and two anonymous referees for helpful comments. Remaining errors are mine.

I. Introduction

Gasoline "divorcement" statutes restrict -- and in their most extreme form, proscribe -- the vertical integration of gasoline refiners and gasoline retailers. Divorcement laws are currently in effect in six states (Hawaii, Connecticut, Delaware, Maryland, Nevada, Virginia), and the District of Columbia, and have been considered in many more. Since 1974, divorcement bills have come before forty-one state legislatures; currently, both San Francisco and San Diego are considering whether to impose such restrictions.

Historically, divorcement legislation has been rationalized as a means for preventing "predation" on the part of refiner-owned service stations against their franchised dealers. This theory is difficult to reconcile with economic analysis. Predation normally is thought of as an action taken against a *rival* for the purpose of eliminating that rival as a competitive constraint, thereby conferring (additional) market power upon the predator. Thus, it is possible to imagine one refiner engaging in predation against another refiner, or a retailer preying upon a rival retailer. But it would make little sense for a refiner to prey upon its affiliated retailers. These retailers are not the refiner's competitive constraint; other refiners are. Even a refiner possessing substantial market power has no incentive to drive its efficient dealers out of business -- to the contrary, refiner profits will be maximized only when wholesale and retail distribution is efficient.[1]

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[1] A given refiner might wish to eliminate the retailers of *rival* refiners, but this would be a means to the end result of eliminating the rival refiner. Moreover,

(continued...)

Although the notion of predatory behavior by refiners against retailers makes little sense, it is possible nonetheless to construct a public policy rationale for divorcement policies that is potentially reconcilable with a well-specified model of economic behavior.[2] Recent theoretical models have established the possibility of welfare-reducing vertical integration.[3] If behavior in wholesale and retail gasoline markets is well-described by such models, then it is possible that divorcement policies could result in greater equilibrium output than would occur absent the restrictions on vertical integration.

The alternative explanation for joint ownership of refiners and retailers is that integration creates economic efficiency. The economics literature has identified numerous efficiency-enhancing motives for vertical integration, such as eliminating

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[1] (...continued)
proponents of divorcement do not appear concerned by this interbrand effect -- rather, they appear to be motivated by the elimination of "intrabrand" competition (*e.g.*, a refiner-owned Mobil station eliminating an independent Mobil dealer).

[2] Somewhat more plausibly, one could perhaps view divorcement statutes as a means for protecting retailers against "hold-ups" by their affiliated refiners. This theory is only marginally more satisfactory than the "predation" theory, however. Generally speaking, when relationship-specific investments create the risk of opportunism, it is in the mutual interest of both parties to create contractual arrangements to mitigate this risk (*see, e.g.,* Klein, Crawford, and Alchian (1978)). Failure to do so raises the total cost of producing and distributing the product, thus reducing the manufacturer's total profits.

[3] *See, e.g.*, Salinger (1988). For a critical review of this literature, see Reiffen and Vita (1995).

[4] *See* Spengler (1950). More recently, models have been constructed in which producers deliberately endow their retailers with market power (*e.g.*, through the granting of exclusive territories), and thereby induce double marginalization, yet nonetheless increase their profits by doing so (*see* Bonanno and Vickers (1988); Rey and Stiglitz (1995)). The logic is as follows: by granting their retailers (downstream) market power, each producer reduces its demand elasticity, leading to higher equilibrium upstream prices.

If the market for gasoline refining and retailing were conducive to these arrangements, divorcement statutes seemingly would be unnecessary, for refiners would then have a private incentive to avoid integration into retailing. It might be argued, however, that producers could find themselves in a prisoners' dilemma, whereby joint profits would be maximized if all refiners eschewed vertical integration, but where noncooperative behavior results in an equilibrium with a (privately) excessive degree of vertical integration. In this case, divorcement regulations might enforce the joint-profit maximizing "no integration" equilibrium.

This scenario is implausible, however, for two reasons. First, as a theoretical matter, this prisoners' dilemma does not arise in either the Bonanno and Vickers model or the Rey and Stiglitz model – in both models, producers have a unilateral, as well as a joint, incentive to avoid vertical integration. Second, there is little evidence that integrated gasoline refiners favor divorcement policies, as they likely would if the primary effect of divorcement laws was to attenuate this prisoners' dilemma. Rather, most of the political pressure for divorcement appears to come from independent retailers.

[5] Coase (1937).

[6] *See*

gasoline using state-level monthly data covering the period 1995-97. Controlling for other exogenous determinants of retail price, I find that divorcement regulations raise the price of gasoline by about 2.7¢ per gallon, resulting in a sacrifice of consumers' surplus of over $100 million annually. This finding is consistent with the earlier empirical literature on the effects of retail divorcement, and strongly suggests that current proposals to divorce gasoline retailing from refining will be detrimental to consumers' interests.[8]

II. Background and Literature Review

[8] *See* Goldstein, Gold, and Kleit (1998) for a discussion of recent divorcement proposals.

[9] See generally Tirole (1988), ch. 4.

In choosing a vertical structure, the general problem facing the refiner is that retail output is a function of downstream sales efforts by the station manager and of downstream prices. Because these determinants of downstream demand differ in the extent to which they can be observed and contractually-specified, the contractual form outcome.[10] Shepard argues that where unobservable (hence noncontractable) demand-increasing efforts by on-site managers are an important element of retail demand, contractual arrangements that make this manager the residual claimant to the attendant profits -- either “lessee-dealer” or “open-dealer” contracts -- will be preferred.[11] This situation is likely to arise where, for example, the station provides full repair services in addition to gasoline sales.

By contrast, where unobservable retailer efforts are less important -- for example, at self-service, gasoline-only stations -- the principal rationale for vertical restraints would be elimination of double-marginalization problems (Shepard, 1993, p. 63). In principle, this could be addressed through contract, since retail price is observable; however, as noted above, until recently there have been legal limits on maximum RPM contracts. Although there are alternative contractual mechanisms available (*e.g.*,

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[10] For example, until recently maximum resale price maintenance contracts were illegal *per se*. *See State Oil Co. v. Khan*, 522 U.S. 3 (1997). Two-part prices are legal, but may not be first-best if contractors are not risk-neutral (Barron and Umbeck, 1984, p. 318). Moreover, as Shepard notes (1993), attainment of the first-best may require a different contract for each retailer. This may be prohibitively costly.

[11] With “lessee-dealer” contracts, land and immobile capital assets are owned by the refiner, who leases the property to the retailer. The refiner typically sets the wholesale gasoline price, the property rental rate, and minimum monthly wholesale gasoline volumes. With “open-dealer” contracts, the retailer owns the physical assets. The refiner establishes the wholesale price and minimum volumes. *See* Shepard (1993, p. 62).

[12] *See* Tirole (1988, p. 176).

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stages of production in the pre-integration competitive environment. A merger of an upstream and downstream firm is undertaken, which causes the integrated entity's costs to fall (because the input is now transferred at marginal cost). If the upstream affiliate of the vertically integrated entity can commit to no longer selling to other downstream firms (*e.g.*, as in Salinger (1988)), the nonintegrated upstream firms may have the ability to increase prices to these buyers. Offsetting this, however, is the fact that the derived demand curve facing these sellers will shift leftward, owing to the expansion of output by the integrated entity. In equilibrium, retail prices may rise or fall; so might input prices. One possible outcome is for the input prices facing unintegrated firms to rise at the same time downstream prices fall (*see, e.g.*, Reiffen and Vita (1995)). Though consumers would benefit from vertical integration in this particular outcome, this equilibrium would be consistent with complaints from unintegrated dealers that they frequently find themselves caught in a price-cost "squeeze."

From a theoretical perspective, then, divorcement laws could have either a positive or negative effect on retail prices. If the principal effect of the law is to attenuate anticompetitive vertical "foreclosure," one should expect to observe lower equilibrium prices in divorcement states than in nondivorcement states *ceteris paribus*. The opposite result should obtain if the divorcement policies prevent refiners and retailers from realizing efficiencies that can be obtained only through vertical integration. In what follows, I attempt to discriminate between these competing hypotheses by specifying and estimating an empirical model of retail gasoline prices.

III. The Empirical Model

I attempt to analyze the competitive effects of divorcement legislation by estimating a reduced form price equation with time series-cross section data on state average gasoline prices. I estimate an equation of the following general form:

$$P_{it} = f(\textit{demand shifters}_{it}, \textit{cost shifters}_{it}, \textit{regulation dummies}_{it}) \qquad [1]$$

where P_{it} is the (average) retail price of gas, net of taxes, in state *i* and period *t*; demand and cost shifters (discussed in greater detail below) represent exogenous determinants of gasoline demand and supply; and "regulation dummies" are variables indicating the presence or absence of certain types of regulations affecting petroleum retailing. In this specification, the equilibrium impact of the divorcement statute would be captured by the coefficient on the divorcement dummy variable. If the net effect of the legislation is to eliminate efficiencies from vertical integration, then the coefficient on this dummy variable will reflect the resulting upward shift in the retail cost function (*i.e.*, the coefficient will have a positive value). If the effect of the legislation is to reduce opportunities for anticompetitive behavior (*i.e.*, if it reduces price-cost margins relative to an environment where there are no restrictions on vertical integration), the coefficient should take on a negative value.

The dependent variable in this model is average monthly retail price (net of taxes), in state *i*, for regular unleaded gasoline, measured in cents per gallon. These data are obtained from the Energy Information Admnre Energy Irdmnre Ene tsmaardSSnTltt1.02P r r

Cost Shifters:

1. WAGERATE	= real hourly earnings for retail employees in state ($/hour)
2. TRANSPORT	= real imputed transportation cost (see discussion below), (¢/gallon)
3. CRUDE	= real spot price of West Texas Intermediate crude oil ($/bbl.)RFG)trequirem hes29.4 Td ()Tj /TT2 198Tj 0.0207 Tc -0.07 T14

[14] To compute a heating or cooling degree day, add the high and low temperature for a given day. Divide the result by 2 to get the average temperature, and subtract 65. If negative, this result is termed "heating degree days;" if positive, "cooling degree days." Thus, if on a given day the high temperature equaled 50, and the low 30, that day had 25 heating degree days.

Regulatory Variables:

1. DIVORCE = 1 if state had divorcement regulation; 0 otherwise

2. SELFSERV = percentage of gasoline sold through self-service pumps

The means and standard deviations of these variables are presented in Table 1. All nominal monetary values are deflated by the Consumer Price Index.

The basic specification of equation [1] reflects general theoretical considerations; the specific choice of explanatory variables reflects the findings of previously published estimates of gasoline demand.[15] Economic theory implies that gasoline demand in an area will depend in significant part upon the characteristics of the population living in that area. These population characteristics include total population size (**POP**); average per capita real income (**INCOME**); age distribution (**%OVER65**); vehicle ownership (**VEHICLES/POP**); and driving licensure (**DRIVERS/POP**). It is expected that gasoline demand (hence price) should increase with income, vehicle ownership, and licensure, and decline with population age.

Previous researchers (*e.g.*, Lin *et al.*, 1985) also have found that gasoline demand is influenced significantly by the population density (**DENSITY**). The impact of increased density on price is ambiguous *a priori*. Travel demand, hence derived gasoline demand, should fall as the population is increasingly concentrated in smaller

[15] *See* Espey (1996, 1998) and Lin (1985).

areas; moreover, there tend to be more alternative transportation modes available (*e.g.*, buses) in densely populated areas. Additionally, increased population density likely reduces costs of transporting fuel from the wholesale "rack" to retailers (since increased population density likely will be associated with increased station density). *Ceteris paribus*, these effects should induce a negative relationship between density and price.[16] Conversely, increased population density also leads to traffic congestion, hence increased fuel consumption per mile traveled, and higher land rental values. Both of these factors should contribute to higher fuel prices.

Last, month dummies are included to control for the substantial seasonal component of gasoline demand (*see, e.g.*, Borenstein and Shepard, 1996, p. 440); year dummies are included to control for unobservable determinants of price that vary intertemporally, but not cross-sectionally.

Equation [1] also incorporates exogenous determinants of cost. Obviously, a major determinant of gasoline costs is the price of crude oil. Following Borenstein and Shepard (1996), I use the price of West Texas Intermediate crude as the relevant price (although similar results are obtained when other spot prices (*e.g.*, Brent crude) are used). It is well documented that retail prices respond to crude prices with a lag

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[16] Dealers' costs also might be a function of population density. *Ceteris paribus*, increased density might result in increased volume at a smaller number of dealers, allowing the latter to exploit economies of scale in retailing.

[17] Ideally, one also would like to control for the cost of transporting crude oil from the field to the refinery. Because I lack direct measures of these costs, I instead control for crude transport price variation with four dummy variables: **NE**

areas, beginning January 1, 1995.[19] In addition to the nine cities where RFG was mandated, a number of other cities adopted the RFG program voluntarily. Because

[19] The original areas are Baltimore, Chicago, Hartford, Houston, Los Angeles, Milwaukee, New York, Philadelphia, and San Diego. Later, Sacramento was added to this list.

5¢ to 15¢/gallon to the production cost of gasoline.[20] To control for the impact of this regulation on equilibrium prices, I include a dummy variable (**CARBGAS**) that takes on a value of 1 for May 1996 and all subsequent periods for all California observations. Because the production costs of CARB gasoline are thought to have fallen over time, I also interact **CARBGAS** with a year dummy (equal to 1 for 1997).

A final determinant of the cost of retail gasoline is the transportation cost of shipping the gasoline from the refinery to the dealer. Typically, bulk gasoline is shipped either by pipeline or water transportation from the refinery gate to the wholesale supply terminals, from which the gasoline is dispensed into tanker trucks for final delivery to the retail dealer. Ideally, we would like to incorporate a direct measure of these transportation costs into the empirical analysis. While interstate oil pipeline tariffs are filed with the Federal Energy Regulatory Commission, and are thus publicly available, there is no comparable source of public information for intrastate pipelines or for spot tanker/barge rates. As an alternative, I impute the cost of transporting gasoline from the refinery to the terminal (**TRANSPORT**) as the difference between a spot refinery price and the average terminal (or "rack") price for each state, as reported by the Energy Information Administration.[21]

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[20] *See* the *CAL/EPA Factsheet* at www.calepa.ca.gov/publications/factsheets/1997/cleangas.htm.

[21] For western states, I use the Los Angeles spot price. For midwest and southeastern states, I use the Gulf Coast spot price. For states in the Northeast, I use the New York Harbor spot price.

$$y_{it} = X_{it}\beta + \varepsilon$$

[22] Other panel data estimation procedures, such as OLS with state-specific dummy variables (*i.e.*, a fixed-effects model) are precluded by the fact that there is no within-state variation in the regulatory variables for the sample period used here.

The coefficients on most of the exogenous variables have signs consistent with prior expectations.[23] Current and lagged crude prices (**CRUDE, CRUDE_1, CRUDE_2**) are positively related to retail prices, as are the imputed transportation costs (**TRANSPORT**) and two of the three reformulated gasoline programs (**OXYGENGAS** and **CARBGAS**).[24] Increased population density (**DENSITY**) is negatively related to price. Motor vehicle ownership **(VEHICLES/POP**), income (**INCOME**), and proportion of drivers aged 20 to 44 (**%DRIVERS20-44**) are all positively related to retail price, although none are different from zero at conventional levels of statistical significance. Some of these controls (**DRIVERS/POP**, **%OVER65**, and **WAGERATE)** have coefficients with unexpected signs, but only in the case of **WAGERATE** is the coefficient statistically significant. The coefficient on heating degree days (**HEATINGDAYS**) is positive and statistically significant.

The parameter estimates presented in Table 2 provide a clear pattern of evidence suggesting that retail prices are 2¢ -3¢ per gallon higher in states with divorcement laws than in states without such restrictions; the 95 percent confidence interval on the estimated **DIVORCE** parameter in column (c), the fully specified version of model estimated with the FGLS procedure, is approximately 1.3¢ to 4¢ per gallon. The null

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[23] Exceptions are **WAGERATE** and **%DRIVERS20-44**. In neither case can we reject the null hypothesis that the true parameter is equal to zero.

[24] Contrary to expectations, however, the coefficient on **YR3*CARBGAS** is positive, suggesting that the cost of refining CARB standard gasoline rose, rather than fell, over the course of the sample period.

hypothesis that divorcement laws have no effect on retail prices can be rejected at the 1 percent significance level.

Divorcement statutes thus appear to have had the effect of increasing equilibrium retail prices. It is difficult to construct a procompetitive characterization of this result. One possibility is that there is some unobserved (by the econometrician) average quality difference between dealers in divorcement and nondivorcement states that consumers value at (approximately) 2.7¢ per gallon. While this possibility is, by definition, untestable (if we could observe all relevant aspects of quality we would include this information in the form of additional regressors), it would seem unlikely, given available empirical information on the characteristics of company-owned versus independently-owned stations. Existing research suggests the former are more likely to have characteristics valued by gasoline purchasers than the latter. For example, Shepard (1993) found that in her sample, company-owned stations tended to have greater sales capacity than independently-owned stations;[25] other things equal, greater capacity suggests less time spent in a queue waiting for an open pump. Shepard also reported that the independent open-dealer stations tended to have older physical plants than other stations;[26] this suggests, among other things, that the company-owned and

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[25] Shepard (1993, p. 67) reports that the average open-dealer station had the capacity to serve 3.6 cars at a time, versus 5 or more cars at other station types. In her sample, approximately 75 percent of the open-dealers had only a single island, whereas only about 30 percent of the other stations were single island.

[26] Shepard (1993, p. 68) reports that less than half of the open-dealers had been (continued...)

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divorcment regulations. Espey (1998, p. 279) provides estimates of the long-run price elasticity of gasoline demand that range from 0 to -2.72 (median = -0.43). Using these estimates, and annual volume data from the *EIA* (1999), we can compute the quantity increases that would be induced by the predicted 2.7¢ / gallon price reduction that would accompany a relaxation of the divorcement restrictions. With this information, it is straightforward to calculate the attendant increase in Marshallian consumer surplus, which ranges from $111.4 million (assuming completely inelastic demand) to $115.4 million (assuming an elasticity of -2.72, Espey's upper bound). For the median elasticity estimate (? =-0.43), the corresponding surplus increase is approximately $112.0 million.

V. Conclusion

Although divorcement regulation has been imposed in only six states, there is recurrent interest in this policy, particularly in areas (*e.g.*, San Francisco, San Diego) where retail prices appear "inexplicably" high (Goldstein, Gold, and Kleit, 1998; Borenstein and Gilbert, 1993). As noted in the introduction, while it is possible theoretically for vertical integration to result in noncompetitive equilibria, previous empirical studies of divorcement not only fail to show that such policies result in lower prices, they indicate strongly that divorcement results in prices significantly higher than would have obtained had no such restrictions been imposed. This suggests that the integration of refiners and retailers is a source of economic efficiency that is foregone when integration is restricted or proscribed.

The analysis presented here reaffirms these earlier findings. Using state-level data for the middle-1990s, I find that divorcement regulations increased the retail price of unleaded regular gasoline by more than 2.7¢ per gallon. While this number might seem small, it must be borne in mind, as Borenstein and Gilbert (1993) emphasize, that a relatively small distortion can translate into a rather sizable aggregate welfare loss in a large market. Annual retail sales of gasoline exceed $147 billion per year. Were divorcement policies imposed via national legislation (eagifAiyt2lp imposedTd rced. wo noefailcesro

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Table 1

Descriptive Statistics

Variable Name	Mean	Standard Deviation
R_RETAIL	51.43	6.23
DENSITY	172.62	235.68
VEHICLES / POP	0.82	0.12
DRIVERS / POP	0.69	0.05
%DRIVERS20-44	0.52	0.03
%OVER65	0.12	0.02
INCOME	14907.2	2255.2
WAGERATE	7.99	.89
TRANSPORT	4.42	2.89
CRUDE	12.83	1.24
HEATINGDAYS	4900.16	1783.16
REFORMGAS	.18	.33
OXYGENGAS	0.03	.11

Table 2

Retail Price Regression

Monthly Data, 1995-97

Dependent Variable = Real Price Unleaded Regular Gasoline, Net of Taxes, in ¢/gallon

Variable	Coefficient (t-statistic) (a)	Coefficient (t-statistic) (b)	Coefficient (t-statistic) (c)	Coefficient (t-statistic) (d)
DIVORCE	2.11 (3.59)	1.91 (3.59)	2.67 (3.89)	2.08 (6.28)
SELFSERV	-2.07 (-2.57)	-2.07 (-2.57)	-3.43 (-3.71)	-2.92 (-6.96)
DENSITY			-0.003 (-3.09)	-0.004 (-7.84)
POP			-5.66 (-1.49)	-3.69 (-2.01)
VEHICLES/POP			0.73 (0.52)	1.31 (1.92)
DRIVERS/POP			-3.87 (-1.12)	-4.17 (-2.37)
%DRIVERS20-44			2.00 (0.21)	-0.65 (-0.14)
%OVER65			0.23 (1.59)	0.24 (3.52)
INCOME	-0.00008 (-0.92)	-0.00004 (-0.46)	0.0001 (0.84)	0.0001 (1.79)
WAGERATE	-0.092 (-0.65)	-0.13 (-0.90)	-0.29 (-2.00)	-0.25 (–3.10)
TRANSPORT	0.27 (12.36)	0.23 (12.26)	0.21 (11.53)	0.35 (12.21)
CRUDE	1.02 (16.87)	0.79 (13.77)	0.78 (20.75)	0.62 (5.83)
CRUDE(-1)		1.21 (20.06)	1.22 (20.75)	1.02 (8.12)
CRUDE(-2)		0.59 (11.29)	0.59 (11.51)	0.65 (7.10)
HEATINGDAYS			0.0005 (4.29)	0.0004 (7.60)

Variable	Coefficient (t-statistic) (a)	Coefficient (t-statistic) (b)	Coefficient (t-statistic) (c)	Coefficient (t-statistic) (d)
REFORMGAS	-0.41 (-1.37)	-0.45 (-1.74)	-0.19 (-0.72)	1.06 (3.32)
OXYGENGAS	1.29 (2.06)	0.75 (1.27)	0.56 (0.96)	3.02 (4.60)
CARBGAS	1.21 (0.98)	0.54 (0.48)	1.95 (1.67)	0.34 (0.35)
CARBGAS*YR3	0.37 (0.26)	1.32 (1.06)	1.92 (1.54)	0.60 (0.55)
AK	24.66 (27.82)	24.48 (25.76)	26.26 (20.52)	25.07 (41.09)
HI	15.38 (15.85)	15.97 (15.45)	15.85 (13.71)	14.91 (24.05)
WEST	5.79 (18.09)	5.80 (17.13)	5.89 (15.29)	5.60 (30.14)
NE	2.55 (5.83)	2.39 (5.11)	1.75 (3.27)	1.70 (6.91)
CONSTANT	37.36 (21.23)	16.44 (8.12)	13.29 (2.24)	16.94 (5.61)
autocorrelation coefficient	0.6865	0.7571	0.7684	na
R^2	na	na	na	0.85
Log Likelihood	-3474.48	-2976.13	-2934.36	na

Coefficients in columns (a)-(c) estimated with feasible generalized least squares assuming homoskedasticity and a constant autocorrelation coefficient across states. Coefficients in column (d) estimated with ordinary least squares. Coefficients on month and year dummies not shown.