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The Existence and Nature of Physician Agency: Evidence of Stinting from the British NHS

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The Existence and Nature of Physician Agency: Evidence of stinting from the British NHS[1]

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Abstract

The ability of physicians to make take-it-or-leave-it offers of treatment implies that even fully informed consumers of health care may receive treatments that they would not themselves choose. This paper examines both the extent and direction of this distortion away from patient choice — the physician agency effect — using a large patient-level claims-based data set for dental treatments under the British National Health Service. We find that an increase in competition between dentists results in an increase in treatment effort when those dentists are remunerated on a fee-for-service basis, which is suggestive of *stinting* — physician agency resulting in under-treatment relative to what patients would choose — and that this effect is increases in the extent to which patients are insulated form the cost of their treatment.

Keywords: Physician agency, incentives, insurance, stinting.

JEL Classification: I11

1 Introduction

As noted by Arrow (1963), one important characteristic of health care markets is that physicians have more detailed information than their patients. McGuire (2000) uses the term *physician agency* to denote the issues that arise out of this information advantage and the market power that it generates. In essence physician agency implies that the quantity and quality of health care that a physician delivers may differ from those which a fully informed patient would choose conditional upon prevailing prices, and evidence of this comes from an observed correlation between health care delivery and physician specific variables, for example physician income or remuneration method, after controlling for variations in the patients who are treated. If the amount or quality of health care delivered changes according to a variable that should only enter into the physician's welfare, and hence would not affect a patients choices, physician agency would appear to be at work. The most discussed evidence of this type concerns the relationship between physician income and the utilisation of health care services and has spawned a literature on the ability (or otherwise) of physicians to manipulate the demand for their services — physician induced demand Evans (1974).

As McGuire (2000) points out, estimates of the responsiveness of treatment to physician income incorporate information about the rate of substituting between income and other variables that enter physician utility functions, as well as information about the extent to which physicians are able to adjust treatments. They do not however, provide information as to whether physician agency results in patients being given more or less treatment than they would otherwise choose. And yet the direction in which physician agency moves treatments away from fully informed patient choices has important implications for policy because when patients are insulated from the cost of the services that they receive, there is a tendency for over-consumption — termed *ex post moral hazard* Zweifel & Manning (2000). Thus physician agency may either mitigate or exacerbate consumer moral hazard problems.

The purpose of this paper is to examine both the extent and direction of physician agency effects in dental treatment in the British National Health Service (NHS). We use a large patient-level claims-based panel data set for dental claims in Scotland and estimate a model of treatment effort expended by dentists. After controlling for variations in patients' dental conditions and accounting for dentist specific (fixed) effects, we find evidence of physician agency which acts so as to reduce treatment below that which patients, who in the British NHS are either partially or completely insulated from cost, would otherwise choose — an outcome that Newhouse (2002) refers to as *stinting*. Specifically we find that an increase in competition, as measured by physician density causes a small increase in treatment effort. In addition we find that the size of this effect is dependent upon a number of characteristics of the area, dentist and patient. First, we find that agency effect is greater when competition is measured relative to a locality rather than a region. Second, we find that the effect only applies to dentists who are paid on a fee-for service basis. Finally, we find that the extent of the agency effect is dependent upon the insurance arrangement of the patient and that fully insured patients receive a greater increase in treatment effort as a consequence of increased competition, than patients who contribute towards the cost of their treatment.

The theoretical background to our study is the literature on physician agency as reviewed by McGuire (2000). Specifically we take as our starting point a simple model of monopolistic competition in which dentists are able to make take-it-or-leave-it offers on account of the nonretradable nature of health care. Since in the British NHS, as in many health care systems prices for treatment are administered, we restrict attention to a dentist's offer of treatment effort[1] and assume that this is constrained because patients have the ability to contact other dental service providers. Variations in the tightness of this constraint provide us with a way of testing for both the existence and direction of physician agency effects.

The empirical background to this paper is the extensive literature dealing with the relationship between physician specific variables and health service utilisation, which is usually associated with testing the hypothesis of physician induced demand. This literature has highlighted a fundamental identification problem — increased health care utilisation may be due to either physician choice or attributable to patient preferences (or health care need). Resolving this identification problem has been the concern of the most recent literature in the area. Identifying exogenous income shocks in order to separate these competing explanations empirically has generated a search for appropriate Instrumental Variables (see, for example, Grytten & Sørensen (2001) and Sørensen & Grytten (1999)) despite the potential drawbacks of this approach as illustrated by Dranove & Wehner (1994).[2] Gruber & Owings (1996), using

[1] We thus abstract from a dentist's choices of quality of care, efforts to reduce costs or other dimensions of choice that have been emphasised in associated literatures that deal with multi-tasking aspects of physician behaviour, see, for example, Ma (1994).

[2] Dranove & Wehner (1994) cast doubt on the validity of some instruments employed to identify

an apparently genuinely exogenous negative income shock — a reduction in fertility in the US — find a small but significant increases in Caesarean section delivery rates. Given the coverage of fee-for-service remuneration systems for dental services, dentistry has been a relatively fertile sector within which to test for the existence of physician agency. The results have been generally supportive of the view that dentists pro-actively respond to exogenous income related shocks. For example, using a two-part regression analysis to model the joint determination of attendance and expenditure conditional upon attendance per patient Grytten et al. (1990) find that a measure of dentist density is positively related to both the probability of attendance and expenditure. In a study of dentistry in the UK Birch (1988) shows that a sufficient, but not necessary, condition for demand inducement in a health care system with fixed fees is that there is a positive correlation between dentist density and the amount of treatment per visit. Using data on the cost per course of treatment in each of 98 primary health care districts in England for 1982 Birch (1988) finds support for physician agency effects.

In contrast to most existing studies we utilise data that provides detailed information on both the treatments delivered, the patients to whom they are delivered and the dentists who perform the treatment. We are thus able to control for the unobserved dentist- and area-specific variables that may be correlated with utilisation through a fixed effects regression model. Our empirical analysis is also uniquely set within the framework of dental services in Scotland in which most dentists receive

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PID by finding that an increase in the physician density of obstetrics and gynaecology physicians led to an increase in the number of births.

fixed fee-for-service payments. Thus we concentrate on the effect of an exogenous increase in competition between dentists on the utilisation of dental services at the *intensive margin*: the amount of treatment conditional upon attendance.

In section 2 we set out a simple theoretical model of the choice of treatment intensity by dentists that serves to provide a framework within which to interpret our empirical findings. In section 3 we describe our data, set out our empirical model and report the results of the fixed effects regression. Section 4 concludes.

2 Theoretical Framework

We consider a supplier of dental services, henceforth dentist, who is remunerated by a single purchaser for delivering treatment to each of a given number[3] of patients with a specific dental condition over a specified duration of time.

We denote by e the *treatment effort* that the dentist provides for each of their patients. The payment that a dentist receives potentially varies according to the number of patients treated, the effort expended in treatment and upon the form of the payment contract and we summarise these dependencies in a *payment function* $P(e)$. The predominant payment function that is used in the NHS is a fee-for-service arrangement, in which $P(e)$ reflects the fact that more intensive treatments require a greater number and variety procedures to be carried out, each of which is remunerated. We assume that the dentist derives a *net benefit,* $b(e, p(e), z)$, from delivering

[3]We assume the number of patients treated is predetermined relative to the decision of how much treatment effort to offer. In practice, decisions about treatment effort may impact upon the number of patients that are available to be treated in future time periods, but for reasons of clarity we ignore these inter-temporal aspects of treatment decisions and focus upon within period effects.

a treatment of effort e, where z is a vector of exogenous variables impacting upon a dentist's utility. We assume that the function $b(.)$ is differentiable and concave in e. The function $b(.)$ captures the idea that a dentist may care about the dental well-being of the patients that they treat so that whilst both monetary and non-monetary (i.e. time) costs will be increasing in e, we admit the possibility that $b_e > 0$.

We assume that each patient derives a monetary equivalent benefit from dental treatment of $B(e, x)$, where x is a vector of exogenous variables, such as, for example, dental health status, income, age and gender which affect an individual's utility. We assume that $B(.)$ is increasing and concave in e, and that the patient pays $\theta p(e)$ for their treatment, where θ denotes the co-insurance rate.[4] Following McGuire (2000) we suppose that the non-retradeable nature of health care means that patients regard the offer of treatment made by the dentist as a take-it-or-leave-it offer and will refuse treatment if the net benefit $B(e, x) - \theta p(e)$, is less than their reservation utility which we denote $\overline{U}(y)$, where y is a vector of variables, such as the number of alternative dentists, the degree of congestion in the dental services market and time and distance costs that affect the value of alternative offers of treatment.

Central to the notion of physician agency is the possibility that the dentist's offer of treatment effort does not conform to the patients informed choice, which in the framework thus described will be denoted $e^p \equiv \arg\max\left[B(e, x) - \theta p(e)\right]$ with resulting patient utility of $U^p \equiv B(e^p, x) - \theta p(e^p)$.

[4] In the UK NHS this co-insurance rate is equal to zero for some patients — those who are termed *exempt* — but for the majority of patients, and the majority of treatments, $\theta = 0.8$. The patient payment function, $p(e)$, reflects the cost of treatment received, which is evaluated in the British NHS using the function $P(e)$ as defined for the purpose of paying fee-for-service dentists. Thus even when the patient is treated by a salaried dentist, the payment that they are required to make is the same as if they had been treated under fee-for-service.

The dentist's choice of treatment effort, which we denote e^d, is the solution to the programme

$$\max_e b(e, P(e), z) \text{ subject to}$$

$$B(e, x) - \theta p(e) \geq \overline{U}(y).$$

We consider three possible cases in the first of which, the requirement of satisfying the patient utility constraint is such that the dentist chooses $e^d = e^p$. In this case, the physician acts as the perfect agent for the patient and there is no physician agency issue. The observed choice of effort, should in this case, reflect only those variables that impact upon the patient's utility. Therefore, components of x should be observed to have an impact upon e, but variables that enter exclusively into z should not have an effect. Since in this case patient utility is maximised, further improvements in the vector y will not affect the observed treatment effort.

A second possibility is that the solution to the dentist's programme involves setting e^d to satisfy $B(e^d, x) - \theta p(e^d) = \overline{U}(y)$ but where the resulting utility is less than U^p. In this case there is a physician agency issue but the dentist is constrained by patient welfare. Depending upon the functions $b(.)$ and $B(.)$ either $e^d > e^p$ — which we refer to as *over-treatment* — or $e^d < e^p$ — which we refer to as *under-treatment*. In both cases, changes in the vectors x and y should result in an observed change in e. In the case of over-treatment any component of y that is associated with an increase in consumer utility should *reduce* treatment effort, and vice versa in the case of under-treatment.

A third possibility is that is that a dentist can choose treatment effort unconstrained by patient utility — we refer to this as *unconstrained physician agency.* Because in this case e^d satisfies $b_e(e^d, P(e^d), z) = 0$, neither x nor y should be observed to affect treatment effort.

Which of these three cases prevails for a particular course of treatment with a specific dentist will depend upon x, z, y and θ and the functions B, P, p and $\overline{U}$. However, there are a small number of dentists in the NHS who are remunerated on a fixed salary[5] basis — these are dentists for whom $P(e) = 0$. These dentists are employed in areas where there is a general shortage of fee-for-service practitioners and operate under conditions in which there is little or no competition for patients. *A priori* there is little reason to believe that the treatment decisions of fixed salaried dentists will respond to competitive pressures and, hence, they might be thought of as naturally falling into the category of *unconstrained physician agency*

3 Empirical Implementation

3.1 Data

The details of all NHS covered dental treatment in Scotland is collected by the Management Information and Dental Accounting System (MIDAS). This is a database primarily used for paying dentists. The data collection process can be concisely described as follows. When a dentist completes a course of NHS work, they submit

[5] Since a salary is paid irrespective of how many treatments are carried out, in a strict sense these dentists have no concern as to whether their offers of treatment are acceptable or not. However, in practice the requirements of the employment contract and monitoring by the employer may force such a concern.

details of themselves, the patient and the treatment to a central payment system to claim for payment. The claim for payment is validated through a series of checks to avoid fraud. Once these checks are complete payment is made.

MIDAS covers all NHS courses of dental treatment over the last 10 years – in 2000-2001 there were about 4.1 million courses of NHS dental treatment provided. Each practice, dentist, patient, course of treatment and individual treatment is allocated a unique identifier and it is therefore possible to follow patients, dentists, types of treatment etc. over time. For the purposes of this exploratory analysis the data used here are a simple random sample from this vast pool: data were extracted from claims for patients whose identification number ended in the digits 001 for self-employed dentists and 001, 002 or 003 for salaried dentists.

The data are organised as follows. Consider the treatment of a patient who complains of a sore tooth that requires extraction. The dentist will design a treatment plan for this patient which represents the treatment required for a specific complaint, in this case a sore tooth. MIDAS calls this treatment plan a *claim*. Within each claim the patient may receive a number of specific treatments: an examination, a scale and polish, a radiograph, the extraction itself and so on. Each of these *claim treatments* has a specific code (and fee) associated with it. These fees are determined annually in a bilateral bargain between dentists' representatives and health boards and the menu of fees is set out in an annual publication: the Statement of Dental Remuneration (SDR). While the level of fees has increased over time, the relative fees for treatments have remained fixed and based on the initial timings referred to in Section 2. Hence, the total value of a claim provides an indication of the time that the dentist has spent treating a patient and we use the (log of the) real fee per claim, $\ln(fee)$[6] to measure the treatment effort of the dentist e.

Our data set contains 14053 useable claims. We have restricted the sample further to include only those courses of treatment that require some 'active' intervention by a dentist (approximately 75% of the full sample). The 'inactive' treatments are the empirical counterparts of treatments carried out at minimum intensity $\underline{e}$. We operationalise $\underline{e}$ by associating it with 'examination only' claims, 'scale and polish only' claims and 'examination and scale and polish only claims'. These seem to be qualitatively different from the other treatments in the sample and are more likely to be provided when there is little need for active intervention.[7] Table 1 provides descriptive statistics of these data.

The variables in Table 1 can be related to the theoretical model of Section 2 directly or indirectly. The dummy variables *ddiag*, *dprev*, *dperio*, *dcons*, *dsurg*, *dprosth*, *dorth* and *dother* are based on the broad treatment categories defined in the SDR and thus identify different types of dental condition which we can expect to be reflected in the functions $b(.)$ and $B(.)$ through the dentist and patient-specific variables, z and x, respectively. For example, *dcons* is a dummy variable which equals 1 if the patient received any type of conservative treatment – such as fillings, for example – and 0 otherwise. Besides dental specific characteristics, we use standard patient characteristics – age and sex (and its square) – as further proxies for different types of patients. The exemption status of the patient, *exempt*, is the empirical counterpart of

[6] Adjusted to prices in 1999-2000

[7] Inducement may lead to more *claims* for inactive treatment. Our concern in this paper, however, is dentists' adjustment to shocks at the intensive margin.

Table 1: Descriptive statistics by contract

Variable	Description	Mean
	Total number of active claims	10957
$\ln(fee)$	The log of the real fee per claim	3.43
ddiag	Equals 1 if at least one treatment on the claim was a diagnosis item	0.62
dprev	Equals 1 if at least one treatment on the claim was a preventive item	0.0001
dperio	Equals 1 if at least one treatment on the claim was a periodontal item	0.40
dcons	Equals 1 if at least one treatment on the claim was a conservative item	0.63
dsurg	Equals 1 if at least one treatment on the claim was a surgical item	0.15
dprosth	Equals 1 if at least one treatment on the claim was a prosthetic item	0.12
dorth	Equals 1 if at least one treatment on the claim was an orthodontic item	0.03
dother	Equals 1 if at least one treatment on the claim was an 'other' item	0.16
page	The age of the patient	37.68
dpsex	The sex of the patient	0.44
exempt	A dummy varible equal to 1 if the patient is exempt	0.37
npc	The number of dentists per postcode area per year	7.97
nhb	The number of dentists per health board area per year	118.17
comppc	Population per dentist (by postcode area p.a.)	4711
comphb	Population per dentist (by HB area p.a.)	4986

Note: The 'other' claims constitute miscellaneous treatments not categorised elsewhere.

θ, the co-insurance rate. An exempt patient is fully insured against the cost of dental treatment whilst a non-exempt patient is only partially insured. Conventionally, θ would be expected to impact on a dentist's choice of effort through the net benefit function of the patient: consistent with perfect agency. However, a reduction in θ leading to an increase in effort is also consistent with constrained agency. Patients may be exempt from payment of NHS dental charges for a number of reasons depending upon their individual circumstances including age, employment/income status or general health (e.g. pregnant and nursing mothers are exempt). Thus, in practice, *exempt*, may be correlated with x and y.

The competition variables we use are annual population to dentist ratios calculated at two levels of aggregation: health board, *comphb*, and postcode sector, *comppc*. Table 1 illustrates that *comppc* provides a much more localised measure of competition than the health board measure. For example, the average number of dentists in each postcode sector is 8 per year compared with almost 118 at the level of the health board. In the analysis of physician agency that follows we use both variables as the empirical analogue of y.

3.2 Empirical Model

To address the fundamental concern that dentists may choose where to practice according to their monetary and non-monetary costs and hence that dentist characteristics are correlated with our measures of competition, *comphb* and *comppc*, we use a fixed effects regression model. In order to control for variations in patient types across dentists we include patient specific and treatment specific variables. Hence, we estimate a model of the following form:

$$\ln(fee)_{ij} = \beta comp_{ij} + w'_{ij}\gamma + \lambda_j + \alpha_i + \varepsilon_{ij}, \qquad (1)$$

where i and j denote the dentist and patient respectively. The variable $comp_{ij}$ is one of the two competition controls, *comphb* and *comppc*, defined above. Given the dependent variable is in log form, and the competition measure is defined as the population to dentist ratio, $\beta < 0$ can be interpreted as the percentage increase in the real fee associated with a unit *increase* in competition. We expect that the local measure of competition, *comppc*, will be have a greater impact upon e than the regional measure of competition, *comphb*. The matrix of additional patient controls, w_{ij}, consists of the treatment categories, the exemption status of the patients and their demographic characteristics. λ_j are effects included to control for periodic changes to the nominal fee scale for dental services – changes in $p'(e)$[8] – and α_i denotes the dentist-specific fixed effects.

3.3 Results

Table 2 presents the regression results from variants of Equation (1). Column (1) represents the baseline regression specification with no controls for competition. From column (1) we note that the controls for patients and their treatment are generally significant, with the exception of the sex of the patient. Exempt/fully insured patients receive approximately 28% more treatment effort than non-exempt patients.

Columns (2) and (3) introduce the Health Board and postcode level competition measures, respectively. Column (2) indicates that competition measured at the health board level has no effect on the intensity of treatment per patient. In contrast, the coefficient on *comppc* in column (3) suggests dentists do respond to exogenous shifts, albeit at a very small rate. Evaluated at the mean, the coefficient suggests that a 1% reduction in population per dentist (an increase in competition) increases the real fee

[8] The estimates from these dummies are not reported but are available from the authors upon request.

(treatment effort) by 0.065%.

As noted in section 2 some dentists receive a fixed salary and Column (4) therefore replicates the regression in column (3) using 655 observations from 38 salaried dentists in Scotland over the same period. We conjecture that the response to competition effect we observe in column (3) should not be present for salaried dentists, because these dentists operate in areas where there is little or no alternative dental service provision. Indeed, a significant coefficient on *comppc* might suggest some specification error in our regression formulation. However, as can be seen in Column 4 this variable is not significant for salaried dentists.

The theoretical analysis of Section 2 shows that the effects of an increase in competition, y, may differ according to the exemption status of the patient. Columns (5) and (6) test this prediction by repeating the regression in column (3) for the non-exempt and exempt sub-groups respectively. The results support the hypothesis that the physician agency effect is greater for exempt/fully insured patients than for non-exempt/partially insured patients. Indeed, for the (approximately) 40% of patients who are exempt/fully insured the elasticity of the competition variable is approximately 0.094. In contrast, the effect of an exogenous shock to competition on the treatment of non-exempt patients is not significant. This analysis therefore uniquely tests for and finds a physician agency effect operating through the insurance contract of patients. Given NHS dental services operate within a set of administered prices, this effect cannot be interpreted as an increase in the fee (as in Gruber & Owings (1996)) but, rather, as the effort decisions of the dentist being affected by a binding demand constraint.

The configuration of responses we observe in Table 2 provides evidence of which physician agency regime NHS dentists operate within. In summary, we find that increased competition is associated with increased treatment effort. This result is consistent with both physician agency and under treatment of patients — stinting — relative to the perfect agent effort level e^p.

4 Discussion

The idea that physicians can impose health care decisions on their patients — physician agency — is naturally a matter of continuing concern to health care policy-makers. Two immediate issues are whether, in some particular context, physician agency exists and whether as a consequence physicians provide too much or too little treatment relative to what their patients would choose. Our findings indicate both that there is physician discretion in the choice of dental treatment in the British NHS and that this discretion results in a reduction of treatment below that which patients want — stinting.

Our focus has been on over- versus under-provision of treatment and we have utilised the response of dentists to an exogenous variation in the extent of competition to identify which of these two cases describes the data. We find that the response of treatment effort to competition is positive and significant. However, the magnitude of our estimated coefficients are such that competition cannot be regarded as a powerful policy instrument for influencing treatment effort because the elasticity of effort with respect to the number of dental practitioners in an area is small. Nevertheless, the sign of this elasticity is important in understanding how physician agency operates. In particular, it suggests that any policy that seeks to mitigate physician agency — for example, by increasing patient choice — will potentially result in increased treatment effort and thus cost.

Our results also indicate that there is an important interdependency between the decisions of physician agents and the insurance arrangements of their patients which has potentially important implications for policy makers who are concerned with mitigating the over-consumption of services where consumers are insulated from the cost of treatment.

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Table 2: Regression results

	(1)	(2)	(3)	(4)	(5)	(6)
Physician payment	FFS	FFS	FFS	Salaried	FFS	FFS
Patient's insurance	All	All	All	All	Partial	Full
Competition level	All	HB	Postcode	Postcode	Postcode	Postcode
page	0.02427**	0.02425**	0.02458**	0.01386*	0.02506**	0.01859**
	(0.00216)	(0.00216)	(0.00221)	(0.00680)	(0.00312)	(0.00428)
page2	-0.00025**	-0.00025**	-0.00025**	-0.00014	-0.00028**	-0.00016**
	(0.00003)	(0.00003)	(0.00003)	(0.00008)	(0.00004)	(0.00005)
dpsex	0.02034	0.01997	0.01992	0.02021	0.05211	-0.02803
	(0.02205)	(0.02206)	(0.02276)	(0.06251)	(0.03046)	(0.04624)
trauma	0.32141**	0.32412**	0.33742**	0.31430	0.29243**	0.33522**
	(0.06228)	(0.06233)	(0.06324)	(0.24749)	(0.08327)	(0.11301)
dcons	0.89035**	0.89039**	0.88937**	0.96042**	0.88979**	1.01337**
	(0.02389)	(0.02389)	(0.02462)	(0.07873)	(0.03259)	(0.04458)
dsurg	0.51818**	0.51818**	0.50914**	0.28407**	0.52227**	0.46234**
	(0.02802)	(0.02802)	(0.02871)	(0.08896)	(0.03884)	(0.04985)
dprosth	1.11522**	1.11530**	1.09479**	1.47665**	1.09197**	1.10936**
	(0.03491)	(0.03491)	(0.03564)	(0.10337)	(0.04727)	(0.06403)
dorth	1.45348**	1.44962**	1.43524**	0.00000	0.99809	1.36858**
	(0.08492)	(0.08499)	(0.08695)	(0.00000)	(0.96226)	(0.09775)
dother	0.19088**	0.19175**	0.19011**	-0.27688**	0.25728**	0.12920**
	(0.02880)	(0.02881)	(0.02941)	(0.10114)	(0.04227)	(0.04790)
exempt	0.25017**	0.24987**	0.24116**	0.08779	—	—
	(0.02313)	(0.02313)	(0.02362)	(0.07200)		
comphb	—	-0.00004	—	—	—	—
		(0.00003)				
comppc	—		-0.000014*	.0000218	-.0000116	-.0000199*
			(5.69e-06)	(.000027)	(7.79e-06)	(9.55e-06)
Constant	2.50216**	2.73273**	2.55400**	2.36117**	2.46873**	3.10167**
	(0.11527)	(0.23425)	(0.12299)	(0.29409)	(0.15088)	(0.23153)
Observations	8139	8139	7702	655	4656	3046
Number of did	1133	1133	1074	38	918	748
R-squared	0.29	0.29	0.29	0.44	0.25	0.32

Standard errors in parentheses * significant at 5%; ** significant at 1%