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Doctors' Fees in Ireland Following the Change in Reimbursement: Did They Jump?

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Abstract: This paper analyses the pure time-series properties of doctors' fees in Ireland to assess whether a structural change in the series is observed at the time of the change in reimbursement in 1989. Such a break would be consistent with doctors responding to the reimbursement change in a manner predicted by supplier-induced-demand behaviour and would provide indirect evidence that such inducement had taken place. Structural change is assessed on the basis of CUSUM and CUSUMSQ tests. The data is also analysed for the presence of unusually influential observations. In neither case are the results consistent with a break around the time of the introduction of the change.

I INTRODUCTION

In a recent paper Madden, Nolan and Nolan (2005, henceforth MNN) explored the extent to which visiting patterns to General Practitioners in Ireland changed following a change in reimbursement. More specifically, in Ireland, individuals below an income threshold, termed "medical card patients", are entitled to free GP consultations while the remainder of the population, termed "private patients", must pay the full cost of each consultation. Prior to 1989, GPs were reimbursed on a fee-per-service basis for both medical card and private patients, by the state and the patient respectively. In part in response to evidence in favour of demand inducement presented by Tussing (1983; 1985), the reimbursement system for medical card patients was changed from fee-for-service to capitation in 1989, thus removing any incentive for GPs to induce visits from medical-card patients. MNN examined the "difference-in-differences" between medical card and non-medical card visits before and after the change in reimbursement. The results showed that visits by *both* private and medical card patients fell and hence the differential in visiting rates did not narrow, as might have been anticipated if supplier induced demand played a major role.

One factor which MNN were unable to take account of was whether, following the change in reimbursement, GPs increased their fees for private patients to offset any loss in induced demand from medical-card patients. Failure to take account of this implies that some form of supplier-induced demand for medical card patients prior to 1989 cannot be unambiguously ruled out. This is because while the change in reimbursement was introduced with the intention of lowering medical-card patients' visits (and evidence suggests that it succeeded in this in the short run at least), doctors may have responded to their loss of income from this form of inducement by raising fees for non-medical card patients. If GP visits for non-medical patients are price inelastic, as is typically assumed, then such a course of action would have led to increased revenue from private patients, yet no narrowing of the visiting differential since visits from *both* groups would have fallen.

Unfortunately, MNN were unable to explicitly control for such an effect since their data listed GP visits on an *annual* basis (i.e. numbers per year for each individual) and so it was not possible to assign individual visits to the particular month or quarter. In the absence of sufficient time variation it was not possible to condition on price in the analysis.

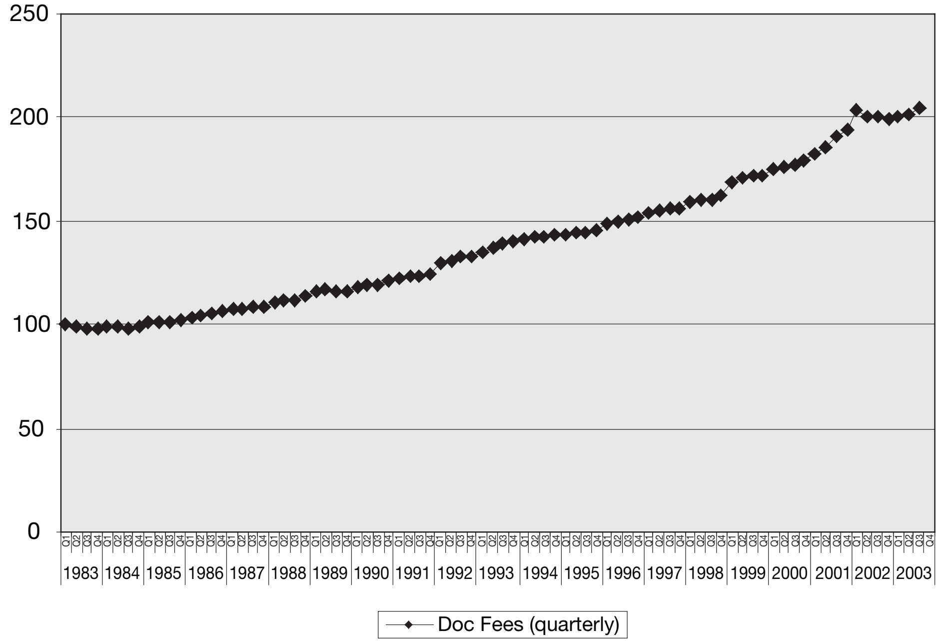
In this note we utilise an alternative data source and approach to investigate the evolution of doctors' fees over time. In particular, we examine whether any form of break or discontinuity (we define precisely what we mean by this below) can be observed in the time-series data on doctors' fees around the time the change in reimbursement was introduced. If such a break is observed then it is consistent with doctors responding to the change in reimbursement by raising private patients' fees. In turn this could be regarded as a classic reaction to a situation where inducement had previously existed, but where the scope for such inducement had been diminished by the change in reimbursement.

The remainder of the paper is organised as follows. In the next section we describe our data source and the methodology we employ to detect any break in the time-series on doctors' fees. In Section III we present our results and in Section IV we offer concluding comments.

II DATA AND METHODOLOGY

This section describes our data and methodology. The data we use is quarterly data on doctors' fees from 1983 Q1 to 2003 Q3 provided by the Irish Central Statistics Office. This index is a sub-component of the overall Consumer Price Index. To obtain the change in the real price of doctors' fees we deflate the index for doctors' fees by the index for all items. Figure 1 shows the change in the real price of doctors' fees from 1983 to 2003 (indexed at 100 for 1983 Q1).

Figure 1: *Doctors' Fees, Quarterly, 1983 Q1 = 100*



Purely eye-balling the graph we see that doctors' fees (in real terms) stayed constant from early 1983 to about the last quarter of 1985. We then see the index start to increase and there is some evidence of a slight "blip" upwards in the first quarter of 1989, but this seems to be followed by a levelling off for the rest of 1989. From then on the rate of increase is reasonably constant (though there is some evidence that it picks up around the end of 2000) with evidence of other occasional blips e.g., 1992 Q1, 1999 Q1 and, in particular, 2002 Q1. The fact that most of the blips occur in Q1 may indicate some seasonality in price setting (i.e. GPs change their fees at the beginning of every year) and the particularly large rise in 2002 Q1 may reflect the changeover to the euro.[1] We return to this below.

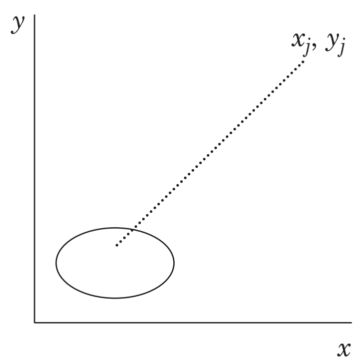
While eye-balling the data can be revealing in terms of suggesting possible breaks, it is also desirable to test for such breaks more formally. We adopt two approaches here: first of all we search for any observations which appear to be unusually influential and second we formally test for structural breaks.

Taking influential observations first, following the discussion in Belsley, Kuh and Welsch (1980) we can think in terms of three key issues in identifying model sensitivity to individual observations. These are residuals, leverage and influence. Any given data point with a large residual is an outlier and clearly there is concern that such outliers will exert undue influence upon estimated coefficients.

However, large residuals are not the only way in which individual points can affect estimates unduly. In the same way that the actual and estimated values of the dependent variable can be far apart it is also possible that some individual values of the independent variable may be far apart from the mass of other values.

In Figure 2 we have a scatterplot of y against x such that all points are located in a mass concentrated in the ellipse in the lower left side of the diagram, apart from a single point (x_j, y_j) in the top right-hand corner. The dashed line shows the estimated regression line obtained, which clearly comes very close to the point (x_j, y_j). Thus (x_j, y_j) is not an outlier in the sense of having a large residual, yet it has a dramatic effect on the estimated slope of the regression line, since if this point was deleted then the estimates would change markedly. In this case, the point (x_j, y_j) is said to have high *leverage.*

Figure 2: *Leverage*



[1] In January 2002 Ireland, along with a number of other nations in the EU, adopted the euro as its currency. This led to many prices being "rounded" up or down. A rounding up of doctors' fees seems to be a plausible explanation for the relatively sharp rise observed in 2002 Q1.

Thus we can think of influence being exerted in two ways, via large residuals or a high degree of leverage. Belsley, Kuh and Welsh (1980) suggests a variety of statistics which can be used to detect influential observations. The particular statistics we adopt are: leverage; standardised residual; studentised residual; DFITS; Cook's Distance; Welsch's Distance; various DFBETA statistics and the covariance ratio. Leverage, studentised and standardised residuals and the DFBETA statistics essentially examine the significance of individual observations on estimated regression coefficients. The DFITS, Cook's Distance and Welsch's Distance measures address essentially the same issue except that they examine the sensitivity of the predicted values of the dependent variable to individual observations while the covariance ratio addresses the influence of individual observations on the variance-covariance matrix of the estimates.[2]

Table 1: *Residuals and Leverage Tables*

	Quadratic		*Cubic*		*Quartic*	
Residual	1993q3	4.041	1983q1	4.159	1994q2	3.326
	1994q2	4.076	1994q2	4.314	1994q1	3.567
	1994q1	4.418	1994q1	4.598	2001q4	4.052
	2002q2	5.803	2002q2	5.249	2002q2	5.157
	2002q1	11.107	2002q1	10.714	2002q1	10.940
Leverage	1983q3	.085	2003q1	.122	2003q1	.1477
	2003q2	.094	2003q2	.147	2003q2	.196
	1983q2	.094	1983q2	.147	1983q2	.196
	2003q3	.103	2003q3	.176	2003q3	.262
	1983q1	.103	1983q1	.176	1983q1	.262
Standardised Residual	1993q3	1.615	1994q2	1.772	1994q2	1.492
	1994q2	1.628	1983q1	1.856	1994q1	1.600
	1994q1	1.765	1994q1	1.888	2001q4	1.833
	2002q2	2.363	2002q2	2.207	2002q2	2.352
	2002q1	4.509	2002q1	4.479	2002q1	4.963
Studentised Residual	1993q3	1.632	1994q2	1.797	1994q2	1.504
	1994q2	1.646	1983q1	1.886	1994q1	1.617
	1994q1	1.789	1994q1	1.920	2001q4	1.861
	2002q2	2.435	2002q2	2.264	2002q2	2.424
	2002q1	5.188	2002q1	5.153	2002q1	5.961

[2] The interested reader is referred to Belsley, Kuh and Welsch (1980) for details.

Table 2: *DFITS, Cook's Distance, Welsch's Distance and COVRATIO Tables*

	Quadratic		*Cubic*		*Quartic*	
DFITS	2002q3	.417	1983q2	.485	1983q1	.483
	2002q2	.632	1983q1	.873	2001q4	.457
	2002q1	1.277	2002q2	.632	2002q2	.678
			2002q1	1.323	2002q1	1.539
Cook's Distance	2002q3	.057	2003q2	.090	2003q2	.320
	2002q2	.125	2003q3	.049	2003q3	.413
	2002q1	.411	1983q2	.059	2003q1	.062
			1983q1	.184	2002q2	.086
			2002q2	.095	2002q1	.328
			2002q1	.330		
Welsch's Distance	2002q2	5.912	1983q1	8.706	2002q2	6.372
	2002q1	11.911	2002q1	12.365	2002q1	14.390
DFBETA (q)	2002q1	–.673	2002q1	.290	2003q2	.576
	2002q2	–.354	1998q3	.220	2003q3	.755
	1994q1	.220	1983q1	–.614	1983q1	–.307
	2002q3	–.246	2003q2	–.326		
	1983q1	–.288	1983q2	–.322		
			2003q3	–.259		
DFBETA (q^2)	2002q1	.744	2002q1	–.324	2003q2	–.601
	2002q2	.388	1998q3	–.225	2003q3	–.785
	2002q3	.269	1983q1	.586	1983q1	.296
	1983q1	.271	2003q2	.344		
			1983q2	.306		
			2003q3	.272		
DFBETA (q^3)			2002q1	.364	2003q2	.626
			2002q2	.226	2003q3	.815
			1998q3	.228	1983q1	–.285
			1983q1	–.561		
			2003q2	–.363		
			1983q2	–.292		
			2003q3	–.286		
DFBETA (q^4)					2003q2	–.655
					2003q3	–.845
					2003q1	–.229
					1983q1	.275
COVRATIO	1983q4	1.125	2002q1	.347	2002q1	.1706
	1983q2	1.133	1983q2	1.151	2002q2	.796
	2003q1	1.134	1983q4	1.167	2003q2	.854
	1983q3	1.135	2002q4	1.172	1984q1	1.168
	2003q3	1.155	2003q1	1.176	2002q4	1.186
			1983q3	1.187	1983q4	1.201
			2003q3	1.219	1983q3	1.249
					1983q2	1.315
					1983q1	1.384

An alternative approach to searching for unusually influential observations is to examine the data for a structural shift in the estimated relationship. Perhaps the best known of such tests is the Chow test. However, a problem with the Chow test is that while it can tell whether the relationship has changed for two different periods with the cut-off date chosen arbitrarily, it does not identify when exactly the relationship begins to change.

A potentially more useful approach is to examine the *recursive residuals* from the regression (see Brown *et al.*, 1975, and Galpin and Hawkins, 1984). These are the residuals obtained after discarding successive observations (starting with the last) and calculating the (standardised) residual of the last observation from the new line. The examination of plots of the recursive residuals can be extremely useful in detecting a "change in regime" in the regression model. Brown *et al.* (1975) suggest plotting the cumulative sums (CUSUM) of the recursive residuals and if all the regression assumptions are satisfied then the plot of these residuals should be a random walk within a parabolic envelope (where the borders of the envelope can reflect significance levels) about the origin.[3]

Complementary to the CUSUM plot is that of the CUSUM of squares which is particularly useful when departures from constancy of the estimated regression coefficients is haphazard rather than systematic.

In the next section we present values of the above statistics for influential observations and for structural breaks for the case of doctors' fees. We are concerned only with the pure time-series properties of doctors' fees, hence our regression model will only have time and higher order terms in time as explanatory variables. Ideally, we would like to estimate a structural or even reduced form of inverse demand function whereby doctors' fees would depend upon such factors as underlying health, supply of GPs etc. Such data is simply not available and so we concentrate purely on the time series properties of doctors' fees.

There are a variety of models we could estimate to investigate the pure time-series properties of doctors' fees. Perhaps the simplest is where we simply let doctors' fees depend upon an n-th order polynomial in time. For comparison we include results for a quadratic, cubic and quartic in time. For the case of leverage, standardised residuals and studentised residuals we present those observations with the five highest values. For the other statistics outlined

[3] The CUSUM approach may be regarded as an example of a generalised fluctuation test which does not assume a particular type of deviation from the null hypothesis of no structural change. This may be contrasted with approaches which test for specific alternatives in terms of the number of structural changes (e.g., Bai and Perron, 1998, 2003). For a general discussion see Zeileis *et al.* (2003) and Perron (2005).

above we list those observations in excess of the critical values suggested by Belsley, Kuh and Welsch (1980).

III RESULTS

The results for influential observations do not lend any support to the idea that 1989 is in any way "different" in the sense that the relationship between doctors' fees and time is unduly influenced by events in this year. In no case does an observation from 1989 exceed the critical value, nor are they ranked high in terms of leverage or the standardised or studentised residuals. Are there any observations which consistently appear to be influential? In terms of residuals, it is clear that the first two quarters of 2002 and, to a lesser extent, of 1994 are outliers. As suggested above, the behaviour of doctors' fees in early 2002 is probably due to rounding up following the introduction of the euro. A possible explanation for the higher residuals in 1994 is that some doctors may have invested in premises and developed group practices arising from some of the suggestions contained in the blueprint policy document *The Future of General Practice in Ireland* (Department of Health, 1991).[4]

In terms of leverage, the greatest influence is exerted by observations at the beginning and end of the sample period. In the case of the various measures combining residuals and leverage, the influence of large outliers appears to dominate that of observations with high leverage. Hence, 2002 Q1 has the highest value of DFITS, Cook's and Welsch's Distance. For COVRATIO it is generally those observations with highest leverage which exert the most influence.

Turning now to the results for structural breaks, when we calculate the Chow statistic above for the quadratic, cubic and quartic in time for our data using 1989 Q1 as the date for the structural shift we obtain F values of 125.74, 117.24 and 100.01 respectively, clearly rejecting the null hypothesis that there is no structural shift. So, is this clear evidence that doctors' fees did take a jump in 1989? Not really, since if we calculate the same statistic for different dates, chosen somewhat randomly, then we also obtain high F values. For example, choosing 1986 Q1 we obtain F values of 129.19, 119.41 and 96.74 respectively, while choosing 1995 Q1 we obtain 97.63, 78.57 and 79.48. Thus while the Chow Test can tell whether the relationship has changed for two different periods with the cut-off date chosen arbitrarily, it does not identify when exactly the relationship begins to change.

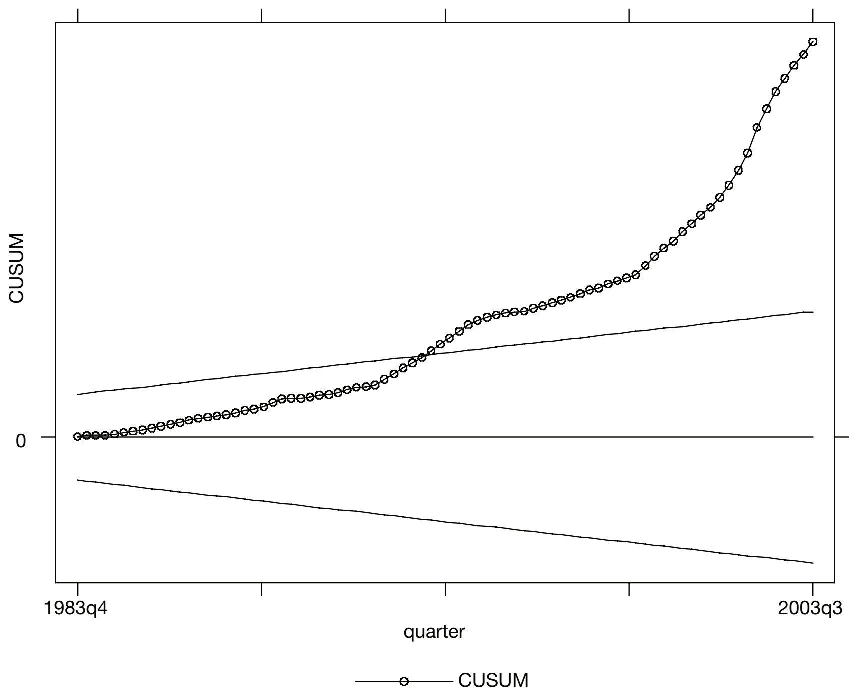
[4] I am grateful to an anonymous referee for this suggestion. For details on the extent to which GPs have moved towards group practices in recent years see *Structure of General Practice in Ireland, 1982-2005* (O'Dowd *et al.*, 2006).

In Figures 3 to 10 we present the plots of the CUSUM and CUSUMSQ for the different regression models estimated for doctors' fees, while in Table 3 we show for what quarter, if any, the CUSUM and CUSUMSQ plots move outside the 95 per cent confidence intervals and for what quarter, if any, they move back inside the limits.

Table 3: *"Break-Out" Quarters for Doctors' Fees*

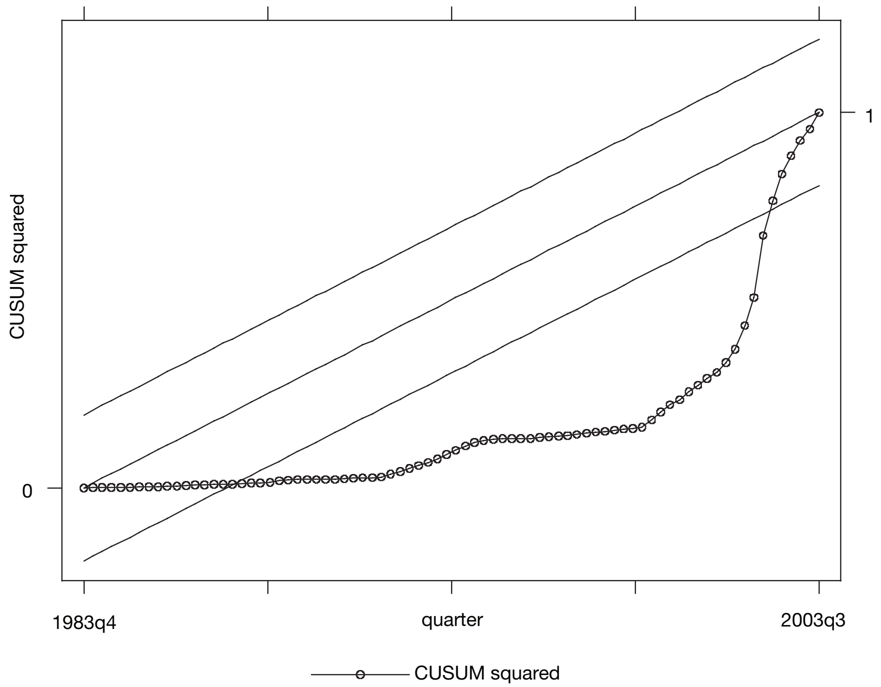
	Break Out Quarters			
	Linear	*Quadratic*	*Cubic*	*Quartic*
CUSUM	1993 q2	1997 q4	2001 q4	–
CUSUMSQ	1988 q1	1988 q2	1988 q2	1988 q3
	Break In Quarters			
	Linear	*Quadratic*	*Cubic*	*Quartic*
CUSUM	–	1999 q3	–	–
CUSUMSQ	2002 q2	2002 q1	2002 q1	2003 q1

Figure 3: *CUSUM Plot for Linear Regression Against Time*



The results for CUSUM show no consistency in terms of when a regime change may have occurred. Those for CUSUMSQ do show consistency, with evidence of a change in regime sometime in 1988 (see Figures 4, 6, 8 and 10). This, however, pre-dates the change in reimbursement. This raises the intriguing possibility that doctors *anticipated* the change in reimbursement regime. Given the debate within the medical profession in the lead-up to the change in reimbursement, it is clear that most GPs would have been aware of the broad details of the scheme before it was actually implemented and it is possible that they may have raised fees before implementation.[5]

Figure 4: *CUSUMSQ Plot for Linear Regression Against Time*



[5] While there was a strong majority of doctors in favour of the change, the implementation of the system was delayed as some Dublin based GPs argued that the new reimbursement system favoured rural GPs while others argued that since the deal was negotiated between the Department of Health and the Irish Medical Organisation (IMO) and they were not members of the IMO, hence the deal did not apply to them (see *Irish Independent*, November 7, 1988a).

Figure 5: *CUSUM Plot for Quadratic Regression Against Time*

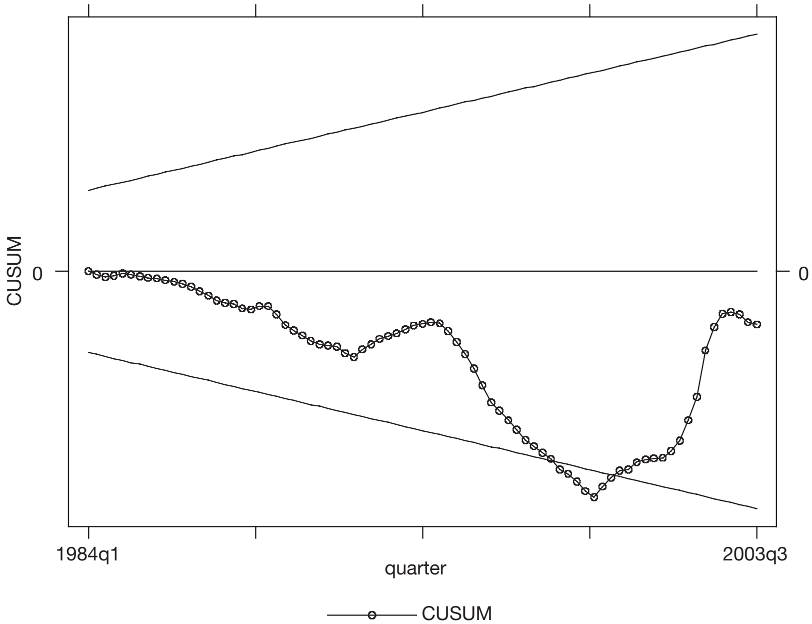


Figure 6: *CUSUMSQ Plot for Quadratic Regression Against Time*

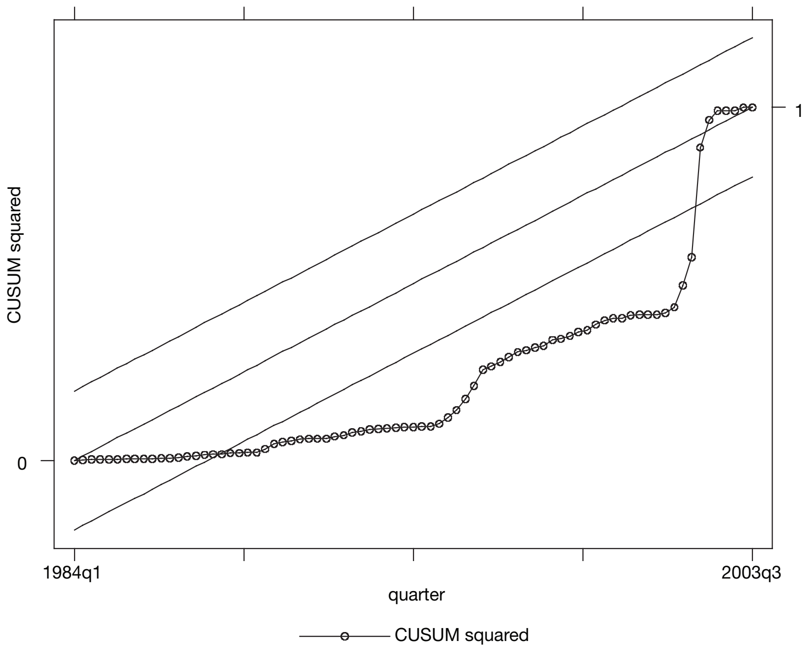


Figure 7: *CUSUM Plot for Cubic Regression Against Time*

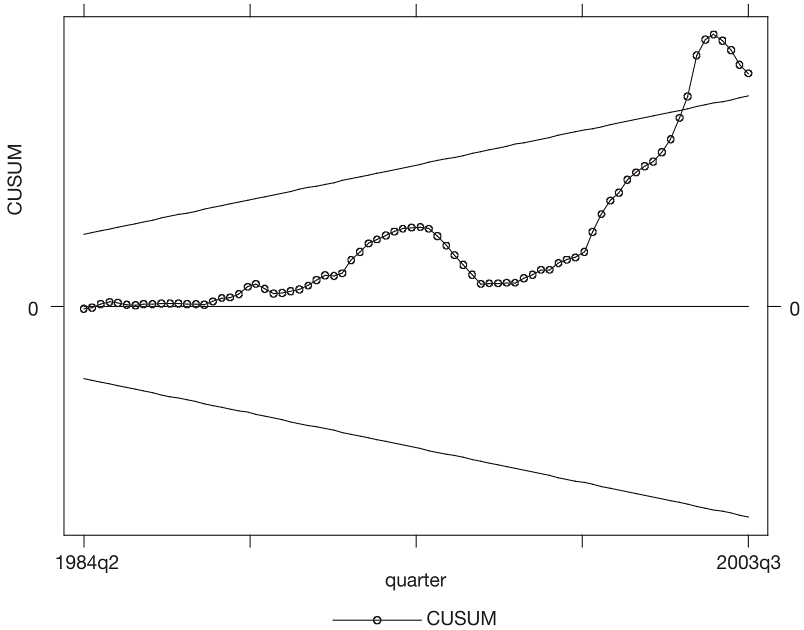


Figure 8: *CUSUMSQ Plot for Cubic Regression Against Time*

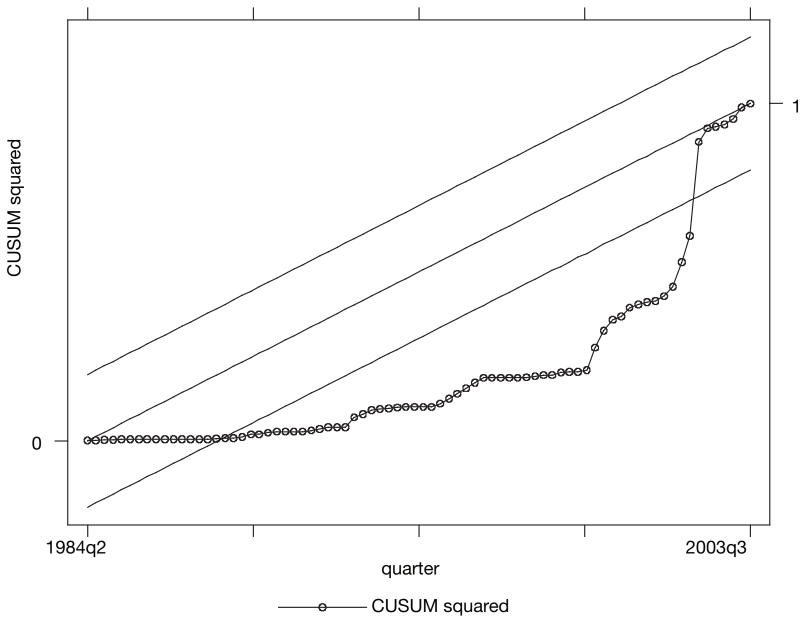


Figure 9: *CUSUM Plot for Quartic Regression Against Time*

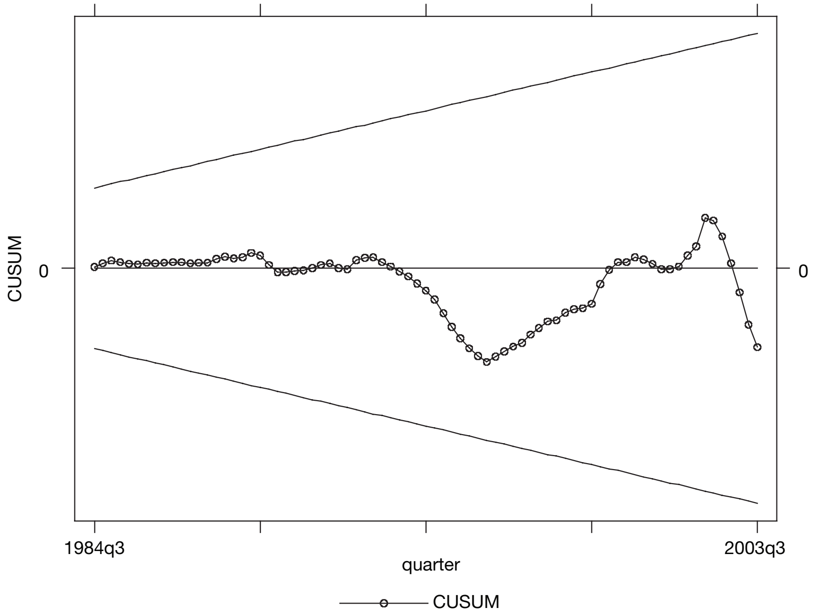
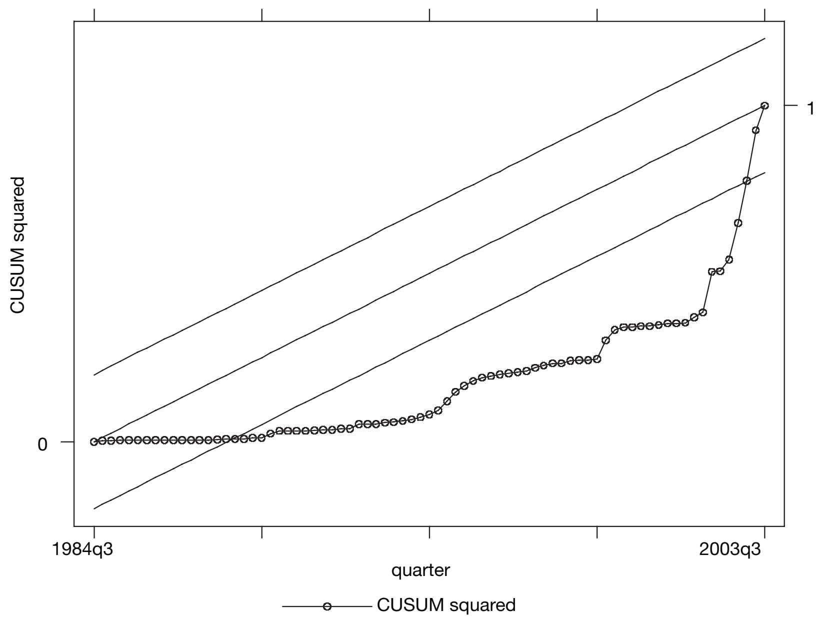


Figure 10: *CUSUMSQ Plot for Quartic Regression Against Time*



IV DISCUSSION AND CONCLUSION

This paper has approached the issue of supplier-induced demand in the Irish health system from a slightly unusual angle. Following on from the investigation by MNN of the natural experiment of the change in reimbursement in early 1989, an analysis of the time-series properties of doctors' fees gives no indication that there was any unusual upwards "blip" around about the time the reimbursement change was introduced, despite the incentive for such a rise. Are there any plausible reasons as to why this might be the case?

First of all there is the possibility pointed out above that doctors may have anticipated the change in regime and increased fees before the new reimbursement system was introduced. Evidence for this possibility comes from the results of the CUSUMSQ test which shows some evidence of a regime switch in 1988. However, for the linear, quadratic and cubic versions of the CUSUMSQ test, the change in regime appears to occur in the first half of 1988. This is about three to six months before the controversy over the new regime arose so it could be argued that the degree of anticipation shown by doctors is not credible.

An alternative possibility is that while the change in reimbursement system reduced the incentives to induce demand at the margin for medical card patients, it still led to an overall increase in doctors' incomes and hence if doctors obeyed the "target income" hypothesis there would have been no need for any offsetting increases in private patients' fees. The fee-for-service arrangement cost the Department of Health IR£39 million in 1987 and the capitation fee system was predicted to cost IR£53 million in addition to providing extra benefits such as pension arrangements, holiday pay, sick leave etc. Thus it could be argued that the new regime provided not just higher pecuniary rewards but also additional non-pecuniary benefits, and it is noteworthy that amongst doctors there was a 68 per cent vote in favour of accepting the deal (*Irish Independent*, September 8, 1988b). If the new reimbursement regime was very favourable to doctors then it could explain why visits from both medical card and private patients fell following the reimbursement change.

Finally, the analysis concludes that to the extent that any period could be identified where doctors fees did appear to behave unusually it was 2002 Q1, the period when the changeover to the euro occurred and when there was some anecdotal evidence of prices being rounded up.

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