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Patient heterogeneity and income under mixed remuneration – empirical explorations of general practice partnerships

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Abstract

Background: Based upon the assumption that GPs utility as a function of income and leisure it has been suggested that GPs serving complex patients will face lower utility in mixed remuneration systems. The income effect in this model is ambiguous but is has been shown, with Danish data, that solo practices have lower income the higher the complexity of their patients. No analysis of partnership practices has been undertaken.

Aim: To assess the income effect of patient complexity for partnership practices and discuss potential differences between solo – and partnership practices.

Methods: A reduced form income equation based on the income-leisure utility function is applied using OLS regressions on a dataset of partnership practices. Bootstrapping technics is used to estimate confidence intervals around the income effect of patient complexity and subgroup analysis is undertaken to assess differences between small and large partnerships.

Results: As solopractices, partnerships have negative income effect of patient complexity meaning that the remuneration system is fully rewarding the resource use connected to serving complex patients. However the confidence interval on partnerships is ambiguous (-4,614;2,559) and analysis of subsamples show that the income effect is negative for small partnerships (less than 4 GPs) and positive for larger partnerships (4 or more GPs). Analysis of list size and visits per patient indicates that larger partnerships are able to supply more fee for services to complex patients indicating either supply inducement from large partnerships or time rationing on small partnerships (and solo practices).

Conclusion: The behavioural pattern in partnerships differs from that in solo practices and it cannot be assumed that their behaviour can be derived from the same utility function. It seems that we do not yet have a full understanding of the theoretical foundation of partnership behaviour under mixed remuneration.

Keywords; General practice, remuneration systems, partnerships

JEL; I10, I18

Introduction

The mixed remuneration system with both per capita and fee for service payments have the potential to leave GPs with equal income regardless of the patient characteristics. This is because the two payment fees have complementary effect on income. GPs having very complex patient will most likely be unable to serve a below average size and hence loose on the capitation part. However, because the more complex patients are having more visits there is a gain in the fee for service part of the remuneration. However, it is shown in Olsen (2011) that the overall utility is lower when serving more complex patients and that the income effect is a function on the choice of list size and marginal number of visits served to complex patients. Using a Danish dataset of solo practices it is shown that the income effect for solo practices is negative (Olsen, 2011). This can be explained by the increase in fee for service due to the higher complexity and hence higher need for services cannot replace the loss in capitation. A relevant question is whether there is a time rationing on the solo practice GPs in the sense that they are not able to supply the number of visits that is needed drives the result or if it is solely a matter of wrong relative prices between capitation and fee for services. In either case it could be argued that the per capita fee should be reduced, fee for services increased or a differentiation of the per capita fee would be wanted.

In this paper we analyse the same research question as in Olsen (2011) but use partnership practices in the empirical analysis.

The paper is structured as follows. In the next section we briefly present the theoretical framework and the empirical model and in the following section we present the results. Then the results are discussed with perspectivation to other models of GP behaviour.

Theoretical background

The theoretical background for the analysis of the association between patient heterogeneity and GP income under mixed remuneration is the seminal paper by (McGuire & Pauly 1991) which focuses on modelling GP behaviour subject to exogenous payment schemes and the trade-off between income and leisure. This approach is used in later work on GP behaviour. For example by Iversen (2004) who use an income/leisure model for to analyse GP income and behaviour. In this paper the empirical section use both solo and partnership practices. Olsen (2011) is based on Iversen's interpretation of the model but argues that it might only be applicable for solo practices and only solo practices is used in the empirical testing of the model. The approach is presented below.

The GPs utility can be expressed as $U_i = y_i^{pc} + y_i^{ffs} - \mathrm{C} + v(l_i)$ where y refers to income and *v* refer to leisure. The GPs maximisation problem can be defined by

$$\max_{n_i} U_i = p^{pc} n_i + p^{ffs} \cdot (n_i \cdot \alpha(\theta_i)) - C + v(l_i) \tag{1}$$

Where $v_i(l_i)$ is GP i's utility from leisure (l_i) and the rest of the equation defines the net income. It is assumed that the list size, n_i, is the endogenous parameter to be determined by the GP. *C* reflects investment in equipment and housing and is in this context assumed constant. p^{pc} and p^{ffs} refer to the per capita and the fee for service payment and for ease of presentation we assume that the average need for services for patients on GP *i*'s list is defined by α which is assumed to be a function of the complexity (represented by θ_i) of the patients on the list. The per capita price p^{pc} was 285 DKK (app. 60 US$) in 2006, whereas the fee for service system consists of a large number of fixed national prices for various services (consultations, vaccination, measuring blood pressure etc).

We assume that the patient complexity can be defined by an index variable, $\theta_i > 0$, which increases with the level of complexity. The complexity index cover factors such as need for health care services, co-morbidity and socio demographics.

The total level of services supplied by GP *i* is defined by ($n_i \cdot \alpha(\theta_i)$). Notice that the subscript *i* on θ_i refers to the fact that we allow the complexity of the patients to vary between GPs. We assume that $\alpha' \geq 0$.

Due to GP shortage we assume that the GPs face excess demand from patients who want to enter their list and hence it is further assumed that the GP has no incentive to supply any excess services over and above $\alpha(\theta_i)$.

It is assumed that the GPs utility is increasing but at a diminishing rate with respect to leisure – hence $v' > 0$ and $v'' < 0$. We also explicitly define leisure as $l_i = T - t(\theta_i)\cdot(n_i \cdot \alpha(\theta_i))$, where T is the total amount of time available and $t(\theta_i)$ is the average level of time needed per consultation for patients on GP i's list. We assume that $t' \geq 0$, entailing that more complex patients require more time per consultation. From (1) it follows that GPs are assumed to be identical except for their patient complexity characteristics (θ_i) and the utility they associate with leisure ($v_i(l)$).

The solution to the maximisation problem (1) is found by the first order derivative with respect to n_i. This involves the marginal utility of leisure to be equal to the marginal utility of gross income per time unit from adding a patient to the list. This is expressed in equation (2)

$$v'_i(l_i) = \frac{q + p\cdot\alpha(\theta_i)}{t(\theta_i)\cdot\alpha(\theta_i)} \qquad (2)$$

In Olsen (2011) it is shown that the overall utility is lower when serving complex patients. However in the present paper we are focusing income effect for partnerships and not the overall utility. The income effect of a relative change in patient complexity is defined by:

$$\left.\frac{\partial y_i}{\partial \theta_i}\right|_{n=n^*} = p^{pc}\frac{\partial n_i^*}{\partial \theta_i} + p^{ffs}\left(\alpha\frac{\partial n_i^*}{\partial \theta_i} + n_i^*\frac{\partial \alpha}{\partial \theta_i}\right) \qquad (3)$$

It is assumed that $\frac{\partial n_i^*}{\partial \theta_i} < 0$ and that $\frac{\partial \alpha(\theta_i)}{\partial \theta_i} > 0$ and we cannot infer whether the effect on income of increased complexity is positive or negative. It is apparent from (3) that the effect on per capita income is negative, but we cannot determine the sign of the effect on fee for service income as the decrease in list size *ceteris paribus* will reduce the fee for services, but whether the increase in fee for service per individual (due to greater need) will compensate for the initial fall, cannot be determined through theoretical logic, but must be empirically verified.

Empirical approach

It follows from (2) that the equilibrium list size is a function of the remuneration prices, the patient characteristics and the individual GP's utility of leisure. Hence we can derive two structural equations from the model equilibrium

$$n_i^* = g(p^{pc}, p^{ffs}, \alpha(\theta_i), t(\theta_i), T)$$

(4)

$$y_i^* = f(p^{pc}, p^{ffs}, n_i^*, \theta_i)$$

(5)

The empirical approach is defined by deriving the reduced form of the two structural equations of list size and income. The empirical models for the two equations can be defined by:

$$n_i = \beta_0^n + \beta_1^n \theta_i + \mathbf{x}'\gamma^n + D'\lambda^n + \varepsilon_i^n$$

(6)

$$y_i = \beta_0^y + \beta_1^y n_i + \beta_2^y n_i \theta_i + \mathbf{z}'\gamma_z^y + D'\lambda_D^y + \varepsilon_i^y$$

(7)

Where i = 1,…, N represent the N practices in the dataset. The first equation describes the model specification of equilibrium list size whereas the second describes income as a function of list size, patient complexity and a set of exogenous variables. Notice that prices are omitted from the model specifications, as there is no variation in prices between GPs. The D vector is a vector of dummy variables defining the number of GPs in the partnership – this variable is of course not included when analyzing solo-practices in Olsen (2011).

The reduced form is obtained from inserting (6) in (7). This gives

$$y_i^{ffs} = \pi_0 + \pi_1 \theta_i + \pi_2 (\theta_i)^2 + \sum_{k=3}^{K} \pi_k x_i^k + \sum_{k=K+1}^{K+(K-2)} \pi_k x_i^k \theta_i + \mathbf{z}'\gamma_z + D'\lambda_D + \varepsilon_i \qquad (8)$$

The reduced form can be estimated by OLS and the estimate of the income effect is derived at the mean of the exogenous variables as

$$\frac{\partial E[y_i \mid \theta_i, \mathbf{z}, \mathbf{x}]}{\partial \theta_i} = \hat{\pi}_1 + 2\hat{\pi}_2\overline{\theta}_i + \sum_{k=K+1}^{K+(K-2)} \hat{\pi}_k \overline{\mathbf{x}}_i^k \tag{9}$$

Where $\overline{\theta}_i$ and $\overline{\mathbf{x}}_i^k$ refer to the sample mean of patient complexity index and other exogenous covariates from the list size equation respectively. We use bootstrapping techniques to get a confidence statement around (9).

Results

Table 1 show the regression results of the reduced form income equation for solo practice (N= 1,039) as well as partnerships (N=641). It appears that the income effect is negative for both samples. However the confidence intervals indicate that the sign of the income effect for partnerships is ambiguous indicating that the result is not robust in the partnership sample.

Table 1: Reduced model on solo- and partnership practices

Dependent variable: Income	Solo (1)	Partnership (2)
Patient complexity index	35,103	-325,474*
(Patient complexity index)^2	-53	-74
X variables (list size)		
Age	57,302	-315,287
Age^2	-624	2,924
Education of new GPs	5,062	-30,125
X interaction variables		
Age*patient complexity	-1,249	125,30*
Age^2* patient complexity	11	-118*
Education of new GPs* patient complexity	4,103	1,777
Z variables (income)		
Sex (female)	-78,228**	-61,114
GP density	12,052	-2,971
Specialist density	-32,223*	-3,951
Adj R^2	0.17	0.04
N	1,039	641
$\frac{\partial E[y_i \mid \theta_i, \mathbf{x}, \mathbf{z}]}{\partial \theta_i}$	-3,643 [-6,108;-1,179]	-977 (-4,614; 2,559)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

As prices are the same for partnerships and solo practices – this difference must be explained by behaviour and it could for example be hypothesised that partnership practices would be able to organise themselves out of the solo practice dilemma in serving complex patients. However the ambiguity in the sign could also be due to differences between small and large partnerships and the results of a division of the partnership sample is shown in table 2.

Table 2: Income effect for subsamples of partnerships

	Subsample of partnerships with less than 4 GPs	Subsample of partnerships with 4 or more GPs
$\frac{\partial E[y_i \mid \theta_i, \mathbf{x}, \mathbf{z}]}{\partial \theta_i}$	-1,459 [-5,479;2,555]	3,276 (-4,737; 11,290)
N	526	112

Table 2 show that the income effect remains negative for the subgroup of small partnership (less than 4 GPs) but positive for larger partnerships (4 or more GPs). The confidence intervals however still indicate that the sign cannot be determined with a 95% confidence indicating that other determinants than partnership size has an impact.

The income effect is according to (2) a function of the marginal change in list size due to patient complexity as well as the marginal change in fee for services $\frac{\partial \alpha(\theta_i)}{\partial \theta_i}$. In the theoretical analysis it is assumed that the number of services to a patient at a given complexity level is fixed and hence that $\frac{\partial \alpha(\theta_i)}{\partial \theta_i}$ is equal for all practices. The results above indicate that this assumption might be critical and if this is the case it must be assumed that the number of services per patient is an endogenous variable instead of an exogenous variable. If there is a systematic difference between solo- and partnerships it must further be assumed that the utility model should model differences between solo and partnerships. To further assess these issues the fee for services supplies for solo- and various sizes of partnerships is assessed further below.

Table 3: Visits and fee for services by size

Number of GPs	N	Visits per listed patient	FFS per listed patient	List size per GP
≤ 1	1,075	3.7	694	1,605
$1<GP\leq 2$	381	3.8	708	1,518
$2<GP\leq 3$	173	3.8	729	1,495
$3<GP\leq 4$	75	3.7	715	1,535
$4<GP\leq 5$	29	4.0	759	1,376
GP> 5	6	3.8	761	1,472

Table 3 show that the average number of visits per patient is not very different between practices of various size but the average amount of total fee for services per patient tends to be higher for larger partnerships. Furthermore is appears that the list size per fulltime GP is lower for larger partnerships. However what we really need to assess is how the derivative of list size and services wrt complexity is affected by the size of the practice. Hence we need to assess $\frac{\partial n_i}{\partial \theta_i \partial GP}$ and $\frac{\partial \alpha(\theta_i)}{\partial \theta_i \partial GP}$. These are derived in table 4 from the following equations

$$n_i = const + \beta^{GP} GP + \beta^{\theta} \theta_i + \beta^{\theta,GP} GP \cdot \theta_i + \varepsilon_i$$

$$services_i = const + \beta^{GP} GP + \beta^{\theta} \theta_i + \beta^{\theta,GP} GP \cdot \theta_i + \varepsilon_i$$

Table 4 show the results of simple OLS assessment of the association between list size patient complexity and partnership size as well as between services (measured either as visits or FFS) patient complexity and partnership size.

Table 4: OLS analysis of visits and fee for services

	Visits per listed patient	FFS per listed patient	List size per GP
Number of GPs	-0.13*	-42***	-31
Patient complexity index	-0.01	2.9***	-5
Number of GPs * Patient complexity index $\frac{\partial \cdot}{\partial \theta_i \partial GP}$	0.005**	1.8***	-0.6*
R2 adjusted	0.01	0.02	0.03

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Notice that the estimate on the interaction between patient complexity and partnership size equals $\frac{\partial n_i}{\partial \theta_i \partial GP}$ and $\frac{\partial \alpha(\theta_i)}{\partial \theta_i \partial GP}$ respectively. Hence it appears from table 4 that $\frac{\partial n_i}{\partial \theta_i \partial GP}$ is negative (-0.6) and $\frac{\partial \alpha(\theta_i)}{\partial \theta_i \partial GP}$ is positive (0.005 when services are approximated by visits and 1.8 when services are approximated by FFS). This indicates that larger partnerships are more likely to reduce the list size as a response to more complex patients and that they are more likely to supply more services to complex patients. Remember from (3) that the income effect equals

$p^{pc}\frac{\partial n_i^*}{\partial \theta_i} + p^{ffs}(\alpha\ \frac{\partial n_i^*}{\partial \theta_i} + n_i^* \frac{\partial \alpha}{\partial \theta_i})$ hence both results indicate that the income effect is more likely to be positive for larger practices. Caution in this interpretation must be taken because the results in table 4 is based on the assumption that the number of services is an endogenous variable and that this variable as well as the choice of list size is dependent on the number of GPs in the practice. None of these assumptions is explicitly included in the utility maximisation model leading to the income effect in equation (3) – hence a great deal of inconsistency between empirical results and underlying theoretical assumption is present.

Discussion

It has been shown that in general solo practices- and partnerships have negative income effect of patient complexity. This means that the remuneration system is not fully rewarding the resource use connected to serving complex patients. However the confidence interval on partnerships was ambiguous (-4,614;2,559) and analysis of subsamples show that the income effect is negative for small partnerships (less than 4 GPs) and positive for larger partnerships (4 or more GPs). Analysis of list size and visits per patient indicates that larger partnerships are able to supply more fee for services to complex patients indicating either supply inducement from large partnerships or time rationing on small partnerships (and solo practices).

The approach in the paper is critical as we evaluate the prediction of a theoretical framework where the decision on services supplied is assumed exogenous and where the size of the practice is not assumed to have any effect on the decision making process. However the empirical analysis relaxes these assumptions but the results may therefore not be interpreted as associated with the theoretical model. Hence a more complete decision making framework that are better aligned with the above assumption must be assessed to elaborate further on the results. In other words there is a need for including the partnership behavior in the income leisure model used in this paper.

This could be done by using assumption in (Gaynor & Gertler 1995) where the utility function is developed subject to a given sharing rule between the partners and a stochastic demand faced by each partner. The model assumes that external factors, such as reimbursement schemes, do not impact on behavioural patterns. In contrast, the approach used in the present paper, introduced by (McGuire & Pauly 1991) focuses on modelling behaviour subject to exogenous payment schemes and the trade-off between income and leisure, with no focus on internal sharing rules. Our result suggest that a challenge for future is to combine the two approaches by constructing GP behaviour as a function of both exogenously given factors such as various reimbursement schemes as well as internal sharing rules.

Conclusion

The results indicate that the behavioural pattern in partnerships differs from that in solo practices in the sense that the supply of services per patient differs. Hence, it cannot be assumed that their behaviour can be derived from the same utility function and the role of partnership organisation should be included in the utility model. It seems that we do not yet have a full understanding of the theoretical foundation of partnership behaviour under mixed remuneration.

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