11-1-2020

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Abstract

In Canada's most populous province, Ontario, family physicians may choose between the blended fee-for-service (Family Health Group (FHG)) and blended capitation (Family Health Organization (FHO) payment models. Both models incentivize physicians to provide after-hours and comprehensive care, but FHO physicians receive a capitation payment per enrolled patient adjusted for age and sex, plus a reduced fee-for-service while FHG physicians are paid by fee-for-service. We develop a theoretical model of physician labour supply with multitasking to predict their behaviour under FHG and FHO, and estimable equations are derived to test the predictions empirically. Using health administrative data from 2006-2014 and a two-stage estimation strategy, we study the impact of switching from FHG to FHO on the production of a capitated basket of services, after-hours services and non-incentivized services. Our results reveal that switching from the FHG to FHO reduces the production of capitated services to enrolled patients and services to non-enrolled patients by 15% and 5% per annum, and increases the production of after-hours and non-incentivized services by 8% and 15% per annum.

Keywords: fee-for-service, capitation, blended remuneration; financial incentives; access to medical services; comprehensive care, after-hours services

JEL classification: I10; I12; I18; C23; C33

1 Introduction

As in many developed countries, Ontario, Canada's most populous province, is moving away from the pure payment schemes of fee-for-service (FFS) and capitation, towards blended models which combine these schemes with pay-for-performance incentives (OECD, 2016). Pure payment systems have several weaknesses: pure FFS is associated with the over-provision of medical services and higher costs to the health care systems and pure capitation payments may result in the under-provision of medical services and the "cream-skimming" of healthier patients (Newhouse, 1984). Blended schemes address some of the weaknesses of pure payment schemes. In the US, the Comprehensive Primary Care Plus payment system combines capitation, pay-for-performance incentive, and Medicare FFS (Mattison and Wilson, 2017). In Denmark, payment for family physicians blend capitation and FFS (Olejaz et al., 2012), while, Sweden and the UK have mixed global budgets combined with pay-for-performance incentives (OECD, 2016).

Prior to 2003, the vast majority of family physicians in Ontario were paid according to a pure FFS system, under which physicians received a fixed fee for each service provided. In the FFS era, access to family physicians' services was of concern, particularly outside of regular office hours, such as during evenings, weekends and holidays. As part of primary care reform, the government of Ontario introduced a blended FFS model known as the Family Health Group (FHG) in July 2003, in which physicians would continue to receive 100 percent of their FFS payments plus additional financial incentives to provide services after-hours. A blended capitation model, the Family Health Organization (FHO), was introduced in November 2006, with the same after-hours incentives as in FHG. In the FHO, patient enrollment is mandatory and physicians receive capitation payments for providing a basket of services to enrolled patients in addition to 10% (increased to 15% in 2010) of the FFS value of these capitated services. Since 2006, FHG and FHO physicians have been eligible to claim pay-for-performance incentives, including preventive care services such as immunizations and cancer screenings and the management of diabetes and congestive heart failure.

We develop a theoretical model of physician allocating time across different tasks to produce services, which is used to predict the responses of physicians under blended payment schemes. It is applied to the Ontario FHG and FHO environment where four types of services ("multitasking") are provided: capitated services, after-hours services, non-incentivized services to enrolled patients, and services to non-enrolled patients. Our model predicts the type of physicians likely to switch from blended FFS to blended capitation, and importantly, provides a structure in which to understand potential ambiguities in the quantity of services delivered to enrolled and non-enrolled patients during regular and after hours. This is an important contribution given that the multitasking nature of physician services (Dumont et al., 2008; Ma, 1994; Ma and Mcguire, 1997; Shearer et al., 2018), has yet to be accounted for in research on blended payment models (Chami and Sweetman, 2019; Kralj and Kantarevic, 2013; Zhang and Sweetman, 2018).

We use Ontario health administrative data containing information on the number and the type of services provided during regular- and after-hours periods, the fees paid for those services, and physician and patient characteristics, to evaluate the impact of physicians switching from blended FFS (FHG) to blended capitation (FHO) on total services, capitated services, after-hours services, non-incentivized services, and services provided to non-enrolled patients. Although Zhang and Sweetman (2018) examine this issue using data from the early-reform period, they were unable to distinguish between the services provided during regular- and after-hours. Since one of the goals of primary care reform in Ontario was to improve access to primary care both during and after regular working hours, our paper helps assess whether this goal was achieved.

Empirically, our approach builds on recent work on Ontario's primary care reform (Kralj and Kantarevic, 2013; Sarma et al., 2018; Somé et al., 2019; Zhang and Sweetman, 2018) by relying on a two-stage estimation approach: the first stage accounts for the differences between switchers and non-switchers using an inverse probability weighted technique based on a propensity score matching approach that renders switchers and non-switchers comparable in terms of health care services, observable physician and patient characteristics and expected gain in income from switching at the baseline. The second stage estimates the impact of switching from FHG to FHO using panel-data regression models. Our work differs from other published research in several ways. First, we measure services using quantity indices that take account of changes in services (the composition of fee codes) and the value of the fee codes over time rather than the number of visits commonly used in the literature. Second, we allow for unobserved physician-specific effects, year fixed-effects, and physician-specific time trends using a high-dimensional fixed-effects model (Balazsi et al., 2018). Third, we investigate the effects of switching to FHOs across different practice settings. Finally, we use a longer panel-data set on physicians who switched from FHG to FHO to tease out the impact of switching on regular- and after-hours services.

We find that physicians who switched to FHOs reduce capitated services and services to non-enrolled patients, and increase non-incentivized services, reflecting changes in relative prices between these services: physicians substitute away from services whose relative price decreased (capitated basket of services) or that were subject to a hard cap limit (maximum dollar value of services to non-enrolled patients) and produce more of the service whose relative price had risen (after-hours and other services). At the extensive margin, switchers reduce the number of enrolled patients by 2.5%, and increase the number of non-enrolled patients by 9.0%. Overall, the introduction of FHO reduces government spending on physicians by $59,320 (in 2007 Canadian dollars) per year per switcher, representing 0.94 FHG equivalent services.

2 Previous Literature

Several theoretical studies try to understand how physician's compensation systems affect the quantity of medical services provided, often focusing on the two dominant payment systems: FFS and capitation. McGuire and Pauly (1991) develop a theoretical model encompassing the two benchmark cases of profit maximization and target-income behaviour into a utility maximization framework. They use the model to analyze FFS physicians' responses to relative fee changes by Medicare in the US and demonstrate that the expected quantity response of physicians depends on the size of the income effect: with a "very large" income effect, physicians increase the volume of services in response to price cuts; otherwise, the volume is reduced. In a different setting, Woodward and Warren-Boulton (1984) examine the type of remuneration, the level of remuneration, and the number of patients in a work-leisure model that integrates professional ethics. They find that FFS encourages unnecessary services when the number of patients is low and prices (fees) are high, and capitation systems lead ethical physicians to provide less than the appropriate quantity of medical care, regardless of the number of patients or capitation payment levels.

More recently, Iversen (2016) predicts that when a physician cares about the entire community of patients' health, even FFS systems will generate a low level of services per patient. He also predicts that a high density of physicians and the presence of health insurance, encourages the over-provision of services with FFS and under-provision with capitation -- predictions broadly supported by most empirical studies (Devlin and Sarma, 2008; Peckham and Gousia, 2014; Shen et al., 2004). A recent laboratory experiment with 38 medical students by Di Guida et al. (2019)

finds that decreasing fee sizes, patients' health profiles and market conditions affect over-provision of services under FFS. Evidence also suggests that physicians respond to financial incentives (Chandra et al., 2011; McGuire, 2000), but can also respond to non-financial incentives such as altruism (Allard et al., 2014, 2011) and/or intrinsic motivation (Gneezy et al., 2011); which may lead to counterintuitive findings when analyzing the effect of financial incentives. For example, in a review of empirical studies, Rice (2012) reports on several studies that fail to show that service provision is higher under FFS than capitation.

The question of the best physician payment model to achieve the socially optimal quantity of services was addressed by Blomqvist (1997). He uses an economic model to show that a blended payment system combining capitation and FFS can achieve the socially optimal quantity of medical services, thus offering a theoretical basis for the use of a blended payment model. Although blended payment models for primary care physicians are growing in popularity (OECD, 2016; Paris et al., 2010), the blend that will provide the optimal level of medical services remains largely unknown (Peckham and Gousia, 2014; Rudoler et al., 2015). Empirical evidence on physicians' responses to blended payment models is mixed (Campbell et al., 2007; Chami and Sweetman, 2019; Clemens and Gottlieb, 2014; Kralj and Kantarevic, 2013; Li et al., 2014; Mehta et al., 2017; Sarma et al., 2018; Somé et al., 2019; Sutton et al., 2010).

3 Institutional Context

In Canada, medically necessary physician and hospital services are publicly funded and privately delivered: patients do not pay out-of-pocket for these services. Since health care falls under provincial jurisdictions, provinces and territories have the primary responsibility for organizing and delivering health care services and for determining which services are deemed "medically necessary". The role of the federal government is to ensure that each jurisdiction adheres to the national standards enshrined in the *Canada Health Act* (Richardson et al., 2008). The fees for medical services in Ontario are set by negotiations between the Ontario Medical Association and the government of Ontario and are administrated by the Ontario Health Insurance

Plan (OHIP) (Marchildon and Hutchison, 2016). The fees paid are service-specific and are listed in a periodically updated *Schedule of Benefits and Fees.*[1]

In 2000, approximately 95% of family physicians in Ontario were paid by FFS (Sweetman and Buckley, 2014). However, by March, 2016, around 60% of the 14,100 family physicians in Ontario had opted for one of the reformed models (Office of the Auditor General of Ontario, 2016) with Family Health Groups and Family Health Organizations being the two most popular choices.[2] Although both models are group-based, each individual physician must sign a contract with the Ministry as a "Group Physician" to join either FHO or FHG. The physician can opt out at any time to join another one. These two models account for 87% of the 8,800 family physicians in the reformed models, serving 92% of the 10.6 million enrolled patients (Office of the Auditor General of Ontario, 2016). In Ontario, patient enrollment is voluntary and formalized by an enrollment form in which patients commit to seek treatment from their enrolling physician or group of physicians. Physicians can control the number of patients enrolled to their practice by adding and/or removing patients.[3]

The FHG model blends "pure" FFS with pay-for-performance incentives. Under FHG, physicians receive 100% of the FFS payments for all services provided, plus financial incentives for providing comprehensive care and after-hours services to enrolled patients plus a small capitation fee. These incentives are paid to encourage patient enrolment. The comprehensive care premium is 10% of the FFS value of comprehensive care services provided to enrolled patients during regular-hours. The after-hours premium was initially 10% of the FFS value but increased to 15% in April 2005, then to 20% the following year (MOHLTC Bulletin 11020); finally, it increased to 30% in September, 2011 (Sweetman and Buckley, 2014). Per the FHG agreement, physicians are required to provide after-hours services (after 5pm on weekdays or on weekends or statutory holidays) of at least one three hour-block per physician in the group per week. In addition, FHG physicians receive a small comprehensive care capitation payment for each enrolled patient

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[1] For more details, see: http://www.health.gov.on.ca/en/pro/programs/ohip/sob/ (accessed September 2019).

[2] Note that we exclude other reformed models such as Family Health Network (FHN), Comprehensive Care Model (CCM), Rural and Northern Physician Group Agreement (RNPGA), and other payment models as a very small number of physicians practice in these models.

[3] For more details on the process of patient enrolment and the removal of patients see: http://health.gov.on.ca/english/providers/pub/primarycare/proces_enrolment/proces_enrolment.pdf.

($20-$26 on average, per year); bonuses for five categories of preventive care for achieving targeted service levels to specific patients: flu shots to seniors, pap smears, mammograms, childhood immunizations, and colorectal-cancer screening; and financial incentives are awarded for the effective management of diabetes and congestive heart failure.

FHO physicians receive the vast majority of their income from capitation payments for providing a core basket of services to their enrolled patients (listed in Appendix Table A1.1). This basket comprises 119 services (Ministry of Health and Long-Term Care, 2007). FHO physicians receive after-hours premium (a discounted FFS payment) to provide after-hours services to enrolled patients, as well as bonuses for preventive care and chronic disease management. In addition, FHO physicians receive 100% of FFS payments for non-capitated services to enrolled patients, and capitated services to non-enrolled patients subject to an annual maximum amount, the "hard cap", of $52,833 per physician in 2011, increasing to $55,900 in 2013. They also receive 10% (15% since 2010) of the FFS value of capitated services (known as the shadow billing premium) provided to enrolled patients, and an after-hours premium that is the same as in the FHG model (Appendix Table A1.2 for the list of incentive eligible after-hours services for enrolled patients). Table 1 provides a summary of the blended FFS and blended capitation models in Ontario.

4 The Theoretical Model

We model how the supply of health care services by physicians is affected by the decision to switch from FHG to FHO. Services fall into four distinct categories: three are provided to enrolled patients – capitated services ($j = 1$), after-hours services ($j = 2$), and other services ($j = 3$); plus services provided to non-enrolled patients ($j = 4$).

Similar to Somé *et al.* (2019), we define the quantity of service j produced by physician i, Q_{ij}, as a function of the time devoted to service j, h_{ij}, the number of enrolled patients, n_i (Woodward and Wairren-Boulton, 1984), physicians' and patients' characteristics, X_i, and a productivity shock parameter ε_{ij} to capture random elements that affect the time spent per service, including its complexity, the physician's ability to perform services and/or their level of altruism. The Cobb-Douglas production function in each time period is:

$$Q_{ij} = \begin{cases} b(X_i)h_{ij}^{\delta} n_i^{\gamma} \varepsilon_{ij}, & j = 1,2,3 \\ b(X_i)h_{ij}^{\delta} \, \bar{N}_i^{\gamma} \varepsilon_{ij}, & j = 4 \end{cases} , \varepsilon_{ij} > 0, b(X_i) > 0, \quad (1)$$

where δ measures physician efficiency (time spent) in performing service j; and γ represents the marginal return of enrolling a patient. $\bar{N}_i$ is the maximum number of potential patients a physician can see, which is exogenous. We assume that δ and γ are between zero and one to ensure interior solutions for both time for service and the number of enrolled/non-enrolled patients. It also ensures that optimal behaviour will not lead the physician to specialize in the production of only one type of service nor will s/he select only one type of patients. This assumption is reasonable for family physicians. The function $b(X_i)$ represents the quantity of service provided to one enrolled patient when one hour is supplied to service j.

The physician's has a constant elasticity of substitution utility function (Arrow et al., 1961) defined over income, C and leisure, L. We allow for unequal shares between income and leisure:

$$U(C_i, L_i) = \left(\alpha C_i^{\rho} + (1 - \alpha)\,(T - h_i)^{\rho} \quad\right)^{\frac{1}{\rho}}, \rho < 1, \quad (2)$$

where α is the share parameter, ρ is the elasticity of substitution between income and leisure, $T - h_i$ leisure (h_i is working hours and T is total time available). Working hours are allocated across the four services: $h_i = h_{i1} + h_{i2} + h_{i3} + h_{i4}$. Optimal $h_{ij}, \forall\, j$ are positive. Let p_j denote the price of service j, R the capitation rate, and y_i represent non-labour income. The budget constraints under FHG and FHO are given by

$$C_i^{FHG} = (1 + \tau_1)p_1 Q_{i1} + (1 + \tau_2)p_2 Q_{i2} + p_3 Q_{i3} + p_4 Q_{i4} + y_i, \quad (3)$$

$$C_i^{FHO} = Rn_i + \pi_1 p_1 Q_{i1} + \pi_2 p_2 Q_{i2} + p_3 Q_{i3} + \min(p_4 Q_{i4}, HC) + y_i \quad (4)$$

where $\tau_1 = 10\%$ and $\tau_2 = 10\%$ the comprehensive care premium and the after-hours premium for FHG physician. $\pi_1 = 10\%$ is the discount rate on the FFS payment of capitated services (known as the shadow billing premium), and $\pi_2 = 10\%$ is premium on the FFS value of the after-hours services under FHO. These were the rates applicable in 2006. HC is the "hard cap" on the services provided to non-enrolled patients by FHO physicians based on FFS values. The after-hours requirement imposes for both FHG and FHO physicians that $h_{i2} \geq \bar{h}_2$ (at least one three-hour block/week).

We assume common shocks across services $\varepsilon_{ij} = \varepsilon_i, \forall j$ meaning that all services are affected in the same way by new technologies, procedures or new treatment guidelines. As such, we focus on random elements that are specific to the physician and can affect her/his productivity across all services. We acknowledge that the common shocks assumption is restrictive, but it allows for solving the model and to derive the comparative statics. Introducing service-specific shocks would be an interesting extension, but would increase the complexity of solving the model and its application. We focus on supply-side shocks and impose the following to solve the model:

a. For each physician i, nature chooses ε_i;
b. The physician observes ε_i, knows $b(X_i)$, and the price of services; s/he chooses h_{ij} and n_i to maximize utility conditional on h_i;
c. The physician chooses h_i.

This timing assumes that the physician has complete information when making decisions. We solve the physician's utility maximization problem in two steps: for a given h_i, we determine the $\left(h_{i1}^*(h_i), h_{i2}^*(h_i), h_{i3}^*(h_i), h_{i4}^*(h_i), n_i^*(h_i)\right)$ and $\left(\hat{h}_{i1}(h_i), \hat{h}_{i2}(h_i), \hat{h}_{i3}(h_i), \hat{h}_{i4}(h_i), \hat{n}_i(h_i)\right)$ combination that maximizes her/his utility under FHG and FHO models, respectively. Substituting the optimal values back into the utility function gives indirect utility as a function of h_i which we maximize for total hours worked under FHG and FHO. Note that there no explicit functional form for the optimal hours h_i^* and $\hat{h}_i$. Generalized blended FFS and blended capitation models are presented in A0.1-A.03 (Appendix A0). The optimal solutions under FHG and FHO models are presented in A0.4 (Appendix A0).

Assuming for simplicity zero non-labour income, the budget constraint in (3) evaluated at the optimal levels of the quantity of services under FHG is

$$C_i^{*FHG} = (1+\tau_1)p_1 Q_{i1}^* + (1+\tau_2)p_2 Q_{i2}^* + p_3 Q_{i3}^* + p_4 Q_{i4}^* = b(X_i) w_{FHG} h_i^{*\delta} n_i^{*\gamma} \varepsilon_i, \quad (5)$$

where $w_{FHG} = \left(P_1^{\tau} + P_2^{\tau} + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4\right)^{1-\delta}$ determines the marginal return to an hour worked when hours worked is optimally allocated across the services by the physician according to (A12), and $P_j^{\tau} = \left((1+\tau_j)p_j\right)^{\frac{1}{1-\delta}}$, $j = 1,2$, and $P_j = (p_j)^{\frac{1}{1-\delta}}, j = 3,4$.

$\mathrm{w_{FHG}}$ can be interpreted as a wage index which depends on the price of different services. The budget constraint at the optimal quantity levels in the FHO when the hard cap condition is met (i.e., $\mathrm{p_4 Q_{i4}} < \mathrm{HC}$) is given by

$$\hat{C}_i^{FHO} = R\hat{n}_i + \pi_1 p_1 \hat{Q}_{i1} + \pi_2 p_2 \hat{Q}_{i2} + p_3 \hat{Q}_{i3} + p_4 \hat{Q}_{i4} = R\hat{n}_i + b(X_i) w_{FHO} \hat{h}_i^{\delta} \hat{n}_i^{\gamma} \varepsilon_i \qquad (6)$$

where $w_{FHO} = \left(P_1^{\pi} + P_2^{\pi} + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4\right)^{1-\delta}$ is the wage indices under FHO, $P_j^{\pi} = (\pi_j p_j)^{\frac{1}{1-\delta}}$, $j = 1,2$, and $P_j = (p_j)^{\frac{1}{1-\delta}}$, $j = 3,4$.

A utility-maximizing physician will switch from FHG to FHO if doing so increases utility for a given level of ability/productivity or altruism, ε_i . We compare the utility of the physician under both payment systems, using the optimal values of total hours worked and the number of enrolled patients under FHG.[4] This is equivalent to comparing physician's income in (5) and (6) at h_i^* and n_i^*, as the second term in the utility function (1) is the same under FHG and FHO. Lemma 1 follows from the difference between equations (5) and (6) (proofs are in Appendix A0.4).

Lemma 1 (Existence and uniqueness): *Conditional on h_i^* and ε_i, if $0 < \gamma < 1$ and $n_i^* > 0$ there is a unique number of enrolled patients $n_i^{**} = \left(\frac{b(X_i)(w_{FHG} - w_{FHO}) h_i^{*\delta} \varepsilon_i}{R}\right)^{\frac{1}{1-\gamma}}$ solving $\hat{C}_i^{FHO}(h_i^*, n_i^*) - C_i^{*FHG}(h_i^*, n_i^*) = 0$.*

Proposition 1 (Switching decision): *At equilibrium, the FHG physician i with optimal choices n_i^* and h_i^* will switch to FHO only if $n_i^* > n_i^{**}$.*

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[4] Using the optimal values under FHG to analyze switching decision is in the same line as the computation of the expected gain in income by the MOHLTC to advise physicians. The purpose is to predict what would be the physician's income if s/he was paid under FHO given her/his optimal choices under FHG.

This decision rule implies that a smaller wage index gap between the two models as captured by $w_{FHG} - w_{FHO} > 0$ (as $P_j^{\tau} > P_j^{\pi}$) will encourage switching, while the smaller capitation base rate, R, will discourage switching. Also, for a given ε_i, low-productivity physicians will tend to switch to FHO, while more productive physicians will tend to remain in FHG. Note that when a physician chooses n_i^{**}, s/he is indifferent between the two payment systems. Physicians who prefer a small roster size will remain under FHG, while those who prefer large roster sizes will tend to switch to FHO. Thus, a direct comparison of the production of services by physicians switching from FHG to FHO will likely confound the effects of switching.

4.1. Comparative statics

Physicians allocate hours to different services depending on relative prices; time allocated determines the quantity of services provided (see equation A12, A16 and A17). We compare a switcher's outcomes by examining the difference between the optimal responses under FHO and FHG. We evaluate the optimal responses at h_i^*, representing the optimal total hours worked under FHG. Lemma 2 gives the theoretical predictions.

Lemma 2: *(a) When the number of enrolled patients decreases after the physician switched from FHG to FHO ($\hat{n}_i \leq n_i^*$) and the hard cap condition is met (i.e., $p_4 Q_{i4} < HC$), then s/he will (i) decrease hours supplied to capitated services $\left(\hat{h}_{i1}(h_i^*) < h_{i1}^*(h_i^*)\right)$; (ii) decrease hours supplied to after-hours services $\left(\hat{h}_{i2}(h_i^*) < h_{i2}^*(h_i^*)\right)$; (iii) increase hours supplied to services provided to non-enrolled $\left(\hat{h}_{i4}(h_i^*) > h_{i4}^*(h_i^*)\right)$; (iv) and $\hat{h}_{i3}(h_i^*) - h_{i3}^*(h_i^*)$ is unsigned.*

(b) In contrast, when switching leads to more patient enrollment (i.e., ($\hat{n}_i > n_i^*$) and hard cap condition is met, switchers will (i) increase hours supplied to non-incentivized services $\left(\hat{h}_{i3}(h_i^*) > h_{i3}^*(h_i^*)\right)$; (ii) while $\hat{h}_{i1}(h_i^*) - h_{i1}^*(h_i^*)$, $\hat{h}_{i2}(h_i^*) - h_{i2}^*(h_i^*)$ and $\hat{h}_{i4}(h_i^*) - h_{i4}^*(h_i^*)$ are unsigned.

(c) When the hard cap condition is not met (i.e., $p_4 Q_{i4} \geq HC$), then $\hat{h}_{ij}(h_i^*) - h_{ij}^*(h_i^*)$, $j = 1,2,3,4$ are unsigned.

Proposition 2 follows directly from lemma 2 with the following testable predictions.

Proposition 2 (Model's predictions): *(a) If switching from FHG to FHO leads the physician to reduce the number of enrolled patients ($n_i^{**} < \hat{n}_i \leq n_i^*$) and hard cap condition holds, then s/he* *will reduce the production of capitated and after-hours services (Q_{i1} and Q_{i2}) and increase services to non-enrolled patients (Q_{i4}). In that case, the direction of the effects of switching on physician's production of non-incentivized services (Q_{i3}) is ambiguous.*

(b) If switching from FHG to FHO leads the physician to increase the number of enrolled patients ($\hat{n}_i > n_i^* > n_i^{**}$) and the hard cap condition holds, then s/he will increase non-incentivized services (Q_{i3}), but the effects on after-hours services, capitated services and services to non-enrolled patients (Q_{i1}, Q_{i2} and Q_{i4}) are ambiguous.

(c) When the hard cap condition is not met, then $\hat{Q}_{ij}(h_i^*) - Q_{ij}^*(h_i^*),\ j = 1,2,3,4$ are unsigned.

These predictions hold under the assumption of common shocks across services, otherwise all the differences are unsigned. From proposition 2, switchers seeking to maximize their income will reduce the production of less incentivized services: capitated and after-hours services compensated at the fraction of their FFS value; and increase the production of services that are paid full FFS.

4.2. Empirical Testing of Model Predictions

The model allows us to predict the optimal quantities of different types of services (equation A13 in the Appendix A0). In logarithmic form, the predicted quantities under FHG are

$$\begin{cases} \ln Q_{i1}^* = \ln b(X_i) + \delta \ln P_1^\tau - \dfrac{\delta}{1-\delta}\ln w_{FHG} + \delta \ln h_i^* + \gamma \ln n_i^* + \ln \varepsilon_i; \\ \ln Q_{i2}^* = \ln b(X_i) + \delta \ln P_2^\tau - \dfrac{\delta}{1-\delta}\ln w_{FHG} + \delta \ln h_i^* + \gamma \ln n_i^* + \ln \varepsilon_i; \\ \ln Q_{i3}^* = \ln b(X_i) + \delta \ln P_3 - \dfrac{\delta}{1-\delta}\ln w_{FHG} + \delta \ln h_i^* + \gamma \ln n_i^* + \ln \varepsilon_i; \\ \ln Q_{i4}^* = \ln b(X_i) + \delta \ln P_4 - \dfrac{\delta}{1-\delta}\ln w_{FHG} + \delta \ln h_i^* + \dfrac{\gamma - 2\gamma\delta}{1-\delta}\ln n_i^* + \dfrac{\gamma\delta}{1-\delta}\ln(\overline{N}_i) + \ln \varepsilon_i; \\ \ln \sum_{j=1}^{4} Q_{ij}^* = \ln b(X_i) + \ln w_{FHG} + \delta \ln h_i^* + \gamma \ln n_i^* + \ln \varepsilon_i. \end{cases} \tag{9}$$

Similar expression can be derived for the predicted quantities under FHO.

Our empirical model adapts the equations in (9) to estimable reduced-form equations wherein, the natural logarithms of optimal services are linear in working hours,[5] the number of

[5] Physician's working hours variables are not available in our dataset. However, we have information on total days worked per year, and we include this as a proxy variable.

enrolled patients, and the number of non-enrolled patients. Additionally, services depend on physician's characteristics and on the prices of individual services through the wage index. A reduced form model that does not account for these variables may fail to capture the effects of the compensation system on the mix of services. Since the variation in hours worked and number of enrolled patients are not explained by the equations in (9), we cannot identify the structural parameters. Therefore, we exploit the introduction of the FHO payment scheme and estimate a reduced-form model for each outcome (total services, capitated services, after-hours services and non-incentivized services) while controlling for the key variables informed by our theoretical model. To estimate the average treatment effect on those who switched from FHG to FHO, we use matching methods combined with inverse probability weighted panel-data regression models. To help ascertain the robustness of our results, we account for both observable and unobservable heterogeneity affecting outcomes.

The general form of the estimating equation is

$$\ln Q_{it} = \theta_t + c_i + g_i t + X_{it}\beta + \varphi FHO_{it} + \vartheta \ln \mathrm{n_{it}} + \omega \ln(\overline{N}_i) + \sigma \ln(\mathrm{days}_{it}) + P_t\xi + u_{it}, \qquad (10)$$

where $\ln Q_{it}$ represents the natural logarithm of services (total services, capitated services, after-hours services and non-incentivized services) produced by physician i in year t, the parameter θ_t is year fixed-effects, the parameter c_i is physician-specific unobserved factors, and g_i is a physician-specific linear time trend. days_{it}, $\mathrm{n_{it}}$, and $\overline{N}_{it}$ represent the number of days worked, the number of enrolled patients, and the number of non-enrolled patients, respectively. X_{it} is a vector of physicians' observable characteristics (age, age squared, sex (female), whether or not they graduated from an international medical school, group size), geographic indicators for local heath integration networks (LHINs), the 14 administrative units for health care in Ontario, and the characteristics of their patients (average ADG score, average age of patients, proportion of patients in rural areas, and proportion of male patients). P_t is a vector of the prices of different services. The regressor of interest, FHO_{it} is one if the physician i in year t was in a FHO, fractional in the first year of switching,[6] and zero if the physician remained in FHG, and u_{it} is the error term. We

[6] For example, if a physician switched in August 2010, the fraction of year in FHG is 0.7 (8/12).

are interested in the estimated coefficient φ, which captures the effect of physicians switching from FHG to FHO compared to those who remained in FHG.

5 Data and Variables

5.1. Source of data

Data on all medical services provided by physicians, physicians' demographic and practice characteristics, patients' characteristics and the roster sizes in Ontario's FHGs and FHOs between April 1st 2006 (year of FHO introduction) and March 31st, 2015 come from health administrative databases held at the ICES in Ontario, Canada. Physician's demographic and practice characteristics were obtained from the ICES Physician Database (IPDB). Information on the physician's payment model and effective date of eligibility for billing under the Ontario Health Insurance Plan (OHIP) came from the Corporate Provider Database (CPDB).

OHIP data contain the fee codes, the number of services provided by each physician, and the associated fees paid by the MOHLTC, used to construct our outcomes: the quantity index of capitated services, the quantity index of after-hours services, the quantity index of non-incentivized services provided to enrolled patients; and the quantity index of services provided to non-enrolled patients. Aggregated capitated services are based on 119 included fee codes (Table A1.1).[7] After-hours care obligations are the same in both FHGs and FHOs (Sweetman and Buckley, 2014), facilitating comparison across the two models. For each physician, we aggregate fee codes that are eligible for after-hours premiums (Table A1.2). The rest of the OHIP fee codes represents services provided to enrolled patients and are compensated 100% by FFS.

We combine the Ontario's Registered Persons Database (RPDB), and the Client Agency Program Enrollment (CAPE) database to obtain information on each patients' postal code, age, sex and enrolment information. The CAPE links enrolled patients to their family physicians and also provides information on the physician's payment model. Using CPDB, we derive the size of the group the physician is affiliated with (defined as the sum of the number of primary care physicians with the same group number) and the year of graduation.

5.2. Variables

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[7] http://www.anl.com/MOHGUIDE/44%20Family%20Health%20Organization%20(FHO)%20Fact%20Sheet.pdf (accessed in February 2019).

To avoid dealing with fee codes with a large number of zero-observations, we aggregate medical services as in Somé et al. (2019) into four types: capitated services, Q_1, after-hours services, Q_2, non-incentivized services, Q_3, and services provided to non-enrolled patients, Q_4 (the formula for aggregating services and for the Laspeyres price indices are in A0.5 (in Appendix A0). To aggregate services, we use the 2007 prices of services as fixed weights for the quantity indices. For each physician, we multiply the number of OHIP fee codes provided by their corresponding 2007 prices and sum them up to obtain the aggregate quantity of services. Note that while fee code prices may change over time, our aggregated quantity measure ignores these price variations by fixing weights at 2007 prices. For each type of aggregated service, we calculate the corresponding price indices using the formula indicated in Appendix A0. The total quantity of services provided by a physician is the weighted (2007 prices) sum of the four aggregated services. This variable also represents the physician's gross labour income and captures the ability of the physician to produce the mix of medical services to enrolled/non-enrolled patients at different relative prices.

As control variables, we used patients' characteristics: average age, proportion of male patients in physician's practice, proportion of patients living in rural areas, patient's average comorbidity score based on the Johns Hopkins Aggregated Diagnosis Groups (ADGs). The ADG score allows us to control for the possible influence of patient complexity. To derive the ADG score for each patient, we use 32 patients' diagnosis groups along with the Johns Hopkins ACG® System Version 10 case-mix adjustment system (The Johns Hopkins University, 2011), a well-known and commonly used measure of patients' comorbidity status in the health services literature (Glazier et al., 2008). The average ADG score of a physician is defined as the average of ADG scores of that physician's patients. To calculate the proportion of patients living in rural areas in each physician's practice, we used patient postal codes from the RPDB and Statistics Canada's postal code conversion file.

An important variable in explaining the physicians' switching decision is the expected gain in income. We calculate this expected gain in income based on the 2006 algorithm used by the MOHLTC to advise potential FHG physicians interested in switching to FHO.[8] The algorithm is

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[8] The expected gain in income is computed in 2006 based on the actual services provided to both enrolled and non-enrolled patients (all physicians were practicing in the FHG model). It is a sum of (i) estimated capitation payments, (ii) 10% FFS value for in-basket services provided to enrolled patients, (iii) 100% FFS value for out-of-basket services to any patients, (iv) 100% FFS value for in-basket services to non-enrolled patients up to the hard cap limit, and (iv)

based on the actual services provided to enrolled and non-enrolled patients by FHG physicians in the fiscal year 2006/07.

5.3. *Descriptive statistics*

To compare physicians who switched from FHG to FHO to those who remained in FHG, we used a balanced panel of physicians who were practicing in the FHG in April 1st 2006 and follow them until March 31st, 2015. This covers one year before and eight years after the introduction of the FHO model. The switcher group are those who switched from FHG to FHO in any year between 2007 and 2014 and remained in FHO, while the non-switcher group comprises physicians practicing in FHG throughout the study period. After excluding observations with missing values for variables, we ended up with 1,412 switchers (FHG physicians who eventually switched to FHO) and 1,167 non-switchers (FHG physicians) for our empirical analysis. Table A1.3 in the appendix presents for each group in each year the descriptive statistics of the outcome variables, physicians' characteristics and their patients' characteristics.

On average, switchers produced fewer capitated services, after-hours services and services provided to non-enrolled patients, but more non-incentivized services compared to non-switchers. These results hold for the weighted and unweighted quantities. Each year, switchers have fewer patients enrolled and fewer patients seen than non-switchers. The proportion of enrolled patients increases for both switchers and non-switchers from 93% and 88% in 2006 to 94% and 90% in 2008. This proportion remains the same for non-switchers until 2014, when it dropped back to 93% for switchers in 2009 then remains constant until 2014. The main point is that the proportion of enrolled patients is significantly different for the two groups each year. We exploit the differences in the preferences of switchers and non-switchers each year, in particular in term of patient's enrollment and production of the mix-of-services to identify our model.

In 2006, average switcher and non-switcher services are statistically different (the first panel of Table 2). Compared to non-switcher physicians, switchers produced 17% fewer capitated services, 41% fewer after-hours services, 24% more non-incentivized services, and had 5% fewer patients in 2006. Non-switchers were relatively older (51.3 vs. 49.4 years); 40% of switchers were

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several special payments as per the FHO contract. All other income sources remain the same as in FHG (i.e. after-hours premium, preventive care bonuses and chronic disease management (Kralj and Kantarevic, 2013).

female and 36% of those who remained in FHG were female. The proportion of switchers who worked at least half a day (97%) is 1% smaller than the non-switchers (98%). We note the large difference in the average expected gain in income: $112,350 in the switcher group and $75,640 in the non-switcher group. On average, switchers had smaller group size than non-switchers (42 vs. 54 physicians) and the switcher group patients were younger than the non-switcher group. The switcher group had 7% of their patients living in rural areas and 46% of them were males, while the corresponding percentages for the non-switcher group were 4% and 47%. From Table 2, we note that those who tend to switch had higher proportion of enrolled patients (93% vs 88%) which is consistent with the prediction about switching decisions, from proposition 1.

6 Matching Strategies

The propensity score matching (PSM) method deals with the differences in observable characteristics between groups of observations (Rosenbaum and Rubin, 1983); we apply PSM to ensure switcher and non-switcher groups of physicians are comparable at the baseline. However, misspecification of the propensity score model can result in biased estimates of the average treatment effect on the treated (Kang and Schafer, 2007; Smith and Todd, 2005). The choice of the balancing test could affect the set of covariates used to estimate the propensity scores (Lee, 2013). To avoid these concerns, we rely on two alternative matching procedures: the covariate balancing propensity score (CBPS) method (Imai and Ratkovic, 2014) and the entropy balancing (EB) method (Hainmueller, 2012) which balance the covariates between groups even under propensity score model misspecification (e.g., functional form or omission of variables). These directly incorporate covariate balancing in the estimation procedure so as to automatically ensure that the covariates are balanced. CBPS uses a GMM framework to combine score conditions and covariate balancing moment conditions, while the EB method provides the optimal weights under some pre-specified covariate balancing constraints on moments of the data.

6.1. Matching Results

Table A1.4 presents propensity score model estimates using both logit and CBPS methods. The logistic regression results show that the expected gain in income, number of enrolled patients, and average age of patients are positively correlated with the probability of switching. Capitated services in 2006, after-hours services in 2006, and age squared are negatively correlated with the probability of switching. Some covariates that were not statistically significant were kept because they ensured overall covariate balancing. We estimate the same model with CBPS. The results (second column of Table A1.4) are almost similar in sign and magnitude to the results of the logistic regression.

The second panel of Table 2 presents the results of the t-test for equality of means after matching and the standardized bias.[9] The p-values indicate no significant difference in covariate means between the two groups. The large differences between switchers and non-switchers in the original sample (first panel of Table 2) have disappeared in the matched and reweighted sample. The percentage of the bias reduction after matching is between 63.9% and 99.8% yielding the standardized bias for each variable under 6.4% after matching. The regression test results reported in Table A1.5 show that the covariates are largely unaffected by the decision to participate in the FHO model after-matching: the p-values of the F-test are all greater than 5% (except for the proportion of patients in rural areas). We cannot reject the hypothesis that the decision to switch does not affect the covariates (i.e. the decision to switch did not affect the conditional mean of covariates given the propensity score). We match and reweight 1,403 switchers to 1,167 non-switchers; the weight for each observation in the switcher group is one, and the weight for each observation in the non-switcher group is $\hat{\lambda}/(1-\hat{\lambda})$, where $\hat{\lambda}$ is the estimated propensity score based on the PSM, CBPS or EB matching procedure. Our final panel dataset used to estimate the average treatment effect on treated of switching to FHO contains 23,175 physician-year observations on 2,570 physicians practicing in Ontario between the years 2006-2014.

7 Estimating Average Treatment Effects on the Treated

Estimating the model in equation (10) by ordinary least squares (OLS) may produce a biased estimate of φ because the fixed effects θ_t, c_i, and g_i are potentially correlated with FHO_{it}. The decision to switch to FHO is likely to be correlated with unobserved differences in productivity between physicians, implying $E(c_i|FHO_{it}=1)\neq 0$. We first use a fixed-effects regression model to control for c_i (ignoring g_i) and assuming parallel trends (the same θ_t for both switchers and non-switchers). Equation (10) becomes

[9] Standardized bias is defined as the difference of the sample means in these two groups as a percentage of the square root of the average of the sample variances in the two groups (switcher and non-switcher).

$$\ln Q_{it} = \theta_t + c_i + X_{it}\beta + \varphi FHO_{it} + \vartheta \mathrm{lnn_{it}} + \omega \ln(\bar{N}_{it}) + \sigma \ln(\mathrm{days}_{it}) + P_t\xi + u_{it}. \quad (11)$$

In this specification the parallel trend assumption is crucial to identifying the average treatment effect on the treated (ATT). If the parallel trends assumption is violated (i.e., by the existence of unobserved time-varying confounders), FE may lead to biased and inconsistent estimates of ATT (Lechner, 2010). Thus, we relax the parallel trends assumption by allowing each physician to follow his/her own trend by including physician (c_i) and physician-year (g_i) fixed effects as:

$$\ln Q_{it} = c_i + \sum_{t=2006}^{2014} g_i D_t + X_{it}\beta + \varphi FHO_{it} + \vartheta \mathrm{lnn_{it}} + \omega \ln(\bar{N}_{it}) + \sigma \ln(\mathrm{days}_{it}) + P_t\xi + u_{it}, \quad (12)$$

where D_t is a year dummy variable. We use a high-dimensional fixed-effects (HDFE) estimation technique to consistently estimate the average treatment effects on switchers (φ) as well as the fixed effects (c_i and g_i per physician) (Correia, 2016; Guimarães and Portugal, 2010).[10]

8 Estimated Results

The average impacts of switching from FHG to FHO on switchers based on OLS, FE and HDFE estimates are reported in Table 3;[11] for comparison purposes we also include the estimates from first differences model (FD). Overall, the results of the HDFE and FE models are qualitatively similar to those from the FD model. Detailed results are reported in Appendix A.1 (Tables A1.6, A1.7 and A1.8). Differences in the estimated average physician-specific time trend for both switchers and non-switchers from the HDFE model are in the appendix A2 by sex (Figures A2.1-5) and age group (Figures A2.6-10).

The weighted HDFE (FE) results show that, on average, physicians who switched to the FHO model reduce total services, capitated services, and services to non-enrolled patients by

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[10] We use the reghdfe program written in STATA by S. Correia, 2017 available at http://scorreia.com/software/reghdfe/ (accessed April 2019).

[11] We checked bootstrap (with 500 replications) inference of matching estimators for average treatment effects to ensure that inference is valid. We found no substantial change in the standard errors.

10.4% (14.8%), 14.9% (18.9%), and 4.9% (4.0%) per annum.[12] On average, switchers increase their production of after-hours services and non-incentivized services by 8.1% (20.0%) and 14.8% (7.3%), likely because of the additional financial incentives associated with them. Moreover, switching from FHG to FHO decreased the number of total patients by 1.7%, increased the number of non-enrolled patients by 9%, and decreased the number of enrolled patients by 2.5%. The latter result may have been due to the restriction in the FHO contract imposed by the Government to control over-enrollment.[13]

We use the estimates from the HDFE model to calculate the monetary value in 2007 Canadian dollars (2018 dollars in parenthesis) of services in the FHO. The reduction of capitated services and services to non-enrolled patients represents, on average, a diminution in services of \$51,422 (\$67,705) and \$64,830 (\$85,359) per year per switcher, respectively. This reduction is counterbalanced by an increase of \$40,947 (\$53,913) and \$983 (\$1,294) in after-hours and non-incentivized services. Overall, the introduction of FHO reduces service production by \$59,320 (\$78,104) per year per FHO physician (based on the predicted values of HDFE model of total services), representing 0.94 FHG equivalent services – the ratio between the average total services produced by FHOs and FHGs.

Switching to FHO affected the mix of services provided and patient enrollment. Physicians who switched from FHG to FHO reduced capitated services and increased non-capitated services (remunerated on FFS basis) to their enrolled patients. The switchers increased after-hours services, improving patient access to care outside of regular hours. The increase in non-incentivized services to enrolled patients without growth in the total number of patients (sum of enrolled and non-enrolled patients), combined with a decline in the number of enrolled patients, suggest that the physician is increasing the production of services that generate additional revenue, consistent with the physician-induced demand hypothesis in a fee-for-service environment (Grytten and Sørensen, 2001; McGuire, 2000). However, services provided to non-enrolled patients decrease while their

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[12] The reported percent estimates are calculated by using this formula $\left(\frac{\exp(\hat{\varphi})}{\exp(0.5\hat{V}(\hat{\varphi}))} - 1\right)$, where $\hat{V}(\hat{\varphi})$ is the is the estimated variance of $\hat{\varphi}$ the estimate of φ presented in Table 3 (Giles, 2011; Jan van Garderen and Shah, 2003).

[13] Although there is no limit in patients rostering, the FHO contract states that if a physician group's average number of enrolled patients exceeds 2,400 per physician, capitation payments are reduced by half for those patients above 2,400 (Office of the Auditor General of Ontario, 2016).

number increases – perhaps due to the annual hard cap limit imposed by the Government for non-enrolled patients.

These results were based on a kernel based propensity score weighted regression model. To check for robustness, we also estimated the model using weights from the CBPS and EB matching methods, with qualitatively similar results (Table A1.9): switching to FHO decreases total services, capitated services, services to non-enrolled patients, number of enrolled patients; and increases after-hours services, non-incentivized services along with the number of non-enrolled patients.

8.1. Heterogeneous Impacts

Table 4 reports the average impact of switching from FHG to FHO by sex (first panel), graduation cohort (second panel), practice location (third panel) and the switching year (fourth panel). On average, the estimated effect of switching is greater for male physicians except for after-hours services and services to non-enrolled patients: female physicians increased after-hours services by 13.6% as opposed to 4.4% for males. However, males were engaged in after-hours even before the introduction of FHO – providing, on average, 75% more after-hours services than females. The impact of switching is qualitatively similar on services across graduation cohorts, except, again, for after-hours services and services provided to non-enrolled patients. Different graduation cohorts of physician behave differently. The third panel shows some heterogeneous responses based on practice location. Finally, late switchers (who switched in 2009 or after) responded positively to after-hours incentives and reduced services to non-enrolled patients, while early switchers (before 2009) did neither. Early switchers increased the production of non-incentivized services as well as the number of non-enrolled patients compared to late switchers, perhaps reflecting an adjustment to the capitation system of payment on the part of physicians. Overall, across all sub-groups considered, the impact of switching to FHO model is negative or zero for capitated services, services to non-enrolled patients and total services, and positive or zero for after-hours services and non-incentivized services.

9 Discussion

Our theoretical model provides testable predictions regarding how switching from blended FFS to blended capitation affects the mix of services, driven by the differences in the relative prices of services and the number of enrolled patients. For the entire sample of physicians and in almost all cohorts (except for Northern Ontario physicians), switchers reduced the number of enrolled patients. Under this condition, proposition 2(a) predicts that switchers will reduce the production of capitated services following the reduction of the relative prices of those services. We find strong empirical support for this prediction. The predictions of a decrease in after-hours services and an increase in services to non-enrolled patients are not supported by the empirical results – we find the contrary. Theoretically, an income-maximizing switcher will reduce after-hours services if they become less attractive. However, the physician might not seek to maximize income, and rather seek to reach or maintain a given level of income – known as the income-target hypothesis (Kantarevic et al., 2008; McGuire and Pauly, 1991; Rizzo and Blumenthal, 1996) – which may explain why switchers increase the quantity of after-hours services in response to a fee reduction. Similar results were found theoretically by McGuire and Pauly (1991) and empirically by Kantarevic et al. (2008), and Rizzo and Blumenthal (1994). Another explanation could be that physicians who switched to FHO are also motivated by non-financial reasons like altruism (Allard et al., 2014, 2011) and/or intrinsic motivation (Gneezy et al., 2011) by adhering to after-hours obligations.

In theory, services to non-enrolled patients would increase for switchers since they would reduce time devoted to capitated and after-hours services production (paid a reduced FFS), and re-allocate this time to services to non-enrolled patients or non-incentivized services (paid a full FFS). The later prediction is not rejected for physicians who graduated before 1970, but for the majority it is rejected, perhaps due to the hard cap limit to payment for FFS claims of non-enrolled patients. It is also possible that switchers are taking advantage of the capitation payments to increase or maintain their revenue without re-allocating time towards more lucrative services, in particular when their marginal utility of leisure is high. With the Northern Ontario physicians cohort we were able to find support for proposition 2(b). Furthermore, switchers did not change the quantity of non-incentivized services, while the theory predicted an increase of those services (the effects on the three other services were unknown).

The mix of physician services is influenced by the payment system: blended capitation was observed to reduce the provision of capitated services to enrolled patients (a decrease of 15%) and services to non-enrolled patients (a decrease of 5%), and increase the provision of after-hours (an increase of 8%) and non-incentivized services (15%). Policy makers could use the mix of payment systems embodied in the blended capitation model to reduce potential unnecessary medical care by including them into the capitated basket (making them less profitable) and limiting FFS billing to restrict the potential overprovision of non-capitated services to enrolled patients (McGuire, 2000); and to improve the supply of targeted services during after-hours.

At the extensive margin, switchers reduced the number of enrolled patients (a decrease of 2.5%). There are two potential explanations for this result: capitation payments are reduced by 50% for each patient enrolled when the average roster size exceeds the upper-bound of 2,400 patients and risk averse physicians tend to select low-risk patients. We may also be observing a reduction or tempering of "cream-skimming" behaviour (Barros, 2003; Ellis, 1998; Hausman and Le Grand, 1999; Matsaganis and Glennerster, 1994; Newhouse, 1984) because of the increased financial risk of attracting patients whose health care need exceeds the average capitation payment (Ellis and McGuire, 1993). We found that switching to blended capitation increases the number of non-enrolled patients (by 9%), but reduces the volume of services provided to these patients. This result suggests that even if the non-enrolled patients are 'high-risk', FHO physicians do not provide a higher volume of services to them. One potential reason is the existence of an upper bound set by the annual hard cap limit designed to limit such behaviour. Our results also corroborate the theoretical work of Rochaix (1989), who finds that in the presence of imperfect information on patients health status (physicians do not have a relationship with their non-enrolled patients since there is no commitment between them), physicians might provide fewer services to their patients.

Our theoretical model has limitations and can be extended in many ways. Relaxing the common shocks assumption to introduce service-specific shocks would be an interesting extension, because it adds the possibility of analyzing demand and technology shocks separately. This would allow us to integrate demand side variables as determinants of physicians' services. The model currently focuses on the supply-side of physician services, extending it to account for demand-side factors would allow for the consideration of patient's preferences and heterogeneity in the delivery of care. Another limitation comes from our empirical model which focuses only on switchers; our results might not be generalized to all FHG physicians practicing in Ontario. While we control for patients' characteristics in each physician's practice, the extent to which physicians select patients based on their underlying health conditions or their financial value is an area for future research. We have limited information on the de-rostering of patients by physicians in our current data set; more and better data could facilitate the investigation of this phenomenon. Another data limitation concerns the fact that the average time spent on patients by physicians is not available in administrative databases, and use of total days worked is imprecise. Finally, we have focused on examining the quantity response of switching from FHG to FHO. Developing and estimating models that evaluate the quality of services provided by switchers is also worthy of future research.

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Table 1: Comparison of Ontario's FHG and FHO payment models

	FHG	FHO
Group size	Minimum 3	Minimum 3
Patient enrollment requirement	No, but encouraged through incentives	Required (Requirement of 2,400, 3,200 or 4,000 patients for groups of 3, 4 or 5 physicians, respectively)
After-hours requirement	A minimum of one 3-hour block/week	A minimum of one 3-hour block/week
Services		
Capitation services	Remunerated at price $(1+\tau_1)p_1$ [a]	Remunerated at price $\pi_1 p_1$ [b]
After hours services	Remunerated at price $(1+\tau_2)p_2$	Remunerated at price $\pi_2 p_2$
Non-incentivized services	Remunerated at price p_3	Remunerated at price p_3 [C]
Services to non-enrolled patients	Remunerated at price p_4 $0 \leq \tau_1, \tau_2 \leq 1$	Remunerated at price p_4 $0 \leq \pi_1, \pi_2 \leq 1$
Fixed payment	(small) Comprehensive care capitation	Monthly comprehensive care capitation payments for formally rostered patients
Fixed bonuses payment	Bonuses for preventive care (flu shots to seniors, pap smear, mammogram, childhood immunizations, and colorectal-cancer screening) were introduced in late 2006	Access bonus: maximum of 18.59% of the base rate payment less outside use by rostered patients Bonuses for preventive care (flu shots to seniors, pap smear, mammogram, childhood immunizations, and colorectal-cancer screening) were introduced in late 2006

Note: (a) $\tau_1 = \pi_1 = 10\%$ is the Comprehensive Care Premium applicable on 20 fee codes that are included in the capitated basket. (b) shadow-billing premium (c) non-incentivized services include capitation services provided to non-enrolled patients which are paid 100% of FFS rate up to $45,000 per physician, and 100% of FFS rate for excluded services to either enrolled or non-enrolled patients.

Table 2: Mean and Standardized Bias before and after matching FHG and FHO physicians

	Mean and standardized Bias before matching				Mean and standardized Bias after Kernel-matching				
	Switcher (FHO)	Non-switcher (FHG)	P-value of t-test before matching	% of bias	Switcher (FHO)	Non-switcher (FHG)	P-value of t-test after matching	% of bias	% reduction of |bias|
Outcomes									
Total services in 2006	297.09	368.16	0.000	-44.9	297.7	300.13	0.633	-1.5	96.6
FHO services in 2006	220.03	266.30	0.000	-42.4	220.42	221.80	0.704	-1.3	97.0
AH services in 2006	26.36	44.99	0.000	-43.2	26.49	26.53	0.972	-0.1	99.8
Non-incentivized services in 2006	32.33	25.93	0.000	15.7	32.38	29.78	0.102	6.4	88.3
Services to non-enrolled patients	20.99	34.39	0.000	-42.8	21.038	24.69	0.000	-11.7	72.7
Number of enrolled patients	1668.1	1666.9	0.970	0.1	1665.8	1665.5	0.993	0.0	79.1
Total number of patients	1786.9	1884.4	0.003	-11.5	1784.4	1819.6	0.259	-4.2	63.9
Physicians characteristics									
Age	49.35	51.26	0.000	-21.0	49.43	51.26	0.841	-0.20	96.5
Female	0.40	0.36	0.074	7.1	0.40	0.39	0.865	1.79	90.9
FTE>=0.5	0.97	0.98	0.014	-9.9	0.97	0.97	0.872	-0.7	93.2
Expected gain in income ($1,000)	112.35	75.64	0.000	38.1	111.99	110.39	0.630	1.7	95.6
Group size	42.13	53.72	0.000	-17.5	42.32	43.41	0.632	-1.7	90.5
IMG	0.13	0.25	0.000	-29.5	0.13	0.14	0.963	-0.2	99.5
Patients characteristics									
Average ADG score	3.30	3.34	0.042	-8.0	3.30	3.30	0.938	-0.08	96.5
Av. Age of patients	39.14	37.99	0.000	19.0	39.14	39.10	0.870	0.6	96.8
Prop. of patients in rural areas	0.07	0.04	0.000	18.8	0.07	0.07	0.232	-5.5	70.9
Prop. of male patients	0.46	0.47	0.074	-7.1	0.46	0.46	0.982	-0.1	98.8
Higher-order terms									
Expected gain in income squared	20117	16747	0.002	12.1	19987	20173	0.868	-0.7	94.5
Age squared	2511.7	2715.9	0.000	-22.0	2518.9	2525.5	0.840	-0.7	96.7

Total services in 2006 squared	1.1e+05	1.7e+05	0.000	-43.6	1.1e+05	1.1e+05	0.573	-1.6	96.4

Table 3: Impact of switching from FHG to FHO on physicians' services production and patient enrollment

	Unweighted regressions				Weighted regressions (Kernel Matching)			
Outcomes	Pooled OLS	FE	HDFE	FD	Pooled OLS	FE	HDFE	FD
Services production								
Log Total services	-0.244***	-0.146***	-0.111***	-0.102***	-0.194***	-0.160***	-0.110***	-0.105***
	(0.0118)	(0.0068)	(0.0044)	(0.00495)	(0.0127)	(0.0077)	(0.0045)	(0.00503)
Log capitated services	-0.312***	-0.206***	-0.162***	-0.147***	-0.258***	-0.209***	-0.161***	-0.149***
	(0.0116)	(0.0077)	(0.0048)	(0.00558)	(0.0126)	(0.0096)	(0.0049)	(0.00568)
Log AH services	0.061***	0.185***	0.061***	0.072***	0.297***	0.183***	0.078**	0.087***
	(0.0413)	(0.0275)	(0.0169)	(0.0204)	(0.0473)	(0.0294)	(0.0186)	(0.0224)
Log non-incentivized services	0.226***	0.076***	0.137***	0.092***	0.195***	0.071***	0.138***	0.100***
	(0.03331)	(0.0169)	(0.0115)	(0.0121)	(0.0391)	(0.0182)	(0.0123)	(0.0139)
Log services to non-enrolled patients	-0.029	-0.041***	-0.054***	-0.059***	-0.026	-0.041***	-0.051***	-0.059***
	(0.0197)	(0.0140)	(0.0127)	(0.0140)	(0.0243)	(0.0155)	(0.0129)	(0.0141)
Patient's enrollment								
Total number of patients	-0.001	-0.019**	-0.018***	-0.005	-0.008	-0.002	-0.017****	-0.001
	(0.0162)	(0.0087)	(0.0042)	(0.00492)	(0.0174)	(0.0097)	(0.0049)	(0.00532)
Number of enrolled patients	0.048**	-0.034***	-0.034***	-0.0105	0.025	0.002	-0.025***	0.000689
	(0.01987)	(0.0130)	(0.0079)	(0.00959)	(0.0217)	(0.0142)	(0.0080)	(0.00957)
Number of non-enrolled patients	-0.051	0.145***	0.091***	0.050***	0.018	0.102***	0.087***	0.040***
	(0.0363)	(0.0212)	(0.0142)	(0.0141)	(0.0396)	(0.0230)	(0.0151)	(0.0146)
Observations	23,098	23,098	23,098	20,584	23,098	23,098	23,098	20,584
Physicians	2,570	2,570	2,570	2,570	2,570	2,570	2,570	2,570

Legend: Significance level: * p<0.10; **p<0.05; *** p<0.01. Cluster-robust standard errors in parentheses (clustering on the physician).

Note: HDFE: High-dimensional fixed-effects, FE: Fixed effects, FD: First Difference

Table 4: Heterogeneous impact of switching to FHO

	Obs. [Phys]	Dependent variables							
		Log (total services)	Log (Capitated services)	Log (AH services)	Log (non-incentivized services)	Log (serv. to non-enrolled patients)	Log(total patients)	Log(Enrolled patients)	Log(Non Enrolled patients)
Sex									
Males	14,232	-0.113***	-0.164***	0.043**	0.156***	-0.032*	-0.027***	-0.035***	0.085***
	[1,584]	(0.0058)	(0.0063)	(0.0212)	(0.0176)	(0.0165)	(0.0068)	(0.0086)	(0.0193)
Females	8,866	-0.106***	-0.155***	0.1278***	0.115***	-0.074***	-0.005	-0.012	0.083***
	[986]	(0.0073)	(0.0079)	(0.0332)	(0.0163)	(0.0205)	(0.0070)	(0.0146)	(0.0240)
Graduation cohort									
Graduation year < 1970	1,782	-0.079***	-0.117***	0.227***	0.168***	0.124**	-0.035*	-0.077**	0.191***
	[198]	(0.0207)	(0.0217)	(0.0848)	(0.0579)	(0.0549)	(0.0202)	(0.0320)	(0.0606)
Graduation year between 1970 and 1980	6,526	-0.117***	-0.167***	0.030	0.135***	-0.060**	-0.018**	-0.022*	0.153***
	[727]	(0.009)	(0.0100)	(0.0312)	(0.0242)	(0.0279)	(0.0070)	(0.0129)	(0.0284)
Graduation year between 1980 and 1990	8,613	-0.100***	-0.157***	0.119***	0.146***	-0.025	-0.021***	-0.028**	0.126***
	[958]	(0.0066)	(0.0069)	(0.0302)	(0.0174)	(0.0193)	(0.0072)	(0.0140)	(0.0232)
Graduation year after 1990	6,177	-0.120***	-0.165***	0.053	0.130***	-0.118***	-0.004	-0.003	-0.043
	[687]	(0.0090)	(0.0099)	(0.0360)	(0.0232)	(0.0233)	(0.0109)	(0.0136)	(0.0293)
Location									
South West Ontario	4,214	-0.087***	-0.121***	0.014	0.137***	-0.085***	-0.020	-0.031	0.136***
	[469]	(0.0095)	(0.0103)	(0.0385)	(0.0235)	(0.0294)	(0.0135)	(0.135)	(0.038)
Central Ontario	14,862	-0.116***	-0.169***	-0.006	0.146***	-0.054***	-0.016***	-0.035***	0.075***
	[1,655]	(0.0058)	(0.0061)	(0.0200)	(0.0152)	(0.0162)	(0.0043)	(0.0081)	(0.0175)
South East Ontario	3,321	-0.116***	-0.167***	0.288***	0.127***	-0.035	-0.026**	-0.011	0.097**
	[369]	(0.0115)	(0.0130)	(0.0543)	(0.0295)	(0.2959)	(0.0120)	(0.0261)	(0.0379)
Northern Ontario	733	-0.091**	-0.174***	0.379*	0.111	0.067	0.092**	0.163**	-0.103
	[84]	(0.0359)	(0.0440)	(0.2102)	(0.0820)	(0.1027)	(0.0439)	(0.0747)	(0.1003)
Year of switch									
Switched before 2009	13,457	-0.089***	-0.143***	0.035	0.213***	-0.011	-0.039***	-0.058***	0.173***
	[1,502}	(0.0098)	(0.0113)	(0.0465)	(0.0261)	(0.0263)	(0.0124)	(0.0131)	(0.0339)
Switched in 2009 or after	20,083	-0.116***	-0.167***	0.107***	0.123***	-0.066***	-0.0135**	-0.016*	0.050***
	[2,235]	(0.0051)	(0.0053)	(0.0214)	(0.0143)	(0.0144)	(0.0057)	(0.0093)	(0.0171)

Legend: Significance level: * p<0.10; **p<0.05; *** p<0.01. Cluster-robust standard errors in parentheses (clustering on the physician).
Note: FHO=Family Health Organization, FHG= Family Health Group.

Online Appendices
Appendix A0

A0.1 A general model under blended FFS (BFFS) to blended capitation (BCAP).

Physicians can perform $J > 1$ types of services: J_1 services to enrolled patients and $J - J_1$ services to non-enrolled patients. The Cobb-Douglas production function in each time period is:

$$Q_{ij} = \begin{cases} b(X_i)h_{ij}^{\delta}n_i^{\gamma}\varepsilon_{ij}, & j = 1,2,\ldots,J_1 \\ b(X_i)h_{ij}^{\delta}\,\overline{N}_i^{\gamma}\varepsilon_{ij}, & j = J_1+1, J_1+2,\ldots,J \end{cases}, \varepsilon_{ij} > 0, b(X_i) > 0, \quad \text{(A1)}$$

The physician's utility function is specified as

$$U(C_i, L_i) = \left(\alpha C_i^{\rho} + (1-\alpha)\,(T - h_i)^{\rho}\right)^{\frac{1}{\rho}}, \rho < 1, \quad \text{(A2)}$$

Total working hours are allocated across the J services: $h_i = \sum_{j=1}^{J} h_{ij}$. Physician i's budget constraint under the BFFS is given by

$$C_i^{BFFS} = \sum_{j=1}^{J_1}(1+\tau_j)p_jQ_{ij} + \sum_{j=J_1+1}^{J} p_jQ_{ij} + y_i, \quad \text{(A3)}$$

where $0 \le \tau_j < 1$ is the premium paid to encourage physicians to provide certain type of services. The corresponding budget constraint under the BCAP is

$$C_i^{BCAP} = Rn_i + \sum_{j=1}^{J_1}\pi_jp_jQ_{ij} + \sum_{j=J_1+1}^{J} p_jQ_{ij} + y_{i,} \quad \text{(A4)}$$

where $0 < \pi_j \le 1$ is the discount rate on the FFS payment.

A0.2 Blended FFS physician problem

Substituting the budget constraint (3) and the production function (1) in the utility function, and using $h_i = \sum_{j=1}^{J} h_{ij}$, the BFFS physician's problem is:

$$\max_{h_{ij}>0,\, n_i>0\ ,\forall j} U = \left(\alpha \left(\sum_{j=1}^{J_1} (1+\tau_j) p_j b(X_i) h_{ij}^{\delta} n_i^{\gamma} \varepsilon_i + \sum_{j=J_1+1}^{J} p_j b(X_i) h_{ij}^{\delta} (\bar{N}_i)^{\gamma} \varepsilon_i + y_i \right)^{\rho} + (1-\alpha) \left(T - \sum_{j=1}^{J} h_{ij} \right)^{\rho} \right)^{\frac{1}{\rho}}$$

We solve the problem for the optimal time allocated to provide each service, j, keeping total hours worked fixed. The first-order conditions (FOCs) for optimal h_{ij} and n_i are

$$\begin{cases} \delta\alpha(1+\tau_j) p_j b(X_i) h_{ij}^{\delta-1} n_i^{\gamma} \varepsilon_{ij} C_i^{\rho-1} - (1-\alpha)\left(T - \sum_{j=1}^{J} h_{ij}\right)^{\rho-1} = 0\,, & j = 1,2,\dots,J_1 \\ \delta\alpha p_j b(X_i) h_{ij}^{\delta-1} (\bar{N}_i)^{\gamma} \varepsilon_{ij} C_i^{\rho-1} - (1-\alpha)\left(T - \sum_{j=1}^{J} h_{ij}\right)^{\rho-1} = 0\,, & j = J_1+1,\, J_1+2,\dots,J \\ \sum_{j=1}^{J_1} (1+\tau_j) p_j b(X_i) h_{ij}^{\delta} n_i^{\gamma-1} \varepsilon_{ij} - \sum_{j=J_1+1}^{J} p_j b(X_i) h_{ij}^{\delta} (\bar{N}_i)^{\gamma-1} \varepsilon_{ij} = 0 & \end{cases}$$

Assuming common shocks $\varepsilon_{ij} = \varepsilon_i, \forall j$ and solving FOCs, we find

$$\begin{cases} h_{ij}^{*}(h_i) = \dfrac{P_j^{\tau}}{\sum_{j=1}^{J_1} P_j^{\tau} + \left(\frac{\bar{N}_i}{n_i^{*}}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j}\, h_i\ , & j = 1,2,\dots,J_1 \\ h_{ij}^{*}(h_i) = \dfrac{\left(\frac{\bar{N}_i}{n_i^{*}}\right)^{\frac{\gamma}{1-\delta}} P_j}{\sum_{j=1}^{J_1} P_j^{\tau} + \left(\frac{\bar{N}_i}{n_i^{*}}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j}\, h_i\ , & j = J_1+1, J_1+2,\dots,J \\ 0 = n_i^{*\gamma-1} \sum_{j=1}^{J_1} (P_j^{\tau})^{1-\delta} h_{ij}^{*\delta} - (\bar{N}_i)^{\gamma-1} \sum_{j=J_1+1}^{J} (P_j)^{1-\delta} h_{ij}^{*\delta} & \end{cases} \tag{A5}$$

where $P_j^{\tau} = \left((1+\tau_j)p_j\right)^{\frac{1}{1-\delta}}$, $j = 1,2,\dots,J_1$, and $P_j = (p_j)^{\frac{1}{1-\delta}}$, $j = J_1+1,\, J_1+2,\dots,J$ and n_i^{*} is the optimal number of enrolled patients under blended FFS. Substituting back the optimal time devoted to each service $h_{ij}^{*}(h_i)$ into the utility function gives

$$V^{BFFS}(h_i) = \left[\alpha\left(\left(\left(\sum_{j=1}^{J_1} P_j^{\tau} + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j\right)^{1-\delta} b(X_i)h_i^{\delta} n_i^{*\gamma}\varepsilon_i + y_i\right)^{\rho} + (1-\alpha)(T-h_i)^{\rho}\right)\right]^{1/\rho}$$

We then derive the optimal hours worked as

$$h_i^* = \underset{0<h_i<T}{\operatorname{argmax}} V^{BFFS}(h_i)$$

Notice that we cannot derive a closed-form of h_i^*. The optimal quantity of each type of service produced is given by

$$Q_{ij}^* = \begin{cases} b(X_i)\left(\dfrac{P_j^{\tau}}{\sum_{j=1}^{J_1} P_j^{\tau} + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j}\right)^{\delta} h_i^{*\delta} n_i^{*\gamma}\varepsilon_i, \quad j = 1,2,\dots,J_1 \\ b(X_i)\left(\dfrac{\left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_j}{\sum_{j=1}^{J_1} P_j^{\tau} + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j}\right)^{\delta} h_i^{*\delta}(\overline{N}_i)^{\gamma}\varepsilon_i, j = J_1+1, J_1+2,\dots,J \end{cases} \quad \text{(A6)}$$

A0.3 Blended capitation physician problem

BCAP physician utility-maximization problem is

$$\max_{h_{ij}>0,\, n_i>0\ ,\forall j} U = \left(\alpha\left(Rn_i + \sum_{j=1}^{J} \pi_j p_j b(X_i) h_{ij}^{\delta} n_i^{\gamma}\varepsilon_i + \sum_{j=J_1+1}^{J} p_j b(X_i) h_{ij}^{\delta}\left(\overline{N}_i\right)^{\gamma}\varepsilon_i + y_i\right)^{\rho} + (1-\alpha)\left(T - \sum_{j=1}^{J} h_{ij}\right)^{\rho}\right)^{\frac{1}{\rho}}$$

We solve the maximization problem for the optimal $\hat{h}_{ij}(h_i)$ following the same two steps as previously. That gives

$$\begin{cases} \hat{h}_{ij}(h_i) = \dfrac{P_j^{\pi}}{\sum_{j=1}^{J_1} P_j^{\pi} + \left(\dfrac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j} h_i \quad , \qquad j = 1,2,\ldots,J_1 \\ \hat{h}_{ij}(h_i) = \dfrac{\left(\dfrac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} P_j}{\sum_{j=1}^{J_1} P_j^{\pi} + \left(\dfrac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j} h_i \quad , \qquad j = J_1+1, J_1+2,\ldots,J \\ 0 = R + \gamma \hat{n}_i^{\gamma-1} b(X_i)\varepsilon_i \sum_{j=1}^{J_1} \left(P_j^{\pi}\right)^{1-\delta} \hat{h}_{ij}^{\delta} - \gamma\left(\overline{N}_i\right)^{\gamma-1} b(X_i)\varepsilon_i \sum_{j=J_1+1}^{J} \left(P_j\right)^{1-\delta} \hat{h}_{ij}^{\delta} \end{cases} \qquad (A7)$$

where $P_j^{\pi} = \left(\pi_j p_j\right)^{\frac{1}{1-\delta}}$, $j = 1,2,\ldots,J_1$, and $P_j = \left(p_j\right)^{\frac{1}{1-\delta}}$, $j = J_1+1,\ J_1+2,\ldots,J$ and $\hat{n}_i$ is the optimal number of enrolled patients under blended FFS. Substituting back the optimal time devoted to each service $\hat{h}_{ij}(h_i)$ into the utility function gives

$$V^{BCAP}(h_i) = \left[\alpha\left(R\hat{n}_i + \left(\sum_{j=1}^{J_1} P_j^{\pi} + \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j\right)^{1-\delta} b(X_i) h_i^{\delta} \hat{n}_i^{\gamma} \varepsilon_i + y_i\right)^{\rho} + (1-\alpha)(T-h_i)^{\rho}\right]^{1/\rho}$$

We then derive the optimal hours worked as $\hat{h}_i = \underset{0<h_i<T}{\operatorname{argmax}} V^{BCAP}(h_i)$

The optimal quantity of each type of service produced is obtained by substituting $\hat{h}_i$ and $\hat{n}_i$ into the production function in (1)

$$\hat{Q}_{ij} = \begin{cases} b(X_i)\left(\dfrac{P_j^{\pi}}{\sum_{j=1}^{J_1} P_j^{\pi} + \left(\dfrac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j}\right)^{\delta} \hat{h}_i^{\delta} \hat{n}_i^{\gamma} \varepsilon_i, \quad j = 1,2,\ldots,J_1 \\ b(X_i)\left(\dfrac{\left(\dfrac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} P_j}{\sum_{j=1}^{J_1} P_j^{\pi} + \left(\dfrac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \sum_{j=J_1+1}^{J} P_j}\right)^{\delta} \hat{h}_i^{\delta} (\overline{N}_i)^{\gamma} \varepsilon_i, \qquad j = J_1+1, J_1+2,\ldots,J \end{cases} \qquad \text{(A8)}$$

A0.4 FHG and FHO physicians' optimal responses

- ***FHG physician utility-maximization problem is***

$$\max_{\substack{h_{ij}>0,\, n_i>0 \ ,\forall j \\ h_{i2}\geq \bar{h}_2}} U = \Big(\alpha\big((1+\tau_1)p_1 b(X_i)h_{i1}^{\delta} n_i^{\gamma}\varepsilon_i + (1+\tau_2)p_2 b(X_i)h_{i2}^{\delta} n_i^{\gamma}\varepsilon_i + p_3 b(X_i)h_{i3}^{\delta} n_i^{\gamma}\varepsilon_i + p_4 b(X_i)h_{i4}^{\delta}\bar{N}_i^{\gamma}\varepsilon_i + y_i\big)^{\rho} + (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho}\Big)^{\frac{1}{\rho}}$$

To maximize utility we define the Lagrangian

$$L = U - \lambda_1\big(\bar{h}_2 - h_{i2}\big) \tag{A9}$$

And solve the first order conditions (FOCs)

$$\frac{\partial L}{\partial h_{i1}} = 0, \frac{\partial L}{\partial h_{i2}} = 0, \frac{\partial L}{\partial h_{i3}} = 0, \frac{\partial L}{\partial h_{i4}} = 0 \tag{A10}$$

together with the slackness conditions

$$\lambda_1\big(\bar{h}_2 - h_{i2}\big) = 0\,, \qquad \lambda_1 \geq 0. \tag{A11}$$

$$\begin{cases} \alpha\delta(1+\tau_1)p_1 b(X_i)h_{i1}^{\delta-1} n_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1} = 0 \\ \big(\alpha\delta(1+\tau_2)p_2 b(X_i)h_{i2}^{\delta-1} n_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1}\big)U^{\frac{1}{\rho}-1} + \lambda_1 = 0 \\ \alpha\delta p_3 b(X_i)h_{i3}^{\delta-1} n_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1} = 0 \\ \big(\alpha\delta p_4 b(X_i)h_{i4}^{\delta-1}\bar{N}_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1}\big) = 0 \\ \alpha\big(\gamma(1+\tau_1)p_1 b(X_i)h_{i1}^{\delta} n_i^{*\gamma-1}\varepsilon_i + \gamma(1+\tau_2)p_2 b(X_i)h_{i2}^{\delta} n_i^{*\gamma-1}\varepsilon_i + \gamma p_3 b(X_i)h_{i3}^{\delta} n_i^{*\gamma-1}\varepsilon_i\big)C_i^{\rho-1} - (1-\alpha)h_i'(n_i^*)(T - h_i)^{\rho-1} = 0 \end{cases}$$

where n_i^* is the optimal number of enrolled patients under FHO and $h_i'(n_i^*) > 0$. We cannot derive a close form of n_i^*. From (A11) we solve the two cases $\lambda_1 = 0$ and $\lambda_1 > 0$ and substituting back the optimal solutions into the Lagrangian; we reach the global maximum when $\lambda_1 = 0$ and physician supplying more than 3-hours block per week to after-hours services i.e., $\mathrm{h}_{\mathrm{i2}}^*(\mathrm{h_i}) > \bar{h}_2$.

$$\begin{cases} h_{i1}^*(h_i) = \frac{P_1^\tau}{P_1^\tau + P_2^\tau + P_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4} h_i; \\ h_{i2}^*(h_i) = \frac{P_2^\tau}{P_1^\tau + P_2^\tau + P_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4} h_i \ ; \\ h_{i3}^*(h_i) = \frac{P_3}{P_1^\tau + P_2^\tau + P_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4} h_i; \\ h_{i4}^*(h_i) = \frac{\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4}{P_1^\tau + P_2^\tau + P_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4} h_i; \end{cases} \quad \text{(A12)}$$

Using (A2) we have the optimal quantity of each type of service produced

$$Q_{ij}^* = \begin{cases} b(X_i)\left[\frac{P_j^\tau}{P_1^\tau + P_2^\tau + P_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4}\right]^\delta h_i^{*\delta} n_i^{*\gamma} \varepsilon_i, \quad j = 1,2 \\ b(X_i)\left[\frac{P_3}{P_1^\tau + P_2^\tau + P_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4}\right]^\delta h_i^{*\delta} n_i^{*\gamma} \varepsilon_i, \quad j = 3 \\ b(X_i)\left[\frac{\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4}{P_1^\tau + P_2^\tau + P_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} P_4}\right]^\delta h_i^{*\delta} (\bar{N}_i)^\gamma \varepsilon_i , j = 4 \end{cases} \quad \text{(A13)}$$

- ***FHO physicians physician utility-maximization problem is***
    - When the physician meet the hard-cap condition on the services provided to non-enrolled patients i.e., $p_4 Q_{i4} < HC$ which is equivalent to $h_{i4} < \bar{h}_4 = \left(\frac{HC}{p_4 b(X_i)\bar{N}_i^\gamma \varepsilon_i}\right)^{\frac{1}{\delta}}$

$$\max_{\substack{h_{ij}>0,\, n_i>0\ ,\forall j \\ h_{i2}\geq \bar{h}_2 \\ h_{i4}<\bar{h}_4}} U = \Big(\alpha\big(Rn_i + \pi_1 p_1 b(X_i) h_{i1}^{\delta} n_i^{\gamma}\varepsilon_i + \pi_2 p_2 b(X_i) h_{i2}^{\delta} n_i^{\gamma}\varepsilon_i + p_3 b(X_i) h_{i3}^{\delta} n_i^{\gamma}\varepsilon_i + p_4 b(X_i) h_{i4}^{\delta} \bar{N}_i^{\gamma}\varepsilon_i$$

$$+ y_i\big)^{\rho} + (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho}\Big)^{\frac{1}{\rho}}$$

To maximize utility we define the Lagrangian

$$L = U - \lambda(\bar{h}_2 - h_{i2}) - \mu(h_{i4} - \bar{h}_4)$$

And solve the first order conditions (FOCs)

$$\frac{\partial L}{\partial h_{i1}} = 0, \frac{\partial L}{\partial h_{i2}} = 0, \frac{\partial L}{\partial h_{i3}} = 0, \frac{\partial L}{\partial h_{i4}} = 0 \qquad \text{(A14)}$$

together with the slackness conditions

$$\lambda(\bar{h}_2 - h_{i2}) = 0,\ \ \mu(h_{i4} - \bar{h}_4) = 0. \qquad \text{(A15)}$$

$$\begin{cases} \alpha\delta\pi_1 p_1 b(X_i) h_{i1}^{\delta-1} n_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1} = 0 \\ \big(\alpha\delta\pi_2 p_2 b(X_i) h_{i2}^{\delta-1} n_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1}\big) U^{\frac{1}{\rho}-1} + \lambda = 0 \\ \alpha\delta p_3 b(X_i) h_{i3}^{\delta-1} n_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1} = 0 \\ \big(\alpha\delta p_4 b(X_i) h_{i4}^{\delta-1} \bar{N}_i^{\gamma}\varepsilon_i C_i^{\rho-1} - (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho-1}\big) U^{\frac{1}{\rho}-1} - \mu = 0 \\ \alpha\big(R + \gamma\pi_1 p_1 b(X_i) h_{i1}^{\delta}\hat{n}_i^{\gamma-1}\varepsilon_i + \gamma\pi_2 p_2 b(X_i) h_{i2}^{\delta}\hat{n}_i^{\gamma-1}\varepsilon_i + \gamma p_3 b(X_i) h_{i3}^{\delta}\hat{n}_i^{\gamma-1}\varepsilon_i\big) C_i^{\rho-1} - (1-\alpha) h_i'(\hat{n}_i)(T - h_i)^{\rho} \end{cases}$$

where $\hat{n}_i$ is the optimal number of enrolled patients under FHO and $h_i'(\hat{n}_i) > 0$. We have solve for the optimal hours in the following four cases: $\lambda = \mu = 0, \lambda > 0, \mu = 0, \lambda = 0, \mu > 0$ and $\lambda > 0, \mu > 0$. The global maximum is reached when $\lambda = \mu = 0$ i.e., when $\hat{h}_{i2}(\mathrm{h_i}) > \bar{h}_2$ and $\hat{h}_{i4}(\mathrm{h_i}) < \bar{h}_4$. The optimal hours are

$$\begin{cases} \hat{h}_{i1}(\mathrm{h_i}) = \dfrac{P_1^{\pi}}{P_1^{\pi} + P_2^{\pi} + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}\mathrm{P}_4}\mathrm{h_i}; \\ \hat{h}_{i2}(\mathrm{h_i}) = \dfrac{P_2^{\pi}}{P_1^{\pi} + P_2^{\pi} + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}\mathrm{P}_4}\mathrm{h_i}; \\ \hat{h}_{i3}(\mathrm{h_i}) = \dfrac{\mathrm{P}_3}{P_1^{\pi} + P_2^{\pi} + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}\mathrm{P}_4}\mathrm{h_i}; \\ \hat{h}_{i4}(\mathrm{h_i}) = \dfrac{\left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}\mathrm{P}_4}{P_1^{\pi} + P_2^{\pi} + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}\mathrm{P}_4}\mathrm{h_i};; \end{cases} \qquad \text{(A16)}$$

- When the physician meet the hard-cap condition on the services provided to non-enrolled patients i.e., $p_4 Q_{i4} \geq HC$ which is equivalent to $h_{i4} \geq \bar{h}_4 = \left(\frac{HC}{p_4 b(X_i) \bar{N}_i^{\gamma} \varepsilon_i}\right)^{\frac{1}{\delta}}$

$$\max_{\substack{h_{ij}>0,\, n_i>0\ ,\forall j \\ h_{i2} \geq \bar{h}_2 \\ h_{i4} \geq \bar{h}_4}} U = \Big(\alpha\big(Rn_i + \pi_1 p_1 b(X_i) h_{i1}^{\delta} n_i^{\gamma} \varepsilon_i + \pi_2 p_2 b(X_i) h_{i2}^{\delta} n_i^{\gamma} \varepsilon_i + p_3 b(X_i) h_{i3}^{\delta} n_i^{\gamma} \varepsilon_i + HC + y_i\big)^{\rho}$$

$$+ (1-\alpha)(T - h_{i1} - h_{i2} - h_{i3} - h_{i4})^{\rho}\Big)^{\frac{1}{\rho}}$$

To maximize utility we define the Lagrangian

$$L = U - \lambda_0(\bar{h}_2 - h_{i2}) - \mu_0(\bar{h}_4 - h_{i4})$$

In this case the global maximum is reached when $\lambda_0 = 0, \mu_0 > 0$ i.e., when $\hat{h}_{i2}(\mathrm{h_i}) > \bar{h}_2$ and $\hat{h}_{i4}(\mathrm{h_i}) = \bar{h}_4$. The optimal hours are

$$\begin{cases} \hat{h}_{i1}(\mathrm{h_i}) = \frac{P_1^{\pi}}{P_1^{\pi}+P_2^{\pi}+\mathrm{P_3}}\big(\mathrm{h_i} - \bar{h}_4\big); \\ \hat{h}_{i2}(\mathrm{h_i}) = \frac{P_2^{\pi}}{P_1^{\pi}+P_2^{\pi}+\mathrm{P_3}}\big(\mathrm{h_i} - \bar{h}_4\big); \\ \hat{h}_{i3}(\mathrm{h_i}) = \frac{\mathrm{P_3}}{P_1^{\pi}+P_2^{\pi}+\mathrm{P_3}}\big(\mathrm{h_i} - \bar{h}_4\big); \\ \hat{h}_{i4}(\mathrm{h_i}) = \bar{h}_4 \\ \widehat{\mu_0} \equiv (T - h_i)^{\rho-1} > 0; \end{cases} \qquad (A17)$$

;

Proof of Lemma 1:

If $p_4 \hat{Q}_{i4} < HC$

$$f(n_i^* | h_i^*, \varepsilon_i) = \hat{C}_i^{FHO}(h_i^*, n_i^*) - C_i^{*FHG}(h_i^*, n_i^*) = Rn_i^* + b(X_i)(w_{FHO} - w_{FHG}) h_i^{*\delta} n_i^{*\gamma} \varepsilon_i$$

Taking the derivatives with respect to n_i^* gives

$$f'(n_i^* | h_i^*, \varepsilon_i) \equiv R + \gamma b(X_i)(w_{FHO} - w_{FHG}) h_i^{*\delta} n_i^{*\gamma-1} \varepsilon_i$$

Because $\frac{\bar{N}_i}{n_i^*} \approx \bar{N}_i$ by definition of $\bar{N}_i$ (the maximum number of potential patients a physician can see), implying that a small change in n_i^* will not significantly affect w_{FHG} and $w_{1,FHO}$. We have

$$f'(n_i^* | h_i^*, \varepsilon_i) \equiv 0 \text{ iff } n_i^* \equiv \left(\frac{\gamma b(X_i)(w_{FHG} - w_{FHO}) h_i^{*\delta} \varepsilon_i}{R}\right)^{\frac{1}{1-\gamma}} = n_i^0$$

n_i^0 exists since $0 < \gamma < 1$ and $w_{FHG} > w_{FHO}$, as $P_j^{\pi} < P_j^{\tau}$ for some services j. Also, $f'(n_i^* | h_i^*, \varepsilon_i) < 0$ iff $n_i^* < n_i^0$ and $f'(n_i^* | h_i^*, \varepsilon_i) > 0$ iff $n_i^* > n_i^0$. Then the function f is strictly increasing in the interval $]n_i^0, \overline{N}_i[$ and $f(\, n_i^0 | h_i^*, \varepsilon_i) = \left(\frac{\gamma b(X_i)(w_{FHG}-w_{FHO}) h_i^{*\delta} \varepsilon_i}{R^\gamma}\right)^{\frac{1}{1-\gamma}} \left(\frac{\gamma-1}{\gamma}\right) < 0$,

while $\lim_{n_i^* \to \overline{N}_i} f(\, n_i^* | h_i^*, \varepsilon_i) > 0$, otherwise $\hat{C}_i^{FHO}(h_i^*\,, n_i^*) - C_i^{*FHG}(h_i^*\,, n_i^*), \forall n_i^*$ which is absurd.

We have $\lim_{n_i^* \to \overline{N}_i} f(\, n_i^* | h_i^*, \varepsilon_i) > 0$ and $f(\, n_i^0 | h_i^*, \varepsilon_i) < 0$ and f is strictly increasing in the interval $]n_i^0, \overline{N}_i[$ then there is a unique $n_i^{**} \in]n_i^0, \overline{N}_i[$ such as $f(\, n_i^{**} | h_i^*, \varepsilon_i) = 0$ (intermediate value theorem). Let solve for n_i^{**}

$$f(\, n_i^* | h_i^*, \varepsilon_i) = \; R n_i^* + b(X_i)\big(w_{1,FHO} - w_{FHG}\big) h_i^{*\delta} n_i^{*\gamma} \varepsilon_i = 0$$

$$R n_i^* = b(X_i)(w_{FHG} - w_{FHO}) h_i^{*\delta} n_i^{*\gamma} \varepsilon_i$$

$$R n_i^{*(1-\gamma)} = b(X_i)(w_{FHG} - w_{FHO}) h_i^{*\delta} \varepsilon_i$$

$$n_i^* = \left(\frac{b(X_i)(w_{FHG} - w_{FHO}) h_i^{*\delta} \varepsilon_i}{R}\right)^{\frac{1}{1-\gamma}} = n_i^{**}$$

Proof of lemma 2:

(a) If $\boldsymbol{h_{i4} < \overline{h}_4 = \left(\frac{HC}{p_4 b(X_i) \overline{N}_i^\gamma \varepsilon_i}\right)^{\frac{1}{\delta}}}$

Capitated services (j=1)

We have

$$\hat{h}_{i1}(\mathrm{h}_i^*) - \mathrm{h}_{i1}^*(\mathrm{h}_i^*) = \left(\frac{P_1^\pi}{P_1^\pi + P_2^\pi + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} - \frac{P_1^\tau}{P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} \right) \mathrm{h}_i^*$$

$$\hat{h}_{i1}(\mathrm{h}_i^*) - \mathrm{h}_{i1}^*(\mathrm{h}_i^*) = \left(\frac{\mathrm{P}_3(P_1^\pi - P_1^\tau) + (P_1^\pi P_2^\tau - P_2^\pi P_1^\tau) + \mathrm{P}_4 P_1^\tau \left(\left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \frac{P_1^\pi}{P_1^\tau} - \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \right)}{\left(P_1^\pi + P_2^\pi + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4\right)\left(P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4\right)} \right) \mathrm{h}_i^*$$

If $\hat{n}_i \leq n_i^* \Leftrightarrow \frac{\mathrm{N}_i}{\hat{n}_i} \geq \frac{\mathrm{N}_i}{n_i^*}$

The term $P_1^\pi P_2^\tau - P_2^\pi P_1^\tau = \left[\big(\pi_1(1+\tau_2)\big)^{\frac{1}{1-\delta}} - \big(\pi_2(1+\tau_1)\big)^{\frac{1}{1-\delta}}\right] (\mathrm{p}_1 \mathrm{p}_2)^{\frac{1}{1-\delta}} \cong 0$, because the value of the premiums was $\pi_1 = \pi_2 = \tau_1 = \tau_2 = 10\%$ in 2006. Then τ_2 increased throughout the year to 30%, but this still represents a very small number multiplying those percentages. Also, we have

$P_1^{\pi} = (\pi_1 p_1)^{\frac{1}{1-\delta}} < ((1+\tau_1)p_1)^{\frac{1}{1-\delta}} = P_1^{\tau}$ giving the following inequality

$$\hat{h}_{i1}(h_i^*) - h_{i1}^*(h_i^*) < \frac{P_4 P_1^{\tau}\left(\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} - \left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}\right)h_i^*}{\left(P_1^{\pi}+P_2^{\pi}+P_3+\left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}P_4\right)\left(P_1^{\tau}+P_2^{\tau}+P_3+\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}}P_4\right)} < 0 \text{ because } \frac{\bar{N}_i}{\hat{n}_i} \geq \frac{\bar{N}_i}{n_i^*}.$$

Therefore, $\hat{h}_{i1}(h_i^*) < h_{i1}^*(h_i^*)$. Switchers will decrease the time devoted to produce capitated services if the relative number of non-enrolled patient increased after the physician joined FHO.

If $\hat{n}_i > n_i^*$ then $\hat{h}_{i1}(h_i^*) - h_{i1}^*(h_i^*)$ is unsigned.

<u>After-hours services (j=2)</u>

$$\hat{h}_{i2}(h_i^*) - h_{i2}^*(h_i^*) = \left(\frac{P_2^{\pi}}{P_1^{\pi}+P_2^{\pi}+P_3+\left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}P_4} - \frac{P_2^{\tau}}{P_1^{\tau}+P_2^{\tau}+P_3+\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}}P_4}\right)h_i^*$$

$$\hat{h}_{i2}(h_i^*) - h_{i2}^*(h_i^*) = \left(\frac{P_3(P_2^{\pi}-P_2^{\tau}) + (P_2^{\pi}P_1^{\tau} - P_1^{\pi}P_2^{\tau}) + P_4 P_2^{\tau}\left(\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}}\frac{P_2^{\pi}}{P_2^{\tau}} - \left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}\right)}{\left(P_1^{\pi}+P_2^{\pi}+P_3+\left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}P_4\right)\left(P_1^{\tau}+P_2^{\tau}+P_3+\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}}P_4\right)}\right)h_i^*$$

If $\hat{n}_i \leq n_i^* \Leftrightarrow \frac{\bar{N}_i}{\hat{n}_i} \geq \frac{\bar{N}_i}{n_i^*}$ then $\hat{h}_{i2}(h_i^*) < h_{i2}^*(h_i^*)$ because $P_2^{\pi} < P_2^{\tau}$ and $P_2^{\pi}P_1^{\tau} - P_1^{\pi}P_2^{\tau} \cong 0$.

If $\hat{n}_i > n_i^* \Leftrightarrow \frac{\bar{N}_i}{\hat{n}_i} < \frac{\bar{N}_i}{n_i^*}$ then $\hat{h}_{i2}(h_i^*) - h_{i2}^*(h_i^*)$ is unsigned.

<u>Non-incentivized services (j=3)</u>

$$\hat{h}_{i3}(h_i^*) - h_{i3}^*(h_i^*) = \left(\frac{P_3}{P_1^{\pi}+P_2^{\pi}+P_3+\left(\frac{\bar{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}}P_4} - \frac{P_3}{P_1^{\tau}+P_2^{\tau}+P_3+\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}}P_4}\right)h_i^*$$

$$\hat{h}_{i3}(\mathrm{h}_i^*) - \mathrm{h}_{i3}^*(\mathrm{h}_i^*) = \left(\frac{\mathrm{P}_3(P_1^\tau - P_1^\pi) + \mathrm{P}_3(P_2^\tau - P_2^\pi) + \mathrm{P}_4 P_3 \left(\left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} - \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \right)}{\left(P_1^\pi + P_2^\pi + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4 \right)\left(P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4 \right)} \right) \mathrm{h}_i^*$$

If $\hat{n}_i \leq n_i^* \Leftrightarrow \frac{\overline{N}_i}{\hat{n}_i} \geq \frac{\overline{N}_i}{n_i^*}$ then $\hat{h}_{i3}(\mathrm{h}_i^*) - \mathrm{h}_{i3}^*(\mathrm{h}_i^*)$ is unsigned because $P_1^\tau > P_1^\pi$ and $P_2^\tau > P_2^\pi$.

If $\hat{n}_i > n_i^* \Leftrightarrow \frac{\overline{N}_i}{\hat{n}_i} < \frac{\overline{N}_i}{n_i^*}$ then $\hat{h}_{i3}(\mathrm{h}_i^*) > \mathrm{h}_{i3}^*(\mathrm{h}_i^*)$.

Services to non-enrolled patients (j=4)

$$\hat{h}_{i4}(\mathrm{h}_i^*) - \mathrm{h}_{i4}^*(\mathrm{h}_i^*) = \left(\frac{\left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4}{P_1^\pi + P_2^\pi + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} - \frac{\left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4}{P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} \right) \mathrm{h}_i^*$$

$$\hat{h}_{i4}(\mathrm{h}_i^*) - \mathrm{h}_{i4}^*(\mathrm{h}_i^*) = \left(\frac{\left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4(P_1^\tau + P_2^\tau + \mathrm{P}_3) - \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4(P_1^\pi + P_2^\pi + \mathrm{P}_3)}{\left(P_1^\pi + P_2^\pi + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{\hat{n}_i}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4 \right)\left(P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4 \right)} \right) \mathrm{h}_i^*$$

If $\hat{n}_i \leq n_i^* \Leftrightarrow \frac{\overline{N}_i}{\hat{n}_i} \geq \frac{\overline{N}_i}{n_i^*}$ then $\hat{h}_{i4}(\mathrm{h}_i^*) > \mathrm{h}_{i4}^*(\mathrm{h}_i^*)$.

If $\hat{n}_i > n_i^* \Leftrightarrow \frac{\overline{N}_i}{\hat{n}_i} < \frac{\overline{N}_i}{n_i^*}$ then $\hat{h}_{i4}(\mathrm{h}_i^*) - \mathrm{h}_{i4}^*(\mathrm{h}_i^*)$ is unsigned.

(b) If $\boldsymbol{h_{i4} \geq \overline{h}_4 = \left(\frac{HC}{p_4 b(X_i)\overline{N}_i^\gamma \varepsilon_i}\right)^{\frac{1}{\delta}}}$

Capitated services (j=1)

$$\hat{h}_{i1}(\mathrm{h}_i^*) - \mathrm{h}_{i1}^*(\mathrm{h}_i^*) = \frac{P_1^\pi}{P_1^\pi + P_2^\pi + \mathrm{P}_3}(\mathrm{h}_i^* - \overline{h}_4) - \frac{P_1^\tau}{P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} \mathrm{h}_i^*$$

$$\hat{h}_{i1}(\mathrm{h}_i^*) - \mathrm{h}_{i1}^*(\mathrm{h}_i^*) = \frac{P_1^\pi \left(P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4 \right) - P_1^\tau (P_2^\pi + \mathrm{P}_3)}{(P_1^\pi + P_2^\pi + \mathrm{P}_3)\left(P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\overline{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4 \right)} \mathrm{h}_i^* - \frac{P_1^\pi}{P_1^\pi + P_2^\pi + \mathrm{P}_3} \overline{h}_4$$

The first term of the equality is unsigned while the second term is negative. Thus, $\hat{h}_{i1}(\mathrm{h}_i^*) - \mathrm{h}_{i1}^*(\mathrm{h}_i^*)$ is unsigned.

After-hours services (j=2)

$$\hat{h}_{i2}(\mathrm{h}_i^*) - \mathrm{h}_{i2}^*(\mathrm{h}_i^*) = \frac{P_2^\pi}{P_1^\pi + P_2^\pi + \mathrm{P}_3}(\mathrm{h}_i^* - \bar{h}_4) - \frac{P_2^\tau}{P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} \mathrm{h}_i^*$$

Similarly to hours devoted to capitated services, $\hat{h}_{i2}(\mathrm{h}_i^*) - \mathrm{h}_{i2}^*(\mathrm{h}_i^*)$ is unsigned.

Non-incentivized services (j=3)

$$\hat{h}_{i3}(\mathrm{h}_i^*) - \mathrm{h}_{i3}^*(\mathrm{h}_i^*) = \frac{\mathrm{P}_3}{P_1^\pi + P_2^\pi + \mathrm{P}_3}(\mathrm{h}_i^* - \bar{h}_4) - \frac{\mathrm{P}_3}{P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} \mathrm{h}_i^*$$

$$\hat{h}_{i3}(\mathrm{h}_i^*) - \mathrm{h}_{i3}^*(\mathrm{h}_i^*) = \frac{\mathrm{P}_3\left(P_1^\tau + P_2^\tau + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4\right) - \mathrm{P}_3(P_1^\pi + P_2^\pi)}{(P_1^\pi + P_2^\pi + \mathrm{P}_3)\left(P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4\right)} \mathrm{h}_i^* - \frac{\mathrm{P}_3}{P_1^\pi + P_2^\pi + \mathrm{P}_3} \bar{h}_4$$

When $\mathrm{P}_3 \ll P_1^\pi + P_2^\pi + \mathrm{P}_3$ since $\mathrm{h}_i^* > \bar{h}_4$ we have $\hat{h}_{i3}(\mathrm{h}_i^*) - \mathrm{h}_{i3}^*(\mathrm{h}_i^*) > 0$. Otherwise it is unsigned.

Services to non-enrolled patients (j=4)

$$\hat{h}_{i4}(\mathrm{h}_i^*) - \mathrm{h}_{i4}^*(\mathrm{h}_i^*) = \bar{h}_4 - \frac{\left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4}{P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4} \mathrm{h}_i^*$$

$$\hat{h}_{i4}(\mathrm{h}_i^*) - \mathrm{h}_{i4}^*(\mathrm{h}_i^*) = \frac{(P_1^\tau + P_2^\tau + \mathrm{P}_3)\bar{h}_4 - \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4(\mathrm{h}_i^* - \bar{h}_4)}{P_1^\tau + P_2^\tau + \mathrm{P}_3 + \left(\frac{\bar{N}_i}{n_i^*}\right)^{\frac{\gamma}{1-\delta}} \mathrm{P}_4}$$

$\hat{h}_{i4}(\mathrm{h}_i^*) - \mathrm{h}_{i4}^*(\mathrm{h}_i^*)$ is unsigned.

Proof Proposition 2: Model predictions

If $\hat{n}_i \leq n_i^*$, we have $\hat{h}_{i1}(\mathrm{h}_i^*) < \mathrm{h}_{i1}^*(\mathrm{h}_i^*)$, $\hat{h}_{i2}(\mathrm{h}_i^*) < \mathrm{h}_{i2}^*(\mathrm{h}_i^*)$, with $\hat{h}_{i3}(\mathrm{h}_i^*) - \mathrm{h}_{i3}^*(\mathrm{h}_i^*)$ unsigned, and $\hat{h}_{i4}(\mathrm{h}_i^*) > \mathrm{h}_{i4}^*(\mathrm{h}_i^*)$. Therefore, using the production function in equation (1) we can derive the following inequalities regarding the optimal quantities of services

$\hat{Q}_{i1}(\mathrm{h}_\mathrm{i}^*) < \mathrm{Q}_{\mathrm{i1}}^*(\mathrm{h}_\mathrm{i}^*)$; $\hat{Q}_{i2}(\mathrm{h}_\mathrm{i}^*) < \mathrm{Q}_{\mathrm{i2}}^*(\mathrm{h}_\mathrm{i}^*)$ and $\hat{Q}_{i3}(\mathrm{h}_\mathrm{i}^*) - \mathrm{Q}_{\mathrm{i3}}^*(\mathrm{h}_\mathrm{i}^*)$ is unsigned, and $\hat{Q}_{i4}(\mathrm{h}_\mathrm{i}^*) > \mathrm{Q}_{\mathrm{i4}}^*(\mathrm{h}_\mathrm{i}^*)$.

If $\hat{n}_i > n_\mathrm{i}^*$, we have $\hat{h}_{i1}(\mathrm{h}_\mathrm{i}^*) - \mathrm{h}_{\mathrm{i1}}^*(\mathrm{h}_\mathrm{i}^*)$, $\hat{h}_{i2}(\mathrm{h}_\mathrm{i}^*) - \mathrm{h}_{\mathrm{i2}}^*(\mathrm{h}_\mathrm{i}^*)$ and $\hat{h}_{i4}(\mathrm{h}_\mathrm{i}^*) - \mathrm{h}_{\mathrm{i4}}^*(\mathrm{h}_\mathrm{i}^*)$ is unsigned, while $\hat{h}_{i3}(\mathrm{h}_\mathrm{i}^*) > \mathrm{h}_{\mathrm{i3}}^*(\mathrm{h}_\mathrm{i}^*)$. The following predictions are straightforward:

$\hat{Q}_{i1}(\mathrm{h}_\mathrm{i}^*) - \mathrm{Q}_{\mathrm{i1}}^*(\mathrm{h}_\mathrm{i}^*)$, $\hat{Q}_{i2}(\mathrm{h}_\mathrm{i}^*) - \mathrm{Q}_{\mathrm{i2}}^*(\mathrm{h}_\mathrm{i}^*)$ and $\hat{Q}_{i4}(\mathrm{h}_\mathrm{i}^*) - \mathrm{Q}_{\mathrm{i4}}^*(\mathrm{h}_\mathrm{i}^*)$ is unsigned; and $\hat{Q}_{i3}(\mathrm{h}_\mathrm{i}^*) > \mathrm{Q}_{\mathrm{i3}}^*(\mathrm{h}_\mathrm{i}^*)$.

A0.5 Aggregating services

Quantities: We match each aggregated service ($j = 1{,}2{,}3{,}4$) with its associated OHIP fee codes. This aggregation allows us to avoid dealing with fee codes with a large number of zero-observations and renders our econometric estimations tractable. The formula for aggregating services per type *j=1,2,3,4* service for a physician *i* in year *t* is given by the weighted sum of the number of services:

$$Q_{ijt} = \sum_{k=1}^{N_j} q_{ikt} p_{k,2007}$$

where $p_{k,2007}$ is the fee for service *k* in 2007, q_{ikt} is the number of service *k* performed by physician *i* in year *t*=2006-2014 and N_j is the number of fee codes or services of type *j*. It is important to notice that price variation is excluded from the quantity of services by considering the price paid for each service at the base year 2007. This rules out the effect of the variation in prices due to switching to FHO on physicians' services production.

Prices: We also calculate the associated price of each aggregated service *j* in year *t* as a Laspeyres price index from the formula $p_{jt} = \frac{\sum_{k=1}^{N_j} p_{k,t} q_{k,2007}}{\sum_{k=1}^{N_j} p_{k,2007} q_{k,2007}}$, with $p_{k,t}$ the fee for service *k* (of type *j*) in year *t* and $q_{k,2007}$ the number of service *k* (of type *j*) in 2007. The Laspeyres price index excludes quantity variations due to FHO switching from the price of aggregated services.

A0.6 Matching Results: before and after matching distribution of propensity score for switchers and non-switchers

Figure A0.1: Distribution of the propensity scores (kernel matching) FHO vs FHG

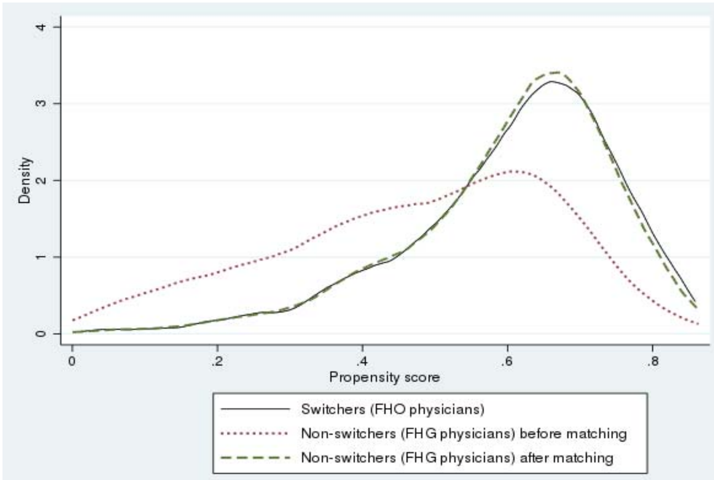


Figure A0.2: Distribution of the propensity scores (CBPS) FHO vs FHG

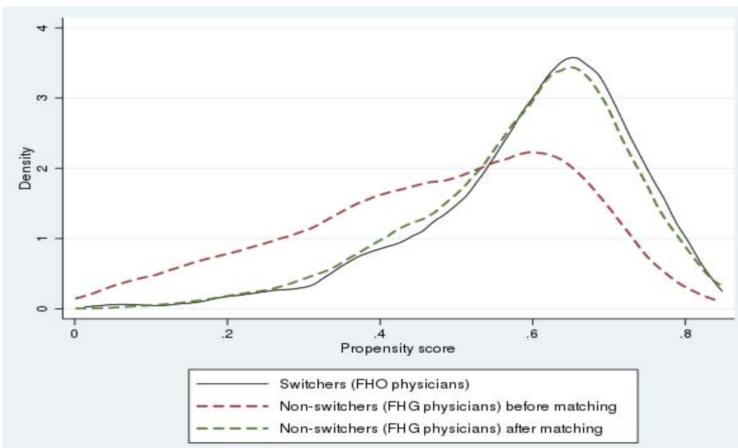
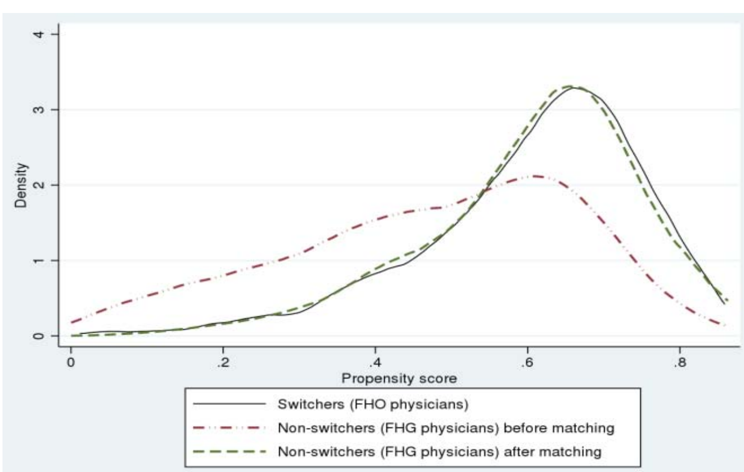


Figure A0.3: Distribution of the propensity scores (EB) FHO vs FHG



Figures A0.1 to A0.3 summarize the distribution of the estimated propensity score for switchers and non-switchers before and after PSM, CBPS and EB. The before matching distribution of propensity scores for switchers and non-switchers were very different. Also, the Kolmogorov-Smirnov (KS) test for equality of propensity score distributions reject the equality of the distributions of propensity score before matching. The figures reveal that the estimated common support or overlapping region of the two distributions is large enough to perform matching (Heckman et al., 1999). Note that nine switchers were dropped from the analysis due to the lack of common support because no match could be found for these switchers.

Figures A0.1 to A0.3 show that the after-matching distribution of propensity scores for switchers and non-switchers are very similar – the solid and the dashed lines largely coincide, suggesting a large reduction of covariate imbalance after-matching. We test again the equality of the propensity score distributions for switchers and non-switchers after matching using KS test. The p-values are 0.542, 0.164 and 0.591 for kernel matching, CBPS, and EB methods, suggesting that we cannot reject the equality of the propensity score distributions for switchers and non-switchers.

Appendix A1

Table A1.1: Capitated comprehensive care fee codes

OHIP fee Codes and definitions
A001 = MINOR ASSESS.-F.P./G.P.
A003 = GEN. ASSESS. -F.P./G.P.
A004 = GEN.RE-ASSESS-F.P./G.P.
A007 = INTERMED.ASSESS/WELL BABY CARE-F.P./G.P./PAED.
A008 = MINI ASSESSMENT-F.P./G.P.
A110 = PERIODIC OCULO-VISUAL ASSESS 19 & UNDER
A112 = PERIODIC OCULO-VISUAL ASSESS 65 YRS +
A777 = PRONOUNCEMENT OF DEATH
A901 = GENERAL/FAMILY PRACTICE-HOUSECALL ASSESSMENT
A903 = GEN/FAM PRACT-PRE-DENTAL/OPER.ASSESS LIMIT 2 PER YEAR/PT
A990 = SPEC VIS PHYS OFFICE - WK/DAYTIME
A994 = SPEC VIS PHYS OFFICE - MON-FRI., EVE
A996 = SPEC VIS PHYS OFFICE - NIGHTS
B990 = SPEC VIS TO PT'S HOME, WK/DAYTIME
B992 = SPEC VIS-PT'S HOME/NON-ELECT -SAC OFF HRS. WK/DAYTIME
B994 = SPEC VIS TO PT'S HOME/NON-ELECT., EVE
B996 = SPECIAL VISIT-HOME-NIGHTS(12MN-7AM) 1ST PT.
C882 = TERMINAL CARE IN HOSP.G.P/F.P
C903 = GENERAL ASSESS.PRIOR TO DENTAL SURGERY-HOSP.
E070 = GERIATRC G/A PREM A003, C003, W102/109,A903,C903,W903 PTS=>70ADD
E071 = GERIATRIC INTERMED ASSESS PREM-PREM A007 PTS=>70 YRS ADD
E542 = ADD ON CODE TO SERVICES WHEN PERFORMED OUTSIDE HOSPITAL
G001 = D./T. PROC.-LAB.MED.-CHOLESTEROL TOTAL.
G002 = D./T. PROC-LAB.MED.-GLUCOSE QUANTITATIVE OR SEMI QUANTITATIV
G004 = D./T. PROC-LAB.MED.-OCCULT.BLOOD.
G005 = D./T. PROC-LAB.MED.-PREGNANCY TEST.
G009 = D./T. PROC-LAB.MED.-URINALYSIS ROUTINE ETC.
G010 = D./T. PROC-LAB.MED.-URINALYSIS- ONE OR MORE PARTS.W/0.MICRO.
G011 = D./T. PROC-LAB.MED.-FUNGUS CULTURE INCL. KOH & SMEAR.
G012 = D./T. PROC-LAB.MED.-WET PREPARATION (FOR FUNGUS, TRICH,PARA)
G014 = LAB.MED.STREPTOCOCCUS IN OFFICE
G123 = D/T PROC.NERVE BLOCK EA.ADD'L ONE ADD TO G228
G197 = D./T. PROC-ALLERGY-SKIN TESTS-PROF.COMP.
G202 = D./T. PROC.-ALLERGY-HYPOSENSITIZATION

G205 = D./T. PROC.-ALLERGY-INSECT VENOM DESENSITIZATION
G209 = D./T. PROC.-ALLERGY-SKIN TESTS-TECH COMP.
G212 = D./T. PROC.-ALLERGY-HYPOSENSITIZATION INJECTION PLUS BASIC
G223 = D./T.PROC.-NERVE BLOCK-ADD'L-SOMATIC/PERIPHERAL NERVE SITES
G227 = D./T. PROC.-NERVE BLOCK-DIAG.-OTHER CRANIAL NERVES
G228 = D./T. PROC.NERV.BLOCK PARAVERT.THOR/LUMB/SACRAL/COCCYGEAL
G231 = D/T. PROC.-NERVE BLOCK DIAG. SINGLE SOMATIC/PERIPHERAL
G235 = D./T. PROC.-NERVE BLOCK-DIAG.-SUPRAORBITAL
G271 = D./T. PROC.-CARDIOV.-ANTICOAGULANT SUPERVISION
G310 = D./.T.PROC.CARDIOV.ECG TECHNICAL COMP.
G313 = D./.T.PROC CARDIOV ECG PROF.COMP-G.P.
G365 = D./T. PROC.-GYNAECOLOGY-PAPANICOLAOU SMEAR
G370 = D/T PROC.INJ/INF.BURSA JOINT GANGLION TENDON SH.ASPIR'N
G371 = D./T. PROC.-INJECTION/INFUSION-BURSA,ETC. EA. ADD. SITE
G372 = D./T. PROC.-INJECTIONS-INTRADERMAL/MUSCULAR ETC. EA. ADD.
G373 = D./T. PROC.-INJ. INTRADERMAL/MUSC. BASIC FEE (SHICK TEST)
G375 = D./T. PROC.-INJECTION/INFUSION-INTRALESIONAL INFILTRATION
G377 = D./T. PROC-INJ/INF.-INTRALESION.-INFILTRATION 3/MORE LESIONS
G378 = D./T. PROC. GYNAECOLOGY-INSERTION OF IUD
G379 = D./T. PROC.-INJ./INFUSION-INTRAVENOUS-CHILD OR ADULT
G381 = D./T. PROC. INJECT/INFUS. INTRAVENOUS CHEMOTHERAPY-1ST INJ
G384 = D./T. PROC.-INFILTRATION FOR TRIGGER POINT
G385 = D./T. PROC.-AS G384-MORE THAN ONE SITE (ADD)
G420 = D&T,OTOLAR.-SYRINGING&/EXTEN.CURETT'G/DEBRIBEM'T N/A W Z907
G435 = D./T. PROC.-OPHTH.-TONOMETRY
G462 = D&T,INJECT/INFUS'N-ADMIN ORAL POLIO VACC.
G481 = D./T. PROC-CARDIO-HGB SCREEN/HCT.-PHYS.OFFICE-WITH VISIT
G482 = D./T. PROC.-VENIPUNCTURE-CHILD
G489 = D./T. PROC.-VENIPUNCTURE- ADOL./ADULT.
G525 = OTOLARYNG.DIAG.HEARING TEST PROF.COMP.TO G440
G538 = D&T IMMUNIZATION-WITH VISIT, EACH INJECT.
G539 = INJECTION OF UNSPECIFIED AGENT - SOLE REASON (FIRST INJECTION)
J301 = PULM/FUNCT-WITH PERM RECORD-VITAL CAPACITY
J304 = PULM/FUNC. FLOW VOL.LOOP-STANDARD LUNG MECHANICS
J324 = PULM.FUNC.-REPEAT J301 AFTER BRONCHODILATOR
J327 = PULM.FUNC.-REPEAT J304 AFTER BRONCHODILATOR
K001 = DETENTION FEE PER FULL 1/4 HR
K002 = INTERVIEWS-RELATIVES ON BEHALF OF PATIENT PER 1/2 HOUR

K003 = INTERVIEW ON BEHALF OF PATIENT (CAS,LEG.GUARD) PER 1/2HR.
K004 = FAMILY PSYCHOTHERAPY-2/MORE MEMBERS-PER 1/2HR.
K005 = INDIVIDUAL CARE PER 1/2 HR
K006 = HYPNOTHERAPY-G.P.-IND. PER 1/2 HOUR
K007 = IND. PSYCHOTHERAPY PER HALF HOUR - GP
K008 = DIAG.INTERVIEW W/CHILD &/OR PARENT-PER 1/2HR.
K013 = COUNSELLING-ONE OR MORE PEOPLE-PER 1/2HR.
K015 = COUNSELLING-RELATIVE ON BEHALF OF PT.SEE PARA.B20 (C)
K017 = ANNUAL HEALTH EXAM-CHILD AFT. 2ND BIRTHDAY.
Q990 = SPEC VIS - OTHER SETTINGS - WK/DAYTIME
Q992 = SPEC VIS - OTHER SETTINGS-SAC.OFF.HRS.WK/DAYTIME, ADDIT'L PT
Q994 = SPEC VIS - OTHER SETTINGS, MON-FRI., EVE
Q996 = SPEC VIS - OTHER SETTING - NIGHTS
R048 = SKIN-EXC.-LOC.MALIG.INCL.BIOPSY-FACE/NECK-1 LESION.
R051 = INTEG.SYST.SKIN-LASER SURG.ON GR.1 TO 4 MALIG.LESIONS
R094 = SKIN-EXC-SIMPLE-MALIG.LESION-OTHER AREA-INCL.BIOPSY-ONE.
Z101 = SKIN-INC.-ABSCESS-SUBCUT.-ONE -LOC.ANAES.
Z110 = INTEGUMENTARY SYST.EXTEN.DEBRIBEM'T ONYCHOGRYPHOTIC NAIL
Z113 = INTEGUMENTARY SYST.BIOPSY(S)-ANY METHOD,SUTURES NOT USED
Z114 = SKIN-INC.-FOREIGN BODY-LOC. ANAES.
Z116 = SURG.PROC SKIN-BIOPSY(S)ANY METHOD WHEN SUTURES USED
Z117 = SKIN.CHEM/CRYOTHERAPY MINOR SKIN LESIONS 1/MORE
Z122 = SKIN-EXC.-GROUP 4-FACE/NECK-ONE LESION-LOC. ANAES.
Z125 = SKIN-EXC.-GROUP 4-OTHER AREAS-ONE LESION-LOC. ANAES.
Z128 = SKIN-DESTRUCTION FINGER/TOENAIL PART/COMP./NAIL PLATE EXC.1
Z129 = SKIN-DESTRUCTION-FINGER/TOENAIL-SIMPLE-PART/COMPL.-MULTI
Z153 = DEBRIDEMENT AND DRESSING - MAJOR (NOT TO BE CLAIMED IN ADDITION TO Z176)
Z154 = SKIN-SUTURE LACER.-UPTO 5CM.-FACE-TIE BLEEDERS/LAYERS.
Z156 = SKIN-EXC-SUT.-BENIGN LESIONS-SINGLE.
Z157 = SKIN-EXC-SUT.-BENIGN LESIONS-TWO LESIONS.
Z158 = SKIN-EXC-SUT.-BENIGN LESIONS-THREE/MORE LESIONS.
Z159 = SKIN-& SUBCUT-REMOVAL BY ELECTROCOAG.-SINGLE LESION
Z160 = SKIN-& SUBCUT-REMOVAL BY ELECTROCOAG.-TWO LESIONS
Z161 = SKIN & SUBCUT.-REMOVAL BY ELECTROCOAG.-THREE/MORE LESIONS
Z162 = SKIN-EXC-SUT.-NAEVUS-ONE.
Z169 = SKIN & SUBCUT.-PLANTAR-REMOVAL BY ELECTRO.-SINGLE LESION
Z170 = SKIN & SUBCUT.-PLANTAR-REMOVAL BY ELECTRO.-TWO LESIONS
Z171 = SKIN & SUBCUT.-PLANTAR-REMOVAL BY ELECTRO-THREE/MORE LESIONS

Z175 = SKIN-SUTURE LACER.-5.1CM-10CM.-OTHER AREA.
Z176 = SKIN-SUTURE-LACERATION-UPTO 5CM.
Z314 = NOSE-EPISTAXIS-CHEM/ELECTROCAUTERY-UNIL.
Z315 = NOSE-EPISTAXIS-ANTERIOR PACKING
Z535 = INTESTINES-ENDOSCOPY-SIGMOIDOSCOPY W/WITHOUT ANOSCOPY
Z543 = ANUS-ANOSCOPY
Z545 = ANUS-INC. THROMBOSED HAEMORRHOID
Z611 = UROGENIT.BLADDER,IN HOSP N/A W PELVIC/GENITO-URINARY SURG.
Z847 = EYE-CORNEA-INCISION-REM. SINGLE EMBEDDED FOREIGN BODY LOC.

Table A1.2: After Hours fee codes for FHG and FHO

OHIP fee Codes and definitions
A001 = MINOR ASSESS.-F.P./G.P.
A003 = GEN. ASSESS. -F.P./G.P.
A004 = GEN.RE-ASSESS-F.P./G.P.
A007 = INTERMED.ASSESS/WELL BABY CARE-F.P./G.P./PAED.
A008 = MINI ASSESSMENT-F.P./G.P.
A888 = PARTIAL ASSESSMENT EM.DEPT EQUIVALENT
K005 = INDIVIDUAL CARE PER 1/2 HR
K013 = COUNSELLING-ONE OR MORE PEOPLE-PER 1/2HR.
K017 = ANNUAL HEALTH EXAM-CHILD AFT. 2ND BIRTHDAY.
K030 = DIABETIC MANAGEMENT FEE
K033 = COUNSELLING - 1 PT/YR/UNIT
Q050 = HEART FAILURE MANAGEMENT INCENTIVE
Q012 = AFTER HOURS PREMIUM

Table A1.3: Descriptive statistics

	2006		2007		2008		2009		2010		2011		2012		2013		2014	
	Sw. (FHO)	N. Sw. (FHG)	Sw. (FHO)	N. Sw (FHG)	Sw. (FHO)	N. Sw (FHG)	Sw. (FHO)	N. Sw (FHG)	Sw. (FHO)	N. Sw (FHG)	Sw. (FHO)	N. Sw (FHG)	Sw. (FHO)	N. Sw (FHG)	Sw. (FHO)	N. Sw (FHG)	Sw. (FHO)	N. Sw (FHG)
Outcomes																		
Number of services per physician [a], simple count																		
Number of capitated serv. (j=1)	7,780 [67.96] (4,253)	9,510 [65.86] (5,090)	7,575 [66.66] (3,992)	9,596 [65.76] (5,228)	7,033 [64.52] (3,532)	9,478 [65.46] (5,351)	6,443 [62.79] (3,174)	9,179 [64.93] (5,297)	5,946 [60.04] (2,964)	8,939 [63.9] (5,342)	5,225 [58.54] (2,684)	8,126 [62.84] (4,983)	4,835 [57.88] (2,663)	7,822 [61.67] (4,904)	4,564 [56.6] (2,405)	7,566 [61.49] (4,913)	4,284 [56.14] (2,236)	7,299 [61.34] (4,952)
Number of AH services (j=2)	1,302 [11.37] (1,571)	2,218 [15.36] (2,596)	1,275 [11.22] (1,593)	2,231 [15.29] (2,623)	1,205 [11.05] (1,481)	2,159 [14.91] (2,589)	1,115 [10.87] (1,375)	2,030 [14.36] (2,492)	1,086 [10.97] (1,306)	1,992 [14.24] (2,541)	996.1 [11.16] (1,213)	1,848 [14.29] (2,413)	994.5 [11.9] (1,202)	1,811 [14.28] (2,456)	989.9 [12.28] (1,170)	1,765 [14.34] (2,415)	946.8 [12.41] (1,176)	1,695 [14.24] (2,344)
Number of Non-incentivized services (j=3)	1,611 [14.07] (1,288)	1,403 [9.72] (1,314)	1,849 [16.27] (1,424)	1,598 [10.95] (1,480)	2,026 [18.59] (1,599)	1,761 [12.16] (1,645)	2,028 [19.76] (1,782)	1,799 [12.73] (2,322)	2,202 [22.23] (1,843)	1,949 [13.93] (2,460)	2,095 [23.47] (1,722)	1,926 [14.89] (2,236)	1,917 [22.95] (1,601)	1,982 [15.63] (2,190)	1,883 [23.35] (1,591)	1,929 [15.68] (2,033)	1,788 [23.43] (1,558)	1,873 [15.74] (2,114)
Number of services to non-enrolled patients (j=4)	754.7 [6.59] (901.6)	1,308 [9.06] (1,517)	664.7 [5.85] (707.8)	1,167 [8.00] (1,400)	636.7 [5.84] (644.0)	1,082 [7.47] (1,357)	675.5 [6.58] (756.3)	1,127 [7.97] (1,446)	669.0 [6.75] (795.4)	1,109 [7.93] (1,513)	608.5 [6.82] (659.1)	1,032 [7.98] (1,559)	608.1 [7.28] (689.2)	1,068 [8.42] (1,753)	627.1 [7.78] (694.1)	1,043 [8.48] (1,835)	612.1 [8.02] (687.8)	1,032 [8.67] (2,009)
Total number of services	11,448 [100] (6,163)	14,439 [100] (7,970)	11,363 [100] (5,990)	14,592 [100] (8,288)	10,901 [100] (5,553)	14,479 [100] (8,480)	10,261 [100] (5,277)	14,136 [100] (8,642)	9,904 [100] (5,155)	13,990 [100] (8,885)	8,925 [100] (4,700)	12,931 [100] (8,419)	8,354 [100] (4,607)	12,683 [100] (8,634)	8,063 [100] (4,411)	12,305 [100] (8,680)	7,631 [100] (4,279)	11,900 [100] (8,789)
Price index[b] (base year=2007)																		
Price of capitated services (p_{1t})	0.990	0.990	1.00	1.00	0.981	0.981	1.021	1.021	1.080	1.080	1.071	1.071	1.054	1.054	1.052	1.052	1.051	1.051
Price of AH serv. (p_{2t})	0.985	0.985	1.00	1.00	0.984	0.984	1.026	1.026	1.166	1.166	1.176	1.176	1.172	1.172	1.177	1.177	1.164	1.164

Price of non-incentivized services (p_{3t})	1.002	1.002	1.00	1.00	1.059	1.059	1.181	1.181	1.283	1.283	1.363	1.363	1.594	1.594	1.606	1.606	1.625	1.625
Price of serv. to non-enrol. Pat. (p_{4t})	0.992	0.992	1.00	1.00	0.997	0.997	1.081	1.081	1.172	1.172	1.187	1.187	1.216	1.216	1.219	1.219	1.207	1.207
Quantity/value of services in thousands of 2007 dollars																		
Capitated services (Q_{1t})[c]	220.4 [73.39] (93.79)	266.3 [71.66] (122.2)	216.1 [72.88] (94.18)	270.0 [72.15] (126.8)	201.2 [71.65] (90.00)	267.9 [72.52] (129.5)	184.5 [70.58] (81.97)	259.2 [72.26] (127.7)	172.7 [69.78] (76.38)	253.9 [72.15] (128.5)	153.7 [69.14] (68.27)	233.1 [71.9] (121.1)	139.3 [67.95] (63.51)	221.5 [71.29] (119.6)	132.1 [66.92] (58.54)	216.6 [71.41] (122.5)	125.4 [67.13] (56.84)	211.1 [71.9] (125.9)
AH services (Q_{2t})[c]	26.49 [8.82] (31.36)	44.99 [12.11] (52.32)	25.96 [8.76] (31.69)	45.53 [12.17] (53.33)	24.50 [8.73] (29.63)	44.21 [11.97] (52.90)	22.60 [8.65] (27.44)	41.93 [11.69] (51.44)	21.86 [8.83] (26.03)	41.22 [11.71] (52.60)	19.91 [8.96] (24.01)	38.04 [11.73] (49.41)	19.57 [9.55] (23.37)	36.70 [11.81] (49.20)	19.42 [9.84] (22.35)	35.95 [11.85] (48.68)	18.55 [9.93] (22.41)	34.72 [11.83] (47.64)
Non-incentivized services (Q_{3t})[c]	32.38 [10.78] (43.73)	25.93 [6.98] (37.97)	35.82 [12.08] (47.84)	28.12 [7.51] (40.52)	37.50 [13.35] (48.17)	29.14 [7.89] (42.63)	36.42 [13.93] (45.19)	28.87 [8.05] (44.76)	35.84 [14.48] (44.43)	29.04 [8.25] (46.12)	33.00 [14.84] (42.28)	27.65 [8.53] (43.82)	30.96 [15.1] (42.75)	27.08 [8.72] (47.12)	30.36 [15.38] (42.15)	26.07 [8.6] (43.77)	27.97 [14.97] (42.37)	23.77 [8.1] (43.86)
Services to non-enrolled patients (Q_{4t})[c]	21.04 [7.01] (22.88)	34.40 [9.26] (38.00)	18.60 [6.27] (19.55)	30.58 [8.17] (34.31)	17.55 [6.25] (17.80)	28.23 [7.64] (33.12)	17.85 [6.83] (17.18)	28.74 [8.01] (33.51)	17.10 [6.91] (15.66)	27.76 [7.89] (33.67)	15.62 [7.03] (14.61)	25.34 [7.82] (31.54)	15.22 [7.42] (14.00)	25.36 [8.16] (32.80)	15.52 [7.86] (14.32)	24.68 [8.14] (32.92)	14.90 [7.98] (14.51)	24.04 [8.19] (36.31)
Total services as a sum: $Q_{1t} + Q_{2t} + Q_{3t} + Q_{4t}$	300.3 [100] (134.9)	371.6 [100] (181.2)	296.5 [100] (137.3)	374.2 [100] (188.0)	280.8 [100] (131.5)	369.4 [100] (190.6)	261.4 [100] (121.7)	358.7 [100] (189.9)	247.5 [100] (115.3)	351.9 [100] (193.5)	222.3 [100] (105.2)	324.2 [100] (182.3)	205.0 [100] (101.2)	310.7 [100] (182.5)	197.4 [100] (98.10)	303.3 [100] (185.6)	186.8 [100] (97.94)	293.6 [100] (190.2)
Total services, as a weighted sum (Q_t): $p_{1t}Q_{1t} + p_{2t}Q_{2t} + p_{3t}Q_{3t} + p_{4t}Q_{4t}$.	297.7 (133.7)	368.2 (179.4)	296.5 (137.3)	374.2 (188.0)	278.8 (131.1)	365.4 (188.5)	273.9 (128.7)	372.8 (197.6)	278.0 (131.7)	392.1 (217.3)	251.5 (122.4)	362.1 (205.9)	237.7 (124.6)	350.6 (210.5)	229.5 (122.3)	342.2 (213.7)	216.8 (122.8)	329.9 (218.3)
Number of enrolled patients	1,666	1,667	1,678	1,707	1,651	1,721	1,622	1,699	1,600	1,687	1,572	1,670	1,540	1,638	1,512	1,620	1,475	1,583

	(765.6)	(893.7)	(749.2)	(886.5)	(716.5)	(888.6)	(688.5)	(880.4)	(669.1)	(876.3)	(658.1)	(875.3)	(635.6)	(868.5)	(623.0)	(869.2)	(607.3)	(867.0)
Total num. of patients	1,784	1,884	1,788	1,905	1,763	1,907	1,740	1,894	1,717	1,877	1,687	1,854	1,654	1,817	1,629	1,803	1,592	1,761
	(780.4)	(904.1)	(771.2)	(905.3)	(748.6)	(912.6)	(724.4)	(910.0)	(705.3)	(909.2)	(691.1)	(908.4)	(669.3)	(904.1)	(660.5)	(912.2)	(647.2)	(907.6)
Physicians' characteristics																		
Expected gain in income (thousands of 2006 C$)	112.35	75.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	(86.59)	(105.1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Age	49.43	51.26	50.43	52.26	51.43	53.26	52.43	54.26	53.43	55.26	54.43	56.26	55.43	57.26	56.43	58.26	57.43	59.26
	(8.689)	(9.401)	(8.689)	(9.401)	(8.689)	(9.401)	(8.689)	(9.401)	(8.689)	(9.401)	(8.689)	(9.401)	(8.689)	(9.401)	(8.689)	(9.401)	(8.689)	(9.401)
Group size	42.32	53.72	50.98	64.60	49.86	68.54	42.09	66.72	27.55	60.65	22.92	55.47	22.39	53.82	18.77	48.42	17.29	45.52
	(61.90)	(70.62)	(77.56)	(86.48)	(81.98)	(92.37)	(70.34)	(88.47)	(46.32)	(79.74)	(34.31)	(71.41)	(31.97)	(69.72)	(18.71)	(60.33)	(11.87)	(57.36)
Female	0.399	0.365	0.399	0.365	0.399	0.365	0.399	0.365	0.399	0.365	0.399	0.365	0.399	0.365	0.399	0.365	0.399	0.365
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IMG	0.133	0.247	0.133	0.247	0.133	0.247	0.133	0.247	0.133	0.247	0.133	0.247	0.133	0.247	0.133	0.247	0.133	0.247
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FTE>=0.5	0.973	0.985	0.985	0.988	0.985	0.990	0.989	0.987	0.994	0.985	0.993	0.983	0.993	0.983	0.993	0.983	0.995	0.973
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patients' characteristics																		
Average ADG score	3.302	3.337	3.232	3.275	3.279	3.338	3.271	3.376	3.231	3.358	3.238	3.405	3.140	3.335	3.088	3.301	3.103	3.335
	(0.425)	(0.478)	(0.403)	(0.467)	(0.412)	(0.466)	(0.419)	(0.468)	(0.414)	(0.465)	(0.405)	(0.466)	(0.398)	(0.460)	(0.398)	(0.466)	(0.397)	(0.478)
Av. Age of patients	39.14	38.00	39.58	38.48	40.10	38.88	40.61	39.35	41.17	39.90	41.76	40.46	42.36	41.07	42.92	41.69	43.48	42.27
	(5.857)	(6.223)	(5.827)	(6.232)	(5.917)	(6.274)	(5.952)	(6.367)	(5.991)	(6.419)	(6.028)	(6.506)	(6.044)	(6.607)	(6.056)	(6.643)	(6.133)	(6.692)
Prop. of patients in rural areas	0.0668	0.0426	0.0665	0.0422	0.0664	0.0419	0.0659	0.0419	0.0660	0.0421	0.0658	0.0424	0.0661	0.0426	0.0664	0.0428	0.0663	0.0433
	(0.147)	(0.126)	(0.147)	(0.126)	(0.147)	(0.125)	(0.145)	(0.124)	(0.143)	(0.124)	(0.142)	(0.124)	(0.141)	(0.124)	(0.140)	(0.123)	(0.139)	(0.123)
Prop. of male patients	0.458	0.466	0.459	0.469	0.460	0.471	0.461	0.473	0.462	0.475	0.463		0.464	0.476	0.466	0.477	0.468	0.479
	(0.123)	(0.121)	(0.122)	(0.120)	(0.121)	(0.119)	(0.120)	(0.118)	(0.120)	(0.117)	(0.120)	(0.116)	(0.119)	(0.116)	(0.119)	(0.116)	(0.119)	(0.116)

Note: Percentages in squared brackets and standard deviations in parentheses.

Legend: [a] represents a sum of the number of services $\sum_{k=1}^{N_j} q_{ikt}$, where q_{ikt} is the number of service *k* performed by physician *i* at year *t* and N_j is the number of fee codes or services of type *j*. [b] Laspeyres price indices computed with the FFS price of services as reported in the OHIP Schedule of Benefits and Fees. [c]The (weighted) quantity are computed using the formula describes in the subsection 5.2: $Q_{ijt} = \sum_{k=1}^{N_j} q_{ikt} p_{k,2007}$. Sw.: Switcher, N. Sw.: Non-Switcher

Table A1.4: Propensity score estimates

	Logistic model		CBPS model	
	Coefficient	Std. error	Coefficient	Std. error
Expected gain in income	0.002*	0.0012	0.003**	0.0011
Total services in 2006	0.002	0.0016	0.001	0.0014
Capitated services in 2006	-0.005***	0.0015	-0.004***	0.0012
AH services in 2006	-0.008***	0.0016	-0.008***	0.0014
Age	0.034	0.0450	0.039	0.0415
Number of enrolled patients	0.001***	0.0002	0.001***	0.0001
Female	0.111	0.1879	0.168	0.1714
FTE>=0.5	-0.369	0.3262	-0.302	0.2971
IMG	-0.103	0.1211	-0.105	0.1165
Group size	-0.001	0.0007	-0.001	0.000
Age squared	-0.001*	0.0004	-0.001**	0.0004
Expected gain in income squared	-6.63E-06**	2.58E-06	-6.92E-06	2.23E-06
Total services in 2006 squared	-1.77E-06	1.45E-06	-1.10E-06	1.21E-06
Average ADG score	0.007	0.1305	0.076	0.1190
Av. Age of patients	0.054***	0.0112	0.045***	0.0102
Prop. of patients in rural areas	0.552	0.3408	0.353	0.2889
Prop. of male patients	0.725	0.7224	1.129*	0.6550
Intercept	-1.529	1.3181	-1.852	1.1581
Observations	2,579		2,579	

* p<0.10; **p<0.05; *** p<0.01

Table A1.5: Regression test before and after matching regression test

Covariates	Before	After
Expected gain in income	0.9965	0.5305
Total services in 2006	0.1519	0.2130
Capitated services in 2006	0.1746	0.1657
AH services in 2006	0.9807	0.9599
Age	0.6161	0.3356
Number of enrolled patients	0.9441	0.8318
Female	0.4275	0.4682
FTE>=0.5	0.6044	0.6970
IMG	0.9116	0.9338
Group size	0.5310	0.6319
Age squared	0.5983	0.3665
Expected gain in income squared	0.6504	0.6208
Total services in 2007 squared	0.1839	0.2798
Average ADG score	0.4792	0.4057
Av. Age of patients	0.2170	0.1306
Prop. of patients in rural areas	0.0293	0.6410
Prop. of male patients	0.6729	0.4231
Number of Phys.	2,570	2,570

Note: We consider a polynomial of degree 4 and 7 in the estimated propensity score to compute the F-tests for the covariates

Table A1.6: Estimated results from weighted OLS model

	Log (total services)	Log (Capitated services)	Log (AH services)	Log (non-incentivized services)	Log (serv. to non-enrolled patients)	Log(total patients)	Log(Enrolled patients)	Log(No Enrolle patient
FHO	-0.194***	-0.258***	0.297***	0.195***	-0.0261	-0.008	0.025	0.018
	(0.0127)	(0.0126)	(0.0473)	(0.0391)	(0.0243)	(0.0174)	(0.0217)	(0.0396
FHO in-basket price	2.923***	3.218***	2.816***	-1.714**	1.248*	-0.975***	-1.151**	-4.449**
	(0.275)	(0.348)	(0.762)	(0.699)	(0.690)	(0.254)	(0.496)	(0.520)
AH services price	-0.193***	-0.330***	0.116	-0.199	-0.0984	-0.0703	0.208*	-1.819**
	(0.0616)	(0.0709)	(0.224)	(0.159)	(0.178)	(0.0576)	(0.116)	(0.163)
Non-incentivized services price	0.295***	0.325***	0.615***	-0.743***	0.319**	-0.304***	-0.231**	-1.524**
	(0.0556)	(0.0663)	(0.165)	(0.141)	(0.143)	(0.0536)	(0.0906)	(0.111)
Services to non-enrolled patients price	-1.394***	-2.157***	-2.73***	1.53***	-0.769	0.964***	0.593	6.952**
	(0.219)	(0.264)	(0.643)	(0.540)	(0.530)	(0.201)	(0.381)	(0.445)
time trend	0.0168***	0.022***	-0.061***	0.086***	-0.04***	-0.004	0.0018	-0.078**
	(0.0039)	(0.0046)	(0.0142)	(0.0099)	(0.0086)	(0.00440)	(0.00798)	(0.0123
time trend squared	-0.00234***	-0.00260***	0.00461***	-0.00883***	-0.000682	0.000620*	-0.000597	0.0111*
	(0.000317)	(0.000367)	(0.00112)	(0.000808)	(0.000770)	(0.000361)	(0.000598)	(0.00098
Age	0.0184***	0.0271***	-0.0280	0.00421	0.00878	0.0621***	0.0805***	-0.0856*
	(0.00565)	(0.00554)	(0.0212)	(0.0177)	(0.00917)	(0.00836)	(0.00937)	(0.0175
Age squared	-0.000162***	-0.0002***	0.0003	-0.0001	-0.0001	-0.001***	-0.0007***	0.0007*
	(5.22e-05)	(5.15e-05)	(0.0002)	(0.0002)	(8.52e-05)	(7.68e-05)	(8.59e-05)	(0.0001
Log(days worked)	1.011***	0.766***	0.920***	2.016***	1.021***	0.591***	0.665***	0.300**
	(0.0326)	(0.0477)	(0.0968)	(0.0952)	(0.0556)	(0.0504)	(0.0605)	(0.0815
log enrolled patients	0.258***	0.373***	0.599***	0.194***	-0.207***	-	-	-
	(0.0257)	(0.0315)	(0.0538)	(0.0525)	(0.0263)	-	-	-
log non-enrolled patients	0.136***	0.116***	2.06e-05	-0.0398**	0.754***	-	-	-
	(0.00613)	(0.00587)	(0.0234)	(0.0188)	(0.0115)	-	-	-
IMG	0.0297*	-0.000883	0.303***	-0.137***	-0.00460	0.110***	0.0710***	0.403**
	(0.0163)	(0.0168)	(0.0568)	(0.0445)	(0.0278)	(0.0227)	(0.0256)	(0.0563
Female	-0.166***	-0.0476*	-0.249***	-0.246***	-0.150***	-0.390***	-0.397***	-0.460**
	(0.0269)	(0.0283)	(0.0962)	(0.0752)	(0.0449)	(0.0431)	(0.0513)	(0.0830
Group size	0.000250***	0.000284***	-0.000737**	-0.000104	0.000279*	-2.77e-05	-9.99e-05	0.00017
	(9.68e-05)	(8.93e-05)	(0.000362)	(0.000307)	(0.000160)	(0.000137)	(0.000164)	(0.00029
Average ADG score	0.200***	0.265***	0.436***	-0.0297	0.181***	-0.125***	-0.0937**	-0.281**
	(0.0196)	(0.0198)	(0.0696)	(0.0560)	(0.0305)	(0.0293)	(0.0423)	(0.0562

Av. Age of patients	-0.00634***	-0.0134***	-0.0490***	0.0249***	0.00282	-0.0217***	-0.0202***	-0.0316*
	(0.00176)	(0.00191)	(0.00583)	(0.00534)	(0.00320)	(0.00235)	(0.00280)	(0.0046
Prop. of patients in rural areas	-0.00133	-0.204***	-0.823***	0.957***	0.241**	-0.426***	-0.462***	0.00457
	(0.0445)	(0.0472)	(0.221)	(0.122)	(0.1000)	(0.0661)	(0.0773)	(0.151)
Prop. of male patients	0.150	0.481***	1.153***	-1.040***	0.0764	-0.445***	-0.596***	0.0656
	(0.107)	(0.104)	(0.382)	(0.312)	(0.194)	(0.153)	(0.175)	(0.328)
LHIN02 = South West	-0.0230	0.0324	0.380**	-0.246**	-0.108*	-0.145***	-0.104	-0.356**
	(0.0326)	(0.0321)	(0.149)	(0.107)	(0.0563)	(0.0550)	(0.0635)	(0.122)
LHIN03 = Waterloo Wellington	-0.00788	0.0796**	0.353**	-0.372***	-0.0422	-0.235***	-0.218***	-0.139
	(0.0368)	(0.0344)	(0.140)	(0.111)	(0.0604)	(0.0572)	(0.0662)	(0.133)
LHIN04 = Hamilton Niagara Haldimand Brant	0.00538	0.0535*	0.415***	-0.202**	-0.125**	-0.137***	-0.103*	-0.370**
	(0.0286)	(0.0297)	(0.148)	(0.0969)	(0.0582)	(0.0511)	(0.0569)	(0.123)
LHIN05 = Central West	-0.00509	-0.0384	1.010***	-0.308***	0.00181	-0.211***	-0.195***	-0.265**
	(0.0340)	(0.0327)	(0.133)	(0.105)	(0.0578)	(0.0493)	(0.0561)	(0.125)
LHIN06 = Mississauga Halton	0.0221	-0.0145	0.703***	-0.147	0.0582	-0.186***	-0.161***	-0.317**
	(0.0286)	(0.0283)	(0.135)	(0.0974)	(0.0551)	(0.0464)	(0.0524)	(0.116)
LHIN07 = Toronto Central	0.00460	-0.00612	0.920***	-0.365***	0.0976*	-0.224***	-0.245***	-0.0401
	(0.0282)	(0.0287)	(0.129)	(0.0968)	(0.0505)	(0.0477)	(0.0540)	(0.112)
LHIN08 = Central	0.0296	0.00827	0.972***	-0.278***	0.0165	-0.154***	-0.145***	-0.264**
	(0.0256)	(0.0263)	(0.127)	(0.0904)	(0.0472)	(0.0458)	(0.0529)	(0.109)
LHIN09 = Central East	0.0414	-0.00581	1.223***	-0.251***	-0.0106	-0.127***	-0.0973*	-0.217*
	(0.0264)	(0.0269)	(0.126)	(0.0928)	(0.0474)	(0.0459)	(0.0516)	(0.112)
LHIN10 = South East	-0.0151	0.0301	0.334*	-0.182	-0.0744	-0.296***	-0.238***	-0.711**
	(0.0400)	(0.0428)	(0.171)	(0.144)	(0.120)	(0.0807)	(0.0848)	(0.147)
LHIN11 = Champlain	-0.0241	-0.0303	0.751***	-0.330***	-0.0233	-0.263***	-0.250***	-0.251**
	(0.0284)	(0.0329)	(0.138)	(0.0943)	(0.0545)	(0.0481)	(0.0556)	(0.114)
LHIN12 = North Simcoe Muskoka	0.135**	0.0721	0.979***	-0.0327	0.0901	-0.289*	-0.350	-0.135
	(0.0565)	(0.0885)	(0.306)	(0.316)	(0.231)	(0.165)	(0.239)	(0.305)
LHIN13 = North East	0.0408	-0.169***	-0.279	0.351*	0.0424	-0.231**	-0.267**	0.147
	(0.0743)	(0.0568)	(0.236)	(0.180)	(0.0803)	(0.0919)	(0.109)	(0.179)

LHIN14 = North West	0.0124	-0.00559	0.600***	-0.394	-0.394***	0.173***	0.185***	-0.132
	(0.0732)	(0.0849)	(0.221)	(0.274)	(0.0980)	(0.0602)	(0.0688)	(0.242)
Constant	-4.995***	-4.519***	-7.541***	-8.349***	-6.198***	4.564***	3.642***	8.545**
	(0.285)	(0.350)	(0.850)	(0.778)	(0.483)	(0.380)	(0.459)	(0.731)
Observations	23,034	23,034	23,034	23,034	23,033	23,098	23,036	23,09
Number of physicians	2,568	2,568	2,568	2,568	2,568	2,570	2,568	2,570

Cluster-robust standard errors in parentheses (clustering on the physician). *** p<0.01, ** p<0.05, * p<0.1

Table A1.7: Estimations results from weighted FE model

	Log (total services)	Log (Capitated services)	Log (AH services)	Log (non-incentivized services)	Log (serv. to non-enrolled patients)	Log(total patients)	Log(Enrolled patients)	Log Enr pati
FHO	-0.160***	-0.209***	0.183***	0.071***	-0.041***	-0.002	0.002	0.102
	(0.0077)	(0.0096)	(0.029)	(0.018)	(0.015)	(0.0097)	(0.014)	(0.02
FHO in-basket price	1.152***	1.561***	4.099***	-8.690***	1.055	-0.507**	-1.598***	3.142
	(0.222)	(0.321)	(0.778)	(0.627)	(0.664)	(0.208)	(0.495)	(0.60
AH services price	-0.293***	-0.391***	0.222	-0.532***	-0.363**	0.0450	0.202**	-1.33
	(0.0543)	(0.0577)	(0.212)	(0.142)	(0.172)	(0.0442)	(0.101)	(0.15
Non-incentivized services price	-0.167***	-0.0930	0.979***	-2.619***	0.206	-0.121**	-0.321***	0.614
	(0.0490)	(0.0702)	(0.177)	(0.128)	(0.131)	(0.0493)	(0.0926)	(0.14
Services to non-enrolled patients price	0.337*	-0.590**	-4.055***	8.338***	-0.171	0.357**	0.990***	-0.73
	(0.176)	(0.249)	(0.655)	(0.476)	(0.473)	(0.178)	(0.379)	(0.52
Age	0.024***	0.031***	0.018	0.054***	-0.042***	0.075***	0.097***	-0.08
	(0.00598)	(0.00762)	(0.0205)	(0.0162)	(0.0116)	(0.0079)	(0.0134)	(0.01
Age squared	-0.0002***	-0.0002***	-0.0004**	-0.0003**	-5.68e-05	-0.001***	-0.001***	0.001
	(5.14e-05)	(5.80e-05)	(0.0002)	(0.0001)	(1.00e-04)	(5.77e-05)	(9.30e-05)	(0.00
Log(days worked)	0.993***	0.988***	0.785***	1.422***	1.024***	0.133***	0.220***	-0.06
	(0.0248)	(0.0473)	(0.0638)	(0.0946)	(0.0435)	(0.0257)	(0.0595)	(0.04
log enrolled patients	0.0395***	0.113***	0.182***	0.0565	-0.138***	-	-	-
	(0.0111)	(0.0220)	(0.0442)	(0.0671)	(0.0287)	-	-	-
log non-enrolled patients	0.070***	0.053***	0.007	-0.047***	0.636***	-	-	-
	(0.0059)	(0.0061)	(0.0169)	(0.0171)	(0.0139)	-	-	-
Group size	0.0002***	0.0003***	-0.0002	-0.0004***	0.0003**	-1.26e-05	5.64e-06	-9.83
	(6.08e-05)	(6.54e-05)	(0.0002)	(0.0001)	(0.0001)	(4.71e-05)	(7.53e-05)	(0.00
Average ADG score	0.171***	0.278***	0.198***	0.088*	0.062**	0.047*	0.080**	-0.17
	(0.0187)	(0.0280)	(0.0514)	(0.0456)	(0.0294)	(0.0247)	(0.0392)	(0.04
Av. Age of patients	-0.018***	-0.034***	-0.029***	0.009	-0.0003	-0.022***	-0.015	-0.02
	(0.0034)	(0.0057)	(0.0106)	(0.0072)	(0.0054)	(0.0066)	(0.0141)	(0.00
Prop. of patients in rural areas	-0.132	-0.0324	0.141	-0.749	0.677	-0.897**	-0.267	-0.58
	(0.193)	(0.192)	(0.853)	(0.615)	(0.551)	(0.448)	(0.584)	(0.83
Prop. of male patients	0.0967	0.839**	0.905	-1.665***	0.0474	-0.712	-1.003	-0.01

	(0.234)	(0.379)	(0.679)	(0.501)	(0.354)	(0.680)	(1.113)	(0.58
LHIN02 = South West	-0.531***	-0.380***	0.680***	-0.561***	-1.793***	0.388***	0.143***	2.501
	(0.0202)	(0.0200)	(0.0777)	(0.0539)	(0.0491)	(0.0295)	(0.0395)	(0.05
LHIN03 = Waterloo Wellington	0.0616	0.145	-0.504	-0.135	-0.687**	0.223	-0.418	1.450
	(0.101)	(0.110)	(0.422)	(0.319)	(0.276)	(0.233)	(0.331)	(0.41
LHIN04 = Hamilton Niagara Haldimand Brant	0.0799	0.219**	0.0848	0.0113	-1.048***	0.234	-0.287	0.924
	(0.0967)	(0.0954)	(0.417)	(0.311)	(0.272)	(0.223)	(0.298)	(0.40
LHIN05 = Central West	0.231	0.280**	0.507	-0.0965	-1.384***	0.930***	0.414	-0.03
	(0.141)	(0.140)	(0.476)	(0.346)	(0.305)	(0.276)	(0.359)	(0.44
LHIN06 = Mississauga Halton	0.0318	0.141	0.191	0.0508	-1.364***	0.569**	0.103	-0.22
	(0.0964)	(0.0968)	(0.410)	(0.315)	(0.273)	(0.224)	(0.306)	(0.40
LHIN07 = Toronto Central	0.0849	0.172	0.555	-0.0768	-1.532***	0.647***	0.0481	-0.29
	(0.132)	(0.124)	(0.454)	(0.339)	(0.298)	(0.246)	(0.312)	(0.42
LHIN08 = Central	0.115	0.193	0.498	0.00265	-1.571***	0.891***	0.457	-0.39
	(0.138)	(0.135)	(0.457)	(0.343)	(0.301)	(0.262)	(0.362)	(0.44
LHIN09 = Central East	0.0774	0.115	0.535	0.00701	-1.517***	0.955***	0.508	-0.23
	(0.147)	(0.149)	(0.501)	(0.345)	(0.327)	(0.269)	(0.368)	(0.44
LHIN13 = North East	-0.375	-1.016***	-2.714***	1.774**	-1.592**	1.457***	0.601	0.124
	(0.257)	(0.258)	(1.045)	(0.763)	(0.687)	(0.563)	(0.757)	(1.00
Constant	-1.980***	-2.712***	-4.317***	-3.238***	-2.417***	5.408***	4.860***	7.080
	(0.282)	(0.442)	(0.931)	(0.841)	(0.536)	(0.402)	(0.644)	(0.68
Observations	23,034	23,034	23,034	23,034	23,033	23,098	23,036	23
Number of physicians	2,568	2,568	2,568	2,568	2,568	2,570	2,568	2,

Cluster-robust standard errors in parentheses (clustering on the physician). *** p<0.01, ** p<0.05, * p<0.1

Table A1.8: Estimations results from weighted HDFE model

	Log (total services)	Log (Capitated services)	Log (AH services)	Log (non-incentivized services)	Log (serv. to non-enrolled patients)	Log(total patients)	Log(Enrolled patients)	Log(Non Enrolled patients)
FHO	-0.111***	-0.161***	0.078***	0.139***	-0.051***	-0.017***	-0.025***	0.087***
	(0.0045)	(0.0049)	(0.0186)	(0.0123)	(0.0129)	(0.00494)	(0.00796)	(0.0151)
FHO in-basket price	0.965***	1.294***	3.058***	-8.929***	1.178*	-1.135***	-2.317***	3.330***
	(0.238)	(0.262)	(0.910)	(0.643)	(0.683)	(0.213)	(0.453)	(0.717)
AH services price	-0.403***	-0.541***	0.00579	-0.480***	-0.606***	-0.0030	0.095	-1.395***
	(0.0622)	(0.0699)	(0.255)	(0.162)	(0.187)	(0.0509)	(0.110)	(0.196)
Non-incentivized services price	-0.257***	-0.222***	0.639***	-2.669***	0.165	-0.314***	-0.585***	0.633***
	(0.0446)	(0.0494)	(0.169)	(0.118)	(0.127)	(0.0441)	(0.0870)	(0.135)
Services to non-enrolled patients price	0.683***	-0.103	-2.816***	8.549***	0.0923	1.028***	1.847***	-0.860*
	(0.156)	(0.171)	(0.609)	(0.421)	(0.444)	(0.158)	(0.323)	(0.481)
Log(days worked)	1.032***	1.053***	0.821***	1.365***	1.088***	0.0251	0.0618**	-0.166***
	(0.0187)	(0.0324)	(0.0486)	(0.0805)	(0.0433)	(0.0159)	(0.0271)	(0.0437)
log enrolled patients	-0.00740	0.0536***	0.0658**	0.0170	-0.142***			
	(0.0100)	(0.0168)	(0.0318)	(0.0360)	(0.0224)			
log non-enrolled patients	0.0164***	-0.0145***	-0.0246**	-0.0497***	0.515***			
	(0.00404)	(0.00477)	(0.0116)	(0.0103)	(0.0125)			
Group size	0.000262***	0.0004***	-0.000596***	0.0004***	0.0001	0.0001***	0.0003***	-0.001***
	(3.44e-05)	(3.96e-05)	(0.0001)	(9.67e-05)	(0.0001)	(2.61e-05)	(6.45e-05)	(0.0001)
Average ADG score	0.0584***	0.107***	0.156***	0.00279	0.0130	0.0474***	0.0745**	-0.163***
	(0.0104)	(0.0145)	(0.0332)	(0.0262)	(0.0255)	(0.0175)	(0.0302)	(0.0320)
Av. Age of patients	0.00184	-0.013***	-0.007	0.025***	0.0199***	-0.005	-0.002	-0.005
	(0.0026)	(0.0030)	(0.0072)	(0.0076)	(0.0067)	(0.0073)	(0.0140)	(0.0073)
Prop. of patients in rural areas	0.121	-0.217	-0.323	-0.376	1.123**	-0.704**	0.430	-1.895***
	(0.170)	(0.378)	(0.497)	(0.391)	(0.506)	(0.334)	(0.494)	(0.646)
Prop. of male patients	0.0552	0.166	0.331	-1.456***	0.373	-1.100***	-1.488*	-0.758
	(0.152)	(0.227)	(0.533)	(0.413)	(0.413)	(0.389)	(0.843)	(0.480)
LHIN02 = South West	-0.403	-0.561**	-2.414***	0.544**	0.946	0.258	0.0702	1.750
	(0.269)	(0.267)	(0.784)	(0.247)	(0.780)	(0.286)	(0.108)	(1.516)

LHIN03 = Waterloo Wellington	0.157	0.424*	0.238	-0.106	-0.882*	-0.163	-1.647	2.293***
	(0.211)	(0.222)	(0.216)	(0.157)	(0.461)	(0.358)	(1.015)	(0.299)
LHIN04 = Hamilton Niagara Haldimand Brant	-0.329	0.221	0.250	-1.575**	-2.679***	-0.134	-1.339	0.963
	(0.246)	(0.230)	(0.259)	(0.681)	(0.569)	(0.363)	(1.042)	(1.311)
LHIN05 = Central West	-0.120	0.268	0.506	-1.147	-2.232***	0.356	-0.718	-0.0609
	(0.253)	(0.239)	(0.332)	(0.715)	(0.607)	(0.403)	(1.068)	(1.382)
LHIN06 = Mississauga Halton	-0.219	0.239	0.540*	-1.249*	-2.508***	0.126	-1.032	0.0581
	(0.246)	(0.231)	(0.290)	(0.698)	(0.584)	(0.384)	(1.052)	(1.376)
LHIN07 = Toronto Central	-0.191	0.243	0.432	-1.119	-2.342***	0.216	-1.016	-0.114
	(0.250)	(0.235)	(0.312)	(0.708)	(0.598)	(0.391)	(1.054)	(1.380)
LHIN08 = Central	-0.130	0.271	0.556*	-1.099	-2.253***	0.355	-0.665	-0.200
	(0.251)	(0.237)	(0.320)	(0.712)	(0.602)	(0.398)	(1.070)	(1.382)
LHIN09 = Central East	-0.242	0.162	0.389	-1.217*	-2.067***	0.349	-0.591	-0.225
	(0.254)	(0.240)	(0.357)	(0.714)	(0.628)	(0.396)	(1.066)	(1.389)
LHIN13 = North East	-0.611**	-0.694**	-1.968***	-0.670	-1.506*	0.512	-0.577	-0.422
	(0.298)	(0.342)	(0.573)	(0.871)	(0.801)	(0.495)	(1.136)	(1.491)
Observations	23,033	23,033	23,033	23,033	23,032	23,098	23,035	23,096
Number of physicians	2,568	2,568	2,568	2,568	2,568	2,570	2,568	2,570

Cluster-robust standard errors in parentheses (clustering on the physician). *** p<0.01, ** p<0.05, * p<0.1

Table A1.9: Impact of switching from FHG to FHO on physicians' service production and patients enrollment

	Weighted regressions (CBPS)			Weighted regressions (EB)		
Outcomes	Pooled OLS	FE	HDFE	Pooled OLS	FE	HDFE
Services production						
Log Total services	-0.192***	-0.157***	-0.111***	-0.193***	-0.159***	-0.110***
	(0.0125)	(0.0075)	(0.0045)	(0.0128)	(0.0077)	(0.0045)
Log capitated services	-0.261***	-0.209***	-0.161***	-0.256***	-0.208***	-0.161***
	(0.0124)	(0.0090)	(0.0049)	(0.0126)	(0.0094)	(0.0049)
Log AH services	0.288***	0.183***	0.075***	0.289***	0.186***	0.078***
	(0.047)	(0.0291)	(0.0181)	(0.0480)	(0.0295)	(0.0185)
Log non-incentivized services	0.213***	0.073***	0.138***	0.202***	0.072***	0.139***
	(0.0377)	(0.0180)	(0.0121)	(0.0393)	(0.0181)	(0.0125)
Log services to non-enrolled patients	0.213***	-0.043***	-0.052***	-0.026	-0.041***	-0.052***
	(0.0233)	(0.0151)	(0.0128)	(0.0245)	(0.0154)	(0.0129)
Patient's enrollment						
Total number of patients	-0.006	-0.001	-0.017***	-0.008	-0.001	-0.017***
	(0.0172)	(0.0097)	(0.0048)	(0.0173)	(0.0099)	(0.0052)
Number of enrolled patients	0.028	0.001	-0.025***	0.026**	0.003	-0.025***
	(0.0215)	(0.0141)	(0.0079)	(0.0219)	(0.0145)	(0.0080)
Number of non-enrolled patients	0.014	0.109***	0.088***	0.015	0.107***	0.086***
	(0.0391)	(0.0228)	(0.0149)	(0.0399)	(0.0231)	(0.0153)
Observations	23,098	23,098	23,098	23,098	23,098	23,098
Physicians	2,570	2,570	2,570	2,570	2,570	2,570

Legend: Significance level: * p<0.10; **p<0.05; *** p<0.01. Cluster-robust standard errors in parentheses (clustering on the physician)

Appendix A2: Figures

Figure A2.1: Estimated physician-specific time trend from HDFE model for total services by male and female physicians

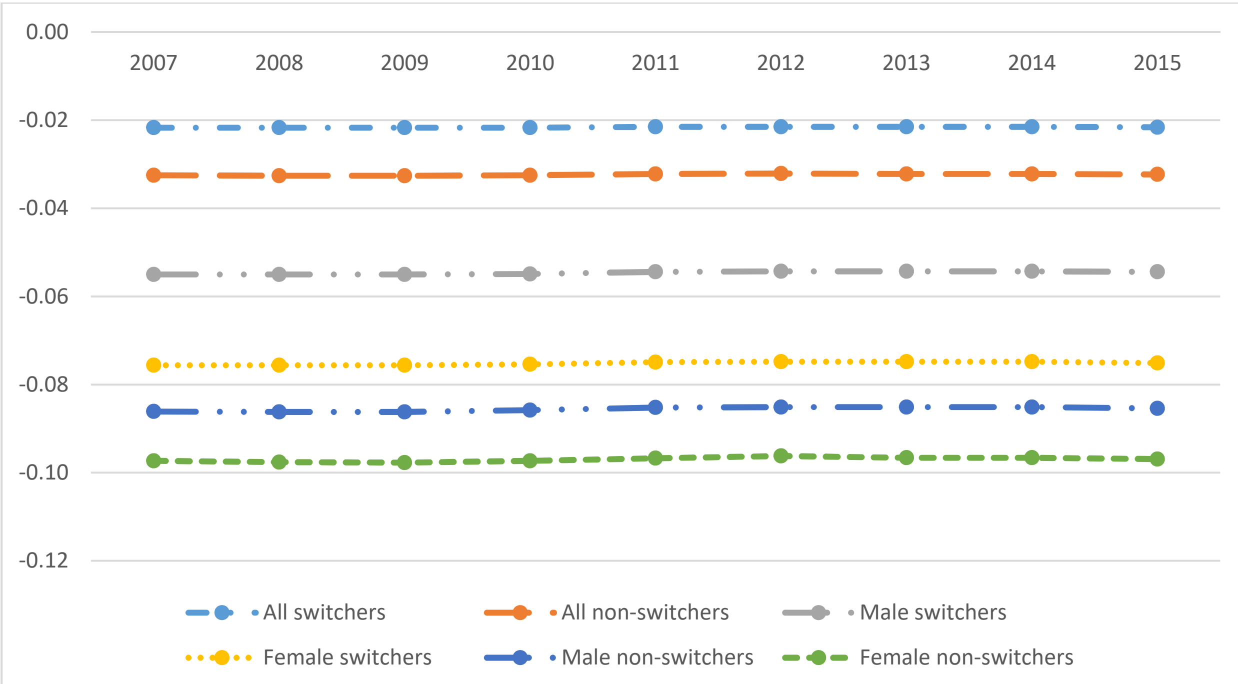


Figure A2.2: Estimated physician-specific time trend from HDFE model for capitated services by male and female physicians

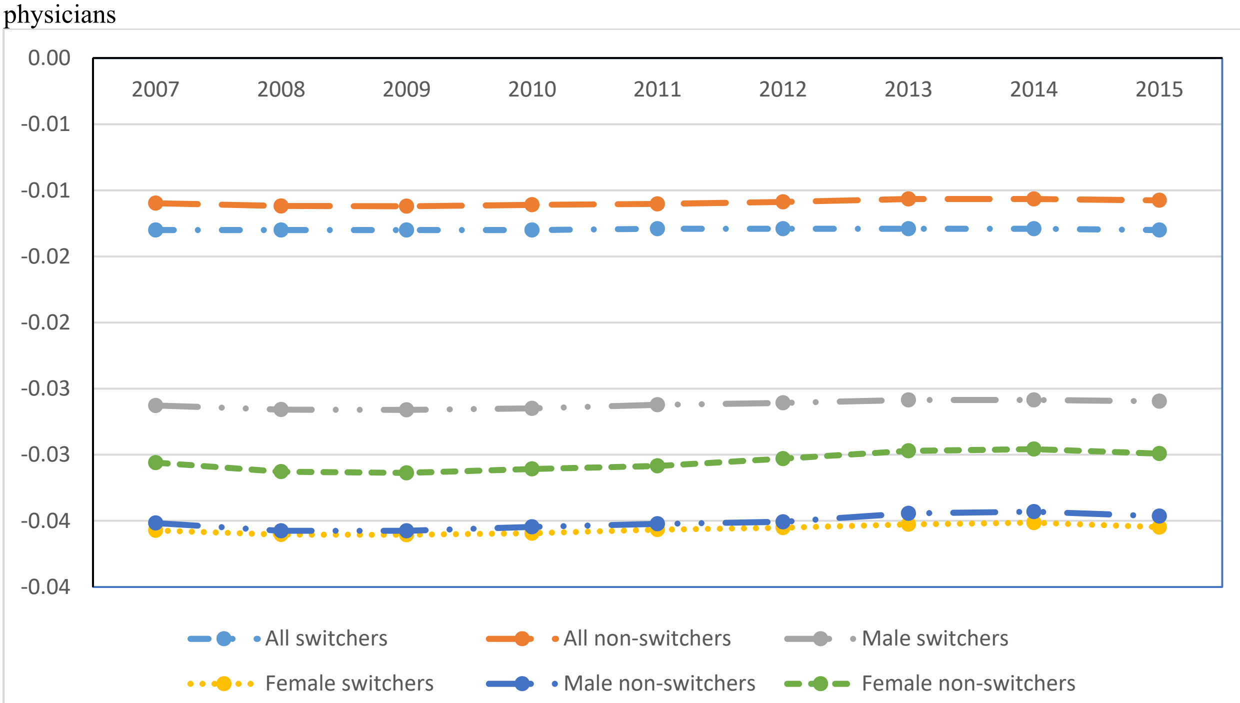


Figure A2.3: Estimated physician-specific time trend from HDFE model for after-hours services by male and female physicians

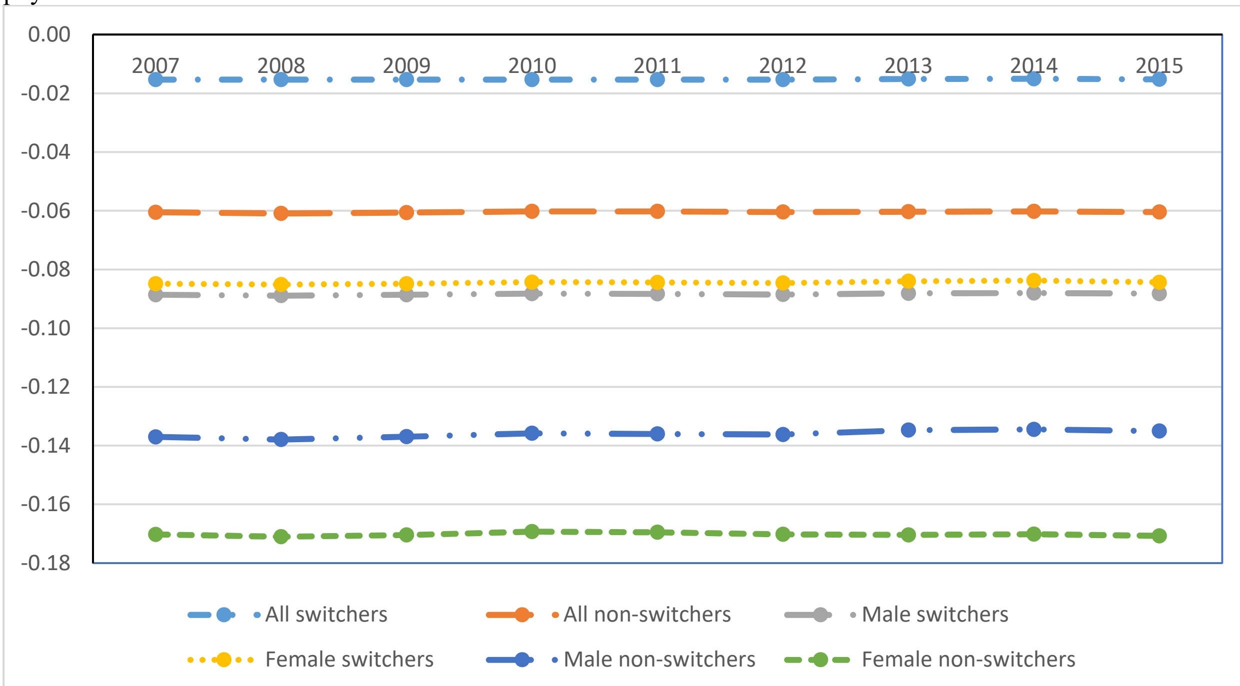


Figure A2.4: Estimated physician-specific time trend from HDFE model for non-incentivized services by male and female physicians

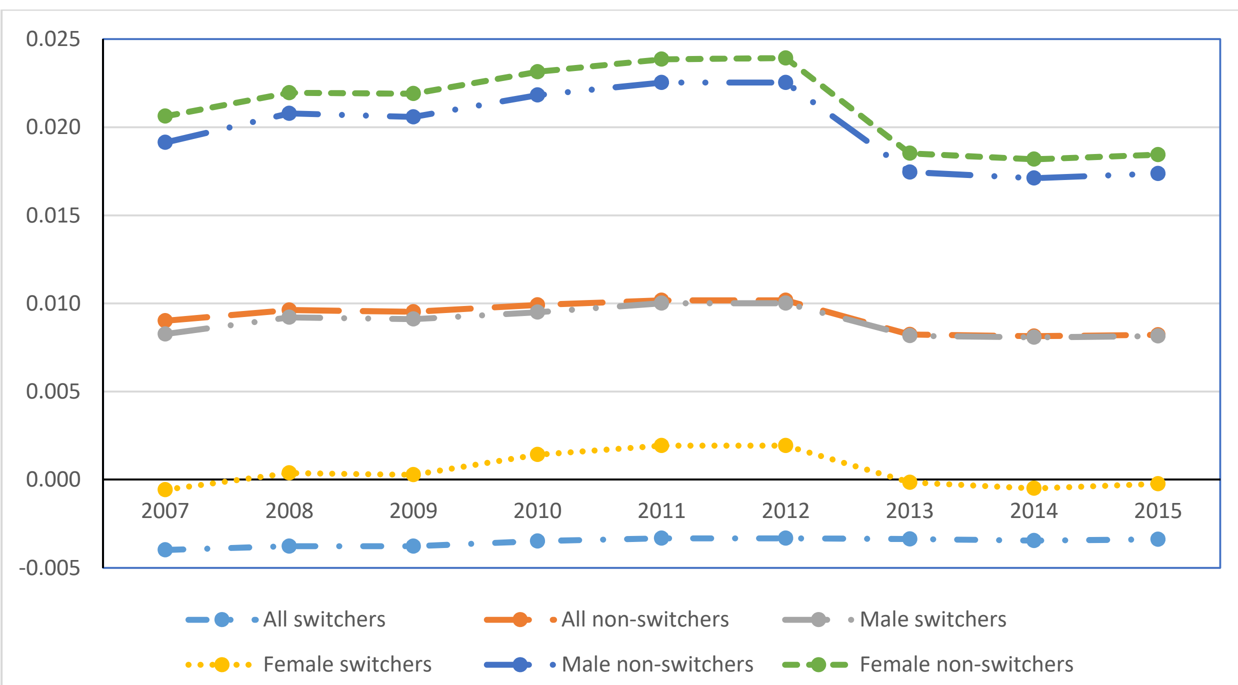


Figure A2.5: Estimated physician-specific time trend from HDFE model for services to non-enrolled patients by male and female physicians

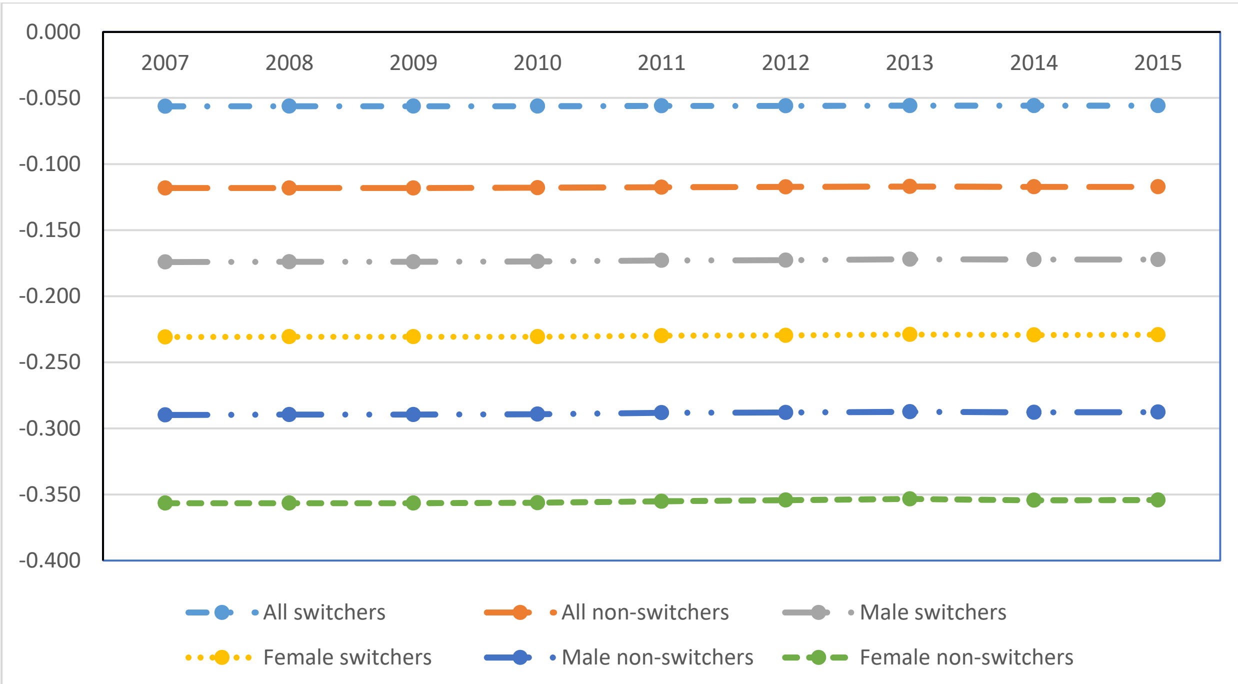


Figure A2.6: Estimated physician-specific time trend from HDFE model for total services by younger (< 55 years old) and older (≥ 55 years old) physicians

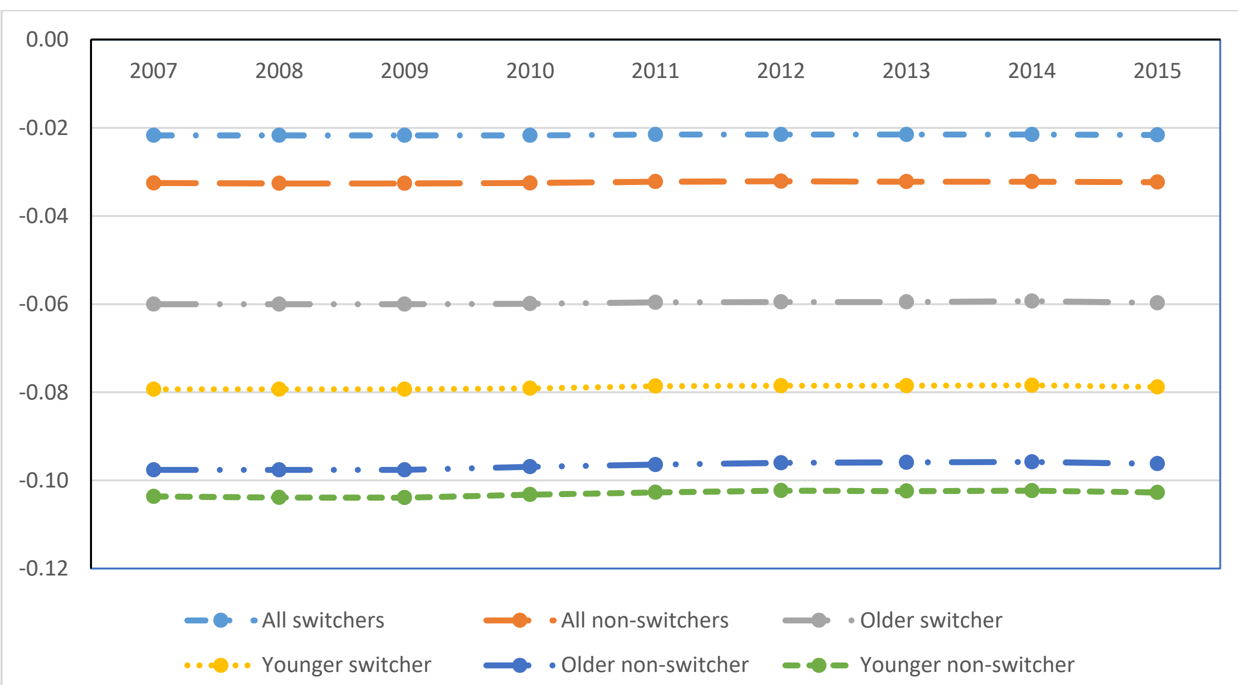


Figure A2.7: Estimated physician-specific time trend from HDFE model for capitated services by younger (< 55 years old) and older (≥ 55 years old) physicians

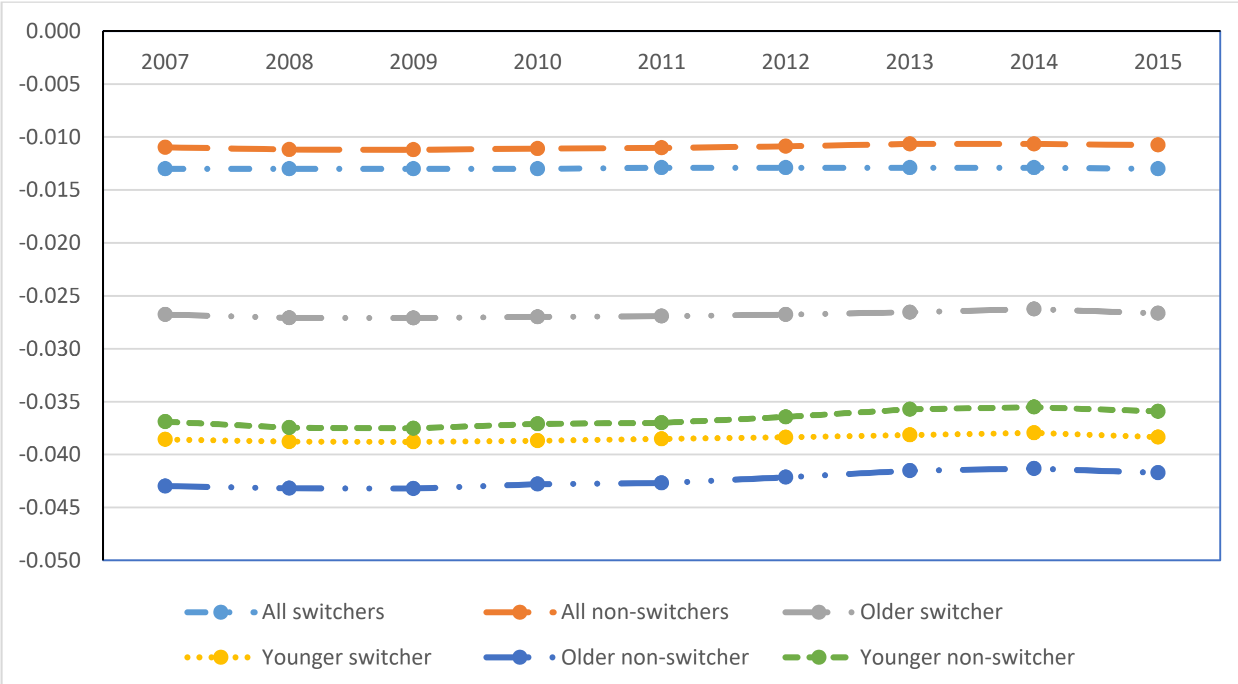


Figure A2.8: Estimated physician-specific time trend from HDFE model for after-hours services by younger (< 55 years old) and older (≥ 55 years old) physicians

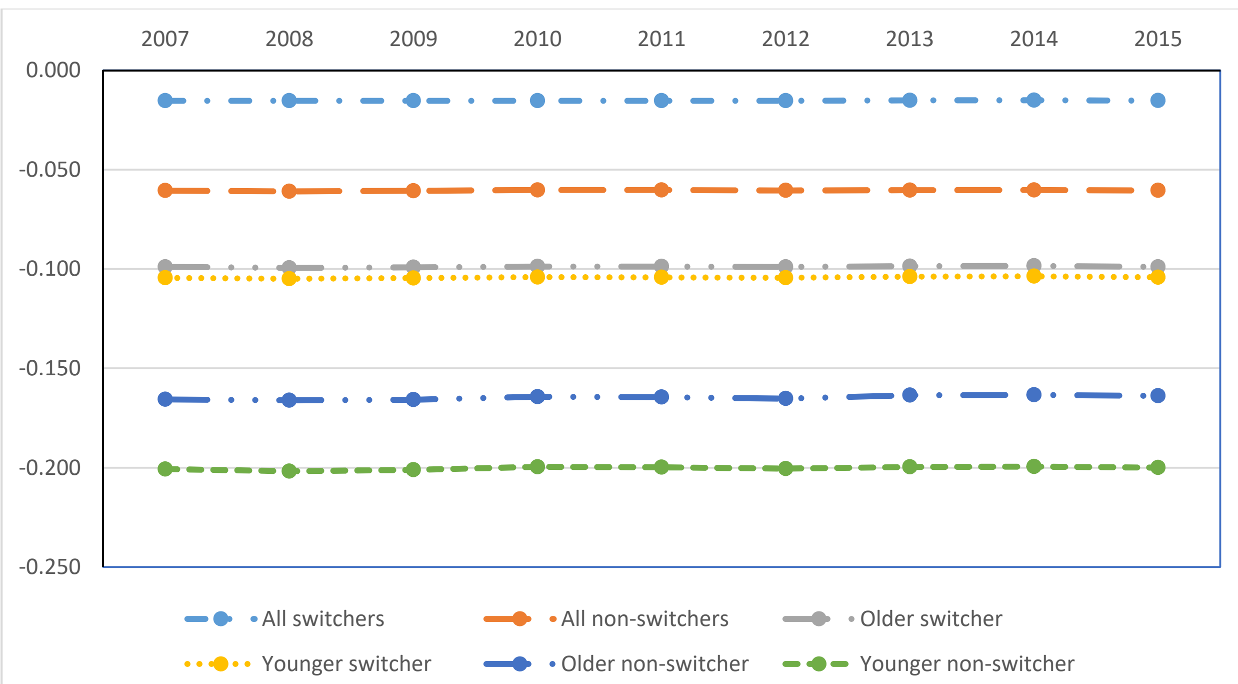


Figure A2.9: Estimated physician-specific time trend from HDFE model for non-incentivized services by younger (< 55 years old) and older (≥ 55 years old) physicians

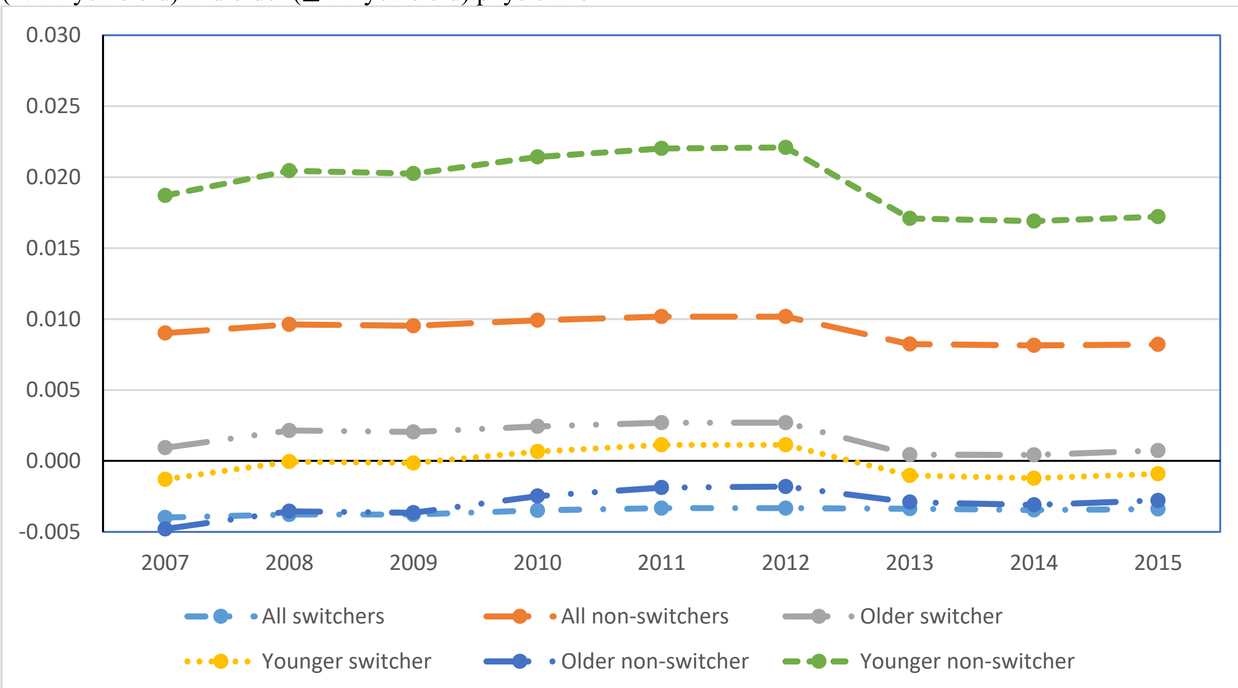


Figure A2.10: Estimated physician-specific time trend from HDFE model for services to non-enrolled patients by younger (< 55 years old) and older (≥ 55 years old) physicians