

# Unverifiable quality in healthcare sector: relational contracts and political stability

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*Barcelona, EEA 2023*

# Motivation: non-contractible quality in the healthcare sector (an agency problem)

- If quality is not verifiable, it is **not contractible**. Although parties **observe** quality, their observations **cannot be verified** by a legal court. Distinction observability/verifiability (Hart and Holmström 1987)
- If **contracts** are **incomplete** unverifiability makes the enforcing of the quality almost impossible by standard contractual clauses.
  - Decisions by the medical staff can be biased by **economic incentives**
  - ...resulting in **different treatment** patterns for the same health problem...
- Most of the incentive/payment schemes may not be appropriate solutions

# Unverifiable quality in healthcare sector

- A general issue in healthcare systems is how to **verify quality**
  - Donabedian (1988) considers different **measures of quality** capturing more dimensions (of care)
    - **Structure, process, and patient outcomes**
- **(No clear rule)** Eggleston (2005):
  - **Structure**
    - **physical structures:** hotel characteristics of the hospital services-hygienic services
    - **human resources:** technical abilities and skills of doctors, medical and nursing assistance in hospital.
  - **Process (procedural quality):**
    - **Unverifiable:** medical choice of the **appropriate treatment** (differences in treatment for the same clinical problem), **C-Sections** (De Luca et al 2021)
    - **Verifiable:** percutaneous transluminal coronary angioplasty (PTCA) in two days, after Acute Myocardial Infarction (AMI)
  - **Outcomes:** refer to both patients' satisfaction and their health status

# Non-contractability: any solution?

- **Main question:** is it possible for the purchaser to obtain (enforce) and buy quality (appropriate services) when dimensions of quality are not verifiable?
- In the literature, typically two solutions:
  - (almost) verifiable **indicators**
    - readmission rate, mortality, number of patients (**biased measures of quality**)
  - **Static** scheme with **altruistic** (non profit/public) providers (Hansmann 1988)
- **Our contribution:** We consider a **reputation mechanism (relational contracting)** in a quasi-market setting showing that:
  - A **discretionary P4P** (value-based purchasing) scheme can enforce unverifiable quality in a **repeated (dynamic) purchaser/provider interaction** under...
  - **Political stability: stable interaction** over time between **purchaser** (government) and **provider** (hospital)

- **P4P-altruistic** provider, **unverifiable** quality, **static** scenario:
  - Eggleston (2005): P4P may **increase verifiable** quality but may **decrease** the **non-verifiable** one, the overall **welfare effect** of a **P4P** is **ambiguous**.
  - Kaarboe and Siciliani (2011): show that the desirability of a P4P depends on ii) **complementary/substitutability** between verifiable and unverifiable quality and ii) provider's **altruism**.
- **P4P-observable** quality and **altruistic** provider:
  - Olivella and Siciliani (2017): altruism affects quality and **whether** quality is **observable matters** in terms of the provider's incentive
  - Siciliani (2009) studies how prices affect **quantity** when public providers **differ in altruism**. Makris and Siciliani (2013) study how the level of **altruism** affects **quantity** (wrt to the first best) under adverse selection.

- **Reputation** mechanism (informal agreement and code) between **principal** and **non-altruistic** agents typically based on past performance on unverifiable tasks  
⇒ requires repeated scenario
- Repeated interaction allows **relational contracts** (Levin AER 2003, QJE 2002, **informal agreements** for unverifiable tasks)
  - Relational contracts are widely applied in the economic literature (MacLeod, JEL 2007; Fucks, AER 2007): **Labour Economics** (Bull, QJE 1987; Levin, QJE 2002 & AER 2003; MacLeod & Malcomson, AER 1998; MacLeod, AER 2003, Li & Matouschek, 2013), **Interaction between/within firms** (Baker et al, QJE 2002; Rayo, AER 2007), **Regulation** (Cesi et al BE-JEAP 2012), **Procurement** (Taylor 1997; Board, AER 2011; Andrew and Bannon AER 2016; Albano et al JPubEc 2017, JEMS 2023); **Experimental Economics** (Bigoni et al., BE-JEAP 2014; Fehr & Schmidt, ECMA 2007), **Environmental Economics** (Cesi & D'Amato SEEDS WP 2021, R&R), **Economics of Institutions** (De Luca et al JPubEc 2021)

# The Theoretical Model

- Infinite-horizon repeated game
- 2 players:
  - Government (purchaser) and hospital (provider)
  - Common discount factor  $\delta \in [0, 1)$
- At all  $t$ , the purchaser awards the delivery of the service with quality  $q_1, q_2 \in [0, +\infty\}$  by proposing a P4P scheme requiring qualities  $q_1, q_2$ , prices  $p_1, p_2$  and a transfer  $T$ .
- Qualities are both **observable**, however  $q_1$  is **verifiable** and  $q_2$  is **unverifiable** (not contractible, not enforceable by a court of law)

# The Theoretical model: the provider

- Semi-altruistic Provider's profit is

$$\pi(q_1, q_2) = \alpha B(q_1, q_2) + T + p_1 q_1 + p_2 q_2 - \phi(q_1, q_2)$$

when awarded the contract for the service, otherwise 0.

- Provider's cost is  $\phi(q_i, q_j)$  with  $i = 1, 2$  ( $j \neq i$ ),  $\phi_{q_i}(q_i, q_j) > 0$ ,  $\phi_{q_i q_i}(q_i, q_j) > 0$  and:
  - $\frac{\partial \phi(q_i, q_j)}{\partial q_i \partial q_j} > 0$  substitutability, more  $q_j$  increases the marginal cost of  $q_i$
  - $\frac{\partial \phi(q_i, q_j)}{\partial q_i \partial q_j} < 0$  complementarity, more  $q_j$  reduces the marginal cost of  $q_i$



- Purchaser's utility is

$$U(q_1, q_2) = B(q_1, q_2) - T - p_1 q_1 - p_2 q_2$$

with  $B_{q_i}(q_i, q_j) > 0$  and  $B_{q_i q_i}(q_i, q_j) \leq 0$ .

- $B_{q_i q_j}(q_i, q_j) < 0$  substitutability, more  $q_j$  decreases the marginal benefit of  $q_i$
- $B_{q_i q_j}(q_i, q_j) > 0$  complementarity, more  $q_j$  increases the marginal benefit of  $q_i$

# The Stage-Game

- The dynamic game we consider is an infinite repetition of this sequential stage-game:
  - **Stage 1** (*the payment definition stage*) the purchaser sets prices  $p_1$  and  $p_2$  for each unit of quality and a fixed transfer  $T$ ;
  - **Stage 2** (*the execution stage*) once fixed the payment, the provider chooses quality and delivers the service. Quality is observed and all payoffs are collected.

# The first best: P4P complete contract

- **Verifiable qualities:** The first best  $(q_1^F, q_2^F, p_1^F, p_2^F)$ :

$$\max_{p_1, p_2, q_1, q_2} W = B(q_1(p_1), q_2(p_2)) - \phi(q_1(p_1), q_2(p_2))$$

## Definition

$$p_1 = B_{q_1}(\cdot); \quad p_2 = B_{q_2}(\cdot)$$

$$(1 + \alpha) B_{q_1}(\cdot) = \phi_{q_1}(\cdot)$$

$$(1 + \alpha) B_{q_2}(\cdot) = \phi_{q_2}(\cdot)$$

with  $T^F$  making the non-negativity profit constraint binding

- P4P contract in the first best corresponds to a standard complete contract.

## The the second best-static contract

Since  $q_2$  is not contractible the buyer is not able to introduce a price  $p_2$  in the contract, the only contractible price is  $p^S$  for  $q_1$ .

- Semi-altruistic Provider's profit is

$$\pi(q_1, q_2) = \alpha B(q_1, q_2) + T + p^S q_1 - \phi(q_1, q_2)$$

- Purchaser's utility is

$$U(q_1, q_2) = B(q_1, q_2) - T - p_1 q_1$$

## The the second best-static contract (ctd)

- The subgame equilibrium  $(q_1^S, q_2^S, p^S)$  of the static game:

$$\alpha B_{q_2} = \phi_{q_2}$$

$$p^S + \alpha B_{q_1} = \phi_{q_1}$$

$$p^S = B_{q_1} + \frac{\frac{dq_2}{dp}}{\frac{dq_1}{dp}} B_{q_2}$$

with  $T^S$  making the non-negativity profit constraint binding. It replicates the static equilibrium in Kaarboe and Siciliani (2011).

# The the second best distortions wrt the FB

- The optimal conditions **for qualities are not distorted** wrt the FB (marginal costs equal to marginal benefit)
- The optimal **condition** for price **is distorted** wrt the FB by:

$$\frac{\frac{dq_2}{dp} B_{q_2}}{\frac{dq_1}{dp}} \text{ with } \frac{\frac{dq_2}{dp}}{\frac{dq_1}{dp}} = \frac{-\alpha B_{q_1 q_2} - \phi_{q_1 q_2}}{-\alpha B_{q_2 q_2} + \phi_{q_2 q_2}}$$

$$\frac{dq_1}{dp} = \frac{\alpha B_{q_2 q_2} + \phi_{q_2 q_2}}{U_{q_1 q_1} U_{q_2 q_2} - U_{q_2 q_1}^2} > 0; \quad \frac{dq_2}{dp} = \frac{\alpha B_{q_1 q_2} - \phi_{q_1 q_2}}{U_{q_1 q_1} U_{q_2 q_2} - U_{q_2 q_1}^2} \geq 0$$

- An increase in  $p$  decreases (increases)  $q_2$  when qualities are **substitutes (complements)** in benefit and in provider's costs:  $B_{q_1 q_2} < 0$  and  $\phi_{q_1 q_2} > 0$ .
- **Overall effect**  $\alpha B_{q_1 q_2} - \phi_{q_1 q_2}$ : if qualities are **complements** in **benefit** but **substitutes** in **costs**, it depends on the relative **strength of the two effects**.
- Clearly, if  $\alpha = 0$  then  $q_2 = 0$

# Repeated game and trigger strategies

- Players' strategies over the infinite repetitions of the game (dynamic scenario)

**Purchaser** ( $s_{pu}$ ): at each time  $t$ , the purchaser sets  $T^*$ ,  $p_1^*$ ,  $p_2^*$  and qualities  $q_1^*$ ,  $q_2^*$  if in all previous periods up to  $t - 1$  the provider has chosen  $q_1^*$  and  $q_2^*$ ; otherwise sets  $T^P$ ,  $p^P$  as in the static Nash equilibrium for ever;

**Provider** ( $s_{pr}$ ): at each time  $t$ , sets  $q_1^*$  and  $q_2^*$  if up to the first stage of time  $t$  the purchaser has set  $T^*$  and  $p_1^*$ ,  $p_2^*$ ; otherwise set  $q_1^P$  and  $q_2^P$  as in the static Nash equilibrium for ever.

$T^P$ ,  $p^P$ ,  $q_1^P$  and  $q_2^P$  are those of the *NE* of the static game

# The P4P-Relational Contract

The two qualities are now "relationally" contractible, via the prices  $p_1^*$ ,  $p_2^*$ .

## Definition

The P4P-RC is defined by the sub-game (perfect) equilibrium values  $q_1^*$ ,  $q_2^*$ ,  $T^*$ ,  $p_1^*$ ,  $p_2^*$  solving the purchaser's maximization problem:

$$\max_{p_1, p_2, q_1, q_2, T} V = \frac{1}{1 - \delta} U(q_1, q_2)$$

$$(ICC) \quad \frac{1}{1 - \delta} \pi^C(q_1, q_2) \geq \pi^D(q_1, \hat{q}_2(\cdot)) + \frac{\delta}{1 - \delta} \pi^S(q_1^S, q_2^S, p^S)$$

where the ICC gives the following condition on the discount factor:

$$\delta \geq \bar{\delta} \equiv \frac{\pi^D(q_1, \hat{q}_2(\cdot)) - \pi^C(q_1, q_2)}{\pi^D(q_1, \hat{q}_2(\cdot)) - \pi^S(q_1^S, q_2^S, p^S)}$$



## Definition

Optimal quality defection  $\hat{q}_2 (p_1^*, p_2^*, q_1^*)$ :

$$\hat{q}_2 (p_1^*, p_2^*, q_1^*) = \arg \max_{q_2} \pi (q_1^*, q_2) \quad (1)$$

$$\alpha B (q_1^*, q_2)_{q_2} = \phi (q_1^*, q_2)_{q_2} \quad (2)$$

- Optimal deviation at the *execution stage* (by sequential actions)
- The defection quality DOES not affect the payment but it affects  $B(\cdot)$  at the second stage

$$\pi^C (q_1^*, q_2^*) = \alpha B (q_1^*, q_2^*) + T^* + p_1^* q_1^* + p_2^* q_2^* - \phi (q_1^*, q_2^*)$$

$$\pi^D (q_1^*, \hat{q}_2) = \alpha B (q_1^*, \hat{q}_2) + T + p_1^* q_1^* + p_2^* q_2^* - \phi (q_1^*, \hat{q}_2)$$

- $\hat{q}_2 < q_2^*$  if  $\alpha < \delta \frac{\frac{d\phi(q_1^*, \hat{q}_2)}{dq_2}}{\frac{d\phi(q_1^*, q_2^*)}{dq_2} - \frac{d\phi(q_1^*, \hat{q}_2)}{dq_2}}$ . Altruism matters.

# The equilibrium in trigger strategies

**Proposition 1** *If  $\delta \geq \bar{\delta}$ , strategies  $s_{pu}$  and  $s_{pr}$  define a self-enforcing P4P-RC entailing  $q_1^*, q_2^*, T^*$  and  $p_1^*$  and  $p_2^*$  such that:*

$$B_{q_1}(q_1^*, q_2^*) = \frac{1 - \delta}{\alpha + \delta} \left[ \alpha B_{q_1}(q_1^*, \hat{q}_2) - \phi_{q_1}(q_1^*, \hat{q}_2) \right] + \frac{1}{\alpha + \delta} \phi_{q_1}(q_1^*, q_2^*)$$

$$B_{q_2}(q_1^*, q_2^*) = \frac{1}{\alpha + \delta} \phi_{q_2}(q_1^*, q_2^*)$$

$$p_2^* = B_{q_2}(q_1^*, q_2^*)$$

$$p_1^* = B_{q_1}(q_1^*, q_2^*)$$

with  $T^*$  satisfying the binding ICC.

# The equilibrium in trigger strategy (ctd)

- The optimal conditions for **qualities** are **distorted** wrt to the first best
- The condition for the optimal **price** satisfies the **first best**
- The higher the weight given to the future interaction ( $\delta$ ):
  - The **higher** the **incentive** of the provider to stick to the required qualities
  - The **smaller** the **distortion** from the first best conditions

- The **willingness** of the purchaser to **substitute away verifiable and unverifiable** quality:

$$\frac{\frac{dB(q_1^*, q_2^*)}{dq_1}}{\frac{dB(q_1^*, q_2^*)}{dq_2}} = \frac{\frac{d\phi(q_1^*, q_2^*)}{dq_1} + (1 - \delta) \left[ \alpha \frac{dB(q_1^*, \hat{q}_2)}{dq_1} - \frac{d\phi(q_1^*, \hat{q}_2)}{dq_1} \right]}{\frac{d\phi(q_1^*, q_2^*)}{dq_2}}$$

- The **lower**  $\delta$ , the **higher** the weight  $(1 - \delta)$  given by the **purchaser** to the **provider's incentive to defect** on the **unverifiable** quality.
- With a less altruistic provider:
  - the **higher** the required **verifiable** quality the **higher** the net incentive from **defection**  $(\alpha \frac{dB(q_1^*, \hat{q}_2)}{dq_1} - \frac{d\phi(q_1^*, \hat{q}_2)}{dq_1})$ , weighted by the time factor
  - With respect to the first best, the purchaser is **less willing to give up unverifiable** quality for **more verifiable** quality *ceteris paribus*.

- A **low** discount factor (a less patient provider) induces an **upward** distortion in the condition for the **unverifiable** quality
- The result for the **verifiable** quality is **less clear-cut**. Consider the case for a **non-altruistic** purchaser ( $\alpha = 0$ ), we may have:
  - i) **downward** distortion with **substitutes** in costs
  - ii) **upward** distortion with **complementarity** in costs
- **Note**: although the optimal price satisfies the **first best** condition, this does not imply that the **optimal** price is set at the specific **first best** level. Thus we cannot implicitly consider the downward or upward distortions in the quality conditions as respectively cases of **under** or **over provision** of quality with respect to the first best

# The main policy conclusion: the discount factor

- When  $\delta \rightarrow 1$  both quality conditions for the first best are satisfied.
- The discount factor defines the interaction between purchaser and provider
  - frequency of interaction within the same period (number of contractual updates), contractual length
  - **Political stability** (i.e. no bankruptcy, no frequent change of the government, no entry)

# Testable implication 1: unverifiable quality

- The provider under-provides unverifiable quality:
  - In the static game without a P4P-RC
  - By deviating from the P4P-RC if  $\alpha$  is small
- The P4P-RC:
  - induces a positive unverifiable quality
  - that also converges to the FB if  $\delta$  increases
- Since  $\delta$  is a proxy for the **political stability**: in the empirical analysis we expect that:

**Hypothesis 1** *A longer political stability improves (restores the FB level of) the unverifiable quality*

## Testable implication 2: verifiable quality

- **Verifiable quality**: the model does not suggest a unique direction
  - the effect depends on several dimensions, such as the **degree of correlation** between verifiable and unverifiable qualities.
  - In our context the **correlation** is **generally positive** and significant, thus there is **complementary**
- For  $\alpha = 0$ , the purchaser is less willing to ask more verifiable quality in the P4P-RC to avoid cheating on the unverifiable quality
  - A higher discount factor reduces the distortion
- For  $\alpha > 0$ , this effect may be mitigated and even reversed.

*Hypothesis 2 The effect of a longer political stability on the level of verifiable quality is unclear.*



# From theory to data: empirical analysis.

- **Regional governors** and **hospitals** are the two players of the relational contract. We aim at testing the impact of the **discount factor**
- Two measurement issues: i) the discount factor is **not** directly **observable**, ii) precise and well established **definitions** of verifiable and unverifiable **quality** of healthcare **do not exist**
- Our proxy of the discount factor is the **tenure of the regional governor** (suitable for contracting with elected bodies).
- If governors remain in force for longer periods, future interactions will be more **likely** and more **valued** by the parties.
  - As an alternative, we run the empirical analysis replacing the explanatory variable with the tenure of the regional ministry of health (MoH)

- We merge health and political data about Italian regions from 1996 to 2020.
- Data on quality and controls (health outcomes, supply and patients' satisfaction) come from Health for All database
- Data on the degree of compliance with clinical guidelines comes from the National Outcomes Program (Ministry of Health, 2008-2015).
- A new database for political variables has been generated from the Ministry of Interior database.
- Data on DRG tariffs come from the reports published by the Italian federation of companies producing medical devices (Assobiomedica)
- One (the main) **independent** variable is **tenure**: years in force of the regional governor or MoH
  - This variable equals 0 in the year of the election, 1 in the next year and so on, to track the cases when the same person is in charge of more than one mandate.

- We select **five** proxies of **quality** as **explanatory variables**
  - **structure**: self-reported *satisfaction* of users with 1) hygienic services, 2) medical, and 3) nursing assistance in hospital
  - **process and appropriateness**:
    - share of patients with Acute Myocardial Infarction (AMI) receiving percutaneous transluminal coronary angioplasty (PTCA) in two days: whether or not health care practitioners comply with guidelines (proxy for **appropriateness**).
    - **C-sections** rates on the overall number of deliveries: In Italy, heterogeneous across regions (proxy for **inappropriateness**, Francese et al. 2014, Parazzini et al. 1992)

# A first picture of tenure: Governor and MoH

- **Heterogeneity within and across regions** is much more pronounced for the tenure of the **governor**.
  - The two variables are **very correlated** (exceptions Lombardia and Veneto)

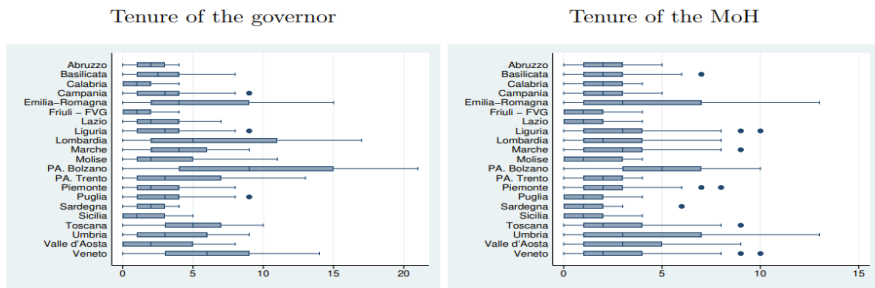


Figure 1: Circles indicate outside value, the upper adjacent line the maximum value, the upper hinge the 75th percentile, the line in the box the median, the lower hinge the 25th percentile, the lower adjacent value the minimum value.

# Empirical strategy 1/3

- OLS approach
- Robust standard errors

$$q_{i,t} = c + \beta_1 tenure_{i,t} + \gamma X_{i,t} + \alpha_1 \sum r_i + \alpha_t \sum y_t + \epsilon_{i,t} \quad (3)$$

- $q_{i,t}$ , quality in region  $i$  at time  $t$ .
- Main independent variable:  $tenure_{i,t}$  (of the governor or MoH)
- We run a separate regression for each of the five proxies of quality
  - C-section rate
  - share of people satisfied with hygienic services
  - share of people satisfied with medical assistance
  - share of people satisfied with nursing assistance
  - share of patients with AMI receiving PTCA in 2 days

- $X_{i,t}$ , set of control variables
- For the determinants of C-section rates controls are:
  - women's and newborns' health state
  - socioeconomic status
  - characteristics of the health care system
  - personal features of the incumbent
- When considering the other proxies for quality control variables capturing the women's and newborns' health state are excluded
- $r, y$  (region and year fixed effects)

## Empirical strategy 3/3: testing the altruism (private vs public hospitals)

- We test effect whether the **effect** of the **discount factor** on the **unverifiable** quality is **higher** in the presence of **non-altruistic** providers.
- We include the **interaction** between our main explanatory variable (**tenure**) and the **private accredited hospital (acute)** beds (ordinary+day hospital) over total acute beds (ordinary + dh)

$$q_{i,t} = c + \beta_1 tenure_{i,t} + \beta_2 tenure_{i,t} pr\_bed_{i,t} + \gamma X_{i,t} + \alpha_i \sum r_i + \alpha_t \sum y_t + \epsilon_{i,t}$$

# Results: Governor's tenure

| VARIABLES        | (1)<br>C-section 3       | (2)<br>hygienic 2      | (3)<br>sat. medical 2  | (4)<br>sat. nursing 2  | (5)<br>ptca 3           |
|------------------|--------------------------|------------------------|------------------------|------------------------|-------------------------|
| tenure           | -0.1025***<br>(0.033498) | 0.0488<br>(0.128152)   | 0.2040*<br>(0.110552)  | 0.0642<br>(0.112329)   | -0.0673<br>(0.100881)   |
| foreigners       | -0.7940***<br>(0.201930) | 1.6285**<br>(0.703460) | 0.7528<br>(0.685895)   | 1.3594**<br>(0.664478) | 1.2612<br>(1.548051)    |
| disoccf          | -0.0654<br>(0.066001)    | -0.1254<br>(0.179961)  | -0.0296<br>(0.187562)  | -0.0882<br>(0.178863)  | -0.2210<br>(0.348736)   |
| gdp              | 0.0000*<br>(0.000008)    | -0.0000<br>(0.000028)  | -0.0000<br>(0.000027)  | -0.0000<br>(0.000027)  | 0.0001<br>(0.000057)    |
| occupmf          | 0.1628<br>(0.169404)     | 0.5612<br>(0.568168)   | 0.5454<br>(0.556964)   | 0.1538<br>(0.551703)   | -0.7667<br>(1.077905)   |
| tariffario       | -1.3151*<br>(0.727436)   | 1.5629<br>(2.756544)   | -1.9584<br>(2.458886)  | 0.8130<br>(2.739599)   |                         |
| fascetar         | 1.3722***<br>(0.498228)  | -1.6742<br>(1.719031)  | -2.2814<br>(1.580667)  | -2.5721*<br>(1.536888) | -2.2988<br>(2.234610)   |
| rps              | 1.2766**<br>(0.552927)   | -1.4472<br>(1.954675)  | -0.9028<br>(1.821431)  | 0.1899<br>(1.850461)   | 4.8405*<br>(2.585479)   |
| pcpubspend       | 0.0038*<br>(0.001997)    | 0.0065<br>(0.007637)   | 0.0040<br>(0.007012)   | 0.0108<br>(0.006624)   | 0.0228<br>(0.013844)    |
| private          | -0.0242<br>(0.043354)    | 0.0959<br>(0.113702)   | 0.1686<br>(0.107096)   | 0.2143**<br>(0.106636) | 0.3357**<br>(0.157406)  |
| samecoalitiongov | 0.4041<br>(0.277890)     | -0.8599<br>(0.874801)  | -0.3220<br>(0.851233)  | -0.9786<br>(0.849081)  | -1.8290*<br>(0.937162)  |
| govmeddoc        | 2.4066**<br>(1.050848)   | 0.5590<br>(2.436259)   | -2.4303<br>(2.240373)  | -0.3463<br>(2.257120)  | -7.3159**<br>(3.653369) |
| govcentleft      | 0.5510<br>(0.353784)     | 0.1375<br>(1.091464)   | -1.5519<br>(1.140404)  | 0.2768<br>(1.140689)   | 1.8399<br>(1.326602)    |
| magedelivery     | -1.1181<br>(0.817333)    |                        |                        |                        |                         |
| spabortionrate   | 0.0224**<br>(0.009257)   |                        |                        |                        |                         |
| neonmort6d       | 0.0630<br>(0.043442)     |                        |                        |                        |                         |
| mvolumi          |                          |                        |                        |                        | 0.0415***<br>(0.011814) |
| Constant         | 42.4449<br>(28.022063)   | -2.9680<br>(25.496876) | 13.0533<br>(25.239993) | 20.8847<br>(24.870368) | -9.4739<br>(60.066228)  |
| Observations     | 404                      | 373                    | 373                    | 373                    | 166                     |
| R-squared        | 0.96                     | 0.79                   | 0.78                   | 0.81                   | 0.87                    |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



# Results: MoHs tenure

| VARIABLES           | C-section                | hygienic               | sat. medical          | sat. nursing           | ptca                    |
|---------------------|--------------------------|------------------------|-----------------------|------------------------|-------------------------|
| tenuremoh           | -0.1508***<br>(0.047901) | -0.1908<br>(0.198944)  | -0.2527<br>(0.182243) | -0.2689<br>(0.174384)  | 0.1988<br>(0.163384)    |
| foreigners          | -1.0111***<br>(0.208475) | 1.6054**<br>(0.686900) | 0.5150<br>(0.685970)  | 1.0739*<br>(0.646721)  | 1.4916<br>(1.602835)    |
| disoccf             | -0.0342<br>(0.065997)    | -0.1570<br>(0.175442)  | 0.0386<br>(0.184444)  | -0.0171<br>(0.170220)  | -0.3874<br>(0.363707)   |
| gdp                 | 0.0000<br>(0.000009)     | -0.0000<br>(0.000028)  | -0.0000<br>(0.000027) | -0.0000<br>(0.000027)  | 0.0000<br>(0.000049)    |
| occupmf             | 0.2057<br>(0.166179)     | 0.6521<br>(0.536879)   | 0.7708<br>(0.547902)  | 0.2710<br>(0.505250)   | -1.7948**<br>(0.813751) |
| tariffario          | -1.4789**<br>(0.717454)  | 1.4444<br>(2.805389)   | -1.0954<br>(2.555459) | 1.4155<br>(2.738187)   |                         |
| fascetar            | 1.6799***<br>(0.442395)  | -0.5547<br>(1.614733)  | -0.5429<br>(1.595585) | -1.2842<br>(1.452913)  | 0.3460<br>(1.812031)    |
| rps                 | 1.0060*<br>(0.538718)    | -1.2274<br>(1.866704)  | -0.6475<br>(1.746089) | 0.1537<br>(1.733463)   | 3.0081<br>(2.218537)    |
| pcpubspend          | 0.0035<br>(0.002120)     | 0.0039<br>(0.007658)   | -0.0003<br>(0.006791) | 0.0076<br>(0.006435)   | 0.0124<br>(0.012860)    |
| sharepprivacutewith | -0.0591<br>(0.042768)    | 0.0524<br>(0.117292)   | 0.1334<br>(0.108328)  | 0.2116*<br>(0.107922)  | 0.3571**<br>(0.144148)  |
| samecoalitionmoh    | 0.6180**<br>(0.258427)   | -1.0543<br>(0.865870)  | -0.9076<br>(0.815027) | -1.1137<br>(0.791933)  | -1.1904<br>(0.975872)   |
| mohmeddoc           | 0.7484**<br>(0.321241)   | 1.1168<br>(1.025488)   | 1.4870<br>(0.993169)  | -0.3144<br>(0.997930)  | -2.5976<br>(2.003321)   |
| mohcentleft         | 1.1500***<br>(0.385055)  | 2.2383*<br>(1.269857)  | 1.6936<br>(1.203768)  | 1.7675<br>(1.164589)   | 1.9479*<br>(1.055080)   |
| magedelivery        | -1.8911**<br>(0.752225)  |                        |                       |                        |                         |
| spabortionrate      | 0.0140<br>(0.008860)     |                        |                       |                        |                         |
| neonmort6d          | 0.0423<br>(0.041170)     |                        |                       |                        |                         |
| mvolumi             |                          |                        |                       |                        | 0.0478***<br>(0.010204) |
| Constant            | 66.2831**<br>(26.338620) | -4.0668<br>(23.884139) | 6.1124<br>(24.835953) | 18.2236<br>(22.759102) | 57.1561<br>(53.879732)  |
| Observations        | 424                      | 392                    | 392                   | 392                    | 177                     |
| R-squared           | 0.96                     | 0.80                   | 0.79                  | 0.83                   | 0.87                    |

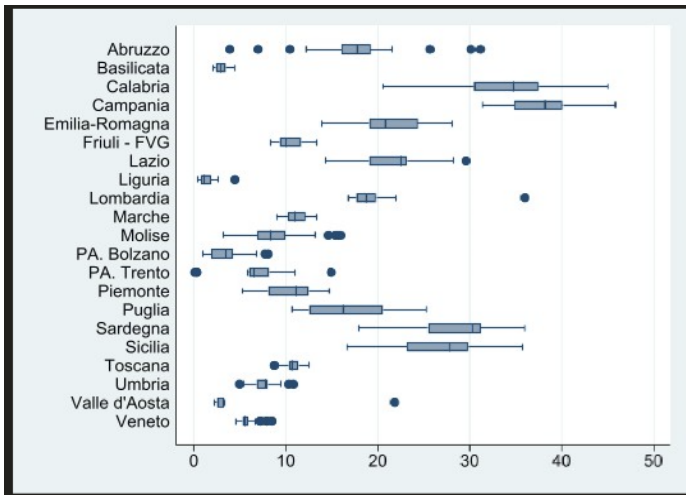
Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# Main result: the role of C-sections

- Results mostly confirm hypotheses coming from the model
- The effect is **stronger** and **coherent** between the two adopted specifications when using the C-section rates as explanatory variable
  - **Political stability** decreases the provision of inappropriate services (P4P-RC works).
  - **C-sections** is one of the most prominent examples of unverifiability in the provision of care (Hypothesis 1).
    - The choice for C-section is driven by: the mother's conditions, the doctor's autonomy allows the physician to argue that the C-section is appropriate even when is not
    - The purchaser has no chance to verify the truthfulness of the medical decision (Chandra et al. (2011) and Johnson & Rehavi (2016))

# The role of private hospitals



# Results: on the role of private hospitals (Gov)

| VARIABLES        | (1)<br>C-section 3       | (2)<br>hygienic 2      | (3)<br>sat. medical 2  | (4)<br>sat. nursing 2  | (5)<br>ptca 3           |
|------------------|--------------------------|------------------------|------------------------|------------------------|-------------------------|
| tenure           | -0.1259*<br>(0.067562)   | -0.1333<br>(0.206420)  | 0.0982<br>(0.174332)   | -0.0939<br>(0.184874)  | 0.0474<br>(0.145953)    |
| tenure_private   | 0.0019<br>(0.004299)     | 0.0149<br>(0.011479)   | 0.0087<br>(0.012380)   | 0.0130<br>(0.012571)   | -0.0097<br>(0.010173)   |
| private          | -0.0251<br>(0.043314)    | 0.0858<br>(0.114024)   | 0.1627<br>(0.108174)   | 0.2056*<br>(0.107269)  | 0.3387**<br>(0.158622)  |
| foreigners       | -0.7963***<br>(0.202146) | 1.5886**<br>(0.700926) | 0.7296<br>(0.685410)   | 1.3248**<br>(0.664201) | 1.4246<br>(1.610662)    |
| disoccf          | -0.0610<br>(0.067440)    | -0.0896<br>(0.181602)  | -0.0088<br>(0.187306)  | -0.0571<br>(0.177913)  | -0.2338<br>(0.357208)   |
| gdp              | 0.0000*<br>(0.000008)    | -0.0000<br>(0.000028)  | -0.0000<br>(0.000027)  | -0.0000<br>(0.000027)  | 0.0000<br>(0.000058)    |
| occupmf          | 0.1658<br>(0.169431)     | 0.5924<br>(0.564833)   | 0.5635<br>(0.553013)   | 0.1809<br>(0.543735)   | -0.8568<br>(1.113978)   |
| tariffario       | -1.2980*<br>(0.724879)   | 1.5938<br>(2.787420)   | -1.9405<br>(2.471880)  | 0.8399<br>(2.743925)   |                         |
| fascetar         | 1.3593***<br>(0.502058)  | -1.7316<br>(1.720453)  | -2.3148<br>(1.585559)  | -2.6220*<br>(1.543059) | -2.5950<br>(2.265836)   |
| rps              | 1.3122**<br>(0.573972)   | -1.1977<br>(1.971246)  | -0.7578<br>(1.826888)  | 0.4066<br>(1.853096)   | 4.2240<br>(2.716097)    |
| pcpubspend       | 0.0039*<br>(0.002008)    | 0.0074<br>(0.007750)   | 0.0046<br>(0.007169)   | 0.0116*<br>(0.006802)  | 0.0218<br>(0.013700)    |
| samecoalitiongov | 0.4112<br>(0.279271)     | -0.7933<br>(0.870487)  | -0.2832<br>(0.852457)  | -0.9207<br>(0.845985)  | -2.0061**<br>(0.965978) |
| govmeddoc        | 2.3948**<br>(1.049244)   | 0.4937<br>(2.463263)   | -2.4683<br>(2.253785)  | -0.4030<br>(2.269660)  | -7.1759*<br>(3.787297)  |
| govcentleft      | 0.5387<br>(0.352523)     | 0.0248<br>(1.091361)   | -1.6173<br>(1.150010)  | 0.1790<br>(1.146818)   | 1.8241<br>(1.317789)    |
| magedelivery     | -1.1156<br>(0.818628)    |                        |                        |                        |                         |
| spabortionrate   | 0.0220**<br>(0.009211)   |                        |                        |                        |                         |
| neonmort6d       | 0.0622<br>(0.043642)     |                        |                        |                        |                         |
| mvolumi          |                          |                        |                        |                        | 0.0415***<br>(0.011785) |
| Constant         | 42.1798<br>(28.039007)   | -5.6264<br>(25.529501) | 11.5095<br>(25.097330) | 18.5760<br>(24.437396) | -2.6621<br>(61.539884)  |
| Observations     | 404                      | 373                    | 373                    | 373                    | 166                     |
| R-squared        | 0.96                     | 0.79                   | 0.78                   | 0.81                   | 0.87                    |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# Results: on the role of private hospitals (MoH)

| VARIABLES         | (1)<br>C-section 3       | (2)<br>hygienic 2      | (3)<br>sat. medical 2 | (4)<br>sat. nursing 2  | (5)<br>ptca 3           |
|-------------------|--------------------------|------------------------|-----------------------|------------------------|-------------------------|
| tenuremoh         | -0.1421*<br>(0.083599)   | -0.3666<br>(0.296655)  | -0.1714<br>(0.276114) | -0.1503<br>(0.259316)  | 0.3599*<br>(0.217025)   |
| tenuremoh_private | -0.0008<br>(0.006484)    | 0.0162<br>(0.017380)   | -0.0075<br>(0.017806) | -0.0110<br>(0.016801)  | -0.0142<br>(0.012671)   |
| private           | -0.0579<br>(0.043145)    | 0.0278<br>(0.122018)   | 0.1448<br>(0.112293)  | 0.2281**<br>(0.112089) | 0.3766**<br>(0.148284)  |
| foreigners        | -1.0139***<br>(0.209141) | 1.6601**<br>(0.690517) | 0.4897<br>(0.693510)  | 1.0370<br>(0.650776)   | 1.5566<br>(1.609510)    |
| disoccf           | -0.0340<br>(0.066267)    | -0.1590<br>(0.174818)  | 0.0396<br>(0.185462)  | -0.0158<br>(0.171283)  | -0.3986<br>(0.366181)   |
| gdp               | 0.0000<br>(0.000009)     | -0.0000<br>(0.000028)  | -0.0000<br>(0.000027) | -0.0000<br>(0.000027)  | 0.0000<br>(0.000048)    |
| occupmf           | 0.2054<br>(0.166271)     | 0.6800<br>(0.536094)   | 0.7579<br>(0.547363)  | 0.2522<br>(0.505505)   | -1.8324**<br>(0.816582) |
| tariffario        | -1.4832**<br>(0.713162)  | 1.5877<br>(2.822428)   | -1.1616<br>(2.568613) | 1.3187<br>(2.736514)   |                         |
| fascetar          | 1.6852***<br>(0.444952)  | -0.5935<br>(1.620062)  | -0.5250<br>(1.598606) | -1.2580<br>(1.455153)  | 0.2047<br>(1.839134)    |
| rps               | 1.0062*<br>(0.539355)    | -1.1945<br>(1.870425)  | -0.6628<br>(1.749430) | 0.1315<br>(1.739175)   | 2.8055<br>(2.201681)    |
| pcpubspend        | 0.0034<br>(0.002138)     | 0.0045<br>(0.007821)   | -0.0005<br>(0.006888) | 0.0073<br>(0.006505)   | 0.0118<br>(0.012928)    |
| samecoalitionmoh  | 0.6168**<br>(0.259099)   | -1.0167<br>(0.867684)  | -0.9249<br>(0.819964) | -1.1390<br>(0.791748)  | -1.3148<br>(1.013735)   |
| mohmeddoc         | 0.7445**<br>(0.320298)   | 1.1959<br>(1.025634)   | 1.4505<br>(0.992752)  | -0.3678<br>(0.986602)  | -2.6210<br>(1.996548)   |
| mohcentleft       | 1.1458***<br>(0.380056)  | 2.3217*<br>(1.270183)  | 1.6550<br>(1.194990)  | 1.7112<br>(1.158695)   | 1.9577*<br>(1.043961)   |
| magedelivery      | -1.8868**<br>(0.759337)  |                        |                       |                        |                         |
| spabortionrate    | 0.0141<br>(0.008829)     |                        |                       |                        |                         |
| neonmort6d        | 0.0425<br>(0.041403)     |                        |                       |                        |                         |
| mvolumi           |                          |                        |                       |                        | 0.0484***<br>(0.010226) |
| Constant          | 66.1600**<br>(26.550823) | -6.0455<br>(23.957039) | 7.0270<br>(24.847556) | 19.5584<br>(22.832292) | 59.9590<br>(53.922552)  |
| Observations      | 424                      | 392                    | 392                   | 392                    | 177                     |
| R-squared         | 0.96                     | 0.80                   | 0.79                  | 0.83                   | 0.87                    |

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

- The **coefficient** of **GoV's-MoH's** tenure variable is in general **negative** and **significant**
- These results is confirmed regardless of the degree of **involvement of private providers** in the provision of service.
- The relational contract works for any degree of altruism (even when the presence of the **private sector** in healthcare is relevant).

- A **Pay for Performance-Relational Contract (P4P-RC)** allows the purchaser to enforce **desired quality (verifiable and unverifiable) with and without altruism**
- The **P4P-RC** entails
  - **price** of (verifiable and unverifiable) quality satisfies the first best conditions.
  - The (**downward and upward**) distortions for the **unverifiable and verifiable** quality depend on the **political stability**
- When regional **governments** are **stable**
  - **C-sections** rates are lower (**unverifiable** quality improves)
  - The **verifiable** quality may improve.
- According to the theoretical predictions, **empirical analysis** allows a more precise definition of (un)verifiable quality dimensions

# Further extensions

- Imperfectly observable quality
- Stick and carrot strategy
- Hospitals competition



THANK YOU!!

# A summary of our results: empirical analysis

- We look at C-section rates (unverifiable quality) at a regional level in Italy, from 1980 to 2015.
- WHO estimates the "optimal" share of C-sections around 10%-15% (Bètran et al. 2016). In Italy the share is around 36% (Kambale et al., 2011).
- We find that C-sections rates are lower when regional governments are more stable:
  - a more frequent interaction and a more durable relation between hospitals and regional governments reduces the distortion from the delivery of C-sections.
- The verifiable quality (i.e. hygienic conditions) is positively related with the length of the governor's tenure.

# Empirical Analysis: institutional background

- The Italian healthcare system is a National Health Service regionally based and funded by general taxation.
- The core basic package of services to be evenly provided across the national territory are defined by the central government but regions are autonomous in defining the organization of care; they contract volumes with public autonomous and private hospitals.
- Autonomous public and private accredited hospitals providing services on behalf of the National Health Service are reimbursed by the region that can modify national tariffs.

- The effect of **Altruism** on the **contractual efficiency** is still an open issue (Bassi et al 2014).
- **Altruism** in the Health system
  - **Altruistic** providers: Choné and Ma (2007), Ma (2007) and Jack (2005).
  - **Partially altruistic** providers: (model with asymmetric information) Ellis and McGuire, 1986; Eggleston, 2005; Chalkley and Malcomson, 1998a.
  - **Surplus/profit maximisers** providers: Ma, 1994; Chalkley and Malcomson, 1998b; Ellis, 1998; De Fraja, 2000; Beitia, 2003; Chalkley and Malcomson, 2002.

- In Italy, the provision of C-sections is very heterogeneous across regions, suggesting that provision might be inappropriate in certain regional contexts.
- Kambale (2005) found a rate of C-sections of 36.2%. *Age* and *residence* were the sole social factors significantly affecting C-sections (Kambale et al., 2011).
- In 2015, Friuli Venezia Giulia was the region with the lowest rate (22.93%) while Campania had the highest incidence (HFA Database, 2016).

- $X_{i,t}$ :
  - **Women's health:** mean age at childbirth, fertility rate, obese women, overweight women, smokers
  - **Socioeconomic status:** the number of residence permits, the number of foreigners residing in Italy, the employment rate, the female unemployment rate and the percentage of women with at least middle school degree.
  - **Tariffs in each region:** whether or not the region has its own set of tariffs, whether an update of tariffs occurred in the year and whether the region differentiates tariffs according to the type of hospital.
  - **Ownership:** rate between public and private health care personnel