# Designing Incentives for Multitasking Agents: Evidence from Payments to Physicians in England

Filippo Paternollo (Columbia)
Pietro Tebaldi (Columbia)
Andre Veiga (Imperial)

CEPR-TSE Health Economics Conference, June 2025

# Incentive Design in Principal-Agent Problems

- Many incentive design problems involve multi-tasking, i.e., tasks are complements / substitutes
  - doctor scans for illness A $\rightarrow$ easier to also scan for B
  - teacher spends more time on subject A $\rightarrow$ harder to increase student scores in B
- Well developed theory since Holmstrom and Milgrom [1991]
- Empirics have lagged behind:
  - counterfactuals require interaction between pairs of outcomes $\rightarrow$ # of parameters grows rapidly with number of tasks
  - We prove identification but it requires
    - aggregate variation in incentives
    - cross-sectional variation across agents in exposure to tasks
  - $\rightarrow$ most applied work focuses on testing

# This Paper

- Empirically tractable model of multitasking
- Proof of sufficient conditions for identification
- Application to Quality of Outcomes Framework (QOF) in England
  - world's largest pay-for-performance scheme in primary care
- Strong evidence of
  - physicians responding to financial incentives
  - interactions between indicators (multitasking)
- Counterfactuals:
  - removal of QOF: payer's utility $\downarrow$ by 5%
  - optimal re-design: payer's utility $\uparrow$ by 3%

# Roadmap

# GP clinics (GPCs)

- Approximately 8000 GPCs in England
- Provide prescriptions, minor interventions, referral to secondary care
- Zero prices to patients
- Revenue:
  - $\approx$ 75% capitation (# of individuals registered, very mild risk adjustment)
  - $\approx$ 25% financial incentives, mainly from QOF

# Quality of Outcomes Framework (QOF)

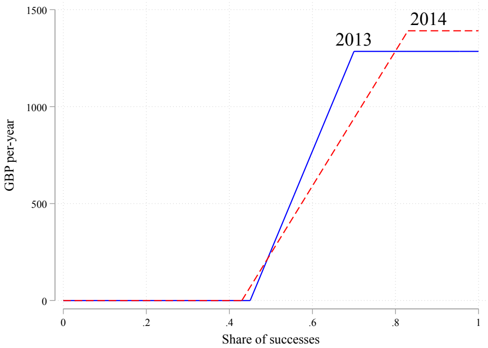
- Started 2004; several changes over time
- Gives GPCs yearly financial incentives to perform tasks ("indicators"), e.g.:
  - DM11: % of diabetes patients in whom the last glycohaemoglobin IFCC-HbA1c $\leq$ 64 mmol/mol
  - PAD4: % of patients with peripheral arterial disease taking aspirin or an alternative anti-platelet
- Voluntary participation (95.1% in 2019)
- Total payments $\approx$ £1B / year
- Electronic record-keeping $\rightarrow$ minimal errors / cheating
- We focus on 40 "truly clinical" indicators

# Data

- NHS public data covering 2009-2019
- GPC $i$, indicator $j$, year $t$
- Achievement $y_{ijt}$
- GPC covariates $x_{it}$ (number of doctors in the clinic, average age, share of fully qualified physicians)
- Nr of relevant patients $n_{ijt}$ (diabetics, asthmatics, etc)
- Incentives for each indicator over time

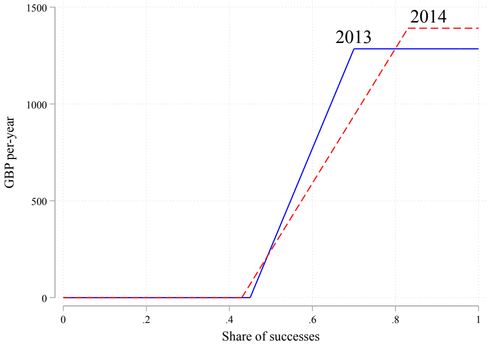
# Piecewise linear incentives

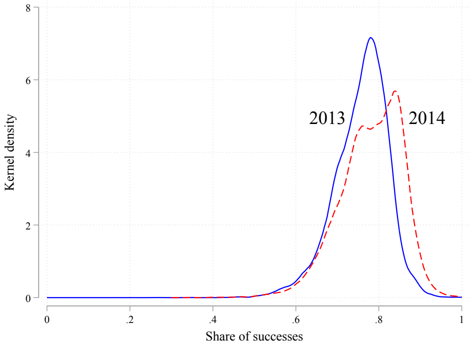
- Success rate $y_{ijt} \in [0,1]$
- Revenue per patient has slope $\alpha_{jt}$ for $y_{ijt} \in \left[\underline{y_{jt}}, \overline{y_{jt}}\right]$
- DM11, Practice with 300 patients:



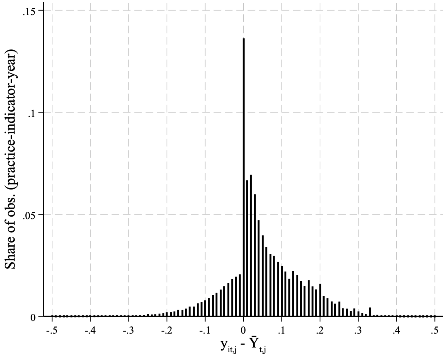
# Piecewise linear incentives

- Success rate $y_{ijt} \in [0,1]$
- Revenue per patient has slope $\alpha_{jt}$ for $y_{ijt} \in \left[\underline{y_{jt}}, \overline{y_{jt}}\right]$
- DM11, Practice with 300 patients:



# Bunching suggests strong response to financial incentives




For all indicators, distribution of $y_{ijt} - \overline{y_{jt}}$

- Achievement above $\overline{y_{jt}}$ suggests non-financial motivation and/or complementarities between tasks
  - there is significant heterogeneity in bunching across indicators

# Summary of Reduced Form Evidence (details in the paper)

- Practices respond to
  - incentives
  - incentives $\times$ exposure (n. of patients)
- Cross-indicator interactions: $\uparrow\uparrow$ incentives for j $\Rightarrow$ $\Delta$ outcomes of k, ceteris paribus

Details

# Roadmap

# Simplified model: 1 task

- 1 GPC
- 1 Task
- $n$ identical patients
- GPC chooses achievement $y \in [0,1]$
  - assume $n$ large $\rightarrow$ negligible noise in $y$
  - abstract from sequential nature of tasks
- GPC utility:

$$U(y) = n\rho(y) + n\theta y - n\lambda y^2$$

- Financial Return (observed)

# Simplified model: 1 task

- 1 GPC
- 1 Task
- $n$ identical patients
- GPC chooses achievement $y \in [0,1]$
  - assume $n$ large $\to$ negligible noise in $y$
  - abstract from sequential nature of tasks
- GPC utility:

$$U(y) = n\rho(y) + n\theta y - n\lambda y^2$$

- Financial Return (observed)
- Non-financial return
  - expect $\theta > 0$ to explain $y > \bar{y}$

# Simplified model: 1 task

- 1 GPC
- 1 Task
- $n$ identical patients
- GPC chooses achievement $y \in [0,1]$
  - assume $n$ large $\rightarrow$ negligible noise in $y$
  - abstract from sequential nature of tasks
- GPC utility:

$$U(y) = n\rho(y) + n\theta y - n\lambda y^2$$

- Financial Return (observed)
- Non-financial return
  - expect $\theta > 0$ to explain $y > \bar{y}$
- Direct Costs

# Simplified model: 2 tasks

- Achievement $y = (y_1, y_2)$
- Number of patients $n_1, n_2$
- GPC utility:

$$
\begin{aligned}
U(y) = & n_1 \rho_1(y_1) + n_2 \rho_2(y_2) \\
& + n_1 \theta_1 y_1 + n_2 \theta_2 y_2 \\
& - n_1 \lambda_1 y_1^2 - n_2 \lambda_2 y_2^2 \\
& - 2(n_1 + n_2) \lambda_{12} y_1 y_2
\end{aligned}
$$

- Financial Return, Non-financial return, Direct Costs
- Complementarities
  - $\lambda_{12} > 0$: tasks are "substitutes"
  - $\lambda_{12} < 0$: tasks are "complements"

# Many tasks ($J > 2$)

- Achievement $y = (y_1, \ldots y_j, \ldots, y_J)$
- GPC utility

$$U(y) = \sum_j n_j \left(\rho_j(y_j) + \theta_j y_j\right) - y \Lambda y^T$$

where

$$\Lambda = \begin{bmatrix} n_1\lambda_1 & n_2\lambda_{12} & \cdots & n_J\lambda_{1J} \\ n_1\lambda_{12} & n_2\lambda_2 & & \\ \vdots & & \ddots & \\ n_1\lambda_{1J} & n_2\lambda_{2J} & & n_J\lambda_J \end{bmatrix}$$

- Implies constant returns to scale
- Assume GPCs
  - have the same cost matrix $\Lambda$
  - Differ in non-financial returns $\theta$

# Roadmap

# Variation

- Exogenous variation in aggregate incentives (changes in $\underline{y}, \overline{y}, \alpha$ over time)
- Variation patient composition:
  - Clinic A: 90 diabetics, 10 asthmatics
  - Clinic B: 10 diabetics, 90 asthmatics
  - Suppose payments rewarding diabetics health $\uparrow\uparrow$
    - this incentive is most important for A
  - Compare asthmatic patients in A vs. B
  - If asthmatics health improves more in A, diabetes and asthma care are complements

# Endogenous patient composition

- Patient composition might be endogenous
  - Patients might choose GPCs particularly motivated to treat their illness
- We will estimate unobserved GPC quality in each illness using a demand model
  - disease prevalence in the region is an IV for patient composition at each GPC
- Let $z_{i\ell}$ be distance from location $\ell$ to GPC $i$
- In a location $\ell$, a patient of illness $j$ has utility for GPC $i$ in year $t$ of:

$$u_{i\ell jt} = -\eta_j \log(z_{i\ell}) + \mu_j x_{it} + \xi_{ijt} + \varepsilon_{ij\ell t}$$

- Logit market shares are $P_{ij\ell t}$
- If $N_{t\ell j}$ is prevalence of illness $j$ in location $\ell$, observed number of patients is

$$n_{ijt} = \sum_{\ell} N_{t\ell j} P_{ij\ell t}$$

- We recover unobserved quality $\xi_{ijt}$
  - which is indeed correlated with $y_{ijt}$ (i.e., composition is endogenous) Details

# Endogenous patient composition

- Then, we allow $\theta_{ijt}$ to depend on
  - observed GPC characteristics $x_{ij}$
  - unobserved quality $\xi_{ijt}$

$$\theta_{ijt} \sim F\left(\theta \mid x_{it}, \xi_{ijt}\right)$$

- We also allow for correlation between elements of the vector $\theta_{it}$
- We prove that $\Lambda$ and $F(\theta \mid x_{it}, \xi_{ijt})$ are separately identified

# Estimation

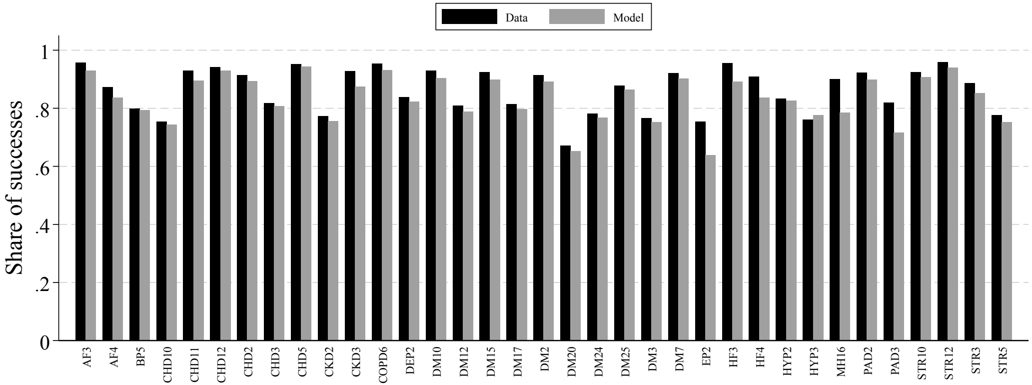
- First, we obtain $\xi_{ijt}$
- Assume observed $y_{ijt}$ is the optimal achievement (up to integers)
- Use the linear-quadratic FOCs
  - $\frac{\partial U_{it}}{\partial y_{ijt}}$ is linear in $\theta_{ijt}$
- Can derive the (discrete-continuous) distribution of $\theta_{ijt}$ analytically ▸ Details
- We parameterize

$$\theta_{it} \sim \mathcal{N}\left(\beta_x x_{it} + \beta_\xi \xi_{it}, \Sigma\right)$$

- We estimate:
  - elements $\lambda_{ij}$ (in $\Lambda$) fully flexibly
  - vectors $\beta_x, \beta_\xi$.
  - diagonal elements of $\Sigma$ flexibly and otherwise allow for simple correlations via a factor structure.
- Estimate by MLE ($\approx$1060 parameters)

# Roadmap

# Goodness of Fit



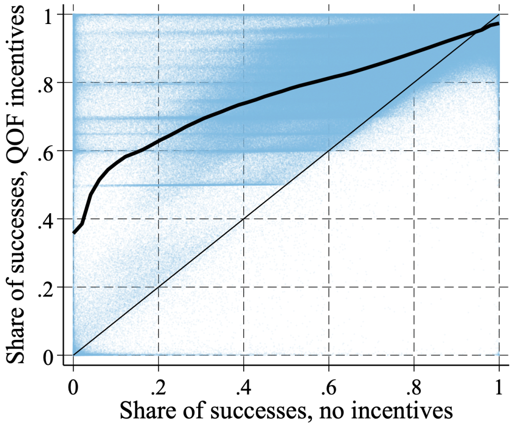
# Cost matrix Λ

- Most indicators are complements (yellow / blue)

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| In those patients with Atrial Fibrillation in whom re is a record of a CHADS2 score of 1 (latest in preceding 15 months), % of patients who are ly treated with anti-coagulation drug rapy or an anti-platelet rapy. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| In those patients with Atrial Fibrillation whose latest record of a CHADS2 score is greater than 1, % of patients who are ly treated with anti-coagulation drug rapy | 3.03 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with hypertension in whom last blood pressure (measured in previous 9 months) is 150/90 or less. | 0.21 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with coronary heart disease who are ly treated with a beta blocker (unless a contraindication or side -effects are recorded). | 1.36 | -0.10 | -1.52 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with coronary heart disease in whom last blood pressure reading (measured in previous 15 months) is 150/90 or less. | -0.17 | 0.51 | -7.48 | -6.10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with coronary heart disease whose last measured total cholesterol (measured in previous 15 months) is 5mmol/l or less. | -1.94 | 0.21 | -4.14 | -6.43 | -7.47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with coronary heart disease with a record in preceding 12 months that aspirin, an alternative anti-platelet rapy, or an anti-coagulant is being taken | 0.98 | 0.53 | -0.78 | -5.70 | -15.66 | -4.26 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with a history of myocardial infarction (from 1 April 2011) ly treated with an ACE inhibitor (or ARB if ACE intolerant), aspirin or an alternative anti-platelet rapy, beta-blocker and statin | 0.45 | 0.87 | -0.19 | 0.10 | -0.43 | 0.26 | -0.92 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with coronary heart disease who have had influenza immunisation in preceding 1 September to 31 March | -0.65 | -1.87 | -0.53 | -2.55 | -16.11 | -5.89 | -13.72 | 1.21 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients on CKD register in whom last blood pressure reading, measured in previous 15 months, is 140/85 or less. | -1.86 | 0.63 | 1.85 | -2.49 | -1.75 | -3.31 | 0.92 | 0.12 | -1.17 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients on CKD register with hypertension and proteinuria who are treat ed with an angiotensin converting enzyme inhibitor (ACE-I) or angiotensin receptor blocker (ARB) (unless a contraindication or side effects are recorded). | 0.18 | -0.18 | -0.21 | 0.88 | -0.71 | 1.30 | -0.98 | -1.02 | 1.08 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with COPD who have had influenza immunisation in preceding 1 September to 31 March. | -0.78 | -0.14 | 0.54 | -1.29 | -1.74 | 1.00 | 0.86 | 0.06 | -3.33 | -0.20 | 0.10 | | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients aged 18 or over with a new diagnosis of depression in preceding 1 April to 31 March, who have been reviewed not earlier than 10 days after and not later than 56 days after date of diagnosis | -0.24 | 0.72 | | | 0.78 | -1.66 | -0.12 | -0.39 | 0.52 | 0.04 | -0.10 | 0.17 | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with diabetes in whom last HbA1c is 10 or less (or equivalent test/reference range depending on local laboratory) in previous 15 months. | 1.74 | | -5.96 | 1.01 | 0.08 | -1.49 | 0.55 | 0.48 | 2.22 | 1.42 | 0.85 | 3.70 | | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with diabetes, on register, in whom last IFCC-HbA1c is 64 mmol/mol or less in preceding 12 months | 1.00 | 1.23 | -4.58 | 0.29 | 0.87 | -0.42 | 0.62 | 0.43 | 0.82 | -1.00 | 1.33 | 1.12 | -0.50 | | | | | | | | | | | | | | | | | | | | | | |
| % of patients with diabetes in whom last HbA1c is 9 or less (or equivalent test/reference range depending on local laboratory) in previous 15 months. | 0.87 | 1.07 | -3.71 | 0.73 | 0.35 | 0.03 | -0.36 | -0.02 | 1.36 | 1.40 | -0.07 | 2.26 | -0.10 | | -28.3 | | | | | | | | | | | | | | | | | | | | |
| % of patients with diabetes in whom last blood pressure is 145/85 or less. | 0.36 | | -6.91 | -0.37 | -3.06 | 1.47 | -0.25 | -0.44 | 5.09 | -2.75 | -0.14 | 0.31 | | -0.86 | 0.71 | -2.11 | | | | | | | | | | | | | | | | | | | |
| % of patients with diabetes who have had influenza immunisation in preceding 1 September to 31 March. | -0.04 | 0.30 | -0.15 | -0.63 | 2.76 | 2.93 | 2.43 | -0.42 | -11.60 | 0.78 | -0.69 | -1.90 | -0.27 | -2.65 | -0.19 | -2.88 | -5.49 | | | | | | | | | | | | | | | | | | |
| % of patients with diabetes in whom last blood pressure is 150/90 or less. | 0.43 | 0.39 | -3.59 | -2.03 | -1.07 | 1.31 | 1.32 | 0.40 | 2.91 | 0.12 | -0.01 | 1.03 | -0.03 | | 1.99 | -1.26 | | -4.06 | | | | | | | | | | | | | | | | | |
| % of patients with diabetes, on register, in whom last blood pressure reading (measured in preceding 12 months) is 140/80 mmHg or less | 0.63 | -0.54 | -2.53 | 0.45 | -3.25 | 3.06 | -2.19 | -0.22 | 1.74 | -3.82 | 0.12 | 0.01 | -0.06 | | -1.05 | 0.31 | | -0.91 | -21.00 | | | | | | | | | | | | | | | | |
| % of patients with diabetes whose last measured total cholesterol within preceding 15 months is 5mmol/l or less | -1.09 | -0.98 | -0.35 | -0.70 | 1.28 | -4.55 | -1.70 | 0.27 | 3.69 | 0.19 | -0.01 | -0.61 | 0.36 | -7.33 | -2.98 | -5.63 | -7.57 | -5.26 | -1.60 | -5.01 | | | | | | | | | | | | | | | |
| % of patients with diabetes, on register, with a diagnosis of nephropathy (clinical proteinuria) or micro-albuminuria who are ly treated with an ACE-I (or ARBs) | 0.35 | 0.13 | -0.19 | 0.13 | 0.46 | -0.30 | -0.25 | 0.17 | 0.15 | 0.06 | -0.59 | 0.06 | -0.17 | 0.44 | 0.09 | 0.35 | 0.02 | -0.42 | 0.16 | -0.13 | 0.02 | | | | | | | | | | | | | | |
| % of patients with diabetes in whom last HbA1c is 7 or less (or equivalent test/reference range depending on local laboratory) in previous 15 months. | -2.18 | -1.26 | -5.91 | 1.05 | -0.91 | 0.12 | -2.28 | -0.36 | 0.34 | -1.06 | -0.51 | -2.10 | 0.84 | -10.27 | -17.03 | -8.18 | 3.29 | -1.09 | -6.27 | -1.58 | -7.50 | -0.06 | | | | | | | | | | | | | |
| % of patients age 18 and over on drug treatment for epilepsy who have been seizure free for last 12 months recorded in previous 15 months. | -4.84 | 0.30 | -0.30 | 1.83 | -0.29 | -0.57 | 0.17 | 0.22 | -0.26 | -3.81 | -0.88 | -1.87 | 0.53 | 0.30 | -0.85 | 1.15 | 0.90 | -1.00 | 2.73 | -1.64 | 0.52 | 0.50 | -0.68 | | | | | | | | | | | | |
| % of patients with a diagnosis of heart failure due to Left Ventricular Dysfunction ( LVD) who are ly treated with an ACE inhibitor or Angiotensin Receptor Blocker (ARB) , who can tolerate rapy with no contra -i | -1.44 | -0.37 | -0.57 | 1.52 | 0.63 | -3.36 | -1.99 | -0.34 | 0.26 | 0.08 | 0.01 | -0.50 | 0.14 | -0.24 | -0.51 | 2.15 | -0.61 | -0.85 | -0.89 | 0.11 | -0.31 | -0.66 | 1.57 | -0.61 | | | | | | | | | | | |
| % of patients with heart failure due to LVD who are ly treated with an ACE inhibitor or Angiotensin Receptor Blocker, who are additionally treated with a beta -blocker licensed for heart failure, or recorde | -1.11 | -1.44 | 0.02 | -0.86 | -0.06 | 0.14 | 0.68 | -0.29 | 0.80 | 0.12 | -1.72 | -0.76 | -0.38 | | 0.02 | 0.36 | 0.45 | -0.49 | 0.24 | -0.46 | -0.95 | 0.31 | 1.07 | 1.45 | -12.40 | | | | | | | | | | |
| % of patients with hypertension in whom last blood pressure reading (measured in preceding 9 months) is 150/90 mmHg or less | -0.37 | -0.39 | | | -8.55 | 0.06 | -2.21 | -0.21 | -2.38 | -1.50 | -0.06 | -0.46 | -0.24 | | -4.56 | -2.96 | | 0.48 | -1.77 | -3.19 | -1.99 | -0.18 | -7.21 | 0.74 | -0.71 | -0.03 | | | | | | | | | |
| % of patients aged 79 or under with hypertension in whom last blood pressure reading (measured in preceding 9 months) is 140/90 mmHg or less | 0.97 | 0.04 | | | 3.37 | -4.89 | 1.72 | 0.05 | 2.37 | 2.54 | -0.14 | 1.55 | 0.08 | | 1.15 | 0.57 | | -0.73 | -1.76 | -0.67 | 2.87 | 0.01 | 0.69 | -2.17 | 1.05 | -0.14 | -3.79 | | | | | | | | |
| % of women with schizophrenia, bipolar affective disorder and or psychoses whose notes record that a cervical screening test has been preformed in preceding 5 years. | -0.46 | -1.43 | -0.20 | 0.52 | 0.83 | -0.70 | 0.80 | 0.92 | 0.02 | -0.25 | -1.43 | -0.92 | | | 1.08 | -0.30 | | -0.54 | -1.66 | 0.55 | 1.00 | 0.05 | -0.42 | 0.70 | -0.71 | 1.84 | | | | | | | | | |
| % of patients with peripheral arterial disease in whom last blood pressure reading (measured in preceding 15 months) is 150/90 or less | 3.10 | -0.16 | -0.28 | 0.22 | -2.53 | 0.81 | 1.84 | 0.58 | 0.14 | -0.63 | -0.27 | 0.18 | -0.24 | | 1.48 | 1.68 | | 0.17 | 0.19 | -1.86 | -0.39 | 0.03 | -1.30 | -0.41 | -4.86 | -1.09 | -0.22 | -0.03 | -0.11 | | | | | | |
| % of patients with peripheral arterial disease in whom last measured total cholesterol (measured in preceding 15 months) is 5.0mmol/l or less | 3.48 | -0.94 | 0.41 | 2.57 | -0.29 | -4.30 | 0.66 | -0.82 | 0.53 | -1.06 | 0.56 | -1.33 | 0.38 | | 0.00 | -0.96 | | 0.21 | 0.42 | 0.20 | -0.01 | 0.73 | -0.38 | -0.62 | 5.24 | 1.45 | 2.52 | -2.36 | 0.58 | -2.62 | | | | | |
| % of patients with peripheral arterial disease with a record in preceding 15 months that aspirin or an alternative anti-platelet is being taken | 0.49 | -0.10 | 0.06 | -0.97 | 1.46 | 1.05 | -2.32 | 0.16 | 0.96 | -0.39 | 0.30 | -1.68 | -0.76 | | 0.62 | 0.99 | | -0.55 | 0.68 | -0.68 | -0.17 | -0.09 | -1.21 | 0.56 | -1.84 | -0.90 | -0.13 | -0.05 | 0.18 | -12.56 | -1.34 | | | | |
| % of patients with a history of TIA or stroke in whom last blood pressure reading (measured in previous 15 months) is 150/90 or less. | -1.55 | -0.53 | -0.29 | 0.86 | -8.41 | 1.06 | 2.30 | 0.58 | 3.87 | -0.29 | 0.85 | -0.77 | -0.85 | 0.66 | 0.25 | 0.64 | -1.28 | 0.52 | -0.19 | -0.35 | 0.22 | -0.14 | -0.92 | 1.07 | 0.78 | -0.09 | -0.53 | 0.46 | -1.27 | -0.68 | -0.36 | 0.47 | | | |
| % of patients with a stroke shown to be non-haemorrhagic, or a history of TIA, who have a record that an anti-platelet | -1.77 | -4.77 | 0.01 | -0.21 | 1.89 | 2.40 | -3.86 | 0.41 | 1.69 | -0.07 | -0.23 | -0.95 | -0.91 | 1.08 | 1.07 | 0.38 | -0.61 | 0.47 | 0.48 | -0.87 | -0.48 | 0.19 | -1.01 | -3.96 | 2.28 | -0.61 | 0.16 | 0.35 | 0.57 | 1.79 | 1.30 | -0.91 | -5.10 | | |
| % of patients with TIA or stroke whose last measured total cholesterol (measured in preceding 15 months) is 5 mmol/l or less | -3.15 | 1.55 | 0.16 | -1.58 | 1.54 | -8.90 | 1.94 | -0.75 | 1.90 | -3.48 | -2.36 | -1.98 | 5.50 | 0.63 | 0.07 | 0.58 | 2.77 | -0.59 | 0.66 | 2.23 | -2.69 | 0.05 | 0.73 | 2.60 | 0.81 | -0.53 | 3.19 | -3.95 | 0.23 | -0.46 | -4.32 | -1.38 | -5.84 | -4.45 | |
| % of patients with TIA or stroke who have had influenza immunisation in preceding 1 September to 31 March. | 0.55 | -1.13 | -0.48 | 1.65 | 3.61 | 1.37 | 2.77 | -0.47 | -10.68 | -0.21 | 0.57 | -1.57 | -0.50 | 0.90 | 0.20 | 0.63 | 0.95 | -1.80 | 0.59 | 0.43 | 0.71 | 0.00 | -0.29 | 1.41 | 1.94 | 0.50 | -0.50 | 0.43 | 0.57 | -0.58 | -0.21 | -0.10 | -13.61 | -8.44 | -5.30 |

# Roadmap

# Shutting Down QOF: achievement



# Optimal incentive design

- $b_j$ are health benefits net of medical costs for indicator $j$ (observed, in £, from NICE guidelines)
  - known only for 20 indicators (out of 40)
- Fix $\underline{y_j}$ and set $\overline{y_j} = 1$
- Choose slopes $\alpha = (\alpha_1, \alpha_2, \dots)$ to maximize the payer's objective

$$W = \sum_{i,j,t} n_{ijt} \int (y_{ijt} b_j - \rho_{jt}(y_{ijt} \mid \alpha_{jt})) f(\theta_{ijt} \mid \tilde{x}_i, \xi_{ijt}) \, d\theta_{ijt}$$

where $y_{ijt}$ is optimally chosen by GPCs in response to $\alpha$

- Computational feasibility: we k-means cluster GPCs into 20 groups by $x_i, \xi_i, n_{ijt}$
  - Maximize approximate $W$.
  - At the solution, compute outcomes for all GPCs

# Optimal incentives

| | No QOF<br>Δ from QOF | QOF | Optimized QOF<br>Δ from QOF |
|---|---|---|---|
| Practice payoffs | -348<br>-11% | 3,240 | 164<br>5% |
| QOF payments | -353<br>-100% | 353 | 199<br>56% |
| Medical costs | -1,431<br>-3% | 43,189 | 683<br>2% |
| Health benefits | -5,553<br>-4% | 131,565 | 3,857<br>3% |
| Welfare | -4,117<br>-5% | 91,264 | 3,139<br>3% |

- Shutting down QOF: payer's objective $\downarrow\downarrow$ by 5%
- Optimizing the QOF: payer's objective $\uparrow\uparrow$ by 3%

# Roadmap

# Next Steps

- Integrate into the estimation indicators removing during sample period

# Conclusion

- Empirically tractable principal-agent model with multitasking
- Sufficient conditions for identification relying on variation in exposure to different tasks
- Apply model to QOF program in England
- Ample evidence of response to incentives and multitasking
- Model allows counterfactuals:
  - Program generates large welfare gains
  - Scope for optimization of incentives accounting for multitasking

# Thank you!

a.veiga@imperial.ac.uk

Additional slides:

# Literature

- Empirical models of multitasking: Slade [1996], Buser and Peter [2012], Hong, Hossain, List, and Tanaka [2018], Goes, Ilk, Lin, and Zhao [2018], Manthei and Sliwka [2019], Rodríguez-Lesmes and Vera-Hernández [2021], Kim, Sudhir, and Uetake [2022], Dinerstein and Opper [2022]
  - We go beyond testing.
  - We quantify complementarities $\rightarrow$ can consider counterfactual designs
- Pay-for-performance in healthcare: Gaynor et al. [2004], Dumont et al. [2008], Mullen et al. [2010], Choné and Ma [2011], Clemens and Gottlieb [2014], Li et al. [2014], Einav et al. [2018], Gupta [2021], Rodríguez-Lesmes and Vera-Hernández [2021], Einav et al. [2022], Gaynor et al. [2023], Dunn et al. [2024], Shi [2024, and many more]
  - We incorporate multitasking
  - We focus on primary care in non-US context

# References


Thomas Buser and Noemi Peter. Multitasking. *Experimental economics*, 15(4):641–655, 2012.

Philippe Choné and Ching-to Albert Ma. Optimal health care contract under physician agency. *Annals of Economics and Statistics/Annales d'Économie et de Statistique*, pages 229–256, 2011.

Jeffrey Clemens and Joshua D Gottlieb. Do physicians' financial incentives affect medical treatment and patient health? *American Economic Review*, 104(4):1320–1349, 2014.

Michael Dinerstein and Isaac M Opper. Screening with multitasking: Theory and empirical evidence from teacher tenure reform. Technical report, National Bureau of Economic Research, 2022.

Etienne Dumont, Bernard Fortin, Nicolas Jacquemet, and Bruce Shearer. Physiciansâ multitasking and incentives: Empirical evidence from a natural experiment. *Journal of health economics*, 27(6):1436–1450, 2008.

Abe Dunn, Joshua D Gottlieb, Adam Hale Shapiro, Daniel J Sonnenstuhl, and Pietro Tebaldi. A denial a day keeps the doctor away. *The Quarterly Journal of Economics*, 139(1):187–233, 2024.

Liran Einav, Amy Finkelstein, and Neale Mahoney. Provider incentives and healthcare costs: Evidence from long-term care hospitals. *Econometrica*, 86(6):2161–2219, 2018.

Liran Einav, Amy Finkelstein, Yunan Ji, and Neale Mahoney. Voluntary regulation: Evidence from medicare payment reform. *The quarterly journal of economics*, 137(1):565–618, 2022.

Martin Gaynor, James B Rebitzer, and Lowell J Taylor. Physician incentives in health maintenance organizations. *Journal of Political Economy*, 112(4):915–931, 2004.

Martin Gaynor, Nirav Mehta, and Seth Richards-Shubik. Optimal contracting with altruistic agents: Medicare payments for dialysis drugs. *American Economic Review*, 113(6):1530–1571, 2023.

Paulo B Goes, Noyan Ilk, Mingfeng Lin, and J Leon Zhao. When more is less: Field evidence on unintended consequences of multitasking. *Management Science*, 64(7):3033–3054, 2018.

Atul Gupta. Impacts of performance pay for hospitals: The readmissions reduction program. *American Economic Review*, 111(4):1241–1283, 2021.

Bengt Holmstrom and Paul Milgrom. Multitask principal–agent analyses: Incentive contracts, asset ownership, and job design. *The Journal of Law, Economics, and Organization*, 7(special_issue):24–52, 1991.

Fuhai Hong, Tanjim Hossain, John A List, and Migiwa Tanaka. Testing the theory of multitasking: Evidence from a natural field experiment in chinese factories. *International Economic Review*, 59(2):511–536, 2018.

Minkyung Kim, K Sudhir, and Kosuke Uetake. A structural model of a multitasking salesforce: Incentives, private information, and job design. *Management Science*, 68(6):4602–4630, 2022.

Jinhu Li, Jeremiah Hurley, Philip DeCicca, and Gioia Buckley. Physician response to pay-for-performance: Evidence from a natural experiment. *Health economics*, 23(8):962–978, 2014.

Kathrin Manthei and Dirk Sliwka. Multitasking and subjective performance evaluations: Theory and evidence from a field experiment in a bank. *Management Science*, 65(12):5861–5883, 2019.

Kathleen J Mullen, Richard G Frank, and Meredith B Rosenthal. Can you get what you pay for? pay-for-performance and the quality of healthcare

# Analytic MLE

- For instance, in the 2D case:

$$\frac{\partial U}{\partial y_1} = n_1 \rho_1'(y_1) + n_1\theta_1 - 2n_1\lambda_1 y_1 - (n_1+n_2)\lambda_{12} y_2$$

- If data is $y_1 = 1$, and knowing $\rho_1'(1) = 0$, then

$$\frac{\partial U}{\partial y_1}|_{y_1=1} \geq 0 \Leftrightarrow \theta_1 \geq 2\lambda_1 + \frac{n_1+n_2}{n_1}\lambda_{12} y_2$$

- If $y_1 \in (\overline{y_1}, 1)$, the FOC holds, so

$$\frac{\partial U}{\partial y_1} = 0 \Leftrightarrow \theta_1 = 2\lambda_1 y_1 + \frac{n_1+n_2}{n_1}\lambda_{12} y_2 - \rho_1'(y_1)$$

- Bunching: $y_1 = \overline{Y_1}$. This implies

$$n_1 \rho_1'\left(\overline{Y_1}\right) + n_1\theta_1 - 2n_1\lambda_1 \overline{Y_1} - (n_1+n_2)\lambda_{12} y_2 \geq 0$$

$$n_1\theta_1 - 2n_1\lambda_1 \overline{Y_1} - (n_1+n_2)\lambda_{12} y_2 \leq 0$$

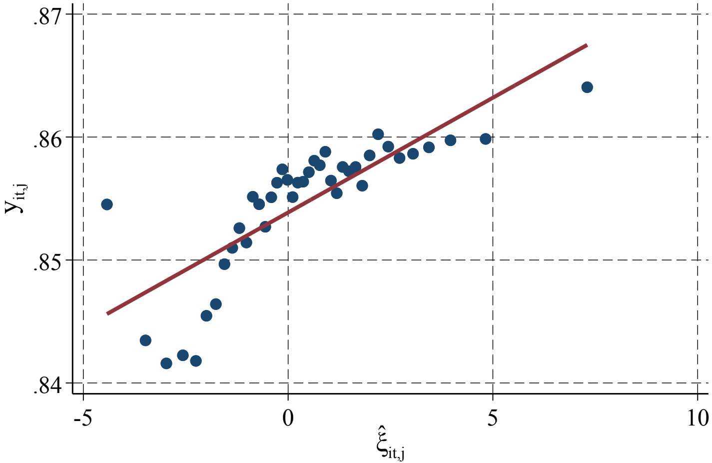
Back

# Summary Reduced Form

| | Extra achievement indicator $j$ (mean = 0.43, std = 0.11) | | | | |
|---|---|---|---|---|---|
| | OLS | OLS | OLS | OLS | IV |
| Payment per patient | 0.117 | 0.278 | 0.302 | 0.289 | 0.24 |
| (std = 0.09) | (0.001) | (0.003) | (0.003) | (0.004) | (0.004) |
| Share of patients | | −0.541 | −0.443 | −0.425 | 0.084 |
| (std = 0.04) | | (0.009) | (0.008) | (0.009) | (0.011) |
| Share of patients × payment per patient | | 3.008 | 1.62 | 1.684 | 3.152 |
| (std = 0.004) | | (0.091) | (0.089) | (0.091) | (0.109) |
| Controls | | | Yes | Yes | Yes |
| FE | | Ind. | Ind., Practice | Ind., Practice | Ind., Practice |
| R-squared | 0.012 | 0.285 | 0.362 | 0.363 | - |
| Observations | 2145595 | 2145595 | 2145595 | 2014257 | 2005257 |

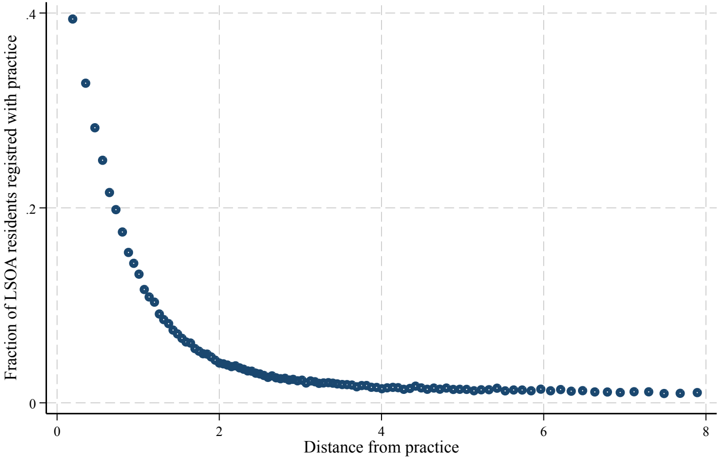
Back

# Demand residual is correlated with achievement




◂ Back

# Distance shifts demand



# Practices respond to incentives: heterogeneity