

"NO MAN IS AN ISLAND": AN EMPIRICAL STUDY ON TEAM FORMATION AND PERFORMANCE

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INTRODUCTION

- Working collaborations are crucial in many activities, both in science and in the private sector.
- In science, decisions to collaborate usually made on a decentralized basis.
- Within-firm workforce evolving toward decentralization (**open workflows, Agile Business Practices**).

What drives selection into projects? **Co-workers** or **project quality**?
Does selection bias the measure of performance?

Can decentralized project participation be an efficient allocation mechanism?

Economics interested in the efficiency of workers' performance.
- Decentralization: potential misalignment due to individual preferences.

THIS PAPER

- Unique data from an important scientific collaboration, **Virgo**:
 - Nobel Prize in Physics 2017;
 - Clean decentralized framework.
- Develop & estimate a 2-stage structural model:
 1. **Project endogenous participation**: estimate main drivers of participation;
 2. **Project efficiency**: estimate the performance of project participants.
- Counterfactual: participation and efficiency under an alternative allocation mechanism.

VIRGO

- Gravitational waves: disturbances in the curvature of spacetime generated by phenomena occurring in the Universe.
- Virgo has been founded in 1987: build up an interferometer to observe gravitational waves.
- First gravitational wave detected in 2017.
- Researchers free to choose what to work on and with whom: endogenous selection into projects.
- Projects are set up in advance.
- Communication via the **Logbook**: on-line mandatory diary of work.

Adv-INJ (Input Mode Cleaner cavity)
swinkels_genin - 19:24, Tuesday 17 April 2018 (41134) [Comment to IMC systematically unlocking a few seconds after the ITF \(Click here to view original report: 41122\)](#)
We likely understand what is going on: At the moment the interferometer unlocks, the injection system almost immediately tri problem is that at that moment, the amplitude of the sidebands is still low (these are reduced by 20 dB during the lock acqul about 5 seconds for Metatron to increase the modulation depth again, this is too late. One easy fix would be to lock the RFC lock.

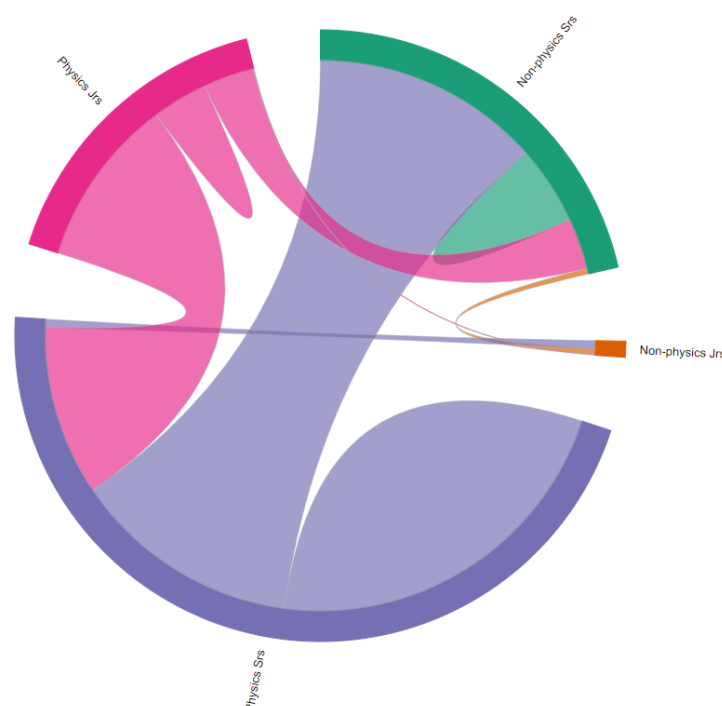
Detector Operation (Operations Report)
Montanari - 16:04, Tuesday 17 April 2018 (41133) [Operator Report - Morning Shift 17 Apr](#)
At my arrival, the ITF was in down, as left last night to allow the work on PSL in early morning (work already started).

DATA

- The activity in Virgo consists of macro-projects and projects.
- 16 macro-projects, 2,243 projects prior the complete functioning of the interferometer (June 2012 - October 2016).

	Mean	St. Dev.
Team projects	71.8%	0.47
Team size	3.09	1.31
Max observed team size	10	

- Researchers employed with a fixed wage (intrinsic motivation).
- Projects require different sets of skills: diverse working environment.
- 190 researchers, 20% Juniors, 61% specialized in Physics.
- Each researcher is assigned to a **type**, i.e. a combination of professional seniority and field of research.



This plot shows the bilateral project connections by types (Physics Juniors, Physics Seniors, Non-Physics Juniors, Non-Physics Seniors).

Project Outcomes

- Use Logbook texts: classify projects into completed/not completed.

TWO-STAGE MODEL

Game of incomplete information.
Each type observes the sets of project's exogenous characteristics and potential entrants, a project-specific shock and her own idiosyncratic shock.

Stage 1: if payoff of joining the project > payoff of not joining, the type joins the project.
Expected payoff of type i for project j :

$$E[\pi_{ij}] = \alpha_i X_i + \eta' D_j + \sum_{g=1}^G \delta_{ig} E[N_{gj}] + q_j$$

depends on types characteristics X , project controls D , expected number of researchers of type g , project ex-ante quality q , idiosyncratic shock ϵ .

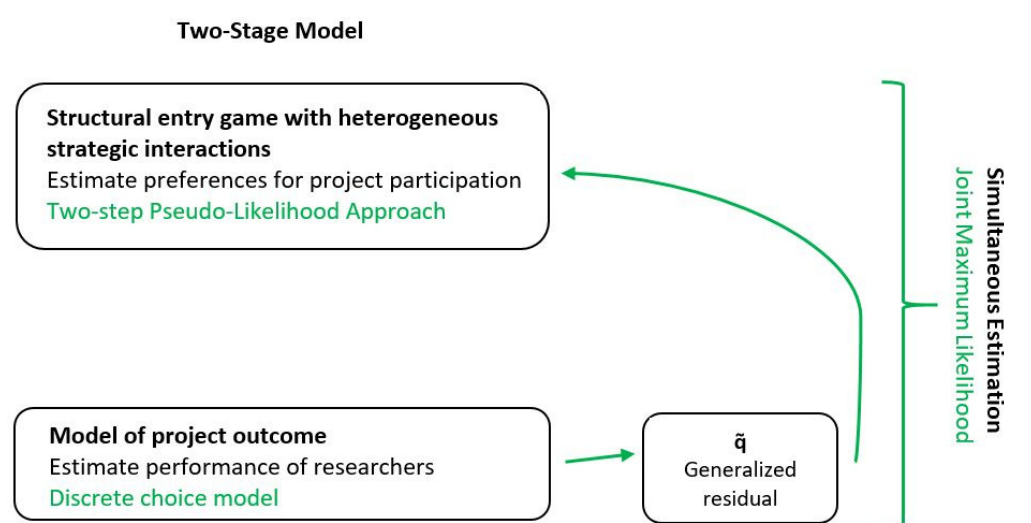
▲ Solve for Bayesian Nash equilibrium(a).

Stage 2: project's outcome realizes

depends on number of researchers of type g , project controls C , project shock q .

ESTIMATION

Project ex-ante quality affects the decision to join a project and the project final outcome:
Endogeneity -> Simultaneous Estimation.



RESULTS

Project Outcome Equation

	Outcome	Participation
β	0.556*** (0.055)	

Number of projects: 2,243. The regression includes project controls and a constant.

- The higher the number of types, the higher the probability of project completion.

Simultaneous Estimation

No Heterogeneity

	Outcome	Participation
β	-0.037 (0.07)	
δ		-1.44*** (0.096)

Number of projects: 2,243. Number of potential participants for each project: 10. Regressions include project controls, type characteristics and a constant. Bootstrap standard errors in parenthesis.

- Selection into projects: no significant effect of participants on project outcome.

- Researchers dislike working with large teams.

Simultaneous Estimation

Full Model

	Outcome	Participation
$\beta_{Non-Physics, Juniors}$	-4.27 (3.9)	
$\beta_{Non-Physics, Seniors}$	-3.67 (2.6)	
$\beta_{Physics, Juniors}$	-2.87 (2.1)	
$\beta_{Physics, Seniors}$	-2.52 (1.98)	
$\delta_{Non-Physics, Juniors}$		-0.81*** (0.4)
$\delta_{Non-Physics, Seniors}$		2.02*** (0.2)
$\delta_{Physics, Juniors}$		-0.83*** (0.08)
$\delta_{Physics, Seniors}$		1.16*** (0.09)

Number of projects: 2,243. # of potential participants for each project: 10. Regressions include project controls, type characteristics and a constant. Bootstrap standard errors in parenthesis.

- Seniors like large teams; vice versa for juniors.

- Heterogeneous selection: there are complementarities from working in teams.

COUNTERFACTUAL

A hypothetical manager allocates researchers to projects ignoring the strategic interactions.

Projects participants and team diversity \uparrow
Probability of project completion \downarrow

Teamwork and performance, peers at work:

Lazear (1998), Hamilton, Nickerson, and Owan (2003), Falk and Ichino (2006), Mas and Moretti (2009), Bandiera, Barankay, and Rasul (2010).

Collaborations in science and innovation:

Guimerà, Uzzi, Spiro, and Amaral (2005), Wuchty, Jones, and Uzzi (2007), Ganglmair, Simcoe, and Tarantino (2018), Akcigit, Caicedo, Miguelez, Stantcheva, and Sterzi (2019).

Empirical entry models with incomplete information:

Seim (2006), Aguirregabiria and Mira (2007), Bajari, Hong, Krainer, and Nekipelov (2010).