

# Matching with contracts: slot-specific preferences in academic communities - proposal

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## 1 Introduction

Scholars academic performance can be estimated in a variety of different measures, however the most common approach is to utilize indexes, based on the articles citation rate with incorporation of journal quality measures in some cases (Popov, 2022). Taking into account different approaches to estimating authors productivity of the research, one should probably be also interested in the factors which affect research success. From empirical literature we can assume that team composition in terms of cooperation between scholars working on research projects affects their productivity (Ductor, Fafchamps, Goyal, & Van der Leij, 2014). Moreover scholars' affiliation firstly affects their potential cooperation set and secondly has a direct effect on their performance (Brogaard, Engelberg, & Parsons, 2014; Popov, 2022). Based on these empirically proved assumptions we are trying to model academic cooperation between scholars on the basis of matching with contracts framework, taking into account their affiliation. Furthermore, since transmission of ideas and knowledge inside any paradigm basically reflects the inter-temporal path of science we will concentrate our analysis on the cooperation between scholars with different qualifications, more precisely between postdocs and their supervisors (Kuhn, 2012).

## 2 Research question

Since the matching with contracts framework is a starting point of our analysis, we are interested in the existence of potential stable matching between different postdocs and supervisors taking into account their affiliation. We assume standard definition of stable matching in terms of individual rationality and absence of blocking pairs or coalitions. We propose the following process of cooperation between scholars. Universities are trying to create a lab, department or research project they first employ supervisors, based on preference profile over different contracts with supervisors, then they hire postdocs for this research units, taking into account preference profile over contracts with postdocs (this

linearly structured employment process can be continued without loss of generality). Such a process is associated with matching with slot-specific priorities framework and it is necessary for taking into account affiliation. Then different supervisors and postdocs cooperate inside research units. However postdocs and supervisors initially do not have preference profiles over potential contracts with universities rather only over cooperation with each other. Such extension significantly changes the existing approaches. On the basis of the discussed process the research question is the following: taking into account slot specificity of affiliation is there any mechanism that provides a stable set of matchings between scholars and universities?

### 3 Literature review

Our research is based on the existing literature, dedicated to the matching with contracts framework, moreover we are taking into account specific background of scientometrics and academic social networks, in order to provide realistic assumptions of matching problem. Our starting point is Hatfield and Milgrom matching with contracts framework and the necessity of substitutability conditions for the existence of stable allocations (Hatfield & Milgrom, 2005; Aygün & Sönmez, 2013) . We then utilize the Hatfield and Kojima approach, which provides weaker substitutability conditions than still guarantee the existence of stable matchings (Hatfield & Kojima, 2010). Finally we will utilize unilateral substitutability conditions, in order to check the existence of a stable matching in our framework (Sönmez, 2013). Since we are working with affiliations and universities we also utilize literature dedicated Cadet-branch allocation, or more precisely matching with slot specific-priorities (Kominers & Sönmez, 2016).

### 4 Novelty and contribution

Current research provides contribution to the following fields: matching with contracts, academic social networks and scientometrics. Firstly we propose a new extension to the matching with contracts framework in terms of slot specificity in conditions of initial absence of scholar's preference over contracts. Secondly we theorize how possible cooperation between scholars affects their affiliation. Finally we theoretically identify the mechanism through which affiliation and cooperation affects the knowledge production process.

### 5 General framework

As we have already mentioned universities hire supervisors in order to create labs or establish some research projects, and they also hire postdocs in order to fill the positions in such structures. Following Hatfield and Milgrom's approach we assume that universities utilize contracts in order to hire scholars. Then the initial simple structure of our framework is the following:

- S - set of supervisors
- Q - set of quotas for supervisors
- P - set of postdocs
- Preference profiles for postdocs and supervisors over each other  $(\succ_a)_{a \in S \cup P}$
- U - set of universities
- X - set of bilateral contracts between universities and supervisors. Obviously in this case any contract is associated with one supervisor and one university.
- Y - set of bilateral contracts between universities and postdocs (properties are the same as in the previous set).
- Preference profiles of universities over contracts with postdocs and supervisors  $(\succ)$

For now we assume that contracts reflect the salary and any additional benefits that workers can obtain (social security, additional education and so on). Moreover it is pretty clear that despite the fact that universities have their preferences over contracts, for supervisors and postdocs it is not the same. Such an issue can potentially lead to violation of transitivity and substitutability conditions which in its turn leads to absence of stable allocation.

## 6 Potential results

Potential solution includes checking existing substitutability conditions in order to prove the existence of stable matching. However in case if their implementation will not be confirmed we will provide restrictions for the initial framework which allow to find a mechanism that leads to stable allocation.

## References

- Aygün, O., & Sönmez, T. (2013). Matching with contracts: Comment. *American Economic Review*, 103(5), 2050–2051.
- Brogaard, J., Engelberg, J., & Parsons, C. A. (2014). Networks and productivity: Causal evidence from editor rotations. *Journal of Financial Economics*, 111(1), 251–270.
- Ductor, L., Fafchamps, M., Goyal, S., & Van der Leij, M. J. (2014). Social networks and research output. *Review of Economics and Statistics*, 96(5), 936–948.
- Hatfield, J. W., & Kojima, F. (2010). Substitutes and stability for matching with contracts. *Journal of Economic theory*, 145(5), 1704–1723.
- Hatfield, J. W., & Milgrom, P. R. (2005). Matching with contracts. *American Economic Review*, 95(4), 913–935.

- Kominers, S. D., & Sönmez, T. (2016). Matching with slot-specific priorities: Theory. *Theoretical Economics*, 11(2), 683–710.
- Kuhn, T. S. (2012). *The structure of scientific revolutions*. University of Chicago press.
- Popov, S. V. (2022). Alma mat (t) er (s): Determinants of early career success in economics. *Plos one*, 17(12), e0278320.
- Sönmez, T. (2013). Bidding for army career specialties: Improving the rotc branching mechanism. *Journal of Political Economy*, 121(1), 186–219.