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Department of Economics
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Refugee Matching as a Market Design Application

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Refugee Matching as a Market Design Application*

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Abstract

This note contains a few brief remarks on the similarities and differences between some standard market design applications (e.g., kidney exchange and school choice) and the refugee assignment problem. The main conclusion is that the refugee assignment problem is more complex in some dimensions than many of the standard market design applications. Consequently, classical mechanisms cannot be used to solve the problem and more research is needed to, e.g., understand how to model preferences, and how to define relevant axioms and multidimensional constraints.

JEL Classification: C78, F22.

Keywords: forced migration, asylum seekers, refugee assignment, matching, market design.

1 Introduction and Statement of the Problem

The point of departure in this chapter is the ongoing European migrant crisis and other similar crises around the world, and, more precisely, the problem of assigning asylum seekers to different geographical areas. According to the UNHCR, the number of forcibly displaced people worldwide reached 65.3 million at the end of 2015 (the highest level ever recorded) and around 1.2 million of these people applied for asylum in European Union member states (more than a doubling compared to 2014). In an attempt to more fairly distribute asylum seekers between the European Union member states, the European Commission has formulated several European relocation schemes. These schemes specify a quota for each member state, based on criteria that reflect the capacity of the member states to absorb and integrate asylum seekers (see [Grech, 2017](#), for a systematic and critical analysis), but does not contain any details about which asylum seekers that should be relocated to what member state.

The above type of resettlement schemes share some fundamental properties with a standard two-sided matching market with capacity constraints ([Jones and Teytelboym, 2016b](#)). More precisely, such matching market can be modelled with the European Union member states on one side of the market and asylum seekers on the other side of the market where the capacities of the member states are determined by the quotas in the resettlement scheme. Note, however, that the refugee assignment problem is not limited to a matching problem on supranational level as the basic structure of the problem is more or less identical independently of if it is specified for the supranational or the national level. For this reason, the remaining part of this chapter will, in general terms, discuss the refugee

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assignment problem within a given geographical region keeping in mind that local regulations may constrain the problem (in similarity with, e.g., the school choice problem where local regulations may impact the design of the matching mechanism).

To model refugee matching as a market design application, it is, however, not enough to know only the sets of agents (i.e., the geographical areas and the asylum seekers) and the capacities of the geographical areas. Additional information is needed, e.g., information related to how asylum seekers arrive to the geographical areas (static versus dynamic arrivals), how to describe asylum seekers in terms of their characteristics, and how to model local constraints and agent preferences. In addition, to identify and evaluate matchings, matching mechanisms and axioms that are tailored for the refugee assignment problem are needed. These issues are briefly discussed in the remaining part of the chapter under separate headings.

2 Static versus Dynamic Refugee Assignment

A first distinction that separates any given refugee assignment problem into one of two possible directions is related to exactly *how* the asylum seekers enter the geographical area.

First, and as described in the above, asylum seekers may be resettled to a geographical area based on a redistribution key. In this case, the local authorities do not only know that they will be assigned a given number of asylum seekers during a pre-defined time period (e.g., the next year), they also know the characteristics of the asylum seekers resettled in their geographical area. Because this information is known and since the problem then lacks dynamics, this type of refugee assignment problem can be modelled as a version of a two-sided matching market with capacity constraints and with given preferences and constraints (complications related preferences and constraints will be discussed in more detail below). This type of refugee resettlement problem has recently been analyzed by [Delacretaz et al. \(2016\)](#) and [Jones and Teytelboym \(2016a,b\)](#).

Second, asylum seekers may arrive directly to a geographical area without being part of a resettlement program. For the European case, the Dublin Regulation then dictates that the member state in which an asylum seeker enters first is obliged to render asylum. This introduces dynamics to the problem since there is now way to predict exactly how many asylum seekers that will arrive directly to a specific geographical area, when they will arrive, and what characteristics they have. Hence, the problem to assign asylum seekers to a locality within the geographical area must be solved upon each arrival, i.e., before knowing the identity and characteristics of all asylum seekers that arrive within a given time period.

Hence, refugee assignment problems can be thought of as either static or a dynamic problem. The dynamic matching literature (not necessarily related to refugee matching) is, in general, far less developed than its static counterpart even if it can be argued that some classical market design applications have dynamic elements. For example, the kidney exchange problem is dynamic in its nature since patient-donor pairs enter the kidney exchange pool in a sequence and because there is no exact agreement on what the optimal size of the patient-donor pool should be before running the matching algorithm.

3 Multidimensional Characteristics and Constraints

In standard matching models (e.g., school choice and kidney exchange), agents and capacities are typically one-dimensional. In, for example, the standard school choice problem, students are usually completely described by their preferences over schools and schools are typically completely described by their their priorities over students and their capacities (priorities may, however, be described by different priority classes to, e.g., reflect walking distance, sibling priority, or controlled school choice). As observed by [Delacretaz et al. \(2016\)](#) and [Jones and Teytelboym \(2016a\)](#), the basic structure in the refugee assignment problem is more complicated. For example, asylum seekers may be described by characteristics in several dimensions including, e.g., nationality, spoken languages, family constellation, need for health care, etc. It is not clear what the relevant characteristics are and how to identify them. For this reason, researchers interested in the refugee assignment problem must approach relevant authorities to seek input in this matter. Note also that it is not unlikely that relevant characteristics differ between geographical areas, e.g., depending on how the health care and education systems are organized.

The multidimensional description of asylum seekers also imposes additional constraints on local authorities. More specifically, a family of asylum seekers need not only accommodation in the geographical region where they are placed, but also a certain number of units of different public services related to, e.g., education and health care. In other words, asylum seekers are not only described by multiple characteristics, these characteristics also introduce explicit multidimensional constraints in local geographical areas. Hence, depending on how asylum seekers are described (in terms of characteristics), the computational as well as the modelling complexity of the matching problem varies. In particular, the description may introduce complementarities which is something that seldom is considered in the matching literature (a famous exception is the matching with couples problem, present in the National Resident Matching Program) and something which generally is difficult to deal with.

4 Agent Preferences

In many market design applications, agents can provide a ranking over the relevant objects. In, for example, the school choice problem, parents have access to information about the schools in their locality and can, based on this information, form preferences over schools. In the refugee assignment problem, however, it may be difficult for local authorities to form preferences over asylum seekers and vice versa even if there is an agreement about how to describe asylum seekers and geographical areas in terms of their characteristics. One reason for this is that there are thousands of asylum seekers (dozens of local geographical areas) and complete information about the asylum seekers (the geographical areas) may be unavailable and even if such information is available, it is not clear how to process it. It is therefore not unlikely that preferences in this type of application needs to be estimated or induced in some way.

Several different approaches may be taken. First, given the assumption that one side of the market can form preferences over agents on the other side of the market, preferences can be induced based on the concept of mutual acceptability. Such preferences has recently been theoretically studied by [Haeringer and Iehlé \(2017\)](#) and in a refugee assignment context by [Andersson and Ehlers \(2016\)](#). Second, preferences can be estimated based on econometric techniques. Here, one can, e.g., imagine

that successful integration is the ultimate goal of both the local authorities and the asylum seekers. Then some type of integration score (like the ones published for Germany in [The Economist, 2016](#)) for each type of asylum seeker in each geographical area may be estimated and preferences over geographical areas and asylum seekers may then be formed based on likelihood of successful integration. A third alternative is to induce preferences in a non-parametric way based only on characteristics of asylum seekers and geographical areas.

There are, of course, other alternatives for estimating or inducing preferences than the above mentioned, but the important conclusion is that it is unlikely that it is easy for the local authorities and asylum seekers to form preferences on their own. It is, therefore, not unreasonable that preferences must be estimated or induced in some way and this is typically not the case in the matching literature. Here, it should be mentioned that it can be argued that preferences, in fact, are induced in some existing market design applications. In the standard kidney exchange problem, for example, it can be argued that preferences are induced in a dichotomous fashion based on reported medical data such as tissue type antibodies and blood group.

5 Matching Mechanisms and Axioms

If local authorities are bounded by multidimensional constraints, the matching problem becomes a complex combinatorial problem and it may even contain complementarities. This may disqualify the use of some of the classical matching mechanisms, like the Deferred Acceptance Algorithm and the Top Trading Cycles Mechanism (see [Delacretaz et al., 2016](#), for a detailed discussion). This also calls for the use of, e.g., combinatorial optimization techniques ([Delacretaz et al., 2016](#)) or graph optimization techniques ([Andersson and Ehlers, 2016](#)).

Furthermore, because the refugee assignment problem differs from classical market design applications, standard axioms for analyzing matching markets such as stability and strategy-proofness may have to be modified. For example, because complementarities may be present, the existence of a stable matching (as classically defined) is not guaranteed. Hence, some standard axioms must be defined and investigated from the perspective of the refugee assignment problem (for such analysis of the stability axiom in a refugee matching context, see [Aziz et al., 2017](#)) and new axioms need to be tailored for the refugee assignment context. Because the refugee assignment problem may also have a dynamic component, dynamic versions of existing axioms may need to be defined. To achieve this, researchers in the field may not only consult the existing market design literature but also literature related to, e.g., social choice, fairness and equity.

6 Summary and Conclusions

Even if this short chapter has not given any explicit advice on how to tackle the refugee assignment problem as a market design application, it has related the problem to some classical market design applications (such as school choice and kidney exchange) and pointed out a few differences and additional complications. The chapter has also cited a few recent papers on refugee matching and explained some problems addressed in these papers. It is, however, clear that more research is needed to identify mechanisms that can be implemented to solve some of the problems that local authorities

face in a refugee assignment context. The ultimate objective must be to provide tools that can be utilized to solve this important allocation problem exactly as the market design community has provided implementable mechanisms for school choice, kidney exchange and many other applications. Even if the discussed problem is on the highest political agenda in the European Union, there are not that many papers written on the subject in the market design literature. In fact, apart from the references mentioned in this paper, I am not aware of any other matching paper that investigates the refugee assignment problem.

Another direction to approach a solution to the problem is to regard the refugee assignment problem as a procurement problem (this was proposed to me by Lawrence Ausubel) or by approaching it as a system of tradable quotas like, e.g., emissions control. The latter approach is taken by [Moraga and Rapoport \(2014\)](#) for the refugee matching context and they demonstrated that tradable quotas can be designed based on matching techniques to solve some specific refugee resettlement problems.

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