

# Matching Markets: Theory and Practice

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# Overview

- In 1962 David Gale and Lloyd Shapley published one of the most influential papers in game theory starting the literature in matching theory.
- Until early 2000s the main practical application of matching theory was entry level labor markets such as the U.S. hospital-intern market.
- This trend has recently changed as matching theory found new applications in (often large scale) resource allocation problems of social importance.
- Research on two of these new applications has especially been influential in practice:
  - School Choice
  - Kidney Exchange

## Kidney Exchange

- Shortly after the first few matching papers on kidney exchange are published in 2004-2005, several regions in the U.S. and a few countries launched centralized kidney exchange programs.
- In his June 2011 Congress testimony, Dr. Myron Gutmann, Assistant Director at NSF emphasized, research on kidney exchange has resulted in measurable gains for the U.S. taxpayer.
- Similarly, in a recent NSF - Science Nation story, Nancy Lutz, program director at NSF remarked:

“In addition, it’s especially rewarding to see such a clear and immediate benefit to the public. This research moved from abstract, academic theory to real world, direct impact very quickly.”

## School Choice

- Shortly after the first matching paper on school choice is published in 2003, several school districts adopted mechanisms advocated in this paper. These school districts include:
  - New York City
  - Boston
  - Chicago
  - Denver
  - New Orleans
- Perhaps more strikingly, these mechanisms are adopted throughout England by all local authorities (more than 150 of them) by 2007.

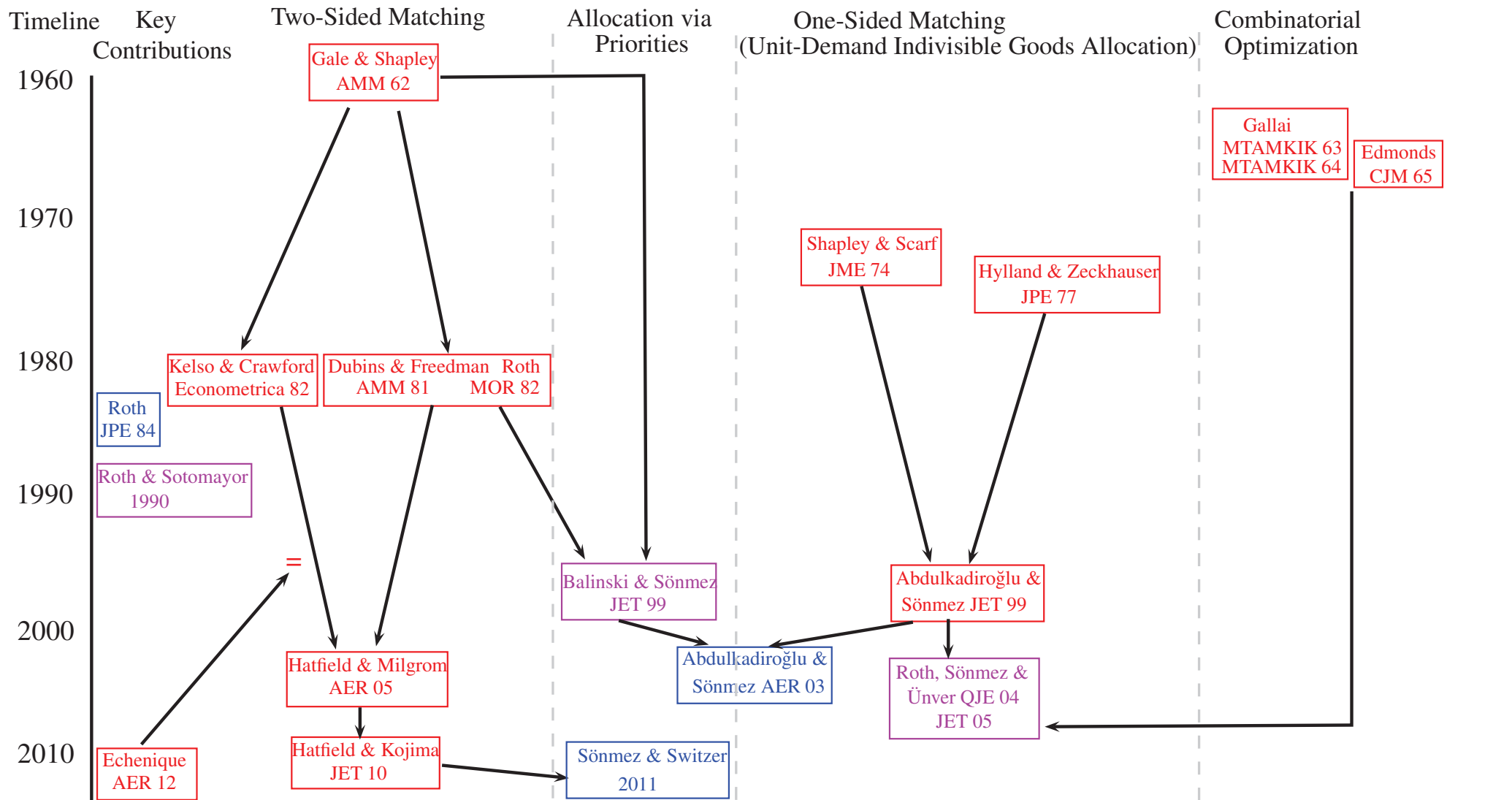
## What is Happening?

- In this series of lectures, we will see that the catalyst for the recent success of matching theory has been the strong theory tradition pioneered by Gale & Shapley coupled with careful modeling bringing the theory and the practice closer.
- Prior to 1990s, research on matching was mostly focused on two-sided matching markets.  
The influential monograph of Roth & Sotomayor (1990) gives a very clear picture of the focus of matching literature in this era.
- While Shapley & Scarf (1974) and Hylland & Zeckhauser (1977) introduced two early models of “one-sided matching,” these models received much less attention until the late 1990s.

# The Rise of One-Sided Matching

- This trend has changed considerably starting with late 1990s. Not only the focus on one-sided matching models increased, matching theorists developed new models at the interface of one-sided matching and two-sided matching.
- It is this recent trend which eventually lead to a number of new applications, including school choice and kidney exchange.
- The last few years have also seen significant advances in two-sided matching theory with the introduction of Hatfield & Milgrom (2005) matching with contracts model.
- Having learned from past experience, market designers have immediately explored the potential links of this exciting model with one-sided matching.  
This approach has already resulted in a brand new application of matching theory: Cadet-branch matching.

# Matching Markets: The Path Between Theory & Practice



<p><b>Real Life Practice</b></p> <p>NRMP &amp; Various other labor markets summarized in Roth &amp; Peranson AER 99</p>	<p><b>School Choice Reforms in:</b></p> <ul style="list-style-type: none"> <li>  New York City</li> <li>  Boston</li> <li>  Chicago</li> <li>  Denver</li> <li>  England</li> </ul>	<p><b>Kidney Exchange Clearinghouses:</b></p> <ul style="list-style-type: none"> <li>  New England Program for Kidney Exchange</li> <li>  Alliance for Paired Donation</li> <li>  National Matching Scheme (England)</li> <li>  for Paired Donation</li> <li>  National KPD Pilot Program (USA)</li> </ul>	
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# Outline of the Lectures

- Thanks to Roth & Sotomayor (1990), the two-sided matching literature prior to 1990s is well-known.
- In these lectures our focus is the subsequent literature, with a special emphasis on the path between the theory and the practice.
- The lectures are organized as follows:
  - Lecture 1: Overview and One-Sided Matching
  - Lecture 2: Kidney Exchange
  - Lecture 3: School Matching
  - Lecture 4: Cadet-Branch Matching