

An Examination of the Inapplicability of Monetary Payments in Establishing Equilibrium in Matching Markets: Analyzing Supply and Demand Balance

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Abstract: Matching markets constitute a distinct market structure in which the balance between supply and demand cannot be achieved through traditional monetary payment mechanisms. This paper, through a literature review, explores the limitations of monetary payments in matching markets, including ethical and legal constraints, the non-quantifiability of preferences, insufficient market thickness and liquidity, and issues of fairness. Findings indicate that the realization of supply and demand balance in matching markets relies on non-monetary mechanism designs, such as stable matching algorithms. This study offers a new perspective for understanding the operational mechanisms of matching markets and offers theoretical support for related policy designs.

Keywords: monetary payment, supply-demand balance, matching market, stable matching, non-monetaryization mechanism

1. Introduction

Matching markets represent a distinct market structure in which supply and demand cannot be balanced through traditional monetary payment mechanisms.

In traditional markets, monetary payment regulates the supply and demand through the price mechanism to achieve the effective allocation of resources. However, in matching market, the realization of the balance of supply and demand often relies on non-monetaryized mechanism design. Through a literature-based analysis, this paper explores the limitations of monetary payment in the matching market and proposes the design ideas of alternative mechanisms.

The research focuses on three following aspects: First, the role of monetary payment in traditional markets and its limitations in matching markets;

second, the definition and characteristics of matching markets; and third, the design of alternative mechanisms and their application in matching markets. adopting a literature review approach, this study analyzes existing research to identify the reasons behind the limitations of monetary payments in matching markets.

The significance of this research lies in providing a new perspective for understanding the operation mechanism of the matching market and offering a theoretical basis for the design of relevant policies. By addressing the limitations of monetary payment in the matching market, this paper offers new insights for the mechanism design of the matching market.

2. The role of monetary payment in traditional markets

In traditional markets, monetary payment serves as a pivotal instrument in regulating supply and demand, operating primarily through the price mechanism to achieve the effective allocation of resources. This price mechanism functions by dynamically adjusting market prices in response to fluctuations in supply and demand, thereby facilitating a balance that is essential for the smooth functioning of the market economy. The adjustment process is straightforward yet profound: when demand for a particular good or service rises, its price typically increases, signaling to producers the opportunity for higher profits and encouraging them to expand production. Conversely, if demand falls, prices tend to drop, prompting producers to reduce output and prevent surpluses. This continuous interplay of price adjustments helps to align the quantity of goods and services supplied with the quantity demanded, leading to a state of market equilibrium.

Moreover, monetary payment acts as a crucial tool for information transmission and resource allocation within traditional markets. It conveys vital information about the relative scarcity of goods and services, as well as the preferences of consumers, enabling both producers and consumers to make informed decisions. Producers can gauge which products are in demand and adjust their production accordingly, while consumers can assess the value of different goods and allocate their spending efficiently. As Smith emphasized in **The Wealth of Nations**, the price mechanism is the cornerstone of the market economy, and monetary payment, through its role in transmitting price signals, serves as the linchpin that guides the allocation of resources. This dual function of monetary payment—both as a regulator of supply and demand and as a conduit for market information—underscores its indispensable role in maintaining the efficiency and stability of traditional markets [1].

3. Definition and characteristics of market matching

Matching market is a special form of market, in which supply and demand balance cannot be achieved through traditional monetary payment mechanisms. The characteristics of matching markets include non-monetaryization, bilateral matching and preference ranking. In matching markets, the realization of supply and demand balance often relies on the design of non-monetary mechanisms. Roth and Sotomayor elaborated on the definition and characteristics of matching markets in their book *"Two-Sided Matching"*, pointing out that the core of matching markets lies in the preference ranking of both participants [2].

4. Limitations of monetary payments in matching markets

4.1. Ethical and legal restrictions

In the realm of matching markets, the introduction of monetary payment often encounters significant ethical and legal barriers, particularly in contexts where human welfare and dignity are at stake. The organ transplantation market serves as a poignant example, where the notion of monetary compensation for organs can lead to exploitative practices such as organ trafficking. This not only raises profound ethical concerns regarding the commodification of human body parts but also violates legal frameworks in many jurisdictions that explicitly prohibit the sale of organs. The ethical dilemma stems from the potential for vulnerable populations to be coerced into selling their organs due to financial desperation, thereby undermining principles of fairness and human rights.

Alvin Roth, in his seminal work, highlighted the unique nature of the organ transplantation market, emphasizing that the ethical and legal implications render monetary payments impractical. He argued that the introduction of monetary incentives could distort the motivations of donors and recipients, leading to inequitable outcomes and eroding public trust in the system. For instance, if

monetary payments were allowed, wealthier individuals might gain preferential access to organs, exacerbating existing social inequalities. Moreover, the commodification of organs could deter altruistic donations, which are often driven by a sense of moral duty rather than financial gain.

Consequently, the reliance on non-monetarized matching mechanisms, such as altruistic donation and waiting list systems, becomes imperative to ensure ethical integrity and legal compliance. These mechanisms prioritize medical urgency and compatibility over financial capacity, thereby aligning the allocation process with principles of equity and justice. By eliminating monetary incentives, such systems aim to preserve the dignity of donors and recipients while maintaining public confidence in the fairness of the organ transplantation process. Roth's insights underscore the necessity of designing matching mechanisms that are not only efficient but also ethically sound, particularly in markets where human lives and societal values are at stake [3].

4.2. Preferences cannot be quantified

Matching markets are characterized by the complexity of preferences, which are often subjective and deeply personal, making them inherently difficult to quantify in monetary terms. The marriage market serves as a quintessential example of this phenomenon, where individuals' preferences are shaped by a myriad of intangible factors such as emotional connection, shared values, personal chemistry, and long-term compatibility. These elements are inherently qualitative and resist monetization, as they cannot be objectively measured or assigned a financial value. Attempting to quantify such preferences through monetary payment would not only oversimplify the decision-making process but also fail to capture the nuanced and multifaceted nature of human relationships.

Gale and Shapley's groundbreaking stable matching algorithm provides an elegant solution to this challenge by shifting the focus from monetary valuation to the systematic ranking of preferences. Their algorithm operates by allowing participants to rank their potential matches based on their subjective preferences, thereby creating a structured framework for pairing individuals in a way that maximizes mutual satisfaction. This approach ensures that matches are stable, meaning no pair of participants would prefer each other over their current matches, thus eliminating the possibility of instability or dissatisfaction in the outcomes. By prioritizing the inherent preferences of individuals rather than relying on monetary incentives, the stable matching algorithm aligns with the fundamental nature of matching markets, where subjective value and personal compatibility take precedence over financial considerations.

The success of the stable matching algorithm in contexts such as the marriage market underscores its broader applicability to other matching markets where preferences are similarly complex and non-monetizable. For instance, in labor markets, job seekers and employers often prioritize factors such as cultural fit, career growth opportunities, and job satisfaction over purely financial compensation. By leveraging preference ranking rather than monetary valuation, the algorithm ensures that matches are not only efficient but also aligned with the intrinsic values and priorities of the participants. This approach highlights the importance of designing mechanisms that respect the subjective nature of preferences, particularly in markets where human relationships and personal fulfillment are central to the matching process [4].

4.3. Market breadth and liquidity

Matching markets typically operate with a limited number of participants, which can pose significant challenges for the effectiveness of monetary payments. In markets with few participants, such as the matching of medical school graduates with hospitals, the use of monetary incentives may lead to market failure due to insufficient liquidity and breadth. For instance, if hospitals were

to compete for graduates primarily through financial offers, smaller or less financially endowed institutions might be systematically disadvantaged, unable to match the lucrative packages offered by larger, wealthier hospitals. This imbalance could result in an inefficient allocation of talent, where graduates are drawn to institutions based on financial incentives rather than alignment with their professional goals, institutional culture, or the needs of the healthcare system. Such a scenario not only undermines the fairness of the matching process but also risks creating long-term disparities in the quality of healthcare services across different regions and institutions.

Alvin Roth's research on medical school matching markets provides compelling evidence that non-monetary mechanisms, such as centralized matching algorithms, can effectively address these issues. These algorithms prioritize the preferences of both graduates and hospitals, ensuring that matches are made based on mutual fit rather than financial capacity. By removing monetary incentives from the equation, the system fosters a more equitable distribution of graduates across institutions, regardless of their financial resources. This approach not only enhances the efficiency of the matching process but also promotes fairness, as it allows smaller or less affluent hospitals to compete on an equal footing with larger institutions. Roth's findings highlight the importance of designing market mechanisms that account for the unique characteristics of matching markets, particularly their limited participant pools and the potential for financial disparities to distort outcomes.

Moreover, the success of non-monetary mechanisms in the medical school matching market underscores their broader applicability to other matching markets with similar characteristics. For example, in residency programs, academic placements, or even certain labor markets, the use of centralized algorithms can help mitigate the risks of market failure by ensuring that matches are based on qualitative factors such as skills, preferences, and institutional needs rather than financial incentives. This not only improves the stability and efficiency of the market but also aligns outcomes with the broader societal goals of equity and resource optimization. Roth's work demonstrates that, in markets where monetary payments may lead to inefficiencies or inequities, non-monetary mechanisms offer a viable and often superior alternative for achieving stable and fair outcomes [5].

4.4. The issue of fairness

The introduction of monetary payments in matching markets can exacerbate existing inequalities and fundamentally undermine the principle of social fairness. In the context of school choice, for example, reliance on monetary payments for admissions could lead to a skewed distribution of educational resources, favoring wealthier families who can afford to pay for access to high-quality schools. This dynamic not only reinforces socioeconomic stratification but also contradicts the foundational ideal of equal opportunity in education, as children from less affluent backgrounds are systematically excluded from the best educational opportunities. Over time, such disparities can perpetuate cycles of poverty and inequality, as access to quality education is a critical determinant of future economic and social mobility.

Abdulkadiroğlu and Sönmez have extensively analyzed the fairness issues inherent in school choice markets and have emphasized the necessity of addressing these challenges through non-monetary mechanisms. They argue that monetary payments distort the allocation process by prioritizing financial capacity over merit, need, or genuine preference alignment. To counteract this, they advocate for the implementation of fair allocation algorithms, such as the deferred acceptance mechanism, which prioritize equitable access to educational resources. These algorithms ensure that students are matched to schools based on objective criteria, such as proximity, academic performance, or lottery systems, rather than their ability to pay. By removing financial barriers, such mechanisms promote a more just and inclusive distribution of educational opportunities,

allowing all students, regardless of their socioeconomic background, to have a fair chance of attending their preferred schools.

The adoption of non-monetary mechanisms in school choice markets not only addresses issues of fairness but also enhances the overall efficiency and stability of the matching process. For instance, centralized algorithms can reduce the administrative burden on families and schools by streamlining the application and allocation process, while also minimizing the potential for strategic behavior or manipulation. Furthermore, these mechanisms align with broader societal goals of promoting social justice and reducing inequality, as they ensure that access to quality education is determined by factors that are more equitable and transparent. Abdulkadiroğlu and Sönmez's work highlights the critical role of well-designed matching mechanisms in achieving fair and efficient outcomes, particularly in markets where the stakes are high and the potential for inequality is significant. By prioritizing fairness over financial incentives, such approaches help to create a more just and equitable society, where opportunities are distributed based on merit and need rather than wealth [6].

5. Design of the alternative mechanism

In the matching market, the design of the mechanism for substituting monetary payment is of vital importance. The stable matching algorithm (such as the Gale-Shapley algorithm) is a commonly used alternative mechanism. This algorithm achieves balance between supply and demand through preference ranking and bilateral matching. Roth further expanded the application scope of the stable matching algorithm and proved its effectiveness in various matching markets [7].

Take the matching market between medical school graduates and hospitals as an example to illustrate why monetary payment is not feasible in these markets and how the alternative mechanism operates. In this market, monetary payment may lead to market failure, while the stable matching algorithm achieves balance between supply and demand through preference ranking and bilateral matching. Roth's research shows that the non-monetaryization mechanism has achieved remarkable success in this market [5].

6. Conclusion

This paper conducts a literature analysis to examine the limitations of monetary payments in matching markets and suggests alternative mechanisms for achieving supply-demand balance. The study reveals that in contrast to traditional markets, where monetary payments effectively regulate resource allocation, matching markets depend on non-monetary mechanisms, such as stable matching algorithms, to facilitate the equilibrium between supply and demand. These non-monetary mechanisms address challenges such as the non-quantifiability of preferences, ethical considerations, and the need for fairness, which are often absent in conventional market structures.

However, the research presented here has certain limitations. The scope of analysis is confined to theoretical frameworks and existing literature, and the empirical validation of the proposed mechanisms is lacking. Future studies could expand the range of case analyses, incorporating real-world examples from various sectors (e.g., labor markets, healthcare, education) to assess the practical implications and effectiveness of non-monetary mechanisms. Furthermore, the inclusion of empirical data would provide a more comprehensive understanding of how these mechanisms function in diverse contexts and enhance the reliability of the theoretical models.

Additionally, future research could explore the integration of monetary and non-monetary mechanisms in hybrid market models, as well as the role of technology and algorithmic advancements in improving the efficiency and fairness of matching processes. Such studies would offer valuable insights into how matching markets can evolve to better meet the needs of both

participants and policymakers. Overall, this paper contributes to a deeper understanding of the operational dynamics of matching markets and lays the groundwork for future research that bridges the gap between theory and practice.

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