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MARKETPLACE INSTITUTIONS RELATED TO THE TIMING OF TRANSACTIONS

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**ABSTRACT**

This note describes the unraveling of transaction dates in several markets, including the labor markets for new lawyers hired by large law firms and for gastroenterology fellows, and the market for post-season college football bowls. Together these will illustrate that unraveling can occur in markets with competitive prices, that it can result in substantial inefficiencies, and that marketplace institutions play a role in restoring efficiency. I'll conclude with open questions about the role of marketplace institutions and the timing of transactions.

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Marketplace institutions related to the timing of transactions, and reply to Priest (2010)

By Alvin E. Roth<sup>1</sup>

10/18/10

**Abstract:** This note describes the unraveling of transaction dates in several markets, including the labor markets for new lawyers hired by large law firms and for gastroenterology fellows, and the market for post-season college football bowls. Together these will illustrate that unraveling can occur in markets with competitive prices, that it can result in substantial inefficiencies, and that marketplace institutions play a role in restoring efficiency. (All of these contradict the conclusions of Priest, 2010). I'll conclude with open questions about the role of marketplace institutions and the timing of transactions.

## 1. Introduction

This note is, first, a response to Priest's (2010) paper, "*Timing 'Disturbances' in Labor Market Contracting: Roth's Findings and the Effects of Labor Market Monopsony.*" Priest writes to rebut what he describes as "The work of Alvin E. Roth and colleagues writing in what might be described as the *Roth tradition*"<sup>2</sup> about "a curious set of phenomena in some labor and product markets."

This note also provides a brief description of phenomena concerning the timing of transactions, and the labor market institutions that have evolved or been designed to deal with them. I will conclude with some open problems concerning how marketplaces deal with issues of timing, both in labor markets and other kinds of markets.

Briefly, the "tradition" Priest addresses has studied the timing of transactions, and observed that some markets go through episodes in which they *unravel* in time, with transactions becoming earlier and more diffuse in time from year to year, and with offers often coming to have very short durations ("exploding" offers). This has often led to changes in marketplace institutions, to introduce a uniform time for market transactions, to restore thickness to the market. Frequently this involves facilitating a marketplace at a later as well as a more uniform time. (For overviews, see Roth and Xing 1994, and Niederle and Roth 2009.)

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I gratefully acknowledge helpful comments from Christine Jolls and Muriel Niederle, and support from the National Science Foundation.

<sup>2</sup> Emphasis added, but a search reveals that the name "Roth" shows up 78 times in Priest (2010).

Priest claims timing problems arise only when prices cannot adjust freely, and that timing problems do not arise in markets with adjustable prices:

“Time-of-contracting “problems” could be eliminated...by removing the monopsony or monopoly conditions and allowing price to serve as the market clearing mechanism.”  
(Priest, 2010, p450)

I will explain why in fact it seems likely that there are many different causes of unraveling, some of which apply no matter how freely prices are adjustable. And I’ll describe unraveling in markets in which prices adjust freely, to explain why Priest’s claim is empirically false.

For example, Priest contrasts the market for law graduates who seek judicial clerkships, a market which has had serious timing problems and in which wages are set by Congress, with the market for law students seeking jobs with law firms, which he claims has not experienced timing problems. Specifically, Priest (2010, p453) says:

“...scholars in the Roth tradition have not explained why there is a troublesome acceleration of offers with respect to the market for medical residents and federal judicial clerks, but not apparently with regard to other postgraduate labor markets, say, for the markets for law students not choosing to clerk...”

But, as I will discuss in the next section, this characterization of the larger law market is incorrect: the market for entry level positions in large law firms has persistently experienced episodes of unraveling, and over several decades the legal community has attempted to establish marketplace institutions and rules to control this unraveling, with only limited success. (For an account of unraveling in the non-clerk law market, see Roth and Xing (1994), which is brought up to date below. For an account of unraveling in the clerkship markets, see Roth and Xing (1994) and Avery, Jolls, Posner and Roth (2001, 2007)).)

This reply will have three main parts in addition to this introduction, each with copious supporting references to relevant empirical observations (often from the “tradition” Priest criticizes). Section 2 briefly describes unraveling in three markets: the market for new hires by law firms, the market for post-season college football bowls, and the market for new hires in gastroenterology. These will illustrate that unraveling can occur in markets with competitive prices, and that it can result in substantial inefficiencies.

Section 3 further indicates where Priest’s other specific predictions, descriptions, and conclusions are contradicted by the evidence, and why his conclusions about the timing of transactions do not follow at all from his model (in which time is not modeled at all). More productively, section 4 describes some of the many unanswered questions associated with the study of the timing of transactions, and the role and design of marketplaces.

To foreshadow the open questions, a great deal is still unknown about how labor markets and other matching processes clear, and the role that marketplace institutions play. We understand much more about how price clears markets for simple commodities. And even competitive commodity markets develop institutions related to the timing of transactions (such as the opening and closing times of the NY Stock Exchange), intended to foster a thick market. But in lots of markets, unlike commodity markets, you can't simply *choose* what you want, even if you can afford it, you also have to be *chosen*. Thus prices seem to play a different role in clearing "matching markets" than in markets for commodities.

For example, colleges don't raise tuition until exactly enough applicants remain to fill the available places, nor do universities lower the wage of assistant professors until just enough remain. Instead, there's courtship on both sides; not only do students have to apply to selective colleges, but colleges have to woo their admitted students, who are also admitted to other colleges, and similarly for highly skilled professionals and the firms from which they seek employment and which seek to employ them. This can take time; time for interviews and offers and visits and negotiations, and acceptances and rejections. Consequently these markets can experience *congestion* (cf. Roth and Xing 1997), when participants find they have insufficient time to evaluate the different possible transactions they face. So the marketplace institutions and practices that mediate these "matching markets" must address the fact that transactions are time consuming.

The emerging research tradition that seeks to understand how marketplaces deal with these issues and many others, and sometimes succeed and sometimes fail, and can sometimes be fixed when they are broken, is called *market design* (cf. Roth 2002a, 2008a).

## **2. Introduction to unraveling**

### **Hiring by large law firms:**

A July 2010 announcement from Northwestern University School of Law gives a clue that there presently is unraveling in the market for new lawyers seeking employment in law firms, and efforts are being made to resist it (see also Rampell 2010). The announcement begins:

"Northwestern University School of Law and the global law firm Jones Day announced today July 26 that the firm will conduct its on-campus interviews for 2011 summer associates in September instead of during the law school's official on-campus interviewing (OCI) program, which begins Aug. 11. ...

*"Jones Day joins Northwestern Law in the belief that the current recruitment system has created a competitive race among law schools and law firms to conduct on-campus interviews earlier. The result is an inefficient system that does not serve employers or student applicants well, according to the law*

*school and law firm.* ”<sup>3</sup> (emphasis added)

The announcement refers to the 2010 interviewing and hiring of *summer associates* for the summer of 2011, after they will have finished only their second year of law school. That is, the movement to earlier interview dates means that the competition to find summer employment and summer employees for the summer after the second year of law school has now moved a year in advance, to the summer after the first year. This unraveling of interview dates is what Northwestern and Jones Day are trying to halt or reverse by delaying interviewing until September.

Why are summer hires important? Because at the biggest law firms, much of the hiring of full time associates, who join the firm after the completion of their third year of law school, has unraveled into the summer associate market; i.e. the competition for summer associates is fierce because summer associates largely become full time employees. According to the NALP (formerly known as the National Association for Law Placement), this has been only somewhat eroded by the recent financial crisis: in 2009, large firms offered 69% of summer interns a full-time job, down from about 90% in 2004-8, but with a corresponding increase of acceptances to about 85%, up from the high 70's (NALP, 2010a). With the unraveling of interviews for summer associate positions, this means that much of the hiring of law school graduates by big law firms has moved to the summer after their first year of law school, two years before they will begin full time employment.

Why might this possibly be inefficient? There are many possibilities (of which more below), but one that was made starkly clear by the recent economic crisis (which reduced demand for outside legal services) is that hiring more than a year before the start of employment makes it difficult for firms to forecast their demand. For example, thousands of the summer associates at large firms who accepted permanent offers shortly after their second year summer associateships in August 2008 (for permanent jobs in 2009), had them rescinded or deferred. The NALP reports:

“From the employer perspective, over half of the summer 2008 associates (class of 2009 graduates) accounted for in the survey were deferred beyond December 1, 2009. While it is impossible to determine the exact number of associates whose start dates were deferred, analyses of the survey data from law schools and law firms suggests that the number was at least 3,200 and could be as high as 3,700.” NALP (2010b).

That is, after being recruited two years in advance of employment, and accepting a position one year in advance of employment, and therefore declining or not searching for other opportunities, thousands of lawyers graduated in June 2009 only to be told that the position they had accepted was not available. And some of the law firms, to maintain their reputation and their relationships, paid the deferred employees a part of what would have been their

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<sup>3</sup> <http://www.northwestern.edu/newscenter/stories/2010/07/law-school-on-campus-recruitment.html>

starting salary and encouraged them to spend a year doing *pro bono* work (see e.g. Petak, 2010).

Roth and Xing (1994) note that firms similarly withdrew positions from law graduates in 1991, following unraveling in the 1980's that sometimes resulted in hiring as much as a year earlier than we are presently seeing:

“by the middle of the 1980's the unraveling of recruiting had proceeded to such an extent that some students were being offered summer associate positions before they had matriculated at law school.” (Roth and Xing 1994, p1005).

Then, as now, there was considerable concern that many of these early offers were also exploding offers. In an attempt to regulate the market, the NALP, formed in 1971, issued regulations intended to govern the timing and duration of offers by law firms.<sup>4</sup> For instance, one of the regulations adopted in 1988 specified that offers should remain open for at least two weeks, and others specified dates until which offers should remain open. But Roth and Xing (1994, p1007) note that

“some law firms began to give offers which met the letter of [these regulations], but which structured the compensation so that the offer was competitive because it included a ‘signing bonus’ which could only be collected if the offer was accepted much more promptly.”

In response to such strategic behavior, the NALP rules have been modified repeatedly, in 1985, 1988, 1992, 1994, 2002, 2004, 2005, 2009, and 2010. The 2010 rules (NALP 2010c), in the section “General Standards for the Timing of Offers and Decisions” include several variations on the following (some of which specify 28 days instead of two weeks, for different categories of candidates, e.g. first year students).

“All offers to law student candidates (“candidates”) should remain open for at least two weeks after the date of the offer letter...”

Other regulations specify times before which offers should not be made:

“Prospective employers and first year law students should not initiate contact with one another and employers should not interview or make offers to first year students before December 1.”

An accompanying document called “Interpretations” (NALP 2010d) includes

**Q.** May employers offer signing bonuses that decline or evaporate according to the date of acceptance of the offer of employment?

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<sup>4</sup> The preamble to the NALP rules includes the following ( <http://www.nalp.org/principles>, emphasis added):

“NALP's Principles & Standards are guidelines that offer an ethical framework for all participants in law student recruiting. They guide *the timing of responses to offers* and set forth the obligations of all participants in the recruiting process. Compliance with the Principles is voluntary, yet virtually all ABA-accredited law schools and many of the nation's legal employers subscribe to these guidelines.

“NALP also offers interpretations of the Principles that provide guidance for dealing with specific difficult recruiting situations, such as *signing bonuses*, *exploding offers*, establishing a waiting list, and first year recruiting.”

**A.** This type of signing bonus violates the letter and spirit of the Principles & Standards.... Signing bonuses or other benefits that require a decision in advance of the dates in Part V or that vary according to the date of acceptance are considered special inducements and violate this provision.

The history of these regulations and the frequent adjustments to them reflects a market in which many participants have great respect for obeying the “letter of the law,” but devote considerable ingenuity to circumventing its spirit.

In summary, both local (campus recruiting) and national (NALP) marketplace institutions have developed to try to coordinate the market, and regulate and contain unraveling of the market for law graduates going to law firms. However, the conclusions of Roth and Xing (1994, p1007) about this market still seem timely (emphasis added):

“Thus in the market for new associates, particularly new associates in the largest law firms, attempts to halt the unraveling of recruiting and of appointment dates have been unsuccessful, as have attempts to establish uniform dates (however early) for recruiting and hiring. *Thus the problems of unraveling are not confined to markets in which salaries cannot be easily adjusted to help clear the market.*”

#### **The market for post-season college football bowls:**

In many markets it is difficult or impossible to quantify the effects of unraveling on efficiency, because it is hard to measure the output of the market (and hence difficult to draw conclusions, for example, about how unraveling in the markets for law graduates affects the production of justice). So it is useful to look at unraveling in markets in which efficiency losses can be measured. The market for post-season college football games provides such an opportunity.

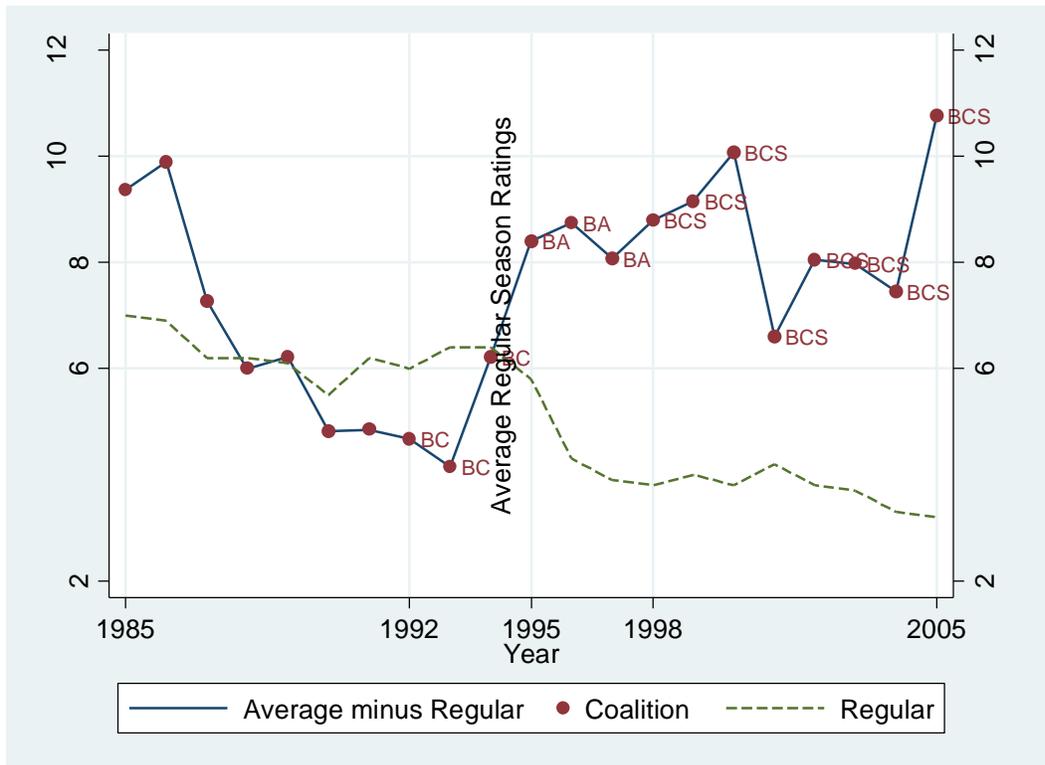
Briefly, college football teams play each other on weekends throughout the Fall, and college bowls are businesses that operate stadiums that each host a post-season game between two teams that had successful seasons. Roth and Xing (1994) note

“The National Collegiate Athletic Association (NCAA) tried for a number of years to prevent unraveling of the dates at which bowls and teams finalized agreements about which teams would play in which bowls. However it gave up in failure following the 1990-91 football season.”

The costs of unraveling in this market are connected to the fact that if two teams are matched to play a postseason game before they have finished the regular season, it is possible that one or both will lose some of their remaining regular season games, making the postseason game less attractive than it would have been if it had featured more successful teams.

Starting in 1992, and subject to many subsequent modifications, various consortia of bowls and football conferences (called the Bowl Coalition, the Bowl Alliance, and the Bowl Championship

Series) have tried to increase the probability of good matchings of teams, by making the market thicker (including more teams and bowls in the pool from which matches can be made), and delaying the determination of matchings until after the regular season games have all been concluded. Fréchette, Roth, and Ünver (2007) point out that, if we take television viewership to be a reasonable proxy for what this industry produces, unraveling produced very inefficient matches, compared to those that have been achieved when the market was thicker and later. The figure below, from that paper, shows how television viewership recovered as unraveling was reversed.<sup>5</sup>

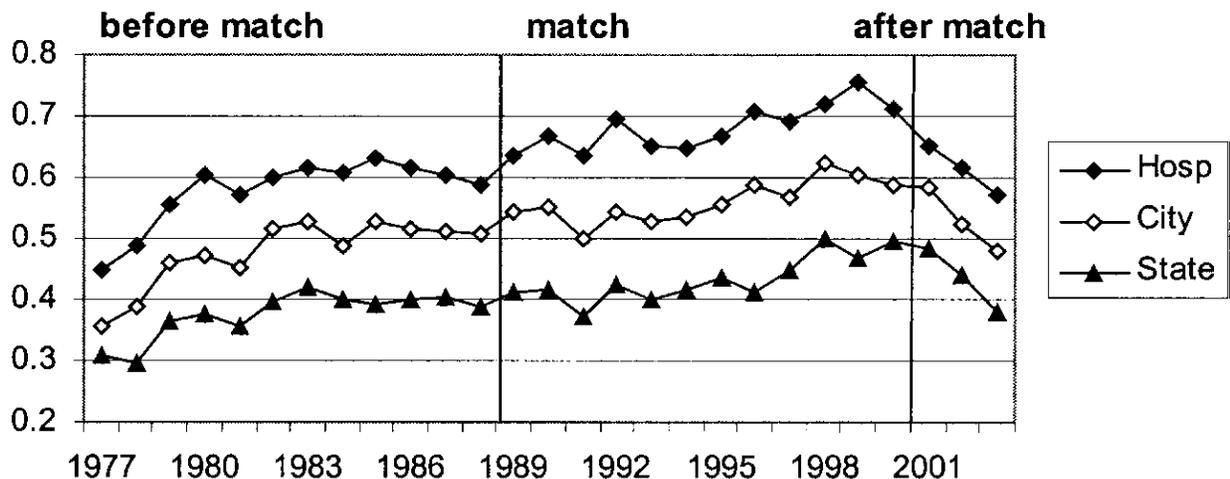


Television viewership dropped as the market unraveled prior to 1992, but picked up again after unraveling was reversed and the market was gradually made thicker, and more “championship” games were produced. Details are in Fréchette, Roth, and Ünver (2007), who conclude that the reorganization of the football bowl market increased efficiency by delaying the market so that it could operate after end of regular season rankings were known, allowing matches to be made among the highest ranked teams.

### The market for gastroenterologists

<sup>5</sup> The figure shows the average Nielsen ratings per year in the BCS Bowls, normalized by subtracting the average regular-season college football ratings for that year.

Unraveling can have profound effects on who matches with whom. A market that illustrates this clearly is the labor market for gastroenterology fellows (a position that is open to board certified internists who wish to pursue gastroenterology as a subspecialty). After experiencing unraveling similar to that for other entry-level medical positions (cf. Roth 1984, 2003, Harner et al. 2008), the market for gastroenterology fellows employed a centralized labor market clearinghouse, a “match,” starting in 1986. But starting after a shock to the market in 1996 (see McKinney, Niederle and Roth 2005), fellowship directors and potential fellows started to reach agreements before the match, and over the next few years the market unraveled. One consequence of this is that what had previously been a national market broke apart into much more regional markets, as fellows became much less likely to change hospitals, cities, or states when they moved from their internal medicine position to their gastroenterology fellowship. The figure below, from Niederle and Roth (2003), gives an indication of this effect of unraveling on the market. Unraveling affected not only the timing of the market, but also narrowed its scope. (Since 2006, the gastroenterology fellowship market has successfully reinstated a match, which required an intervention to make exploding offers less common, see Niederle and Roth 2004, 2005a,b, 2009a,b, and Niederle, Proctor and Roth 2006, 2008).



Share of mobility of gastroenterology fellows for each year. The vertical lines indicate the beginning and the end of the use of the centralized match, measured in year of fellowship completion. (from Niederle and Roth, 2003)

These examples of markets that have experienced unraveling show that unraveling occurs even in markets with adjustable prices, and it happens even in cases when the outcome is inefficient.

Even these three examples start to suggest that unraveling takes place in different kinds of markets, seemingly for different reasons. I’ve argued elsewhere that unraveling can have many causes, because markets are highly multidimensional and time is only one dimensional (and so transactions can only move in two directions in time, earlier or later). So there can be many

different reasons that make it advantageous for a market participant to try to make transactions earlier.<sup>6</sup>

After discussing several different causes of unraveling, Roth and Xing (1994, p1038) put it this way:

“We do not claim that these are the only causes of unraveling. On the contrary, unraveling seems to occur in a sufficiently wide range of markets so that it is likely that there are many causes.”

Priest (2010), in contrast, claims that unraveling has a single cause, rigid prices. He further claims (see below) that dealing with unraveling and its effects consequently requires no marketplace regulations or institutions.

### 3. Reply to Priest

As indicated above, Priest makes three principal claims (Priest, 2010, p450):

1. “This paper will attempt to demonstrate that the source of the early contracting phenomena in labor markets is labor market monopsony; in product markets, monopoly.”
2. “It is an implication of this demonstration that the proposals of those in the Roth tradition to introduce engineered matching programs to solve the purported ‘market failure’ serve, in fact, to shore up the monopsonies or monopolies that generate the problem.”
3. “Time of contracting ‘problems’ could be eliminated—and in many other labor and product markets are eliminated--by removing the monopsony or monopoly conditions and allowing price to serve as the market clearing mechanism.”

Priest also presents a theoretical argument that he believes supports these claims, and I turn next to that, before continuing from the previous section the discussion of the empirical evidence.

Priest’s basic model is a set of intersecting supply and demand curves to illustrate that if prices aren’t personal (e.g. if, as in the market for judicial clerks, all clerks for all judges receive the same wage), but if workers and employers are heterogeneous, then the fixed prices won’t clear the market in the sense that they don’t make workers indifferent between different employers or employers indifferent between different workers.

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<sup>6</sup> There can also be strategic reasons to *delay* transactions; see e.g. Roth and Ockenfels (2002) and Ockenfels and Roth (2006) on late bidding in internet auctions, and the experiment of Ariely, Ockenfels and Roth (2005).

From this observation, he makes a verbal leap to conclude that judges will make early offers, unraveling will result, and that this will restore efficiency.<sup>7</sup> I call this a “verbal” leap because *time* nowhere enters into Priest’s static model. Why will early contracting and not late contracting be the response to this inefficiency?<sup>8</sup> Or why wouldn’t judges simply make offers to the applicants they like best? Or to those who like them best? Priest’s model is completely silent on how agents might respond to inefficiencies caused by fixed prices, because his model *doesn’t include actions of any kind*. Neither does it include time in *any* way, neither as an action (e.g. to hire earlier or later), nor as a factor in when information is revealed, etc.

Note that the literature contains a number of models of early contracting. Priest cites one, by Li and Rosen (1998), but he is apparently unaware that the conclusions of that model contradict his own. Li and Rosen study early contracting that arises as insurance against future states of the world, at equilibrium *in a fully competitive model, with freely adjustable prices*. (Their model, of course, unlike Priest’s, includes both an early and a late period, and allows employers to decide when to make offers, and workers to decide whether to accept them, and considers an equilibrium of the resulting game.) There are a variety of illuminating models of early contracting and unraveling, with and without adjustable prices.<sup>9</sup> These models reflect some of the diversity of the causes of unraveling and early contracting that we also see in the world. See for example Damiano and Suen (2005), Fainmesser (2010), Halaburda (2010), and Li and Suen (2000, 2004).<sup>10</sup>

Even a claim without theoretical support could have empirical content, so let us now return to the evidence. Priest supports his conclusions with the closely related claim that unraveling does not occur except in monopolistic markets, and names several markets which he asserts are free of unraveling including

“MBA’s, other graduating professionals, or for that matter, college or high school graduates, where early contracting has not been observed” (Priest, 2010, p450);

and,

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<sup>7</sup> E.g. Priest, p459: “Figure 3 also explains why judges and students accelerate the hiring process. As drawn, some students with ability represented on the  $MRPL_1$  curve would accept an offer from a judge whose nonwage benefits equaled only  $w_b$  but of course would prefer an offer from a  $w_a$  judge.”

<sup>8</sup> Indeed, while most judges seem to be trying to hire law students earlier, there is a still small but growing number of judges who are hiring later, by hiring law graduates instead of current law students (see Sloan, 2010).

<sup>9</sup> The distinction between models of simple early contracting versus unraveling in all its detail is a useful one, since models such as Li and Rosen look at early and late markets that are both thick and competitive, i.e. without exploding offers or diffuse timing that makes some decisions occur in thin markets.

<sup>10</sup> There are also models of price compression due to impersonal prices; see Kamecke (1998) and Bulow and Levin (2006), both proposed as models of the resident match, although Kojima (2007) and Niederle (2007) subsequently point out that Bulow and Levin’s conclusions are tied to parts of their model (one resident per hospital and no possibility of personal prices, respectively) that do not fit the actual medical match, which presently uses a clearinghouse algorithm designed by Roth and Peranson (1999). See also Azevedo (2010) for a different approach.

“the markets for law students not choosing to clerk,” (Priest, 2010, p453).

Priest, a law professor, uses this latter market as his central example that unraveling can't happen in competitive markets, writing

“Given the large number of competing law firms within any state, it is implausible that law firm salaries are set oligopsonistically but instead represent competitive market salaries for new law graduates.” (Priest, 2010, p464)

So Priest's claim that there is no unraveling in the market for new hires by law firms provides what he counts as an important demonstration of his conclusion that unraveling doesn't occur in competitive markets, and that prices alone clear such markets without intervening marketplace institutions.

*But as the previous section shows, the evidence from the law firm market makes it impossible to maintain that the market for law students going to law firms hasn't experienced unraveling, or that the result is always efficient, or that marketplace regulations and institutions haven't been formulated to deal with unraveling and its effects, despite the fact that wages are adjustable. (Recall in particular that the free adjustability of wages was even deployed in the form of time-dependent signing bonuses to circumvent rules against making early exploding offers.)*

In this section, more briefly, I'll point out that Priest's claims are also not justified for the other markets he mentions, each of which has experienced at least some episodes of unraveling.

Let's begin with high school graduates, many of whom are interested in going to college (a market that involves both variable announced prices and personalized discounts in the form of financial aid). The organization of colleges and high schools that tries to regulate the timing of transactions in this market is the National Association for College Admission Counseling, NACAC (<http://www.nacacnet.org/>).<sup>11</sup> These regulations accommodate the fact that many selective colleges now make the functional equivalent of early exploding offers through binding “Early Decision” programs that allow a student to apply to one school early by signing a contract to attend if admitted. Avery, Fairbanks and Zeckhauser (2003) recount the growth of these programs, in which unraveling has taken the form not of offers made increasingly early, but of

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<sup>11</sup> NACAC (2009), the latest edition of their guidelines on timing, states that their member colleges agree to “3. permit first-year candidates for fall admission to choose among offers of admission, financial aid and scholarships until May 1 ...; 4. not offer exclusive incentives that provide opportunities for students applying or admitted Early Decision that are not available to students admitted under other admission options;” and “12. not establish any application deadlines for first-year candidates for fall admission prior to October 15 and will give equal consideration to all applications received by that date.”

increasing percentages of admissions made through early offers. (E.g. Cohen, 2010 reports that last year Columbia University filled 59% of its seats through early admission.)

Note that college graduates seeking to go to graduate school (and the universities that seek to attract them) also work under rules concerning the timing of transactions promulgated by the Council of Graduate Schools, that set an April 15 deadline before which offers of financial aid should not explode (see McKinney et al. 2005).

Turning to MBA's, whose markets appear to have experienced only modest unraveling, efforts to regulate the timing of recruitment, duration of offers, etc., mostly seem to be made in a decentralized way by campus recruitment offices. Roth and Xing (1994) say

“The top MBA graduates from the most prestigious Business schools have for some years been regarded as attractive recruits for a variety of businesses. The most aggressive firms (e.g. consulting firms in the 1970's, and investment banking firms in the 1980's) have periodically engaged in early offers with short fuses. (Margaret Neale and Max Bazerman, 1991, p123 also describe a variation on exploding offers in which the offered salary goes down for every day that the candidate delays accepting.) Although we are not aware of any attempt to organize a market-wide response to such practices, the deans of particular business schools whose students are the subject of such offers have sometimes responded with threats to deny the offending firms easy access to their graduates, typically by denying them on-campus recruiting facilities.”

Readers on campuses with business schools should have no difficulty verifying that these concerns have cropped up repeatedly since then, at times of high demand. Similarly, undergraduate recruiting offices attempt, not always successfully, to discourage early exploding offers from consulting firms and investment banks who seek to compete in this way (as well as with wages) both with each other and with other sorts of firms.

Priest also takes up the discussion of medieval markets in Roth and Xing (1994) and argues that timing regulations there could not have had efficiency implications. While we can no longer directly observe medieval markets, readers who go to farmers' markets today may note that (as in the one near my house) they begin at a fixed time (sometimes marked by the ringing of a bell), and that sellers will hesitate to transact beforehand, and will meet with the disapproval of their neighbors should they attempt to. The issue seems to be that, if the vendors transact before the market bell, then some of them will start to set up their stalls earlier, some customers will come earlier, and an afternoon market could quickly unravel to become an all day market, requiring the vendors to devote more time to selling in a thinner market.<sup>12</sup>

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<sup>12</sup> At least in the market near my house, there are no King's men present to collect taxes, and some of the vendors operate on a cash basis with no cash registers or receipts, so it does not appear that a uniform starting time facilitates tax collection.

In addition to asserting, incorrectly, that unraveling does not occur in markets with adjustable prices (like the market for new hires by law firms), Priest (2010) also describes at some length the unraveling in the market for medical residents. I will simply note that, in places critical to his argument, this description also is incorrect.

For example, Priest (2010, p449) describes the resident match introduced in the 1950's as "a *mandatory* matching program" (emphasis added). A more accurate description would be "voluntary." (E.g. Mullen, 1950, spoke of trying to establish a "moral commitment" to participate, saying: "It would be impossible, as well as undesirable, to set up a central office with legal authority to assign interns to hospitals. It is not at all within the compass of this plan to force such developments.") In more recent years, as participation in medical labor market clearinghouses has become well established, rules have been written that have a more "mandatory" tone to them, but as I described above concerning the defection from the Gastroenterology match, there is in fact no mandatory element, in the sense that when participants wish to transact outside of a match they can. What does seem to be the case is that when a well designed centralized clearinghouse attracts sufficient participation, it becomes an equilibrium to participate.

But the distinction between voluntary and mandatory market mechanisms is important to Priest's argument, since he asserts that any voluntary arrangements that are observed (such as unraveling) must be optimal.<sup>13</sup> Of course this is not correct: one need only think of the prisoner's dilemma, or the general problems of efficiently providing public goods.<sup>14</sup>

In particular, voluntary participation in medical labor market clearinghouses has occurred without visibly changing wages. (Niederle and Roth 2003 compare wages of specialties that use a match with similar specialties that don't.) So the success of these clearinghouses at halting and reversing unraveling shows that the question of whether a market unravels is more complicated than how its wages adjust. The market for gastroenterologists unraveled despite having a clearinghouse, while other internal medicine specialties continued to use centralized clearinghouses. So, even if wages play a role in unraveling, they interact with other aspects of the market, and with marketplace institutions.

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<sup>13</sup> E.g. Priest, p454: "the only market test of the optimal acquisition of information is when the information available is sufficient to lead the parties to enter the transaction."

<sup>14</sup> Another point on which one could question Priest's description is that the medical market, with its thousands of employers, is monopsonistic. (Priest addresses that issue this way (p450): "Because some of the examples given include multiple employers, one might describe these markets as oligopsonies though, as we shall see, their operation differs very little from pure monopsony." As it happens, a medical market that more closely resembles the market for law clerks in having centrally administered prices is found in the U.K., see e.g. Roth (1990, 1991) and Unver (2001).

Priest also claims (p467) that the matching program “eliminates the possibility” for hospitals to offer higher wages. I don’t think this is at all correct, and I think it reflects a misunderstanding about why e.g. rural hospitals that have difficulty hiring residents (Roth, 1986) don’t hire away the residents of more attractive hospitals by raising their wages. In fact it may be easier for these hospitals to hire licensed physicians, in much the same way that a college without a graduate program hires assistant professors rather than trying to compete with Yale for graduate students by offering higher graduate stipends—the long term career benefits of being at a top hospital or graduate program make it cheaper for employers who can’t compete on those dimensions to hire people at a later stage in their careers.

Priest also devotes considerable space to making comparable-worth arguments about doctors and lawyers (without noting that doctors are not eligible for licensing immediately after graduation, or other differences between the two markets such as the considerable barriers to entry to medicine and medical specialties).<sup>15</sup> And Priest’s claim that lawyer salaries are much more widely dispersed than resident salaries seems misleadingly disingenuous in view of the very narrow range of salaries paid to new hires by the largest law firms.<sup>16</sup>

Finally, Priest claims that unraveling restores efficiency, but there is no evidence of this, and considerable evidence that unraveling has persisted in markets in which it is inefficient. In section 2 I discussed this in connection with the market for post-season college football bowls. This is a question that can also be examined in the laboratory, and numerous experiments show that unraveling can occur even when it is inefficient (see e.g. Kagel and Roth 2001, McKinney et al. 2005, Haruvy, Roth and Unver 2006, and Niederle and Roth 2009). This is not to say that unraveling may not be more efficient than some alternatives: Kagel and Roth (2001) look at a congested matching environment in which unraveling improves efficiency, but not as much as a clearinghouse that solves the congestion problem.

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<sup>15</sup> I am reminded of the similar arguments made when, in 2002, 16 law firms filed a class action law suit, representing 3 former residents seeking to represent all residents and fellows, arguing that the NRMP violated antitrust laws and was a conspiracy to depress wages. The suit was in fact a *double* class action suit that sought not only to represent a class of plaintiffs, but to name as defendants the class of all hospitals that employed them. Adopting a legal strategy that seemed designed to get a pre-trial financial settlement, the suit named 29 hospitals (in 16 states), and 7 medical organizations, including the NRMP. Thus the defense costs involved assembling law firms representing all these named defendants, and threatened to mount very quickly. However the strategy of naming so many defendants also opened the door to legislative relief, and President Bush signed into law the Pension Funding Equity Act of 2004, which included as an addendum a clause that the resident match could be regarded as a marketplace, and not a *per se* violation of the antitrust laws, so that a suit against the match would have to show actual violations of the law to proceed. The suit was subsequently dismissed.

<sup>16</sup> E.g. Roth and Xing (1994) note “The very highest salaries of all are paid by the largest New York firms, which in 1990 paid a median starting salary to new graduates of \$83,000. And the competitiveness of this market is reflected in the fact that the interquartile range (25th to 75th percentiles) of these salaries was only \$1,000 (NALP, 1991, p52).” Recent NALP salary reports note that, for the Class of 2009, “salaries of \$160,000 accounted for 25% of reported salaries.” (<http://www.nalp.org/salarydistrib> )

To summarize, Priest is certainly correct that, in some of the markets that have experienced unraveling, there isn't a price adjustment mechanism.<sup>17</sup> However it is incorrect to conclude from this, as Priest does, that rigid prices are the cause of unraveling (let alone the only cause), or that unraveling is efficient, or that it doesn't occur in markets with adjustable prices. In fact, there are markets with freely adjustable wages that have experienced persistent unraveling (like the market for new hires by large law firms), and markets with relatively inflexible wages in which unraveling does not occur (like the labor markets for new doctors that employ clearinghouses that produce stable matchings, cf. Roth 2008b). Thus all of Priest's claims about unraveling are falsified by the evidence.

Instead, there are many open questions about unraveling, the timing of transactions generally, and the marketplace institutions that have evolved or been designed to help coordinate transactions in matching markets.

### 3. Open Questions:

The unraveling of markets, and the development of marketplace rules and institutions in response raise a number of very general questions of a sort that economists haven't systematically asked or answered. What are the roles of marketplaces in markets? What properties of transactions, aside from price, do marketplaces help determine? These questions become more focused when we consider labor markets.

Specifically, what factors make a market prone to unraveling? Which markets are adequately organized without a coordinated marketplace (coordinated in time, or space, or both)? For which markets is a centralized marketplace desirable? For which markets does a centralized *clearinghouse* (possibly computer-assisted) offer additional benefits?

Centralized clearinghouses of the kind that now organize many entry level medical labor markets largely arose in response to unraveling.<sup>18</sup> But clearinghouses have also been designed to fix different kinds of market failure, e.g. to help make markets thick when thickness is absent for other reasons than unraveling, or deal with congestion, or to structure incentives so as to make the marketplace safe to participate in.<sup>19</sup> And other kinds of market institutions than

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<sup>17</sup> In addition to law clerks, he might have added the recruiting activities of American college fraternities and sororities, which are called *rush*, in an etymology that comes from unraveling; see Mongell and Roth (1991).

<sup>18</sup> The successful clearinghouses have primarily been those that produce *stable* matchings in the sense of Gale and Shapley (1962). Many questions remain about how decentralized markets succeed or fail in producing stable matchings, and the relationship of stable matchings to market clearing prices (cf. Kelso and Crawford 1982, Niederle and Yariv, 2010; Hatfield and Milgrom 2005; Kominers et al. 2010).

<sup>19</sup> Kidney exchange is a case where making a thick market (and then dealing with subsequent congestion) were the initial impetuses behind the development of clearinghouses, see Roth, Sonmez, and Unver (2004, 2005a,b, 2007) and Saidman et al. 2006, Roth et al. 2006, and Rees et al. 2009. School choice for high schools in NYC adopted a

clearinghouses have developed in response to unraveling (such as the application of rules and procedures to decentralized markets like the market for new hires by law firms). Signaling mechanisms are another example of an institution adopted to ease congestion in decentralized markets (such as the mechanism recently instituted by the American Economic Association to ease congestion in the annual marketplace for interviewing new Ph.D. economists, see Coles et al. 2010).<sup>20</sup>

Understanding what well-designed centralized clearinghouses can contribute will involve understanding better how *decentralized* matching markets succeed and fail. Why do entry level labor markets for highly skilled professionals often seem to use personalized wages less than economic models sometimes suppose? E.g. as noted above, wages are surprisingly uniform even in the market for new hires by the largest law firms.

Unraveling typically involves offers that are not only early, but are dispersed in time, and short in duration (exploding). So, even when prices can move freely, unraveling can be a way for employers to create a small amount of monopoly power, by forcing workers to consider only one offer at a time. But whether this strategy will be successful depends in part on the “market culture” regarding how binding early offers are, e.g. on whether someone who has accepted an early exploding offer can later change his mind (Niederle and Roth 2009).<sup>21</sup>

In summary, smoothly functioning, efficient markets provide a kind of public good, so we shouldn’t be surprised if there is some free riding, for example by people who would like to transact just before the market opens. And *marketplaces* operate to facilitate market transactions, in ways that involve more than just prices. To help markets be competitive, marketplaces need to be safe enough to participate in so that the market becomes thick, and they need to be able to deal with the resulting congestion. There is a lot still to be understood about what makes marketplaces work well, to allow us to better design new marketplaces where they are missing or broken. This calls for an empirically based research agenda—to make progress we’ll need to know a great deal about many different marketplace institutions and how they function in particular markets.

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centralized clearinghouse to deal with congestion (Abdulkadiroglu et al. (2005, 2009), while in Boston the concern was making the marketplace safe to participate in (Abdulkadiroglu and Sonmez 2003, Abdulkadiroglu et al. 2005).

<sup>20</sup> For more on signaling see Coles, Kushnir and Niederle (2010), or Lee and Niederle 2010, or Avery and Levin (2010) who analyze the signaling properties of early decision mechanisms in college admissions.

<sup>21</sup> I conjecture that this may be one of the reasons the market for new MBA’s has experienced only mild unraveling. Many MBA’s are employed in industries in which relationships can be broken with relatively short notice. That is, when firms can let employees go with only two weeks notice, and employees can likewise quit with little notice, the advantage of hiring a worker very early may be diminished, if it doesn’t allow the firm making an early offer to effectively “lock in” the worker, e.g. if he can continue looking for other options and give notice if he finds one he prefers.

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