

# Earnings Inequality and Coordination Costs: Evidence from U.S. Law Firms\*

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## Abstract

Earnings inequality has increased substantially since the 1970s. How much does this reflect decreases in coordination costs that allow individuals to better exploit returns to skill? We provide evidence on this question using confidential Census data on U.S. law offices. We first show that earnings inequality among lawyers increased substantially between 1977 and 1992, and that the distribution of partner-associate ratios across offices changed in ways consistent with the hypothesis that coordination costs fell during this period. We then propose a “hierarchical production function” in which output is the product of skill and time and estimate its parameters, applying insights from the equilibrium assignment literature. We find that coordination costs fell broadly and steadily during this period, such that hiring one’s first associate leveraged a partner’s skill by about 30% more in 1992 than 1977. We find also that changes in lawyers’ hierarchical organization account for about 2/3 of the increase in earnings inequality among lawyers in the upper tail, but a much smaller share of the increase in inequality between lawyers in the upper tail and other lawyers.

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# 1 Introduction

The returns to skill have risen substantially in the United States since the 1970s, as has earnings inequality.<sup>1</sup> These increases have taken place at the same time as large changes in many firms' organizational structure which have resulted in increases in managers' "spans of control" (see e.g. Rajan and Wulf, 2006). This raises the question of whether changes in inequality have organizational underpinnings as well. Suppose that highly skilled managers are assigned greater spans of control in equilibrium, as Rosen (1982) argues. If managers' spans are limited by coordination costs, then decreases in coordination costs can increase earnings inequality by leading spans of control to expand more for higher-skilled managers. Recent research indicates that changes in spans are important for understanding increases in earnings inequality among at least one set of individuals; Gabaix and Landier (forthcoming) and Tervio (2007) provide evidence that changes in firm size account for much of the post-1980 increase in earnings inequality among CEOs at very large U.S. firms.<sup>2</sup>

This paper examines these issues in the context of U.S. lawyers. How much has earnings inequality increased, how much have the coordination costs associated with hierarchical production declined, and how much of the increase in earnings inequality reflects lawyers' organizational response to changes in these costs? We propose an analytic framework based on Garicano (2000) and Garicano and Rossi-Hansberg (2006), and use this framework to answer these questions using law-office level data from the 1977, 1982, 1987, and 1992 Census of Service Industries.<sup>3</sup>

We first describe some general patterns regarding how lawyers' earnings and hierarchical organization changed during our sample period. We show that earnings inequality across lawyers increased substantially and steadily between 1977 and 1992. We then document several preliminary facts that suggest that coordination costs related to working with associates also decreased over this period. First, the share of

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<sup>1</sup>See e.g. Katz and Murphy (1992). Card and DiNardo (2002) argue the growth does not start until 1979, while other authors date the start as early as the mid 1970s. In other countries, the growth in inequality took place but was smaller (except in the UK) and started later. See Autor and Katz (1998) for a survey and Autor, Katz, and Kearney (2007) for recent evidence.

<sup>2</sup>See also Kaplan and Rauh (2007) who find support in a wide range of settings for the idea that scale effects can account for a large portion of the change in earnings inequality at the very top.

<sup>3</sup>This paper builds upon our previous work (Garicano and Hubbard (2007a)), which tests models of hierarchical production, proposes an econometric framework to estimate them, and estimates the returns to hierarchy at one point in time.

lawyers who work in offices without any associates decreased between 1977 and 1992 by one-third from about 30% to about 20%. Second, the distribution of associate-partner ratios across offices changed during this period in a way such that the most “leveraged” lawyers in 1992 were almost 50% more leveraged than the most “leveraged” lawyers in 1977. Third, qualitatively, new information and communication technologies penetrated deeply and broadly in the industry, which contemporary accounts indicate had an important impact on how lawyers worked with each other. Together, these facts suggest that working in hierarchical teams became cheaper in the law during this period.

We then analyze these changes in more depth. We propose a production function in which there are two inputs, skill and time, and a law office’s output is the product of the value of partners’ skill and the time that lawyers in the office spend directly in production. We show that the coordination cost of hierarchical production is identified by the ratio between revenues per lawyer – the office’s average product – and the marginal cost of an associate.<sup>4</sup> Applying ideas from assignment models and the hedonics literature, we estimate this marginal cost for each office, then use this estimate in specifications that uncover the coordination costs of hierarchical production. We analyze how these costs have changed over time, and develop counterfactual exercises that allow us to assess the extent to which increases in earnings inequality reflect lawyers’ organizational responses to these changes. Our estimates indicate that coordination costs declined steadily between 1977 and 1992, such that hiring one’s first associate leveraged a partner’s skill by about 30% more in 1992 than 1977. We find also that most of the increase in inequality among top lawyers between 1977 and 1992 reflects increases in associate-partner ratios that were responses to these decreases. In contrast, we find that most of the increase in inequality between top lawyers and other lawyers during this time reflects other factors that increased the market value of top lawyers’ skill relative to that of other lawyers’ skill, including skill-biased demand shifts. Changes in lawyers’ hierarchical organization account for much of the increase in inequality within the upper tail, but little of the increase in inequality between lawyers in the upper tail and other lawyers. Finally, we show that changes in lawyers’ hierarchical structure account for a modest share of the overall

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<sup>4</sup>An alternative interpretation of this ratio is that it reflects that partners’ market power. In this highly fragmented this is unlikely; we nevertheless consider and test this alternative explanation and find that it is unlikely to account for the changes in this ratio that we uncover.

productivity increases in this industry between 1977 and 1992; although the industry-wide productivity increase associated with coordination cost improvements appears to be relatively small, the earnings inequality evidence indicates that the returns to these improvements are concentrated on lawyers at the very top of the earnings distribution.

Our work complements the literatures we reference above by introducing coordination costs as an important factor in explaining earnings inequality. Methodologically, we do this by endogenizing organizational decisions: agents' spans of control reflect optimizing behavior that trades off knowledge utilization and coordination costs. The equilibrium that we obtain depicts not only the match between individuals, but also involves differences in individuals' hierarchical organization that correspond to skill differences. We show how agents' first order conditions and equilibrium relationships between individuals' earnings and hierarchical organization can be exploited to estimate parameters that reflect coordination costs. A payoff to this is that we can not only assess the degree to which increases in earnings inequality relate to increases in spans of control, but also investigate what drives these organizational changes. Our estimates indicate not only that increases in earnings inequality among top lawyers are related to changes in lawyers' organization, but also that new organizational efficiencies (perhaps enabled by new information technologies) are at the root of these increases.

The rest of the paper is organized as follows. Section 2 documents some key facts and discusses their context. Section 3 develops our analytic framework. We propose an equilibrium model of knowledge-based hierarchies and describe how we use this model as the basis for our empirical specifications. In Section 4, we describe our data. We report and discuss our main results in Section 5. Section 6 concludes.

## **2 The Facts To Be Explained: Earnings and Hierarchical Organization of U.S. Lawyers, 1977-1992**

Table 1 presents our estimates of various quantiles of the earnings distribution among privately-practicing U.S. lawyers between 1977 and 1992. All figures are in 1992 dollars. These estimates use confidential data from the Census of Services; the way

we construct these estimates differs somewhat by year, depending on the variables the Census collects. We discuss the data and how we construct these estimates in Section 4 below.

Earnings inequality among lawyers increased steadily during this time period, and this increase was particularly large when comparing lawyers in the upper tail relative to those at other quantiles. The ratio between the 95th percentile and median earnings increased from 3.5 in 1977 to 4.8 in 1992. In contrast, the ratio between 75th percentile and median earnings was roughly constant. Figure 1 graphically depicts earnings distributions for 1977 and 1992. Earnings were lower below the 80th percentile, and greater above the 80th percentile, in 1992 than in 1977.

This steady increase in earnings inequality is striking in light of large fluctuations in earnings *levels* over time. These fluctuations are correlated with the business cycle, and thus the overall demand for lawyers, though they undoubtedly reflect changes in the number and composition of lawyers as well. Median real earnings dropped by 20% between 1977 and 1982, and large decreases appear in the other quantiles as well. Lawyers' earnings then increased sharply between 1982 and 1987, with the median increasing by 20%, almost returning to the 1977 level. They then decreased slightly between 1987 and 1992. The contrast between the consistent increase in earnings inequality and the fluctuations of earnings levels during this period is interesting, because it suggests that increases in inequality reflect long-run phenomena that are to some extent distinct from factors that can vary from period to period. An explanation of increases in inequality that revolves only around changes in the overall demand for lawyers' services would have difficulty accommodating the fact that earnings inequality has increased not only during booms but during recessions as well: for example, not only between 1982 and 1987 but also between 1977 and 1982.

It is unlikely that changes in earnings inequality reflect changes in the distribution of demands across areas of the law. A well-known phenomena during this time is the "litigation explosion," which raises the issue of whether changes in the demand for litigation and the supply of litigators could explain these trends. However, as we will show in greater detail later in the paper, earnings inequality increased among lawyers in both litigation-intensive (e.g., negligence and insurance law) and non-litigation intensive fields. It is unlikely that increases in earnings inequality reflect other well-known field compositional changes as well. For example, demand for merger and acquisition-related legal services was likely much higher in 1987 than in 1982 or

1992.<sup>5</sup> But as noted before, earnings inequality increased both leading up to and after this peak.

A second broad trend in legal services is that lawyers' hierarchical organization has changed over time. The share of lawyers who are associates increased from 29% in 1977 to 40% in 1992. Table 2 provides further evidence with respect to these changes. We characterize the distribution of "leverage" across lawyers. "Leverage" equals zero for associates and partners at offices with no associates and equals the office's associate/partner ratio for partners at offices with at least one associate. This measure is designed to reflect how many lawyers work under a lawyer. This table shows that leverage has increased on average and has tended to become more unequal over time. The median leverage is zero throughout, while the 95th percentile increased from 1.17 to 1.67, or 43%. The steady increase in earnings inequality across lawyers, especially comparing lawyers at the top of the earnings distribution to other lawyers, coincides with an increase in the leverage of the most leveraged lawyers.

The joint increase in earnings inequality and leverage during this time is particularly striking in light of large changes in the age distribution of lawyers during this time. One possible explanation for these trends would revolve around changes in the lawyers' skill distribution: if the supply of younger, less experienced lawyers increased steadily relative to that of over older, more experienced lawyers, one would expect both increases in leverage and increases in earnings inequality simply because leverage has become cheaper over time. However, changes in the age distribution of lawyers suggest that the opposite is more likely to be the case. Table 3 indicates that the share of privately-practicing lawyers who are 35 or younger decreased by 25% (from 45% to 35%) between 1980 and 1990, then decreased by another 20-25% during the 1990s.<sup>6</sup> Earnings inequality and leverage increased between the late 1970s and early 1990s despite the fact that the number of young, inexperienced lawyers was declining relative to that of older, more experienced lawyers. It is thus difficult to explain changes in earnings inequality and leverage during this time with a theory that relies

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<sup>5</sup>This is reflected in changes in the field composition of lawyers as reported in our data: the share of lawyers that specialize in either banking or corporate law was 10.2% in 1982, 16.8% in 1987, then 13.2% in 1992.

<sup>6</sup>These figures reflect a large, well-known demographic bulge among lawyers that is also manifested by time trends in the entry of new lawyers into the profession. New admissions to the bar increased by 50% from 20,510 to 30,707 between 1971 and 1973, reached 42,756 in 1979, then stabilized. (Abel (1989), Table 21) Changes in the age distribution of lawyers since 1970 have reflected the entry and aging of cohorts, which were far larger than those that preceded them.

only on changes in the experience distribution of lawyers.

Two classes of explanations that can more easily reconcile these changes concern changes in the organizational cost of leverage and skill-biased changes in clients' demands. If the organizational costs of working with associates declined steadily over time, and the marginal benefits of hiring associates is greater for more skilled lawyers, one would expect leverage and earnings to increase disproportionately at the top of their respective distributions over time. This would be true even if the distribution of clients' demands stayed constant. Alternatively, if clients' demand for the most skilled lawyers increased steadily during this time relative to that for less-skilled lawyers, one would expect steady increases in earnings inequality. One would also expect leverage to increase, even if the organizational costs of working with associates did not change.

An empirical goal of this paper is to shed light on these explanations. We will estimate changes in the organizational cost of leverage ("coordination costs"), and distinguish between changes in lawyers' earnings distribution that are directly associated with changes in leverage versus changes in the market value of individual lawyers' time. This exercise directly illuminates the first of these explanations; for example, we are able to assess how much less earnings inequality would be if leverage in 1992 was instead at 1977 levels. It indirectly illuminates the second of these explanations, since changes in the market value of lawyers' time reflect not only any skill-biased changes in demand, but also changes in the distribution of lawyers' skills as well. One possibility with respect to the latter is that decreases in coordination costs could lead to a spreading out of the skill distribution by disproportionately increasing the returns to human capital investment for the most skilled lawyers.

The next subsection places these changes in their institutional context, highlighting the most important institutional and technological changes in law offices during this period.

## **2.1 Technological Change In Law Offices, 1977-1992**

The period of our study is one during which production methods changed within law offices. These changes affected how lawyers retrieved information, produced documents, and communicated with each other and their clients. We summarize the most important of these changes in this subsection.

The commercialization and diffusion of on-line databases such as Lexis and Westlaw lowered lawyers' cost of retrieving information. These services were first offered in the mid-1970s. By the late 1970s many of the largest firms subscribed to at least one of these services, which were usually accessed through one or more dedicated terminals in the firm's office. The cost of these services at the time was very high (over \$100/hour plus the price of leasing terminals) and the coverage of the databases was limited, so very few small and medium-sized firms chose to subscribe. Decreases in the price of both the hardware and these services and increases in their coverage led these services to become common in all but the very smallest offices by the early 1990s, and they are currently available as web-based applications. These services fundamentally changed how lawyers conducted research. Before these services, lawyers depended on paper trails and the memories of their colleagues to find the pertinent information they needed for their work.

Document production changed during this time as well. At the start of the period, practically all documents were typed by hand, often in duplicate, and the physical copies were stored in lawyers' case files. This process changed, first with the development of faster, cheaper photocopiers, then with the diffusion of word processing machines starting in the early 1980s. These machines, which were highly specialized computers, allowed lawyers (or, more precisely, their secretaries) to revise documents without having to retype them entirely and to retain electronic copies of any documents that they produced. The ability to revise documents without having to retype them entirely was valuable not just because it saved the time of retyping documents, but also because it reduced the time spent checking documents since one could focus attention on parts that had changed. The ability to maintain electronic copies was extremely valuable to lawyers because it allowed them to easily reuse text. Most lawyers had files of forms that they used to construct standard documents, but until documents were stored electronically, reusing text from previously-developed documents required them to retrieve the hard copies and retype the relevant text into the new document. PC-based word processing applications gradually replaced specialized word processing machines throughout the 1980s. These offered similar functionality, but were far cheaper, and extended these capabilities to smaller law offices. The change in computing platform from specialized machines to PCs did not immediately change how documents were produced in most cases; PCs at first simply



replaced specialized word processing machines on secretaries' desks.<sup>7</sup> By the early 1990s, word processing applications had been adopted at most law firms, even small ones, though they were not necessarily used directly by the lawyers themselves.

Finally, the way lawyers communicated with each other and with clients changed as well. The most important change in intra-office communication was the diffusion of electronic mail, which occurred late in our sample period and primarily in the largest offices. Personal computers became common on lawyers' desks, first at large firms, in the late 1980s and early 1990s. Adoption of PCs by lawyers themselves generally coincided with the adoption of local area networks which linked these machines together with each other and printers, and which supported intra-office electronic mail.<sup>8</sup> Email not only provided a new way that lawyers could communicate with each other, but also allowed them to more easily share and edit electronic versions of documents. External communication changed throughout our sample period; fax machines became common in law offices during the 1980s, and teleconferencing and videoconferencing became more affordable throughout this period. Lawyers' use of email for external communication as uncommon until the mid-1990s commercialization of the internet, however.

Thus, technological change during this period fundamentally altered how lawyers accomplished three important tasks during this period. Each of these changes had their greatest initial impact on large firms first before diffusing to smaller ones, but they took place at different points in time. Information retrieval improved starting in the late 1970s, document production changed starting in the early 1980s, and intra-office communication costs decreased starting in the late 1980s.

All of these changes decrease coordination costs. The impact of email and other means of electronic communication on coordination costs is straightforward. More subtly, the diffusion of computer-aided legal research decreased coordination costs by reducing the degree to which associates relied on partners' guidance to find relevant material; the results of search queries provide associates guidance that sometimes substitutes for partners' expertise. Finally, the adoption of word processing applica-

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<sup>7</sup>A 1985 Survey by Hildebrandt, Inc. reports that most large firms had one or more PCs, but the majority of these were used by secretaries and administrators.

<sup>8</sup>Staudt and Shiels (1994) provide evidence that by 1993, most lawyers in large firms had personal computers on or near their desks, and the vast majority of large law firms had installed local area networks. The diffusion of networked PCs was very rapid; in the mid-1980s, these were extremely rare.

tions diminished coordination costs by making it less costly for teams of lawyers to edit and unify text that was drafted by different individuals into a single document. A broad consequence of these changes is that partners can delegate work to associates more efficiently than they could in the past, allowing for an increase in the leverage of partner talent.

### 3 The Impact of Coordination Costs On Organization and Inequality: Theoretical Framework

In this section, we study the equilibrium relationship between coordination costs, organization, and earnings. To do this, we proceed in two steps. We first analyze theoretically the impact of coordination costs on organization and earnings inequality with the help of a simple equilibrium model. We then use the model to construct our empirical specifications.<sup>9</sup>

#### 3.1 An Equilibrium Model of Hierarchies with Heterogeneous Skill and Continuous Matching

Following Garicano (2000), we consider an environment where agents are endowed with one unit of time and unidimensional skill  $z \sim g(z)$ ,  $z \in [\underline{z}, \bar{z}]$ ,  $\underline{z} > 0$ . We propose that hierarchical teams allow agents to combine their knowledge with other agents' time as well as their own. Specifically, we assume that the output of a hierarchical team with one manager of skill  $z_m$  and  $n$  workers of skill  $z_w$  is  $y = z_m f(n(z_w))$ , where  $n$  is the number of workers and  $f(n)$  is the effective time in production the  $n + 1$  individuals spend. We assume that managers' span of control is limited by their workers' skill; increasing a manager's span of control  $n$  requires them to delegate a larger share of their team's work, and this in turn requires them to have more-skilled workers. To capture this relationship, we assume that  $n'(z_w) > 0$ .<sup>10</sup>

For estimation purposes, we further specify  $f(n) = (n + 1)^\theta$ , with  $0 \leq \theta \leq 1$ . If  $\theta < 1$ , then the effective time in production of the team is less than the agents' time endowment  $n + 1$ ;  $\theta$  parameterizes the coordination cost associated with hierarchical

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<sup>9</sup>In Garicano and Hubbard (2007a, 2007b), we develop testable implications of this model and find evidence in favor of these implications. Unlike in our previous work, this paper uses the model as a maintained assumption throughout our empirical work.

<sup>10</sup>See Garicano (2000) for a derivation of this condition.

production. Note that such costs do not exist if agents work on their own; if  $n = 0$ ,  $f(n(\cdot)) = 1$ .<sup>11</sup> Our *hierarchical production function* is thus:

$$y = z_m(n(z_w) + 1)^\theta. \quad (1)$$

In contrast, the output of these  $n + 1$  agents is  $z_m + nz_w$  if they worked on their own. The benefit of hierarchical production is that the manager's knowledge is applied to others' time as well as their own, and the team's productivity per unit of time in production is higher than when they work on their own. The drawback is that agents spend a lower share of their time directly in production.

The organizational equilibrium in this model determines: (a) the allocation of agents of skill  $z$  to positions – workers, managers, and "unleveraged" individuals who do not work in a team, (b) the match between workers and managers, including the number of workers with whom each manager works, and (c) agents' earnings. An equilibrium is defined as an outcome in which no agent would be better off by switching teams or positions. As discussed in our earlier work (see Garicano and Hubbard, 2007a), the organizational equilibrium obtained in this model has the following properties:

- *Positive Sorting.* More knowledgeable managers work with more knowledgeable workers.
- *Scale Effects.* More knowledgeable managers work with larger teams of workers.
- *Stratification.* There exist thresholds  $(z_1, z_2)$  that partition agents into positions according to their knowledge: agents with  $z < z_1$  are workers, agents with knowledge  $z > z_2$  are managers, and those in between are "unleveraged."

Given these properties the competitive equilibrium can be characterized as follows:

**Definition 1** *A competitive equilibrium in this economy consists of a duple  $\{z_1, z_2\} \in R^+$  such that all of the agents in  $[\underline{z}, z_1]$  are workers; those in  $[z_1, z_2]$  are "unleveraged," and those in  $[z_2, \bar{z}]$  are managers; a matching function  $m : [\underline{z}, z_1] \rightarrow [z_2, \bar{z}]$  that maps the skill of workers to the skill of the manager they are assigned to; and a wage function  $w(z)$  for  $z \in [\underline{z}, z_1]$  and an earnings function  $R(z)$  for  $z \in [z_2, \bar{z}]$  that*

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<sup>11</sup>Although we label  $\theta$  as "coordination costs," it includes any inefficiency that arises when individuals work in teams but not when they work on their own, including for example agency costs.

determine the earnings of workers and managers, respectively; such that: (i) each manager's optimal choice of worker quality  $z_w$  is the one prescribed by the matching function,  $z_m = m(z_w)$ ; (ii) the matching function is such that the supply and demand of workers is equalized at all points in the distribution of skill; (iii) occupational choices are optimal.

Figure 2 depicts agents' equilibrium earnings as a function of their skill. The equilibrium earnings function is the outer envelope of curves that characterize how much an agent with knowledge  $z$  would earn on their own, as a worker, and as a manager. From the discussion above, the earnings of agents with knowledge  $z$  and who work on their own ( $n = 0$ ) equal  $R(z, 0) = z$ . This is what individuals would earn, absent hierarchical production. The other two curves,  $R(z, n)$  and  $w(z)$ , are the outcome of a competitive labor market equilibrium. We next sketch formally the construction of this competitive equilibrium. We will use this characterization to obtain some comparative statics results concerning the impact of changes in coordination costs on equilibrium earnings and organization.

Consider first condition (i) in the definition above. For a given manager-worker match  $z_m = m(z_w)$  to be optimal, the worker's earnings must be such that it is optimal for a manager with skill  $z_m$  to be matched with workers of skill  $z_w$ . Managerial earnings are given by:

$$R(z_m, n) = \max_{z_w} z_m(n(z_w) + 1)^\theta - n(z_w)w(z_w) \quad (2)$$

where  $w(z)$  is the equilibrium wage function that relates workers' earnings to their skill, which we obtain below. A necessary condition in equilibrium is that each manager chooses  $z_w$  optimally given  $w(z)$ ; thus the first order condition:

$$\theta z_m(n(z_w) + 1)^{\theta-1} = w(z_w) + \frac{w'(z_w)}{n'(z_w)}n(z_w) \quad (3)$$

holds for each manager. The unknowns in this first order condition are  $w'(\cdot)$  and  $w(\cdot)$ . That is, the first order condition determines the differential equation in  $w$  that must hold for managerial choices of worker skill to be optimal. This equation, together with the terminal condition that the marginal worker is indifferent between being a worker or manager,  $w(z_1) = z_1$ , determines the wage function as a function of the (to be determined) cutoff  $z_1$ ,  $w(z; z_1)$ .

As an aside, note that for the purposes of our empirical estimation later, one can exploit the invertibility of  $n(z_w)$  and rewrite the first order condition (3) in terms of  $n$  as:

$$\theta z_m (n+1)^{\theta-1} = w(n) + w'(n) n \quad (4)$$

which will allow us to characterize managers' problem in terms of their demand for leverage rather than their demand for skill.

Consider now equilibrium condition (ii) above, that supply and demand be equal at all points in the distribution. Formally, writing managerial skill in terms of the matching function  $z_m = m(z_w)$  to replace  $z_w$  in  $n(z_w)$  by  $n(m^{-1}(z_m))$ :

$$\int_{\underline{z}}^z g(t) dt = \int_{z_2}^{m(z)} n(m^{-1}(z)) g(z) dz, \quad \forall z \leq z_1,$$

The left hand side is the supply of workers between  $\underline{z}$  and  $z$ . The right hand side is the demand of workers by the managers matched with these workers, that is by the managers between  $z_2 = m(\underline{z})$  and  $m(z)$ . This integral equation implies a shape for the matching function. Intuitively, the shape of the matching function depends on managers' spans of control and the relative masses of workers at different points in the skill distribution. Formally, taking the derivative of the integral equation above with respect to  $z$ , the matching function  $m(z)$  must be such that:

$$m'(z) = \frac{1}{n(z)} \frac{g(z)}{g(m(z))} \quad (5)$$

which, together with terminal condition  $m(z_1) = \bar{z}$  (the best workers are matched with the best managers), results in the equilibrium matching function  $m(z; z_1)$ .

We have now functions  $m(z, z_1)$  and  $w(z; z_1)$  that depend on the cutoff  $z_1$ . To solve for this cutoff we have two conditions left. First, market clearing requires that the least-skilled be matched with the least-skilled manager,  $m(\underline{z}; z_1) = z_2$ . Second, continuity of the overall earnings function requires that the least-skilled manager is indifferent between being a manager or being unleveraged,  $z_2 = R(z_2)$ . These functions and conditions imply a system of two equations with two unknowns that fully characterizes the equilibrium. In the proof of Lemma 1 below we show that if a solution exists it is unique and further characterize the equilibrium.

Stratification implies that the slopes of the segments of the overall earnings function are ordered in the way depicted in Figure 2 (the slope of the self employment

income is 1, the slope of the manager's earnings function is  $(n + 1)^\theta > 1$  and the slope of the wage function is  $w'(z) < 1$ . Thus occupational choices are optimal as long as the overall earnings function is continuous, which we have ensured through the conditions  $z_2 = R(z_2)$  and  $z_1 = R(z_1)$ .

### 3.2 The Impact of a Reduction in Coordination Costs

We are interested in studying the impact of a change in  $\theta$  on equilibrium organization and inequality. Intuitively, an increase in  $\theta$  increases the marginal benefit of leverage, and thus must lead to an increase in managerial earnings and leverage as managers seek to hire more workers. A first step to obtain this result as an equilibrium outcome is to characterize the impact of a change in  $\theta$  on the share of managers and workers in the economy.

**Lemma 1** *A decrease in coordination costs (an increase in  $\theta$ ) increases the share of workers ( $z_1$  increases) and the share of managers ( $z_2$  decreases) at the expense of a reduction in the share of "unleveraged" agents.*

**Proof.** Recall that the equilibrium construction above results in two equations in two unknowns. First, solving the market clearing condition (5), yields  $m(z) = \phi(z) + C$  for some increasing and continuous function  $\phi(\cdot)$ . We eliminate the constant by substituting  $m(z_1) = \bar{z}$ , so that we have  $C = \bar{z} - \phi(z_1)$ , and thus  $m(z) = \phi(z) + \bar{z} - \phi(z_1)$ . We then substitute the other threshold matching condition  $m(\underline{z}) = z_2$ , yielding  $z_2 + \phi(z_1) = \phi(\underline{z}) + \bar{z}$ , which contains only two unknowns, the thresholds  $z_1$  and  $z_2$ . Second, indifference of the marginal manager implies  $R(z_2) = z_2$ . The system of equations we must characterize can thus be written as:

$$z_2 + \phi(z_1) = \phi(\underline{z}) + \bar{z} \tag{6}$$

$$z_2(n(\underline{z}) + 1)^\theta - n(\underline{z})w(\underline{z}, z_1) = z_2 \tag{7}$$

where  $w(\underline{z}, z_1)$  is a function of  $z_1$  but not of  $z_2$  (to see this, note that  $w(z)$  is obtained by substituting  $m(z_w) = \phi(z_w) + \bar{z} - \phi(z_1)$  for  $z_m$  in (3) together with  $w(z_1) = z_1$ ; none of these are functions of  $z_2$ ).

Consider first (6). Since  $\phi' > 0$ , (6) defines a market clearing function  $z_2^m(z_1)$  with  $dz_2^m/dz_1 < 0$ . Intuitively, if more workers are used ( $z_1$  increases), more managers are needed ( $z_2$  decreases). Second, define  $\underline{w} = w(\underline{z}, z_1)$ , and notice that (7) implies

$z_2'(w) > 0$ . Since  $dw(\underline{z}, z_1)/dz_1 > 0$ ,<sup>12</sup> (7) implies a second function  $z_2^r(z_1)$  with  $dz_2^r/dz_1 > 0$ . Intuitively, suppose  $z_1$  were to increase. Since the wage function  $w(\underline{z}, z_1)$  is increasing in  $z_1$ , the wage paid by the marginal manager would increase. This marginal manager becomes better off unleveraged, and  $z_2$  therefore increases. The intersection of the curves  $z_2^m$  and  $z_2^r$ , if it exists, thus uniquely results in an equilibrium  $z_1$  and  $z_2$ . Moreover, inspection of the system above shows that (6) does not depend on  $\theta$ , while the rent function  $R(z_2, \underline{z}, w)$  is increasing in  $\theta$  (by the envelope theorem). Thus an increase in  $\theta$  shifts  $z_2^r(z_1)$  to the right and results in an increase in  $z_1$  and a decrease in  $z_2$ .

Given the characterization of  $z_1$  and  $z_2$ , the characterization of changes in inequality and organization in equilibrium is straightforward.

**Proposition 2** *A decrease in coordination costs (an increase in  $\theta$ ) has the following effects on organization and inequality:*

1. *Organization: An increase in the proportion of workers (increase in  $z_1$ ) and managers (decrease in  $z_2$ ) in the economy at the expense of a decrease in the proportion of self-employed. The increase in the number of workers is larger than the increase in the number of managers. It also results in an increase in the span of control ( $n$ ) of each manager, as well as of the average manager, where the last result takes into account the expansion in the share of managers in the economy (that is, the least skilled manager is less-skilled than before).*
2. *Inequality: An increase in the return to skill for managers,  $R'(z)$ , and in the pay gap among managers [ $R(\bar{z}) - R(z_2)$ ].*

**Proof.** 1. The changes in  $z_1$  and  $z_2$  are shown in Lemma 1 above. The change in the span  $n(z_w(z_m))$  follows straightforwardly from the change in the matching function  $m(z) = \phi(z) + \bar{z} - \phi(z_1)$ :

$$\frac{dm(z)}{d\theta} = -\phi'(z_1) \frac{dz_1}{d\theta} < 0$$

That is, workers of a given skill are assigned less-skilled managers. Inverting the function  $m(\cdot)$  we have that

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<sup>12</sup>The calculation containing this derivative is a bit involved and suppressed here; the Mathematica file containing it is available from the authors.

$$\frac{dz_w(z_m)}{d\theta} > 0$$

Managers of a given skill are assigned more-skilled workers. It follows straightforwardly that  $dn/d\theta = n' \frac{dz_w(z_m)}{d\theta} > 0$ . Managers of a given skill are assigned better workers and manage more of them. To see that the average span for the economy increases, note simply that the lowest span is unchanged by the entry of new managers, since workers with skill  $\underline{z}$  are always matched in equilibrium, and the span of teams involving these workers,  $n(\underline{z})$ , is limited by their skill.

2. To characterize  $\frac{d[R(\bar{z})-R(z_2)]}{d\theta}$  we proceed in two steps. First consider the change in the slope of the rent function  $dR/dz$ .

$$\frac{d^2R}{d\theta dz_m} = (n(z_w) + 1)^\theta \log[(n(z_w) + 1)^\theta + \theta(n(z_w) + 1)^{\theta-1} n'(z_w) \frac{dz_w(z_m)}{d\theta}]$$

The first term is the partial equilibrium impact (that is, holding the matching and spans constant)  $\frac{d^2R}{d\theta dz_m}|_{m(z)} = \frac{d(n+1)^\theta}{d\theta} > 0$ . Intuitively, since managers leverage their talent over a team of workers, decreases in coordination costs increase the return to managerial talent. The second effect is the general equilibrium effect due to the change in matching; by the argument in the proof of the first part of the proposition, it is also positive. Thus the slope  $dR/dz$  is everywhere greater.

Finally,  $\frac{d[R(\bar{z})-R(z_2)]}{d\theta} = \frac{d[R(\bar{z}, z_1, \theta) - z_2]}{d\theta} = \frac{dR}{d\theta} + \frac{dR}{dz_1} \frac{dz_1}{d\theta} - \frac{dz_2}{d\theta} > 0$ . The first term is the direct effect of  $\theta$ , and is positive by the envelope theorem. The second is a general equilibrium/matching effect. Managers are matching with better workers, which leads this term to be positive since  $dz_1/d\theta > 0$  by Lemma 1. The last term is also a general equilibrium effect;  $\frac{dz_2}{d\theta} < 0$ , as Lemma 1 implies that decreases in coordination costs lead the the earnings of the marginal manager to be lower (as more agents become managers).  $\square$

Our empirical work, which estimates how much the coordination cost parameter  $\theta$  has changed over time for lawyers and assesses how much of the increase in earnings inequality among lawyers reflects changes in lawyers' hierarchical organization, provides quantitative evidence that bears on this proposition. In passing, we note that the model above does not generate propositions regarding all possible measures of earnings inequality. To see this, note that decreases in  $\theta$  will lead to increases in  $z_1$  and thus  $w(z)$ ; decreases in coordination costs will lead to earnings increases at the bottom as well as the top of the earnings distribution, and earnings ratios that



compare the highest and lowest quantiles may or may not increase. Our proposition is nevertheless useful for two reasons. One is that it illuminates the mechanism through which coordination costs can lead inequality to increase: inequality can increase both because of a direct impact on the returns to skill and through general equilibrium effects that operate through the matching between workers and managers. The other is that our primary empirical focus will be on lawyers at or above median earnings, and the vast majority of these individuals are either unleveraged or are leveraged partners, not associates. Our analysis will thus concentrate on parts of the earnings distribution where the mechanism we describe in the proposition would be generally expected to lead earnings inequality to increase in response to decreases in coordination costs.

### 3.3 The Empirical Model

This subsection develops our empirical framework, which is the same as that in Garciano and Hubbard (2007a). This framework centers around maximization problem (2) and first order condition (4) and exploits the existence of an equilibrium wage function  $w(n)$ , and consequently the invertibility of  $n(z_w)$ . Doing this requires adapting the theoretical model to our empirical context by introducing stochastic elements into the model and accounting for inputs other than lawyers' human capital.

#### 3.3.1 Partners' Maximization Problem and the Demand for Leverage

We specify a partner's earnings in office  $i$  as:

$$\begin{aligned} R_i(z_{mi}, n) &= \widehat{z}_{mi}(n_i + 1)^\theta - w_i(n_i)n_i - c_i(n_i) \\ &= \varepsilon_i z_{mi}(n_i + 1)^\theta - w_i(n_i)n_i - c_i(n_i) \end{aligned} \tag{8}$$

This specification, which exploits the invertibility  $n(z_w)$ , has two differences from equation (2). One is that we introduce a stochastic shock,  $\varepsilon_i$ , to the partner's revenues. We assume that this is a short-run demand shock realized after the partner chooses how many associates to hire; this reflects that the fact that clients' demands for legal services are uncertain, and this leads to variation in revenues conditional on the skills and size of the legal team. The timing of this shock implies that its realization affects partners' earnings but not the organizational equilibrium we depict above. We assume that  $\varepsilon_i$  is i.i.d., positive, and  $E(\varepsilon_i) = 1$ . The other difference is

the term  $c_i(n_i)$ , which reflects law offices' costs other than associate pay. We defer a discussion of the details of our specification of these costs, which include things such as nonlawyer pay and overhead, until after we describe our data.

Partners choose  $n$  to maximize expected earnings, which produces the first order condition:

$$\theta z_{mi}(n_i + 1)^{\theta-1} = w(n_i) + w'(n_i) n_i + c'_i(n_i) \quad (9)$$

Solving for  $z_{mi}$ , substituting the expression into (8), then rearranging terms and taking logs, we obtain:

$$\ln \frac{[R_i + w_i n_i + c_i(n_i)]}{(n_i + 1)} - \ln(w'_i(n_i) n_i + w_i + c'_i(n_i)) = -\ln \theta + \ln \varepsilon_i \quad (10)$$

$$\ln AR_i - \ln MC_i = -\ln \theta + \ln \varepsilon_i$$

where  $AR_i$  and  $MC_i$  are the average revenues per lawyer and the marginal cost of leverage at office  $i$ . The coordination cost parameter  $\theta$  is thus identified by the ratio between marginal cost and average revenue. If these quantities are equal on average, this implies that hierarchical production is constant returns to scale in the sense that there are no additional coordination costs associated with working with larger teams with greater associate-partner ratios. If marginal cost is much lower than average revenues, in contrast, this implies that there are sharply diminishing returns to leverage: hierarchical production involves considerable coordination costs that reduce the time lawyers spend in production. How the parameter  $\theta$  evolves over time will be of particular empirical interest because it will affect our estimate of how much increases in earnings inequality across lawyers reflect organizational improvements versus other factors.

Average revenues per lawyer at office  $i$  is observed directly in our data, but the marginal cost of leverage is not. We next turn to our specification of one of the components of this cost,  $w'_i(n_i)$ .

### 3.3.2 The Marginal Price of Leverage

Our empirical specification of the function that relates associate earnings to leverage aims to relax the deterministic relationship between these variables while preserving the unidimensional sorting that characterizes the organizational equilibrium we depict above. We specify  $w_i(n_i)$  as:

$$w_i(n) = w(n) + \xi_i \tag{11}$$

where  $w(n)$  is an arbitrary polynomial of  $n$  and  $\xi_i$  is a mean zero random variable that is i.i.d. and independent of  $n$ . This specification implies that the wage-leverage surface that partners at office  $i$  face equals a market wage-leverage surface  $w(n)$  plus an additional term that leads associate pay to be particularly high or low, conditional on the organization and skill of the lawyers at office  $i$ .<sup>13</sup> We interpret this term,  $\xi_i$ , as a compensating differential that accounts for differences in working conditions at office  $i$ : this factor shifts up or down all potential associates' willingness to work at office  $i$ . The marginal wage  $w'(n)$  that partners at office  $i$  confront is simply the first derivative of this expression with respect to  $n$ . We therefore regress associate earnings on a polynomial of  $n$ ; we then use the coefficient estimates to construct an estimate of the marginal wage,  $\widehat{w'_i(n)}$ , for each office, which we then substitute for  $w'_i(n_i)$  in equation (10).

We allow for the possibility that associate earnings are systematically higher in some markets than others and in some fields than others by including county fixed effects and the field shares of lawyers in office  $i$  as controls. We permit  $w_i(n)$  to be determined by more-narrowly-defined labor markets by allowing the shape of  $w(n)$  to differ for offices that serve litigation versus non-litigation-related demands and within the latter, that serve business versus individual demands. We have also explored the possibility that it varies across differently-sized geographic markets, but have not found evidence that this is the case. The specifications we report below therefore allow  $w'(n)$  to vary across broadly-defined classes of demand, but not across geographic markets.

### 3.3.3 Discussion

**Production Function Estimation and Hedonics** Our empirical goal is to estimate the parameter  $\theta$  of the hierarchical production function. Our methodology, however, differs from usual production function estimation in how it treats human capital. The usual approach is to measure labor or human capital in efficiency units, which implicitly assumes that the quality and quantity of human capital are perfect

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<sup>13</sup>If  $\xi_i$  is independent of  $n$ , it must be independent of  $z_m$  as well because  $z_m$  and  $n$  move together in equilibrium.

substitutes. In contrast, our framework explicitly accounts for the possibility that the quality and quantity of human capital are not perfect substitutes: knowledgeable agents can solve problems that no number of less-knowledgeable agents can. We view this as an important characteristic of the market we are studying. This aspect of human capital affects equilibrium labor market outcomes by leading partners to bid up the wages of more knowledgeable associates, and allows the marginal price of skill to be increasing in skill rather than constant. Accounting for this aspect of human capital intensive production allows us to better model and estimate the marginal cost of leverage.

Our analytic framework accounts for this by exploiting close connections between equilibrium assignment models and the hedonics literature (Rosen (1974)), both of which revolve around the equilibrium matching between heterogeneous buyers and sellers. The hierarchical production function that we propose, which has microfoundations in organizational economics, implies an invertibility property that eliminates the empirical problem of sorting on unobserved (to the econometrician) skill, a problem that arises even in unidimensional skill models. The problem is stated in terms of the supply and demand for leverage, which we observe directly, rather than for skill, which we do not. In addition, our production function and data allow us to circumvent the usual identification problems that plague hedonic estimation by appealing to an identification principle that is standard in the production function literature.  $\theta$  can be thought of as a parameter that affects the demand for leverage. Epple (1987) discusses the problems in finding cost shifters that, in a hedonic equilibrium, are independent of unobservables on the demand side. We can identify this parameter from the ratio between the average benefit and marginal cost of leverage and our production function implies that the average benefit of leverage is simply revenues per lawyer, which we observe in our data.<sup>14</sup>

**Biases and Their Likely Magnitude** Our analytic framework assumes that agents make decisions to maximize their current earnings, conditional on their knowledge. This assumption produces a labor market equilibrium in which all partners face the same wage-leverage surface (apart from the shift incorporated in  $\xi_i$ ), and therefore the hedonic earnings regression uncovers a marginal price schedule that every partner

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<sup>14</sup>See Garicano and Hubbard (2007a) for an extended discussion of the relationship between this framework, the hedonics literature, and production function estimation.

faces. This assumption is not innocuous in this context; in particular, it rules out the possibility that agents' decisions reflect forward-looking objectives: for example, associates might value working with more knowledgeable partners because doing so would increase their future earnings through better training or client contacts. If so, the marginal price schedule implied by our regression will understate the marginal price of leverage that partners actually face. A partner who wants to hire slightly more knowledgeable associates has to compete with a slightly-more skilled partner to do so, and this would require this partner to offer more when associates value working with more knowledgeable partners than he or she would if they did not, because this partner would have to compensate the associate to forego any dynamic benefits of working with a more-skilled partner. Under this alternative assumption, our estimates of the marginal cost of leverage will be biased downward, and this will lead our estimate of  $\theta$  to be biased downward.<sup>15</sup> Our counterfactuals will then understate the effect of hierarchy on the earnings distribution, because we would mistakenly infer that coordination costs eat up too much of its potential benefits. As we discuss below and in our earlier work, the practical effect of this bias turns out to be relatively small, because the marginal price of leverage is generally a small part of the marginal cost of leverage.

Another, more mechanical, bias arises because we estimate equation (10) using OLS; applying Jensen's inequality,  $E(\varepsilon_i) = 1$  implies  $E(\ln \varepsilon_i) < 0$ , which implies that our estimate of  $\theta$  is biased upward. This bias is very small and is similar across years, on the order of 0.02 relative to a mean value of 0.55-0.70.<sup>16</sup>

Our discussion of our results will not emphasize these biases, because accounting for them would have only a small effect on our estimates and even less on our inferences, which are largely based on changes over time.

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<sup>15</sup>A similar downward bias would exist if part of the true marginal cost of an associate is the expected value of any transfer from incumbent partners to associates once they are promoted. The existence of such prizes would lead us to understate the marginal cost of leverage. As explained in Garicano and Hubbard (2007a), we are skeptical of this view because it ignores the prospective client-generation-related benefits of promoting promising lawyers; from incumbent partners' perspective, it is probably not a cost to promote lawyers who are expected to be at least as productive as existing partners.

<sup>16</sup>We estimated the equation under the assumption that  $\xi_i$  is distributed log-normally, exploiting the fact that under log-normality  $E(\xi_i) = 1$  implies  $\ln \xi_i$  is distributed  $N(-\sigma^2/2, \sigma^2)$ . The magnitude of the bias is then  $-\sigma^2/2$ .

**Competition and  $\theta$**  Our analytic framework assumes that legal services markets are competitive, and thus the price that partners receive for their office’s output does not decline if they choose to leverage their skill by hiring more associates. This assumption corresponds to the fact that legal services in general is a very unconcentrated industry; even the largest law firms are quite small relative to the size of the industry as a whole.<sup>17</sup> Under this assumption, the ratio of average revenues and marginal costs reveals diminishing returns to scale associated with coordination, not downward-sloping demand curves. If, however, partners were not price takers, this ratio would reflect diminishing returns associated with downward-sloping demand curves as well and our estimates of  $\theta$  would overstate the contribution of coordination costs to diminishing returns. This, in turn, would lead us to understate hierarchical production’s contribution to earnings inequality because we would be overstating the extent to which coordination costs dissipate the benefits from hierarchical production. Cross-sectional comparisons between the actual earnings distribution and what it would be absent hierarchical production will therefore provide a lower bound of the effect of hierarchical production on earnings distributions in each year.

That said, it is reasonable to consider the possibility that lawyers in some more narrowly-defined geographic or product markets face downward-sloping demand curves, and that this might have changed over time in ways that might explain our estimates of how  $\theta$  evolved during our sample period. For example, law offices in very small markets might have faced downward-sloping demand curves early in our period because of a lack of local competition, but this may have become less true over time as bigger-city law firms began to serve small cities, sometimes through local branches. Alternatively, large firms based in large cities may have faced increasing competition over time as firms based in other large cities entered their home markets. Either of these would lead our estimates of  $\theta$  to increase over time, even if coordination costs did not change. Therefore, finding that changes in  $\theta$  over time reflect only small market offices or large offices in large cities would give us pause, because such changes

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<sup>17</sup>To put this into perspective, Bureau of the Census (1996) reports that in 1992 the 50 largest law firms collectively accounted for only 9% of the industry’s revenues. Assuming that the industry is segmented between firms that serve individuals and firms that serve businesses, and that all of the largest law firms serve only businesses, the national C50 increases only to 18% (since about half of industry receipts are from businesses). Even this higher measure puts it among the least concentrated business services industries; it is similar to the concentration levels of other services businesses use such as commercial photography, employment agencies, and architectural services. It is much higher than some individual-oriented service industries use such as physicians and dentists.

could plausibly reflect sources of diminishing returns other than coordination costs. In contrast, finding that changes in  $\theta$  within these subsamples are no larger (or are smaller) than changes in  $\theta$  within subsamples that have faced high levels of competition throughout our sample period – such as small firms in large cities – would indicate that the changes in  $\theta$  that we uncover likely reflect changes in coordination costs rather than systematic changes in the shape of the demand curves partners face.

## 4 Data

Our analysis uses confidential law-office-level data from the 1977, 1982, 1987, and 1992 Census of Services. These data include each office's revenues, employment, and payroll as reported to the Internal Revenue Service for tax purposes. They also include more detailed information collected by questions specifically asked to law offices. We observe the total number of lawyers, the number of associate lawyers, and the number of nonlawyers that work out of the office. We also observe "payroll by occupation" – total payroll to associate lawyers and to nonlawyers – and thus observe average associate pay and average nonlawyer pay at each office. We observe the share of lawyers that work primarily in each of 13 fields defined by the Census (e.g., corporate law, tax law, domestic law) and the share of lawyers who work in multiple fields ("general practitioners"). Finally, we observe the share of the office's revenues that come from clients who are individuals versus businesses or governments. These law-office-level data are collected from a large sample of law offices which includes nearly all law offices with at least 20 employees or that are part of multi-office firms, plus a sample of other offices. All estimates reported in this paper are computed using the Census' sampling weights. The set of law offices that receives a survey form for these data varies from year to year; therefore, our data are repeated cross-sections rather than a panel.

Our main analysis in each year uses only data from offices legally organized as partnerships or proprietorships, and not those legally organized as "Professional Service Organizations" (PSOs) such as Professional Corporations. The reason for this is that the Census asks respondents to classify lawyers according to how they are treated for tax purposes; all lawyers at firms organized as PSOs therefore are considered "associate lawyers," even though lawyers at such firms distinguish among themselves in the same way that lawyers at firms legally organized as partnerships do. The analytic

framework we describe above requires data that distinguishes between partners and associates, and therefore cannot directly utilize the observations of offices organized as PSOs.<sup>18</sup>

## 4.1 Estimating Partners' Earnings

The Census does not ask law firms to report partners' earnings. We therefore must estimate this variable. This is straightforward in 1977 and 1982 because the Census asks respondents to report their total expenses in these years, along with the variables described above. We estimate partners' earnings in each office in these years as just the difference between revenues and operating expenses, divided by the number of partners.<sup>19</sup> Estimating partners' earnings is less straightforward in 1987 and 1992 because the Census did not ask respondents to report operating expenses. Although we observe payroll, we do not observe fringe benefits or non-payroll-related operating expenses ("overhead"), the most important components of which for law offices include rental and lease payments, communication, office supplies, and "pass-through" expenses that are billed at cost to clients such as travel expenses or charges for non-lawyer experts such as engineers (e.g., for patent cases) or economists (e.g., for antitrust cases). For partnerships and proprietorships, the difference between revenues and payroll – which we can compute directly – equals the sum of partner earnings, fringe benefit expenses, and overhead.

We estimate partners' earnings for 1987 and 1992 using the same method as in Garicano and Hubbard (2007a). We exploit the fact that (a) for firms organized as PSOs, the difference between revenues and payroll equals the sum of fringe benefit expenses and overhead, since payroll includes the earnings of all lawyers (and nonlawyers), and (b) fringe benefits are consistently about 15% of payroll at law of-

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<sup>18</sup>We do not believe that this leads to any significant selection issues. PSOs were introduced by states to allow the fringe benefits lawyers and other professionals pay themselves to have same tax advantages as those they pay employees. While firms' legal form of organization varies systematically across states (corresponding differences in when different states began to allow PSOs), conditional on state, there is not a strong relationship between firms' LFO and observables such as office size and lawyers' fields. This is reflected in the fact that in 1992, firms organized as PSOs made up about 1/3 of the industry measured in terms of either lawyers, offices, and revenues. (Garicano and Hubbard (2007b))

<sup>19</sup>Capital expenditures, which are very small in this industry, are treated as part of partner earnings. Since partners are the residual claimants on law firms' assets, this treatment seems appropriate.



ices Our estimate of overhead at offices organized as PSOs is therefore (revenues - 1.15\*payroll). Using these offices, we regress our overhead estimate on characteristics of the office, including revenues, the number of people in the office, lawyers' fields, and local market size, allowing the relationships between overhead and revenues to be nonlinear and different across lawyers' fields, and allowing the relationship between overhead and the number of people in the office to differ with local market size (perhaps because office space is more expensive in larger markets). We then use the coefficient estimates from this regression to generate predicted values for overhead for each of our partnerships and proprietorships. Finally, we generate estimates of partner pay for each of our partnerships and proprietorships by subtracting the sum of estimated overhead and 1.15\*payroll from the office's revenues, and dividing by the number of partners. This procedure produces estimates of partner pay analogous to those generated from the 1977 and 1982 data.

This procedure generates the earnings distributions we reported in Table 1 and discussed earlier. We have compared these distributions to those generated from other sources, in particular lawyer-level earnings data from the Census' Public Use Microdata Sample (PUMS). We report earnings distributions from the 1970, 1980, 1990, and 2000 PUMS in Table A1 in the Appendix. Although direct comparisons are impossible because the PUMS data come from different years than our data and because the PUMS data are top-coded, the distributions exhibit consistent patterns. In particular, the level and general time trend (in particular, low real earnings circa 1980-1982, higher real earnings before and after) in earnings are similar for the two series.

## 4.2 Overhead

The structure of law offices' overhead expenses exhibits a few interesting trends. In Table 4, we report coefficient estimates from regressions that relate overhead to observables.<sup>20</sup> The 1987 and 1992 estimates use PSOs; these are the estimates we use to generate partner earnings for these years. The 1977 and 1982 specifications use our main sample of partnerships and proprietorships (since we can estimate overhead directly for this sample for these years). The estimates indicate that while overhead

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<sup>20</sup>This summary table does not report all of the coefficients in these specifications, for example those on office's field shares and interactions between field shares and revenues. The full set of results for each year are available upon request from the authors.

is related to revenues in all years, the relationship between overhead and employment has tended to become stronger over time, especially for offices in very large cities and especially between 1987 and 1992. We suspect that this reflects, in part, changes in law offices' technology. From our earlier discussion, personal computers started to appear on lawyers' desks only in the late 1980s, and the early adopters of these and complementary hardware tended to be large, big-city law offices. If so, it would not be surprising to find that the relationship between overhead and employment tended to become stronger in the late 1980s and early 1990s, especially for offices in large cities.

The relationship between overhead, revenues, and employment bears on our estimation of equation (10). As noted above, part of the marginal cost of leverage consists of costs other than increases in associate pay,  $c'_i(n_i)$ . We specify  $c_i(n_i)$ , as:

$$\begin{aligned} c_i(n_i) &= (x_i l_i + oh_i)/p_i \\ &= x_i(1 + n_i) + oh_i/p_i \end{aligned}$$

where  $x_i$  is nonlawyer pay per lawyer,  $l_i$  is the number of lawyers in office  $i$ ,  $oh_i$  is overhead at office  $i$ , and  $p_i$  is the number of partners at office  $i$ . We assume that nonlawyer pay per lawyer is constant: hiring an additional associate implies a proportionate increase in the office's support staff. Thus:

$$c'_i(n_i) = x_i + oh'_i/p_i$$

From each partner in office  $i$ 's perspective, an additional associate implies an increase in nonlawyer pay of  $x_i$  and an increase in overhead of  $oh'_i/p_i$ .  $x_i$  is observed in the data. We use the coefficient estimates on employment in the results reported in Table 4 to construct an estimate of  $oh'_i/p_i$  for each office.

Finally, we note that our production function specification must account for the fact that the marginal benefits of leverage from partners' perspective is not simply marginal revenues, but rather marginal revenues, net of the overhead associated with these revenues. We therefore adjust revenues for each office downward by  $(1 - \widehat{k}_i)$ , where  $\widehat{k}_i$  is the estimated derivative of overhead with respect to revenues for office  $i$  implied by the estimates in Table 4.

The production function specification is therefore:

$$\ln \left[ \frac{[R_i + w_i n_i + c_i(n_i)]}{(n_i + 1)} (1 - \widehat{k}_i) \right] - \ln(\widehat{w}'_i(n_i) n_i + w_i + x_i + \widehat{o}h'_i/p_i) = -\ln \theta + \ln \varepsilon_i \quad (12)$$

where  $\widehat{w}'_i(n_i)$  is derived from our estimates of equation (11), presented below in Table 5, and  $\widehat{k}_i$  and  $\widehat{o}h'_i$  are derived from our estimates in Table 4.<sup>21</sup>

## 5 Results

### 5.1 Associate Earnings and Leverage

Table 5 summarizes the coefficient estimates of equation (11); the specifications include county fixed effects and "office class" dummies as well as those reported here. The omitted field is "general practice." The patterns in the field controls are fairly consistent across years and show some expected patterns; for example, associate pay is relatively high at offices with a high share of corporate, tax law, or patent law specialists. Another notable pattern is that 1982 looks different than the other years for some specialized fields. Unlike other years, associate pay was not significantly higher at offices with high shares of banking, insurance, or negligence-defense specialists relative to those with high shares of general practitioners. This suggests that the returns to specialization were lower in this recessionary year than in other years, at least for some fields.

The coefficients of interest are those that relate associate earnings to associate-partner ratios; these are the polynomial coefficients at the top of the table. These coefficients are hard to interpret as presented; we therefore present additional evidence at the bottom of the table. There we report the difference between predicted associate earnings at offices with associate-partner ratios of 1.5 and 0.5; the vast majority of lawyers work at offices with associate-partner ratios in this range. In general, the coefficient estimates imply the following about  $w(n)$ . First,  $w(n)$  is close to linear for each market segment across the range of associate-partner ratios where most of our offices lie. While significant coefficient estimates on some of the squared terms imply that  $w(n)$  is convex or concave for some office class-years, the magnitude of the

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<sup>21</sup>Inserting predicted values on the left side of the specification introduces a source of bias to our estimates of  $\theta$ , once again because of Jensen's inequality (e.g., because  $E[\ln(MC_i)] < \ln[E(MC_i)]$ ). As above we do not account for this bias directly in our estimation because we believe it to be small and consistent across time.

concavity or convexity is never more than slight. Second,  $w(n)$  is flat for individual, non-litigation offices. From the bottom of the table, the predicted change in associate earnings when moving between offices with associate-partner ratios of 0.5 and 1.5 is never more than \$650; a graph showing  $\widehat{w(n)}$  for this class of offices depicts essentially a flat line. This may reflect that from the perspective of partners in this segment of the industry, the quality and quantity of associates are easily substitutable. Third,  $w(n)$  is an increasing function for the other classes of lawyers, with  $w'(n)$  generally greater for business, non-litigation offices than for litigation offices. The predicted increase in associate earnings when moving from an associate-ratio of 0.5 to 1.5 is in the \$4,500-\$6,000 range for business, non-litigation offices in most of these years (lower in 1977), and in the \$2,700-\$4,500 range for litigation offices in three of these years.

## 5.2 The Benefits and Costs of Leverage

We summarize some of the implications of these and our other estimates to date in Table 6. Here we depict how, from the perspective of partners, the marginal benefits and marginal costs have evolved over time. On average, partners worked in offices where revenues per lawyer were \$195,000 in 1977; this declined then increased during our sample period. The average benefit of leverage, which is this figure less the share of revenues that is overhead, exhibits a similar pattern. The average benefits of leverage for 1992 partners were about 30% greater than that of 1977 partners. The marginal cost of leverage, averaged across partners in each year, exhibits a somewhat different pattern. It decreased slightly between 1977 and 1982, then increased substantially between 1982 and 1992. The marginal cost of leverage for 1992 partners was about 50% greater than that of 1977 partners. As noted above, the coordination cost of hierarchies is identified by the ratio between the marginal cost and average benefit of leverage, evaluated at equilibrium quantities. Table 6, which indicates that the marginal cost increased relative to the average benefit of leverage between 1977 and 1992, presage our finding that the coordination cost of leverage has declined over time.

The right part of Table 6 depicts how the composition of marginal costs have evolved. Associate pay has fluctuated, but is a smaller share of the marginal cost of leverage over time, declining from 53% to 45%. Overhead, in contrast, increases

both in its magnitude and its share of the marginal cost of leverage, rising from a negligible share in 1977 to 13% of the average partner’s marginal costs in 1992. The marginal price of leverage, which reflects the possibility that hiring more associates means hiring better associates, is a small, though increasing, part of the marginal cost of leverage for the average partner in each year. This low average masks considerable heterogeneity across offices, but cases where the marginal price of leverage exceeds \$10,000 are rare simply because  $n$  is low in this industry. While it is important to account for these other components, the payroll-related costs of an additional associate make up most of the marginal cost of leverage for most partners.

### 5.3 The Coordination Costs of Hierarchies

Table 7 presents our estimates of the equation (12), and the average predicted value of  $\theta$  that these coefficient estimates imply. From the bottom of the table, on average,  $\theta$  steadily increased between 1977 to 1992 from 0.57 to 0.70. From the perspective of the average partner, hiring one’s first associate increased the time that the (now 2-person) team would spend in production by about one-half in 1977, but by about two-thirds in 1992. The real team size after hiring an associate would have increased from 1 to 2 individuals in both periods; the effective team size would have increased from 1 to  $2^{.57} = 1.48$  individuals in 1977 and to  $2^{.70} = 1.63$  in 1992. The fact that the coordination costs associated with hierarchical production declined steadily during this time is interesting, because it indicates that the overall decline cannot be solely attributed to technological changes that took place only in some of these subperiods. In particular, this pattern cannot be solely due to the diffusion of personal computers within law firms, which was important only in the final subperiod in our sample, 1987-1992. This pattern is consistent with the hypothesis that the steady diffusion of a series of new applications lowered coordination costs during this period, starting with computer-aided legal research in the late 1970s.

Table 8 provides evidence on the hypothesis that changes in  $\theta$  reflect changes in the slope of the demand curves that partners face rather than coordination costs. Here we report average predicted values of  $\theta$ , by year, for cells that are defined by the number of partners in the office and the employment size of the county in which the office is located. These predicted values are generated from production function

specifications that include dummy variables for each of these cells.<sup>22</sup> The general pattern that this table reveals is that  $\theta$  increased during this period in all of our office size\*market size cells, though it tended to increase somewhat more for smaller offices than larger offices. The latter implies a convergence of sorts; the figures in the first column indicate that  $\theta$  was higher for larger offices than smaller offices in 1977, but varied little with office size in 1992. The trends across market size and office size\*market size categories do not support the hypothesis that changes in  $\theta$  over time reflect changes in competition that partners face. From the top panel, the changes in  $\theta$  for offices in small markets were no larger than changes in  $\theta$  for offices in large markets; it does not appear that overall changes in  $\theta$  reflect that partners in small market firms faced increasing competition over time, since this would imply that  $\theta$  should increase more for small market offices than large market offices. From the bottom panel, changes in  $\theta$  for small offices in large markets were, if anything, *larger* than changes in  $\theta$  for large offices in large markets. Partners in small offices in large markets likely faced strong competition throughout this period, but  $\theta$  decreased by more for such partners than for their large office counterparts. We therefore conclude that the changes in  $\theta$  that we uncover are likely to reflect changes in coordination costs during this period, not changes in competition. This is not particularly surprising; as described earlier, most lawyers likely faced strong competition from other lawyers throughout our sample period.

Table 8 also further illuminates the sort of technological changes that might be responsible for coordination cost changes. It reinforces the point that it is highly unlikely that much of the coordination cost improvements we uncover reflect the adoption of internal email systems, word processing applications, or any other IT application that was primarily adopted late in our sample at large law offices.  $\theta$  decreased substantially during the late 1970s and early 1980s, and decreased for small as well as large offices. It is possible that the diffusion of on-line databases such as Lexis and Westlaw are related to these changes, since the diffusion of these took place during this time and lawyers at small law offices often could access these through publicly-accessible law libraries. However, the evidence we are able to provide on this is too indirect for us to make strong conclusions; office-level data on technological adoption is probably necessary to establish this definitively.

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<sup>22</sup>We do not report the coefficient estimates from these specifications for brevity; they are available upon request from the authors.

## 5.4 "Hierarchy-Free" Earnings Distributions

In this section we construct and report estimates of  $R_i(z_{mi}, 0)$ : what lawyers would earn, if they were unleveraged. We refer to the distribution of  $R_i(z_{mi}, 0)$  across lawyers as the "hierarchy-free" earnings distribution, and compare it to lawyers' actual earnings distribution to infer the effect of hierarchical organization on earnings inequality. We emphasize that our analysis on this front is a partial equilibrium analysis, because this counterfactual holds constant the distribution of lawyers' skills as well as the match between clients and law firms. If lawyers, in fact, did not organize hierarchically, this would affect lawyers' investments in skills and the match between clients and lawyers.

We estimate "hierarchy-free" earnings distributions in the following way. For unleveraged partners, estimating  $R_i(z_{mi}, 0)$  is simple: these lawyers' "hierarchy-free" earnings equal their actual earnings. For leveraged partners,  $R_i(z_{mi}, 0) = \hat{z}_{mi} - c_i(0)$ , where  $\hat{z}_{mi} = TR_i/(n_i + 1)^{\hat{\theta}_i}$  and  $c_i(0) = x_i + \widehat{oh}_i/p_i$ . One can think of the first of these components,  $\hat{z}_{mi}$ , as the market value of the partners' (unleveraged) time; cross-lawyer differences in this component would reflect, in part, differences in lawyers' skill but not differences in organization. The second of these components is what lawyers' costs would be if they were unleveraged; these costs include the cost of nonlawyer support staff and overhead. For associates, we assume that  $R_i(z_{mi}, 0) = w_i$ : their earnings if unleveraged equal what they earn as associates. Revealed preference arguments imply that associates' actual earnings should overstate their "hierarchy-free" earnings; in a model where individuals choose where to work to maximize their income, individuals who choose to be associates should earn more as associates than they would as unleveraged partners. Our estimates of "hierarchy-free earnings distributions" thus probably overstate lawyers' hierarchy-free earnings, especially below the median. This assumption will have a minimal effect on our main analysis, however, which focuses quantiles at or above the median. It is important to include associates in the analysis of earnings distributions, but overstating their "hierarchy-free" earnings slightly will not affect our analysis as long as these individuals tend to be below the median in the "hierarchy-free" earnings distributions that we compute.

Table 9 reports quantiles of the hierarchy-free earnings distributions in each of our years. This table is analogous to the earnings distributions we reported in Table 1, which we reproduce in the top panel of this table for comparison. The most important

finding in this table is that inequality is increasing over time in the "hierarchy-free" earnings distribution, just like it does in the realized earnings distribution. The ratio between the 90th and 50th quantile increased from 2.4 to 2.8, and that between the 95th and 50th increased from 3.0 to 3.7 between 1977 and 1992. This finding indicates that increases in earnings inequality over time are not solely due to the degree to which lawyers are leveraged; even taking out the effect of increases in leverage, inequality increased substantially among lawyers above the median.

Before continuing, we note that we have characterized this result carefully. The results in Table 8 do *not* rule out the possibility that all of the increase in earnings inequality could be due to decreases in the coordination costs associated with hierarchical production. If increases in  $\theta$  lead highly-skilled lawyers to accumulate more skill, this would be reflected by changes the hierarchy-free earnings distribution. The "pure leverage" effect to which we refer above is a lower bound of the impact of changes in  $\theta$  on earnings inequality, because it does not include the effect of human capital investments that are responses to these changes.

Another finding in Table 9 echoes Garicano and Hubbard (2007a): hierarchical production amplifies earnings inequality. All of the earnings quantile ratios in the top panel are greater than those in the bottom panel, and the differences between the top and bottom panels are greater when the ratios involve higher quantiles. Our previous work showed this for 1992; here we show that similar conclusions hold for other years.

## 5.5 Organizational Changes and Increases in Earnings Inequality

Table 10 analyzes the extent to which increases in organizational leverage contributed to increases in earnings inequality between 1977 and 1992 through a decomposition of changes in the quantile ratios. The top panel uses law offices in all segments. The first column reports that the ratio between the 90th percentile and median earnings increased by 0.20 log points; in contrast, this ratio increased by 0.16 log points when using our estimates of the hierarchy free earnings distributions in these years. The difference between the two, here called the "residual change in earnings inequality," depicts the change in earnings ratios that is attributable to changes in lawyers' leverage. The final row reports this as a share of the change in the earnings quantile ratio.



From the table, we estimate that 20% of the change in the 90th/50th percentile ratio during this time is due to changes in lawyers' leverage. This figure is greater when examining ratios that focus more on the upper tail: we estimate that 37% of the increase in the 95th/50th percentile ratio, and 63% of the increase in the 95th/90th percentile ratio, is due to changes in lawyers' hierarchical organization.

Increases in organizational leverage thus explain the majority of the increase in earnings inequality among very top lawyers. They explain a substantial, but moderate amount of the increase in inequality between lawyers at the top of the distribution and the median lawyer. Most of the earnings inequality increase between top lawyers and the median lawyer is accounted for instead by differential changes in the market value of lawyers' time. Some of these differential changes may have organizational roots. Declines in the coordination costs of hierarchical production may have led the most skilled lawyers to increase their human capital disproportionately relative to other lawyers. These numbers are therefore likely to be a lower bound on the effect of declines in coordination costs on earnings inequality during this time.

The bottom panel reports a similar analysis, conducted separately for lawyers in "business, non-litigation," "litigation," and "individual, non-litigation" offices. The results for lawyers in "business, non-litigation" and "litigation" offices are similar to each other and to the results in the top panel: changes in leverage explain a large share of the increase in inequality among lawyers in the upper tail of the distribution, and a moderate share of the increase in inequality between these lawyers and the median lawyer. The effect of changes in leverage on earnings inequality among top lawyers is particularly pronounced among lawyers in "business, non-litigation" offices (e.g., offices that do transactional work for business clients but not litigation): over three-quarters of the change in the 95th/90th percentile earnings ratio is accounted for by changes in leverage. The results for lawyers in "individual, non-litigation" offices differ from those in other offices. Inequality increased substantially among lawyers in this segment during this time, especially comparing lawyers in the upper tail to those in the middle. But we find little evidence that this increase reflects changes in leverage: changes in the "estimated earnings, absent hierarchical production" ratios are similar in magnitude to changes in the estimated earnings ratios.

## 5.6 Productivity Decompositions

Our final set of results investigate changes in lawyers' productivity between 1977-92, as measured by revenues per lawyer, in light of the decline in coordination costs that took place during this time. Our analytic framework, and in particular the hierarchical production function that we propose, facilitates this analysis by positing that output is simply the product of skill and time: partner skill multiplied by the time lawyers in the office spend in production.

Dividing both sides of equation (1) by  $n_i + 1$ , we obtain an expression for revenues per lawyer at office  $i$ :

$$y_i/(n_i + 1) = z_{mi}(n_i + 1)^{\theta-1} = z_{mi}s_i$$

where  $s_i = (n_i + 1)^{\theta-1}$ , the share of lawyers' time that is spent directly in production. Office-level productivity increases therefore can either reflect increases in partner skill or increases in lawyers' time-efficiency.

Average revenues per lawyer across all offices is therefore:

$$\begin{aligned} \overline{y_i/(n_i + 1)} &= \overline{z_{mi}s_i} \\ &= \overline{z_m} \overline{s} + \text{cov}(z_{mi}, s_i) \end{aligned}$$

where the covariance and means are calculated using the number of lawyers in the office as weights. Our analytic framework and results imply that the covariance term should be negative: more skilled partners are more leveraged, but if  $\theta < 1$  this lowers the share of time that lawyers spend directly in production. One can therefore decompose changes in average revenues per lawyer in the following way:

$$\Delta \overline{y_i/(n_i + 1)} = \Delta \overline{z_m} \overline{s}_t + \Delta \overline{s} \overline{z_{m,t-1}} + \Delta \text{cov}(z_{mi}, s_i)$$

The first term is the change in the average value of skill that is applied to lawyers' time, holding lawyers' time efficiency constant. The second is the change in the share of lawyers' time spent in production, holding the average value of skill constant. The third is the change in the covariance between skill and time efficiency.

We report our results in Table 11. Real revenues per lawyer increased by \$39,000 between 1977 and 1992; this measure of productivity therefore increased by just over 20% during our sample period. The decomposition indicates that none of the productivity increase is accounted for by increases in lawyers' time efficiency. Although

coordination costs decreased during this period, lawyers responded to this by increasing leverage in a way that left lawyers' average time efficiency unchanged. In contrast, all of the productivity increase is accounted for by increases in the average value of skill that is applied to lawyers' time. Even though the direct effect of reductions in coordination costs are to increase lawyers' time efficiency, lawyers' aggregate response to these reductions ultimately exploited the input that is a source of increasing returns rather than the input that is not; skill rather than time.

One can also break down the average value of skill applied to lawyers time,  $\overline{z_m}$ , into additional components that reflect changes in the mean and variance of partner skill at different points in time and changes in how leverage is allocated across partners. Let  $l_i$  and  $p_i$  equal the number of lawyers and partners in office  $i$ , respectively, and let  $L$  and  $P$  equal the number of lawyers and partners in the economy. The definition of  $\overline{z_m}$  is:

$$\overline{z_m} = \sum z_{mi} \frac{l_i}{L}$$

One can rewrite this as:

$$\begin{aligned} \overline{z_m} &= \sum z_{mi} \frac{l_i/p_i}{L/P} \frac{p_i}{P} \\ &= \widehat{z_{mi} r_i} \end{aligned}$$

where  $r_i$  is the ratio of the lawyer/partner ratio at office  $i$  and the lawyer/partner ratio in the economy as a whole and the "hat" denotes that the mean is weighted by partners rather than lawyers. One can therefore decompose changes in the average value of skill into two terms:

$$\begin{aligned} \Delta \overline{z_m} &= \Delta \widehat{z_m} \widehat{r_t} + \Delta \widehat{r} \widehat{z_{m,t-1}} + \Delta \text{cov}(z_{mi}, r_i) \\ &= \Delta \widehat{z_m} + \Delta \text{cov}(z_{mi}, r_i) \end{aligned}$$

where we have exploited  $\widehat{r} = \sum \frac{l_i/p_i}{L/P} \frac{p_i}{P} = 1$ . Using the definition of correlation, one can further rewrite this equation as:

$$\begin{aligned} \Delta \overline{z_m} = \Delta \widehat{z_m} &+ [\Delta \sqrt{\text{var}(z_{mi})}] \sqrt{\text{var}(r_{i,92})} \text{corr}(z_{mi,92}, r_{i,92}) \\ &+ [\Delta \sqrt{\text{var}(r_i)}] \sqrt{\text{var}(z_{mi,77})} \text{corr}(z_{mi,92}, r_{i,92}) \\ &+ [\Delta \text{corr}(z_{mi}, r_i)] \sqrt{\text{var}(z_{mi,77})} \sqrt{\text{var}(r_{i,77})} \end{aligned}$$

The first two terms account for the impact of changes in the partner skill distribution: changes in the average and in the dispersion of partner skill. The other two terms account for the impact of hierarchical organization: changes in the dispersion of leverage among partners and in the correlation between partner skill and leverage.

Table 12 reports our results. The main result is that nearly all of the increase in the average value of skill that is applied to lawyer time is accounted for by increases in the mean and variance of the distribution of partner skill. Only 10% of the increase in the average value of skill that is applied to lawyer time is accounted instead by increases in leverage – which lead higher-skilled partners to be disproportionately leveraged relative to less-skilled partners. Our previous work (Garicano and Hubbard (2007a)) showed that hierarchical production contributes substantially to lawyers’ productivity, relative to a situation where lawyers did not leverage their skill by using others’ time. Here, we show that the direct effect of the increase in leverage between 1977-1992 accounts for only a modest increase in lawyers’ average productivity. Our evidence on earnings inequality indicates that the impact organizational change on inequality is relatively low on average but large at the very top. The productivity numbers are the other side of the same coin (inequality increases because the marginal product of the most-skilled lawyers increases as they increase their leverage), suggesting that the productivity returns to these leverage increases are also concentrated on lawyers at the top of the earnings distribution.

## 6 Conclusion

The distribution of earnings and the organization of lawyers changed substantially between the late 1970s and early 1990s. Earnings inequality increased substantially among privately-practicing lawyers between 1977 and 1992, primarily through increases in the earnings of top decile lawyers relative to those of other lawyers, and the most leveraged lawyers in 1992 were more substantially more leveraged than their 1977 counterparts.

Our analysis indicates that coordination costs associated with hierarchical production fell steadily during this period. We first provide broad evidence on changes in leverage and in the share of lawyers who work in hierarchically-organized offices that suggests that the returns to organizing production hierarchically increased. We then show that, if decreases in coordination costs are at the root of such changes, then

one should expect to observe a decrease in the extent to which decreasing returns to leverage are observed in this industry: the ratio of the average product per lawyer and the marginal cost of an associate should fall. We estimate this marginal cost for each office, using ideas from the assignment and hedonics literatures, and use these estimates in a specification that estimates the coordination costs associated with hierarchical production. Our results indicate that coordination costs fell steadily during this period throughout the industry; the estimates imply that hiring one's first associate increased the time lawyers spend in production by about 50% in 1977, but by about 63% in 1992. Increases in leverage during this time appear to be responses to declines in coordination costs; the timing of these changes suggests that the diffusion of computer-aided legal research products such as Lexis and Westlaw may be related to coordination cost declines, but it is unlikely that these declines reflect more recent waves of technology adoption related to personal computers.

We then analyze the effect of changes in leverage on changes in earnings inequality. We find that changes in leverage during this time account for the majority of the increase in earnings inequality among lawyers in the upper tail of the distribution, and a smaller but substantial share of the increase in inequality between these lawyers and the median lawyer. This effect likely understates the impact of improvements in coordination costs on earnings inequality, because it does not account for the possibility that these improvements led to disproportionate increases in human capital investments for the most skilled lawyers relative to other lawyers. We then analyze aggregate changes in lawyers' productivity during this period; consistent with this evidence on inequality, we show that increases in the market value of lawyers' skill account for the bulk in the increase in lawyer productivity; on average, only around 10% of the productivity increase is directly related to increases in leverage. While changes in leverage were less important in the aggregate than changes in the market value of lawyers' skill, they appear to be relatively important when explaining changes in the productivity and earnings of very top lawyers.

We see this paper as contributing to the understanding of the organizational underpinnings of changes in labor market outcomes. In our view, changes in external and internal labor markets are closely related; understanding changes in what have traditionally been considered external labor market outcomes is likely to require studying how the demand and organization of skill and time changes inside firms. While law offices are an unusually clean laboratory, given offices' small size and comparable or-

ganizational structures, future studies in other industries may allow further insights, in particular by allowing for an analysis of changes in the number of hierarchical layers in firms, which we could not measure in our data as most law firms (and our data) distinguish only between partners and associates.

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**Table 1**  
**Estimated Earnings Distribution Across Privately-Practicing Lawyers, 1977-1992**

	Earnings Quantiles ('000s of 1992 Dollars)					Ratios of Quantiles				
	5th	10th	25th	50th	75th	90th	95th	75th/50th	90th/50th	95th/50th
1977	21	31	50	81	147	222	282	1.8	2.7	3.5
1982	15	24	40	66	114	185	242	1.7	2.8	3.7
1987	14	26	49	80	136	237	336	1.7	3.0	4.2
1992	3	20	47	77	137	257	373	1.8	3.3	4.8

**Table 2**  
**Estimated Leverage Distribution Across Privately-Practicing Lawyers, 1977-1992**

	Leverage Quantiles									
	50th	55th	60th	65th	70th	75th	80th	85th	90th	95th
<i>All Offices</i>										
1977	0	0	0.13	0.25	0.33	0.50	0.57	0.73	1.00	1.17
1982	0	0	0	0.20	0.33	0.48	0.58	0.78	1.00	1.39
1987	0	0	0.14	0.33	0.50	0.63	0.83	1.00	1.25	1.67
1992	0	0	0	0.20	0.42	0.61	0.80	1.00	1.25	1.67

Leverage equals zero for associates and for partners at offices with no associates, and is the office's associate/partner ratio at offices with at least one associate.

**Table 3**  
**Age Distribution of Full-Time Privately-Practicing Lawyers**

Year	Shares by Age Bracket		
	35 or younger	36-50	51 or older
1970	30%	40%	30%
1980	45%	36%	19%
1990	35%	49%	16%
2000	27%	47%	26%

Source: PUMS 1% State Sample (Form 1, Form 2), 1970; PUMS 5% State Sample, 1980, 1990, 2000  
 Lawyers, at law offices, >39 hrs/week, >45 weeks/year, in labor force, age 25-70.

**Table 4**  
**Overhead, Employment, and Revenues**

Offices That Are Legally Organized As Partnerships or Proprietorships for 1977 and 1982, As PSOs for 1987 and 1992.

Dependent Variable: (Expenses - 1.15\*Payroll) for 1977, 1982; (Revenues - 1.15\*Payroll) for 1987, 1992.

	1977	1982	1987	1992
C	<b>4.237</b> <b>(0.928)</b>	0.960 (1.211)	<b>22.672</b> <b>(3.795)</b>	<b>28.508</b> <b>(2.508)</b>
Employment	0.407 (0.368)	0.014 (0.605)	0.475 (0.802)	<b>2.864</b> <b>(0.603)</b>
Market Size*Employment Interactions				
20K-100K*Employment	<b>-0.958</b> <b>(0.442)</b>	-0.740 (0.679)	-0.098 (0.876)	0.796 (0.662)
100K-200K*Employment	-0.532 (0.516)	1.429 (0.773)	0.483 (0.923)	0.984 (0.701)
200K-400K*Employment	-0.236 (0.456)	-0.333 (0.736)	0.551 (0.866)	<b>2.139</b> <b>(0.647)</b>
400K-1M*Employment	<b>0.903</b> <b>(0.451)</b>	-0.352 (0.766)	<b>2.433</b> <b>(0.858)</b>	<b>2.279</b> <b>(0.657)</b>
More than 1M*Employment	<b>2.616</b> <b>(0.539)</b>	1.473 (0.936)	<b>4.856</b> <b>(1.008)</b>	<b>13.896</b> <b>(0.735)</b>
Revenues Quadratic				
Revenues	<b>0.219</b> <b>(0.004)</b>	<b>0.262</b> <b>(0.007)</b>	<b>0.279</b> <b>(0.009)</b>	<b>0.213</b> <b>(0.007)</b>
Revenues^2	<b>-9.16E-06</b> <b>(1.77E-06)</b>	-4.81E-06 (2.75E-06)	-5.88E-06 (3.39E-06)	<b>-7.61E-06</b> <b>(1.80E-06)</b>
Market Size Dummies				
20K-100K	<b>2.195</b> <b>(1.116)</b>	<b>5.734</b> <b>(1.439)</b>	-2.707 (4.365)	-1.586 (3.023)
100K-200K	<b>3.927</b> <b>(1.364)</b>	<b>5.640</b> <b>(1.739)</b>	-0.043 (4.605)	4.089 (3.319)
200K-400K	<b>6.557</b> <b>(1.158)</b>	<b>5.276</b> <b>(1.589)</b>	-2.364 (4.255)	<b>11.098</b> <b>(2.809)</b>
400K-1M	<b>5.709</b> <b>(1.114)</b>	<b>11.055</b> <b>(1.554)</b>	<b>-9.841</b> <b>(4.034)</b>	<b>7.873</b> <b>(2.756)</b>
More than 1M	<b>9.865</b> <b>(1.308)</b>	<b>11.131</b> <b>(1.980)</b>	<b>-15.302</b> <b>(4.273)</b>	<b>-20.181</b> <b>(3.032)</b>
N	12043	4883	10647	10438
R-Squared	0.59	0.59	0.53	0.70

Specification also includes the (uninteracted) field shares of lawyers in the office, and interactions between the field shares and the revenues quadrat  
Omitted field category is "share(general practitioner)," where general practitioner is defined

**Table 5**  
**Wage-Leverage Surface Estimates, 1977-1992**  
Partnerships and Proprietorships With At Least One Associate

Coefficient Estimates	1977	1982	1987	1992
Associates/Partner -- "Business, Non-Litigation Offices"	0.037 (1.655)	<b>7.829</b> <b>(2.185)</b>	<b>8.524</b> <b>(2.529)</b>	<b>7.552</b> <b>(2.580)</b>
(Associates/Partner)**2 -- "Business, Non-Litigation Offices"	0.766 (0.489)	<b>-1.596</b> <b>(0.637)</b>	-1.367 (0.700)	-0.828 (0.665)
Associates/Partner -- "Litigation Offices"	<b>6.746</b> <b>(2.209)</b>	<b>-6.035</b> <b>(2.533)</b>	3.443 (2.375)	<b>4.032</b> <b>(2.264)</b>
(Associates/Partner)**2 -- "Litigation Offices"	-1.174 (0.637)	<b>2.682</b> <b>(0.683)</b>	-0.346 (0.594)	-0.209 (0.562)
Associates/Partner -- "Individual, Non-Litigation Offices"	-1.776 (2.299)	-3.405 (2.623)	-0.216 (3.508)	-5.179 (3.163)
(Associates/Partner)**2 -- "Individual, Non-Litigation Offices"	0.581 (0.715)	<b>1.596</b> <b>(0.734)</b>	0.269 (1.077)	<b>2.304</b> <b>(0.831)</b>
Share(Banking Law Specialist)	<b>15.878</b> <b>(2.651)</b>	-3.052 (3.146)	<b>9.741</b> <b>(3.162)</b>	<b>9.039</b> <b>(3.285)</b>
Share(Corporate Law Specialist)	<b>17.563</b> <b>(1.998)</b>	<b>14.806</b> <b>(2.512)</b>	<b>29.277</b> <b>(2.658)</b>	<b>35.957</b> <b>(3.050)</b>
Share(Insurance Law Specialist)	<b>7.543</b> <b>(2.449)</b>	-1.575 (2.880)	<b>8.737</b> <b>(2.895)</b>	<b>8.515</b> <b>(2.399)</b>
Share(Negligence-Defense Specialist)	<b>8.694</b> <b>(2.206)</b>	0.887 (2.735)	<b>10.892</b> <b>(2.678)</b>	<b>9.027</b> <b>(2.506)</b>
Share(Patent Law Specialist)	<b>8.948</b> <b>(1.836)</b>	<b>8.290</b> <b>(2.104)</b>	<b>17.602</b> <b>(2.917)</b>	<b>22.479</b> <b>(2.856)</b>
Share(Government Law Specialist)		0.528 (4.036)	8.906 (5.670)	<b>19.534</b> <b>(3.656)</b>
Share(Environmental Law Specialist)				<b>24.839</b> <b>(5.416)</b>
Share(Real Estate Law Specialist)	<b>5.246</b> <b>(2.100)</b>	<b>5.878</b> <b>(2.659)</b>	<b>6.895</b> <b>(2.248)</b>	<b>14.281</b> <b>(2.582)</b>
Share(Tax Law Specialist)	<b>13.840</b> <b>(2.959)</b>	<b>18.200</b> <b>(4.202)</b>	<b>20.141</b> <b>(4.785)</b>	<b>27.125</b> <b>(5.623)</b>
Share(Criminal Law Specialist)	-2.859 (3.158)	-6.982 (4.317)	-4.031 (4.083)	-1.632 (1.074)
Share(Domestic Law Specialist)	<b>-12.074</b> <b>(3.264)</b>	-4.085 (4.301)	<b>-13.521</b> <b>(3.431)</b>	-1.073 (3.742)
Share(Negligence-Plaintiff Specialist)	<b>4.927</b> <b>(2.352)</b>	<b>7.573</b> <b>(3.005)</b>	0.396 (2.822)	<b>12.763</b> <b>(2.514)</b>
Share(Probate Law Specialist)	<b>6.098</b> <b>(2.528)</b>	-3.561 (3.460)	5.433 (4.420)	7.037 (4.433)
Share(Other Specialist)	<b>9.050</b> <b>(1.264)</b>	<b>7.527</b> <b>(1.438)</b>	<b>8.044</b> <b>(1.617)</b>	<b>11.035</b> <b>(1.494)</b>
R-Squared	0.30	0.45	0.38	0.49
N	7560	3058	4835	5319
w(1.5)-w(0.5)				
Business, Non-Litigation Offices	1.623	4.778	5.826	5.896
Litigation Offices	4.548	-0.691	2.769	3.614
Individual, Non-Litigation Offices	-0.634	-0.219	0.324	-0.571

The dependent variable in the wage-leverage surface regression is average associate pay in the office. Offices with at least one lawyer specializing in insurance or negligence law are classified as "litigation" offices. All other offices are classified as "business" or "individual" depending on whether the majority of their revenues come from individuals. This regression includes county fixed effects and "business, nonlitigation" and "litigation" dummies as well as the variables abo

**Table 6**  
**Mean Real Revenues Per Lawyer and the Estimated Marginal Cost of Leverage, 1977-1992**

Partnerships and Proprietorships With At Least One Associate

Year	Revenues/ Lawyer	Overhead Share of Revs.	Estimated Avg. Benefits	Estimated MC	Components of Estimated Marginal Cost					Marginal Price of Leverage
					Associate Pay	Nonlawyer Pay	Benefits	Overhead	$w/h$	
	$TR/(n+1)$	$(1-K)$	$TR/(n+1)*(1-K)$	$MC$	$w$	$x$	$0.15*(w+x)$	$oh*/p$		
1977	195	0.20	156	91	48	28	12	2	2	2
1982	180	0.25	136	85	45	27	11	1	2	2
1987	235	0.24	181	117	57	38	14	6	3	3
1992	247	0.18	204	139	62	39	15	18	4	4
Means, Relative to Mean Estimated MC										
1977	2.15		1.71	1.00	0.53	0.31	0.13	0.02	0.02	0.02
1982	2.11		1.59	1.00	0.52	0.32	0.13	0.01	0.02	0.02
1987	2.00		1.54	1.00	0.48	0.32	0.12	0.05	0.03	0.03
1992	1.78		1.47	1.00	0.45	0.28	0.11	0.13	0.03	0.03

All dollar figures in thousands of 1992 dollars.

**Table 7**  
**Production Function Estimates, 1977-1992**

Partnerships and Proprietorships With At Least One Associate

	1977	1982	1987	1992
Coefficient Estimates				
Constant	<b>0.601</b> (0.007)	<b>0.470</b> (0.010)	<b>0.440</b> (0.012)	<b>0.343</b> (0.010)
Number of Partners	<b>-0.0049</b> (0.0006)	<b>-0.0045</b> (0.001)	<b>-0.0027</b> (0.001)	<b>0.0015</b> (0.0004)
Number of Partners**2	5.81E-05 (8.36E-06)	<b>4.41E-05</b> (7.30E-06)	<b>3.60E-05</b> (5.10E-06)	-1.43E-06 (2.81E-06)
Share(Banking Law Specialist)	<b>-0.229</b> (0.038)	0.062 0.055	<b>-0.264</b> (0.045)	-0.026 (0.038)
Share(Corporate Law Specialist)	-0.031 (0.025)	-0.024 (0.037)	<b>-0.084</b> (0.033)	<b>-0.198</b> (0.028)
Share(Insurance Law Specialist)	<b>0.059</b> (0.028)	-0.019 (0.034)	-0.050 (0.031)	<b>-0.095</b> (0.020)
Share(Negligence-Defense Specialist)	<b>-0.044</b> (0.022)	<b>0.169</b> (0.029)	<b>0.089</b> (0.027)	<b>0.047</b> (0.021)
Share(Patent Law Specialist)	0.025 (0.022)	0.039 (0.031)	-0.041 (0.038)	<b>-0.076</b> (0.029)
Share(Government Law Specialist)			-0.076 (0.064)	0.043 (0.044)
Share(Environmental Law Specialist)				<b>0.137</b> (0.067)
Share(Real Estate Law Specialist)	-0.041 (0.033)	<b>-0.101</b> (0.046)	0.010 (0.036)	<b>-0.140</b> (0.035)
Share(Tax Law Specialist)	<b>0.124</b> (0.041)	0.067 (0.076)	-0.011 (0.071)	0.057 (0.063)
Share(Criminal Law Specialist)	-0.076 (0.053)	0.076 (0.094)	<b>0.164</b> (0.071)	0.060 (0.046)
Share(Domestic Law Specialist)	<b>-0.120</b> (0.055)	-0.018 (0.082)	<b>-0.126</b> (0.061)	<b>0.136</b> (0.053)
Share(Negligence-Plaintiff Specialist)	0.024 (0.030)	<b>0.234</b> (0.049)	<b>0.264</b> (0.036)	<b>0.343</b> (0.025)
Share(Probate Law Specialist)	-0.036 (0.040)	0.010 (0.066)	-0.131 (0.067)	-0.129 (0.057)
Share(Other Specialist)	-0.011 (0.017)	<b>0.072</b> (0.023)	<b>0.049</b> (0.022)	0.005 (0.017)
R-Squared	0.02	0.04	0.05	0.06
N	7560	3058	4835	5319
Average Predicted Value for Theta	0.57	0.63	0.66	0.70

The dependent variable in the production function is  $\ln(\text{revenues}/\text{lawyer}*(1-K))-\ln(\text{MC})$ , where K is the coefficient on revenues in the overhead regre for the office, and MC is the estimated marginal cost of leverage for the office. The coefficients reported here correspond to  $-\ln(\theta)$  in the text. The 0.343 coefficient estimate in 1992 for the constant implies an estimate of theta of 0.710 for an office of general practitioners (the omitted categ

Bold indicates rejection of the hypothesis  $b=0$  using a one-tailed t-test of size 0.05.

**Table 8**  
**Average Predicted Values of Theta**  
 by Year, Office Size, and Market Size

	All Market Sizes	Employment Size of County					
		<20K	20-100K	100-200K	200-400K	400K-1M	>1M
All Office Sizes	1977	0.53	0.53	0.57	0.58	0.60	0.62
	1982	0.62	0.59	0.67	0.62	0.64	0.67
	1987	0.62	0.62	0.64	0.66	0.68	0.69
	1992	0.66	0.65	0.65	0.71	0.73	0.76
<= 5 partners	1977	0.52	0.53	0.57	0.57	0.59	0.61
	1982	0.62	0.59	0.70	0.63	0.64	0.66
	1987	0.62	0.61	0.64	0.66	0.68	0.71
	1992	0.66	0.65	0.64	0.72	0.80	0.76
6-20 partners	1977	0.56	0.53	0.56	0.59	0.59	0.62
	1982	0.62	0.57	0.62	0.60	0.64	0.68
	1987	0.67	0.62	0.64	0.66	0.71	0.71
	1992	0.70	0.65	0.67	0.70	0.68	0.81
>20 partners	1977	(D)	(D)	(D)	0.59	0.61	0.62
	1982	(D)	(D)	(D)	0.64	0.67	0.69
	1987	(D)	(D)	(D)	0.69	0.67	0.66
	1992	(D)	(D)	0.66	0.69	0.66	0.74

The predicted values are generated from specifications that include full interactions between office size and market size categories. All averages are weighted by the number of partners in the office. (D) indicates that the value has been withheld by the U.S. Census for disclosure-related reasons.

**Table 9**  
**Earnings Distribution Across Privately-Practicing Lawyers, 1977-1992**

	Earnings Quantiles ('000s of 1992 Dollars)					Ratios of Quantiles				
	5th	10th	25th	50th	75th	90th	95th	75th/50th	90th/50th	95th/50th
<i>Estimated Earnings Distribution</i>										
1977	21	31	50	81	147	222	282	1.8	2.7	3.5
1982	15	24	40	66	114	185	242	1.7	2.8	3.7
1987	14	26	49	80	136	237	336	1.7	3.0	4.2
1992	3	20	47	77	137	257	373	1.8	3.3	4.8
<i>Estimated Earnings Distribution, Absent Hierarchical Production</i>										
1977	23	33	51	81	136	196	241	1.7	2.4	3.0
1982	17	26	42	66	106	159	194	1.6	2.4	2.9
1987	16	27	48	77	126	204	265	1.6	2.7	3.5
1992	5	21	47	78	131	221	285	1.7	2.8	3.7

All dollar amounts in thousands of 1992 dollars.



**Table 10**  
**Changes in Logged Earnings Quantile Ratios, Privately-Practicing Lawyers, 1977-1992**

	Change In Logged Quantile Ratios, 1977-1992		
	ln(90th/50th)	ln(95th/50th)	ln(95th/90th)
<i>All Offices</i>			
Estimated Earnings	0.20	0.33	0.13
Estimated Earnings, Absent Hierarchical Production	0.16	0.21	0.05
Residual Change in Earnings Inequality	0.04	0.12	0.08
Residual Change as Percent of Estimated Earnings Change	20%	37%	63%
<i>By Office Class</i>			
Estimated Earnings			
Business, Non-Litigation	0.11	0.23	0.12
Litigation	0.31	0.46	0.15
Individual, Non-Litigation	0.48	0.54	0.06
Estimated Earnings, Absent Hierarchical Production			
Business, Non-Litigation	0.10	0.13	0.03
Litigation	0.24	0.31	0.07
Individual, Non-Litigation	0.41	0.54	0.13
Residual Change in Earnings Inequality			
Business, Non-Litigation	0.01	0.10	0.09
Litigation	0.07	0.15	0.08
Individual, Non-Litigation	0.07	-0.01	-0.07
Residual Change as Percent of Estimated Earnings Change			
Business, Non-Litigation	10%	44%	77%
Litigation	24%	33%	53%
Individual, Non-Litigation	14%	-1%	-126%

Residual Change in Earnings Inequality is the difference between the figures in the "estimated earnings" panel and the "estimated earnings, absent hierarchical production" panel. This is a measure of the degree to which changes in leverage have affected earnings inequality.

**Table 11**  
**Decomposition of Productivity Changes**

Revenues Per Lawyer and Its Components				
Year	$\overline{y_i / (n_i + 1)}$	$\overline{z_m}$	$\overline{s}$	$cov(z_{mi}, s_i)$
1977	188	229	0.86	-9
1982	172	211	0.86	-10
1987	227	288	0.83	-13
1992	227	280	0.85	-12

Decomposition of Changes in Revenues Per Lawyer

	$\overline{\Delta y_i / (n_i + 1)}$	$\Delta \overline{z_m} \overline{s_t}$	$\Delta \overline{s} \overline{z_{m,t-1}}$	$\Delta cov(z_{mi}, s_i)$
1977-1992	39	44	-1	-3

All dollar amounts are in thousands of 1992 dollars.

**Table 12**  
**Decomposition of the Average Value of Skill Applied to Lawyer Time**

Year	$\overline{z_m}$	$\widehat{z_m}$	Average Value of Skill and Its Components	
			$\sqrt{\text{var}(\widehat{z_m})}$	$\sqrt{\text{var}(r_{i,92})}$
1977	229	206	123	0.37
1982	211	183	124	0.42
1987	288	246	169	0.43
1992	280	238	180	0.45
				$\text{corr}(\widehat{z_{mi,92}}, r_{i,92})$
				0.52
				0.53
				0.58
				0.52

Decomposition of Changes in Average Value of Skill Applied to Lawyers' Time

Year	$\Delta \overline{z_m}$	$\Delta \widehat{z_m}$	$\sqrt{\text{var}(r_{i,92})\text{corr}(z_{mi,92}, r_{i,92})}$	$\Delta \sqrt{\text{var}(z_{mi})}$	$\Delta \sqrt{\text{var}(r_i)}$	$\sqrt{\text{var}(z_{mi,77})\text{corr}(z_{mi,92}, r_{i,92})}$	$\Delta \sqrt{\text{var}(r_i)}$	$\sqrt{\text{var}(z_{mi,77})\sqrt{\text{var}(r_{i,77})}}$
1977-1992	51	32	14	5	0			

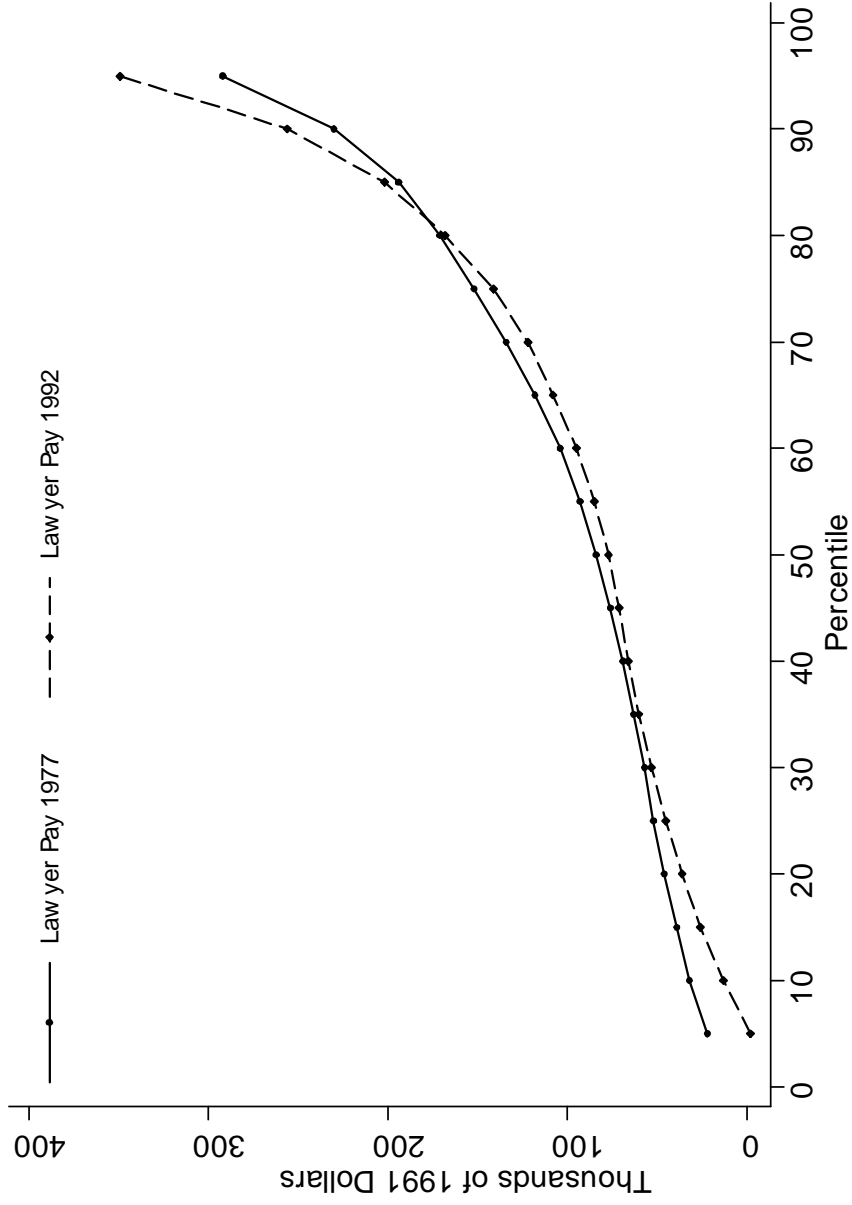
All dollar amounts are in thousands of 1992 dollars.

**Table A1**  
**Earnings Distribution of Privately-Practicing Lawyers**

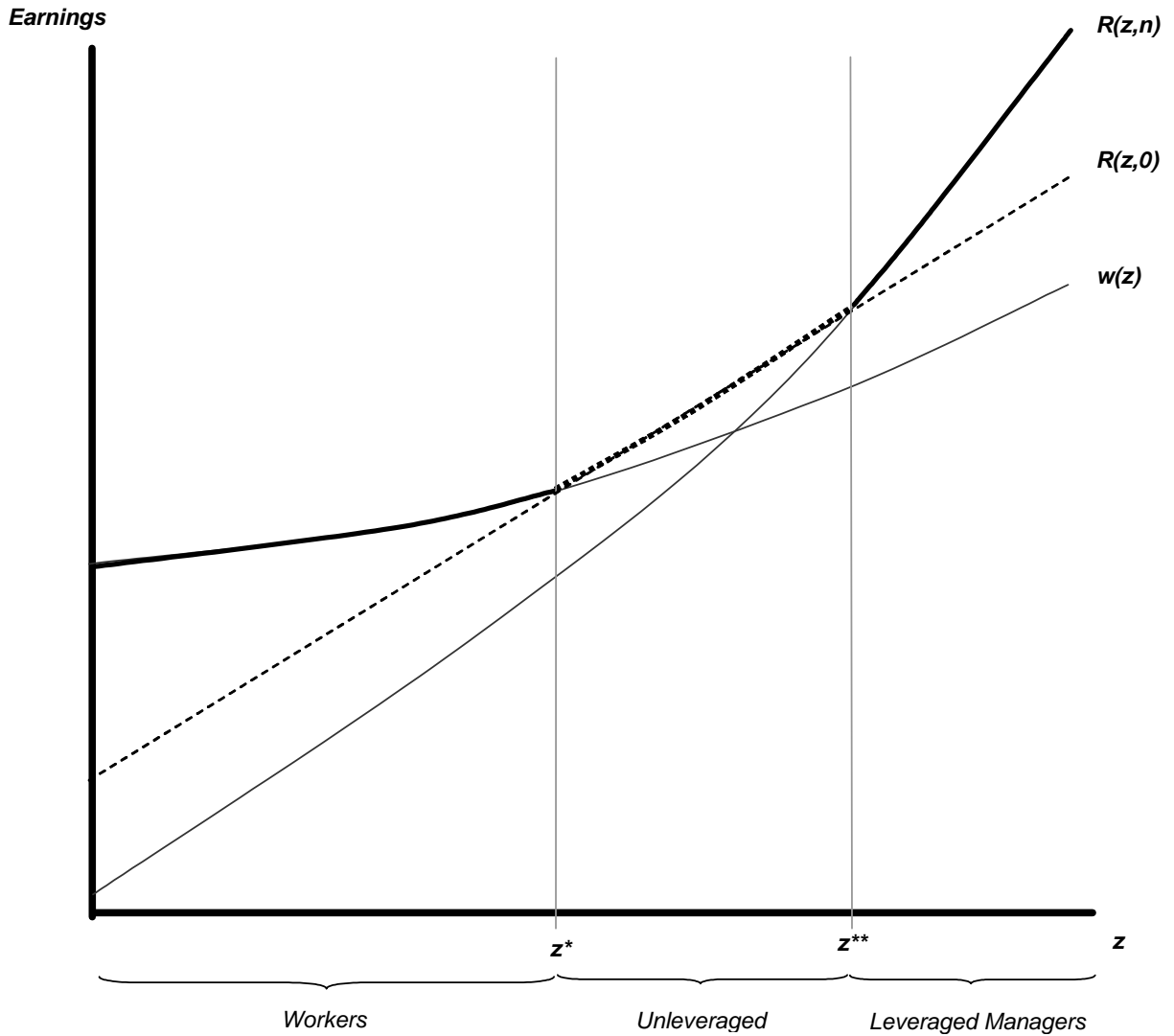
	Earnings Quantiles ('000s of 1992 Dollars)										Top Coded Above...
	10th	20th	30th	40th	50th	60th	70th	80th	90th		
1969	31	40	50	60	75	88	105	134	184		\$ 191,150
1979	23	34	42	50	59	73	91	116	*		\$ 144,975
1989	29	40	51	61	74	88	*	*	*		\$ 101,790
1999	27	39	50	61	72	84	105	*	*		\$ 106,092

Asterisk indicates top-coded value.

Source: PUMS 1% State Sample (Form 1, Form 2), 1970; PUMS 5% State Sample, 1980, 1990, 2000. Lawyers, at law offices, >39 hrs/week, >45 weeks/year, in labor force, age 25-70.



**Figure 1. The Distribution of Lawyers' Earnings in 1977 and 1992.** This Figure reports 20 quantiles of our estimated distribution of lawyers' earnings in 1977 and 1992. Earnings declined slightly below the 80th percentile, and increased above the 80th percentile.



**Figure 2. Equilibrium Earnings and Assignment.** The three curves in this Figure represent agents' earnings as a function of their skill,  $z$ , if they are (a) managers with others working under them ( $R(z, n)$ ), (b) working on their own ( $R(z, 0)$ ) and (c) workers working under managers ( $w(z)$ ). The equilibrium wage-skill surface is the outer envelope of these curves, which is in bold. A goal of the empirical work is to estimate how  $R(z, 0)$  changes over time.