The Impacts of the Americans with Disabilities Act on the Entry and Exit of Retail Firms[1]

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Abstract

Congress enacted The Americans with Disabilities Act of 1990 over the protests of small business advocates who claimed that the ADA would trigger a wave of bankruptcies. Although the profitability of firms may suffer from the costs of ADA compliance, no systematic evidence is available. This paper seeks to determine if the ADA had a measurable impact on both the entry of new firms and the failure rates (exit) of existing firms.

The data used in the study are counts of business establishments currently operating by county and type of business. Backing out the entry and exit rates from the establishment count data is a major econometric contribution of the paper.

The empirical results imply that the ADA indeed decreased the number of retail firms. There were fewer retail firms after the ADA was passed, and the drop was larger in states in which the ADA was more of a legal innovation, and in states that had more disabled people, more ADA-related lawsuits, and more ADA-related labor complaints. The same conclusions hold when baseline trends for larger establishments (those least vulnerable to the costs imposed by the ADA) are differenced out. There is also evidence that employment and access discrimination suits imposed real costs on retail stores, encouraging exit. However, the exit of incumbents was partially offset by new entrants, which may imply that stores less able to adapt to the new requirements made room for the entry of stores better able to adapt. So, while the prediction by the pessimists that the ADA would cause firms to fail may be correct, the decline in the number of firms was partially offset by new entry.

1 Introduction

The Americans with Disabilities Act of 1990 (ADA) is the most recent major federal antidiscrimination law. The ADA seeks to prevent employment and wage discrimination of disabled workers, and to ensure the physical accessibility of businesses to disabled customers. Congress enacted the ADA over the protests of small business advocates who claimed that the ADA would trigger a wave of bankruptcies. Despite allegations, no systematic evidence has been presented to substantiate or refute this claim. The profitability of smaller firms may be vulnerable to the costs of ADA compliance. These costs stem from provisions mandating accommodation of disabled workers and customers, and from the civil lawsuits and penalties to which the ADA exposes firms.

The immediate question this paper seeks to answer is if the ADA had a measurable impact on the number of firms, the entry of new firms, and the failure rates of existing firms in the retail sector. We focus on retailers because they are subject to both the employment and customer accessibility provisions of the ADA. The empirical results imply that the ADA indeed decreased the number of retail firms. There were fewer retail firms after the ADA was passed, and the drop was larger in states in which the ADA was more of a legal innovation, and in states that had more disabled people, more ADA-related lawsuits, and more ADA-related labor complaints. The same conclusions hold when baseline trends for larger establishments (those least vulnerable to the costs imposed by the ADA) are differenced out. There is also evidence that employment and access discrimination suits imposed real costs on retail stores, encouraging exit. However, the exit of incumbents was partially offset by new entrants, which may imply that stores less able to adapt to the new requirements made room for the entry of stores better able to adapt. So, while the prediction by the pessimists that the ADA would cause firms to fail may be correct, the decline in the number of firms was partially offset by new entry.

The investigation also makes two subsidiary contributions. The first is an inquiry into the response of industry dynamics to increases in costs. In the theoretical model developed in section 4, we show that increases in marginal and fixed costs may have interesting and non-obvious effects on entry and exit. Before costs change, the model exhibits behavior that matches the retail sector examined here: fewer but larger firms over time, and significant amounts of entry and exit. When costs rise, the market quantity supplied falls, but the number of firms may rise or fall due to composition effects as the size distribution of firms changes. In addition, regardless of how the number of firms changes, entry and exit of firms may each increase or decrease. The main potential outcomes from a cost increase are the *competitor neutral* case, in which entry decreases and exit increases, the *entrant favoring* case, in which entry and exit both increase, and the *incumbent favoring* case, in which entry and exit both decrease. The model places restrictions on which outcomes are possible given which costs rise (marginal or fixed). The entrant favoring case can arise only from an increase in marginal cost (when demand is inelastic), which favors small entering firms relative to larger incumbents. The incumbent favoring case can come about only from an increase in fixed cost, which favors incumbents with their larger market share relative to small entrants. These restrictions allow us to infer the nature of the cost increases caused by the various components of the ADA. The same model could easily be adapted to examine the impacts of other forms of cost-increasing regulation or exogenous process innovation on industry dynamics.

The second subsidiary contribution of the paper is an econometric model that allows entry and exit rates to be estimated from counts of currently operating firms. Given that the impacts of the ADA on firms may be subtle, a large data set is required to assess the evidence with any degree of precision. The data used in the study are the comprehensive Census Bureau counts of business establishments by county and type of business. Thus, the data are counts of the number of businesses currently operating in a year, and do not directly give entry and exit rates. There is no publicly available data set as disaggregated and as large that gives direct information on entry and exit.[1] While standard count models can be used to investigate changes in the number of firms in the market, backing out the entry and exit rates from the establishment count data is the major econometric contribution of the paper. Borrowing techniques from queuing theory, we develop the maximum likelihood estimator for a generalized Poisson queuing system based on the available count data. The model incorporates unobserved heterogeneity in and correlation between the entry and exit rates. Identification of the entry and exit rates is secured through the assumption that entry and exit are Poisson stochastic processes, conditional on time-varying covariates and correlated, gamma-distributed mixing terms (i.e., random effects that relax the Markovian assumptions in the model). Although we use techniques drawn from the existing queuing theory literature, the likelihood for the count data is non-trivial to derive and we have not seen the likelihood for this model presented elsewhere. We develop this model here out of necessity, due to the particular limitations of the available data; however, there are many other potential applications for the econometric model. We return to these possibilities in the final section of the paper.

The queuing system[2] adopted to recover entry and exit rates is an extension of a simple $M/M/\infty$ model.[3] The first extension is to introduce dependence in the entry and exit rates on covariates that evolve period to period. The second extension is to add correlated random effects in the entry and exit rates. Conditional on these random effects, entry and exit are Markovian; unconditionally, duration dependence is allowed in the processes. We denote the model a $CM_t/CM_t/\infty$ queuing system, where the CM is for "conditionally Markovian" and the subscript denotes rates that vary each period. In this queuing system, each period nature first draws a pair of heterogeneity terms that enter the specification of the rates for the entry and exit processes (this is made precise in

[1] Other researchers have exploited the *Longitudinal Research Database* (LRD) from the U.S. Census Bureau to study entry and exit. The LRD, however, covers only the manufacturing sector, which is not likely to be affected by Title III of the ADA, as explained below. The new *Longitudinal Business Database*, also from Census, covers the retail sector and is a promising resource; it was not yet available when the present study was begun.

[2] Bunday (1996) provides an accessible introduction to queuing theory.

[3] Kendall notation provides a compact description of a queuing system: an $A/B/c$ system has interarrival time distribution A, service time distribution B, and c servers. A and B are chosen from a few traditional symbols such as M for the exponential distribution (for its Markovian property).

section 5). Conditional on these random effects[4] and the period-specific entry rate, firms enter with an exponential interarrival distribution. Once in the system, a firm's lifetime (again conditional on the heterogeneity terms and a period-specific rate) has an exponential distribution.[5] Unconditionally, the entry and exit processes have less restrictive functional forms, as is discussed in section 5.

The plan of the paper is as follows. In the next section we discuss the costs that the ADA creates for firms. Section 3 reviews the relevant literature. Section 4 introduces the theoretical model of firm dynamics and response to the ADA. In Section 5, we formalize the $CM_t/CM_t/\infty$ econometric model and present the likelihood of the data. Section 6 discusses empirical strategies to identify impacts of the ADA on the number, entry, and exit of retail firms, and includes the results of the estimations. A final section concludes and discusses the broader applicability of the theoretical and econometric models in the paper. Proofs and the detailed derivation of the $CM_t/CM_t/\infty$ likelihood are in an appendix.

2 The Costs of the ADA for Firms

The ADA was passed in July 1990. Most likely to affect private firms are Title I, which prohibits discrimination by employers against disabled individuals, and Title III, which (among other things) bans discrimination in access to private commercial facilities. Title I protects disabled individuals who can perform the "essential functions" of a position, both in applying for a job and once on payroll. The employer is not allowed to discriminate against disabled workers in hiring, firing, or wages. The employer is required to make "reasonable accommodations" for disabled workers, as long as accommodation does not create "undue hardship" (which is not defined) for the employer. The employment provisions took effect July 1992 for "employers" with 25 or more employees, and

[4] Such heterogeneity terms are also known as *mixing terms*.

[5] The infinite-server assumption means that the firm's exponentially distributed lifetime "begin" immediately upon entry; there is no "queuing for a server".

two years later for businesses with 15-24 employees. Smaller firms remain exempt.

Title III of the ADA requires businesses to make accessible all areas of stores where customers might go. In addition, it instituted a national building code for new construction: up to 20% of any construction or remodeling costs must be spent on accessibility. Title III took effect January 26, 1992 for businesses with more than 25 employees, six months later for firms with 11-25 employees, and one year later for smaller firms.[6]

What then are the costs of the ADA to firms?[7] The non-discrimination clause means that employers cannot base hiring, firing, and wage decision solely on the marginal product of the individual worker, which may lead to higher operating costs. Other costs stem from real or perceived violation of the law. Enforcement of Title I is delegated to the Equal Employment Opportunity Commission (EEOC). From July 1992 to September 2001, 158,280 discrimination charges have been filed with the EEOC.[8] When a worker files a charge, the EEOC investigates, attempts to settle, and in some cases sues the firm (or gives permission to the worker to privately sue the firm). Of the 11% of charges leading to non-litigated compensation, the average benefit paid to the worker was \$19,226.[9] If the case is litigated and the plaintiff prevails, the ADA requires firms to pay remedies, such as back pay and all court costs.[10] A related law (the Civil Rights Act of 1991) also makes the firm liable for damages ranging from \$50,000 to \$300,000.[11] Thus costs come from three sources. The first two are the direct accommodation costs for disabled workers[12] and the litigation, remedy,

[6] In addition to the employee count, the businesses with 11-25 employees also had to have gross receipts of less than \$1,000,000, and the businesses with 0-10 employees had to have gross receipts of less than \$500,000.

[7] This section draws on the similar discussion in Acemoglu and Angrist (2001).

[8] These data are from the EEOC, available from <http://www.eeoc.gov/stats/ada-charges.html>.

[9] *Ibid.*

[10] Court costs in employment practices suits average \$50,000 to \$100,000 per claimant (Dertouzos, 1988; Chanzit, 2001).

[11] Compensatory damages averaged \$395,197 in the 101 successful suits for wrongful termination due to discrimination (of which ADA suits are a subset) in California during 1992-1996.(Jung, 1997) Plaintiffs prevailed (through verdict or settlement) in about 38.1% of such cases. Punitive damages averaged another \$895,863 in the 25 cases with punitive damage awards. These figures do not include out-of-court settlements.

[12] There are no good estimates of the magnitude of accommodation costs. A non-random survey cited in Acemoglu and Angrist (2001) finds average costs of \$930 per accommodation through 1997, but this figure does not include involuntary accommodations, the value of time spent on compliance, or reduced efficiency of the firm due to compliance.

and penalty costs. The third is the cost of a new kind of insurance that has arisen in response to such lawsuits. In the past decade, more firms have begun to purchase Employment Practice Liability Insurance (EPLI), with basic premiums ranging from $5,000 to $20,000 per year.

The costs of Title III stem from similar sources. One estimate places access accommodation costs at $500–$3000 on average (Chebium, 2000).[13] Enforcement of Title III is up to the Justice Department; civil penalties can be as high as $110,000 per violation, and remedies such as repayment of court costs and construction costs can make losing a Title III case even more expensive for a firm.[14]

These actual and expected costs prompted small business advocates to lobby hard against the ADA, claiming that it would trigger a wave of bankruptcies (Teltsch, 1993). While no such wave of bankruptcies has been reported in the press, there certainly have been thousands of lawsuits, and the law may have had subtle effects on the decisions of firms to enter or exit markets. For example, if there are differences in the organizational adaptability of firms, then the changed legal environment may have induced those firms to exit which found it most costly to adapt, making room for the entry of new firms that find it less costly to adapt. In this case, the number of firms in a market may change little, even though the turnover rate of firms increases during the period of adaptation and transition. This example highlights why entry and exit rates are interesting in their own right, instead of looking only at the number of firms in the market.

3 Relevant Literature

Three strands of literature come together in this paper: empirical studies evaluating the effects of the ADA, the industrial organization literature on firm entry and industry dynamics, and applica-

[13] The estimate is from the National Federation of Independent Businesses. The most common accommodation is ensuring wheelchair access. Some court-ordered accommodations are less obviously needed, including one that required a bank to install Braille signs on the driver's side at drive-through teller locations (Hudgins, 1995).

[14] It is difficult to estimate the number of lawsuits filed under Title III. The DOJ files suit itself relatively rarely and only for high-profile cases; the DOJ does not track private suits. In section 6 I use a measure of Title III suits brought to judgment in the federal court system.

tions of queuing theory in economics. There are but a few studies in the economic literature on the ADA. Schumacher and Baldwin (2000) find relatively few differences in the labor market outcomes of disabled workers between 1990 and 1993, suggesting that the ADA had little impact, positive or negative. Acemoglu and Angrist (2001) show with different data that not only did the ADA fail to help disabled workers, that in fact, it appears to have reduced the employment of disabled men of all ages and of women under age 40. These studies focus on the labor market.[15] This paper extends the empirical literature on the ADA to the impacts on the firm's profitability and industry dynamics.

Numerous empirical studies in industrial organization examine the entry or exit of firms.[16] A few empirical regularities emerge from these studies (see Geroski (1995) for a review). First, within an industry, high entry rates are correlated with low exit rates (Dunne, Roberts and Samuelson, 1988). This fits the usual intuition that when conditions are profitable in a market, not only are new entrants attracted to the market but existing firms are unlikely to exit. Second, there are large cross-sectional variations in the entry and exit rates of industries (Dunne et al., 1988; Geroski, 1995). Third, across industries in the cross section, high entry rates are correlated with high exit rates (Dunne et al., 1988; Honjo, 2000). Fourth, the hazard rates (exit rates) estimated from panel data typically decline with the age and the size of firm (Hall, 1987; Evans, 1987).[17] In the age dimension, therefore, there is negative duration dependence.[18] We view these four stylized facts as necessary possible outcomes for any econometric model; the $CM_t/CM_t/\infty$ model can accommodate them all. All of these studies use longitudinal data on individual firms in the manufacturing sector. Geroski and Mazzucato (2001) is one of the few studies that models the number of firms in the industry

[15] Virtually the only other empirical economic study on the ADA is DeLeire (2000).

[16] There is also a large related literature in the fields of corporate demography and organizational ecology. See Carroll and Hannan (2000) for an overview.

[17] It is well known that estimated negative duration dependence may be a spurious result of estimating a common hazard rate for firms that actually have constant but differing rates. I account for this explicitly in my econometric model.

[18] A notable exception is Holmes and Schmitz (1995), who find that the hazard rate may be ∪-shaped for small firms run by their founders.

directly, in a dynamic setting.[19] Unlike the present work, Geroski and Mazzucato (2001) do not attempt to back out the entry and exit rates from the data.

Among the theoretical studies of firm entry and exit, three of the prominent models are Jovanovic (1982), Hopenhayn (1992), and Klepper (1996). The model in section 4 is based on Klepper (1996),[20] which is a more convenient model to work with than the complex dynamical system in Jovanovic (1982) and admits non-steady state analysis more easily than does the model in Hopenhayn (1992). Our theoretical model simplifies Klepper (1996) by abstracting away from innovation (which is not as important in our retailing context as in Klepper's (1996) manufacturing setting) and adds a microstructure for costs for the sake of exploring the various channels through which the ADA might increase firms' costs.

There are many applications of queuing theory in economic literature, but empirical applications of queuing theory (e.g., De Vany and Frey (1982); Daniel (1995); Prieger (2001; 2002*a*; 2002*b*)) are scarcer than theoretical studies. None of these empirical queuing studies attempts to infer arrivals and departures from the number of units currently in the system, as we do here.

4 The Theoretical Model

In a longer version of the paper, we construct a model to investigate the response of industry dynamics to increases in costs. For the sake of brevity, here we will only describe the impacts that the ADA is assumed to have on costs and the results from the theoretical model; the details of the model and proofs are omitted. In each period $t = 1, 2, \ldots$, there is a continuum of atomistic potential entrant firms indexed by their fixed cost $F \in [\underline{F}, \bar{F}] \equiv \mathcal{F}, 0 < \underline{F} < \bar{F}$. The variable inputs of a firm are capital K, with price r, and workers. Workers are either disabled (D, with wage w_D), or not (L, with wage w_L). The production technology of each firm is identical, and is described

[19] There are several structural models of entry in static settings (see Bresnahan and Reiss (1987) and Berry (1992) for seminal papers).

[20] See also Klepper (2002).

by the constant returns to scale production function $q = G(L, D, K) = \gamma(L + eD)^{\alpha}K^{1-\alpha}$, $\gamma > 0$, $\alpha \in (0, 1)$, where $e \in (0, 1)$ is the relative efficiency of disabled workers. Note that disabled and nondisabled workers are perfect substitutes at rate e nondisabled workers for one disabled worker.

Each unit of disabled labor requires an accommodation cost $a > 0$; assume that e would be zero in the absense of accommodation of disabled workers. It is assumed that both disabled and nondisabled workers are active in the labor force, which in a competitive labor market requires that $w_D = ew_L - a$; the substitutability of labor implies that firms are indifferent between disabled and nondisabled workers at those wages. Labor supply of both types is assumed to be completely elastic at the given wages. Under these assumptions, the marginal cost of production is constant at βw_L^{α}, where β is a function of (α, γ, r).[21]

After the passage of the ADA, costs change for several reasons. First, the equal-pay provision of the ADA mandates that w_D rise to w_L. It is assumed that to minimize the risk of lawsuits, labor employed by each firm is now composed of D and L in the same proportion as in the labor force at large. Let x be the fraction of workers that are disabled in the labor force. Second, under the ADA firms that have entered the market are exposed to potential litigation costs. Litigation is of two types: employment discrimination suits, as authorized under Title I of the ADA, and accessibility suits, as authorized under Title III.

Employment suits may stem from (perceived) hiring discrimination and wrongful termination of disabled workers. Assume that firms lay off and replace fraction θ of their work force each period, that the size of the pool of potential hires is H, and that each worker composing H applies for only one of the positions open in the current period at each firm, and that H is large compared to any one firm's labor demand. A disabled applicant that is not hired for a position sues with probability ℓ_H; the firm (assumed to be risk neutral) has expected costs of A_H from each suit, inclusive of litigation, settlement, and damages awarded. Then the expected cost from hiring discrimination suits is $xH\ell_H A_H \equiv \Lambda_H$. A disabled worker that is fired sues with probability ℓ_T and expected cost

[21] In particular, $\beta \equiv (\delta^{1-\alpha} + \delta^{-\alpha})r^{1-\alpha}/\gamma$, where $\delta \equiv \alpha/(1-\alpha)$.

A_T. The expected termination costs are therefore $\theta D \ell_T A_T \equiv \Lambda_T D$. This formulation implies that hiring suits raise fixed costs and that termination suits raise marginal costs.

Accessibility suits may also raise both fixed and variable costs. The expected number of accessibility suits is $s_F(y) + s_V(y)q$, where y is the fraction of the population that is disabled; s_F and s_V are assumed to increase with y. Here s_F may represent the suits filed by activists or otherwise occurring without respect to the size of the firm.[22] The term $s_V q$ represents suits filed by customers, and is therefore assumed to be proportional to output. The expected cost of each Title III suit to the firm is A_{III}. Letting $\Lambda_F \equiv s_F A_{III}$ and $\Lambda_V \equiv s_V A_{III}$, the total expected cost of accessibility suits is $\Lambda_F + q\Lambda_V$.

These assumptions imply that after the ADA costs rise to

$$\begin{aligned} C(q) &= \left(\beta \left[\frac{w_L + (a + \Lambda_T)x}{1 - x(1-e)}\right]^{\alpha} + \Lambda_V\right) q + F + \Lambda_H + \Lambda_F \qquad (1) \\ &\equiv c(x, \Lambda_T, \Lambda_V)q + \phi(\Lambda_H + \Lambda_F) + F \qquad (2) \end{aligned}$$

where the other arguments of marginal cost c are suppressed. With this notation, pre-ADA costs have marginal cost $c(0,0,0)$ and fixed cost $\phi(0)$.

Entry, production, and exit in the model are similar to the model of Klepper (1996), and are not described in detail here. Consumers view firms' products as homogeneous. Market demand is a function of the current market price only, and increases (for given p) over time. If a firm stays in the market it keeps all previous customers and attracts a share of new buyers (and those whose previous supplier exited) in proportion to last period's market share". The firm can also sell more product by incurring a marketing cost. Market price declines and the market quantity increases over time in equilibrium, and therefore the quantity for any firm staying in the market increases over time.

Since firms are atomistic, they are assumed to be price takers. Firms can project the current

[22] There are several cases reported in the press of litigants actively seeking out firms to sue under the ADA. A Florida lawyer has sued over 740 businesses, mostly on behalf of a single disabled activist group (Voris, 2001). Another individual in California has filed 350 ADA suits, claiming to lose only one (Valcke, 2002). Such litigants appear to be "equal opportunity suers", filing against firms of all sizes.

period's market-clearing price, but are myopic in that they base entry, exit, and production decisions only on current period's profits, and do not anticipate the passage of the ADA before it happens. Given an expectation of the market-clearing price, each firm decides by how much to expand output should the firm decide to be in the market. Firms will enter (or stay in the market) if there optimized profit is positive, and will not enter (or will exit) if it is negative.

The equilibrium price is determined by supply equaling demand under the optimal entry, exit, and output expansion decisions.

The model exhibits behavior that matches many of the retail subsectors during the relevant time period: fewer but larger firms over time,[23] with significant amounts of entry and exit.[24] Against this backdrop we can now examine the impact of the ADA. In the period the ADA comes into effect, it is assumed that the firms know that costs have changed before they make their entry, exit, and output decisions.

Lemma 1 (Impact of the ADA) *In the period t in which the ADA is first in effect, the following hold, compared to the same period were the ADA not in effect:*

1. *Equilibrium price rises and equilibrium quantity falls.*
2. *The number of entering firms can increase or decrease; the same is true for incumbent firms.*
3. *The number of firms in the market can increase or decrease.*

The first point results from the fact that variable and fixed costs rise for all firms, and the demand function is unchanged. The second and third results may be shown by simulation of the model. Given that the market quantity falls, when the number of firms increases it must be that

[23] In SIC 54, food stores, the main subsector examined in the empirical work, the average number of firms was 59.2 in 1988, rose to 61.4 in 1992, and then fell to 56.9 by 1997. The percentage of firms with fewer than 20 employees fell from 82.4% in 1988 to 80.0% in 1997.

[24] For example, from 1995 to 1996 there was an 11.1% birth rate and 10.5% death rate in the retail sector (source: Statistics of U.S. Businesses, Census Bureau).

Entry of New Firms	Exit of Incumbents	Nomenclature
decreases	increases	competitor neutral
decreases	decreases	incumbent favoring
increases	increases	entrant favoring
increases	decreases	unlikely

Table 1: Possible Changes in Entry and Exit in Response to cost increases

each firm produces less, or smaller entrants replace larger incumbents (a composition effect),[25] or both.

Thus, this relatively simple model generates interesting, varied, and non-obvious responses to the cost changes. The possibilities for entry and exit are listed in Table 1. The most intuitive case is the *competitor neutral* case, in which entry decreases and exit increases in response to the cost changes. When entry increases, it can be shown that the scale of entry also increases. Thus, since the market quantity falls, entry increases only at the expense of the number of incumbents, the quantity each incumbent produces, or both. We term the case in which entry increases and the number of incumbents falls, *entrant favoring.* The case in which entry increases and exit decreases we term *unlikely*, for the reason that although it is a theoretical possibility, it is unintuitive and we cannot generate it in simulations. When exit decreases, unless we are in the unlikely case the extra incumbents remain in the market at the expense of forgone entrants. This case is *incumbent favoring.* In the competitive neutral case, the number of firms falls, while in the unlikely case the number of firms rises. In the entrant and incumbent favoring caes, the number of firms can rise or fall.

Examining when the various cases are likely to occur allows us to link these observable outcomes to the unobservable changes in the parameters of the model. Recall that the effect of the ADA is to raise marginal cost c and fixed cost ϕ. The following theorem characterizes the impacts that the changes in cost have on entry and exit.

[25] Entrants always produce less than do incumbents.

Theorem 2 *Let period t be when the ADA is first in effect. Using the definitions from Table 1, the following hold:*

1. *If demand is inelastic at the equilbrium price, the entrant favoring case can arise only from increases in c.*
2. *The incumbent favoring case can arise only from increases in ϕ and only when demand is inelastic at the equilbrium price.*
3. *The unlikely case can arise only from increases in ϕ.*

The insight behind these results is sketched here. When costs increase, there are two competing effects on the number of firms in a cohort that will remain in the market: a direct effect and a price effect. The direct effect is that rising costs directly reduce profits. The indirect effect acts through the market price; when costs rises, the equilibrium price rises, which is good for firm's profits ceteris paribus. Which effect predominates cannot be told in general. However, although something can be said for particular cases and cohorts.

When ϕ rises and demand is inelastic at the equilibrium price, if the number of firms rises in any cohort, it rises for the oldest cohort. Thus entrant favoring is not possible, because entrants are the youngest cohort (the first point in the theorem). When ϕ rises and demand is elastic, however, if the number of firms rises in any cohort it rises for the entering cohort, and entrant favoring is possible (but not required). Regardless of the elasticity of demand, entrant favoring is possible when c rises. Concerning the last two points of the theorem, we show that increases in c increase exit from each incumbent cohort, and so incumbent favoring and the unlikely case are not possible. Furthermore, because of the behavior mentioned above when demand is elastic, the incumbent favoring case requires not only increases in ϕ but also inelastic demand.

The implications of the model useful for empirical work are thus threefold. First, the only way the ADA could cause an increase in the number of firms, net of trends, is if fixed costs rise (through Λ_H and Λ_F). This first implication has no bite in the application here, because it turns out that all ADA-related variables are correlated with reductions in the number of firms. Second, when demand is inelastic (as it is in the empirical application to food stores), an entrant favoring outcome from the ADA can come only from increases in x, or through Λ_T and Λ_V, which increase marginal cost. Third, an incumbent-favoring outcome can come only through Λ_H and Λ_F, which increase fixed cost. The competitor-neutral outcome implies no restrictions on the nature of the cost increase. In section 6, we use these latter two implications of the model to infer which elements of the ADA raised which costs.

5 The Econometric Model

In this section we present the econometric models used in the investigation. The first question of interest is the effect of the ADA on the number of firms. To answer this question, we use standard count data models. The first is a Poisson regression model, which assumes equality of the mean and the variance, but yields consistent estimates even if there is overdispersion (Cameron and Trivedi, 1998). The other count models incorporate various forms of heterogeneity and overdispersion: a negative binomial regression model, a Poisson model with fixed effects at the state level, and a Poisson model with gamma-distributed random effects at the county level. Since a Poisson model with gamma-distributed individual random effects generates a negative binomial model (Cameron and Trivedi, 1998), the only difference between the second and fourth models is that in the latter the random effect is constrained to be equal within a county over time.

The other question of interest is the effect of the ADA on entry and exit. For this question we construct the ML estimator for the parameters of the $CM_t/CM_t/\infty$ system. The entry of firms is a nonhomogeneous Poisson process with gamma mixing. In particular, the interarrival times (the epochs between the times at which entry occurs), conditional on a gamma-distributed heterogeneity random variable u, are exponentially distributed with instantaneous rate $\lambda(t)$ at time t. The lifetime of each entered firm, conditional on another gamma-distributed heterogeneity random variable v, is exponentially distributed with instantaneous rate $\mu(t)$. Conditional on (u, v), the entry and exit processes are independent; dependence is introduced by means of correlation between u and v. The random effects serve several roles in the model. They may capture the effects of unobservables have on entry and exit. They may also, by allowing correlation between entry and exit, capture congestion effects. Congestion in this application refers to the notion that in areas where incumbent firms are long-lived, fewer new firms may attempt entry.[26]

In our data the number of currently operating firms is observable, but not the entry and exit times. We derive the likelihood function for the number of firms using techniques from queuing theory (Srivastava and Kashyap, 1982).[27] For the substantially easier problem where the arrival and exit times are observable, see Prieger (2001; 2002*a*; 2002*b*) for models and applications. To economize on notation, the model will be explicated for a single time series of firm counts; the panel dimension will be introduced later below. Let $N(s)$ be the random variable generating the number of firms (i.e., firms that have entered but not exited) at time $s \in [0, T]$, $n(s)$ be a realization of $N(s)$, and n_t be the number of units in the system at the end of period $t \in \{1, \ldots, T\}$. For simplicity each period is of unit length (one year, in the application), so that $n_t = n(t)$.

The entry rate $\lambda(s)$ and the failure rate $\mu(s)$ are taken to be constant within a period, so that $\lambda(s) = \lambda_t$ and $\mu(s) = \mu_t$ for $s \in [t-1, t)$. The rates are modeled as:

$$\lambda_t = \exp\left(\mathsf{X}_t'\boldsymbol{\alpha}\right) u_t = \lambda_{0t} u_t \tag{3}$$

$$\mu_t = \exp\left(\mathsf{Z}_t'\boldsymbol{\beta}\right) v_t = \mu_{0t} v_t, \tag{4}$$

where $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are vectors of parameters, X_t and Z_t are vectors of observed explanatory variables,

[26] In physical queuing systems, congestion is modeled directly by assuming a finite number of servers. Within an infinite server model, there are two main approaches to incorporating congestion. The first is through bivariate random effects as described here. In the second method, one includes covariates reflecting the system state, such as the number of recent arrivals or the number of units in service, directly in the determination of the arrival or service time rates. See Prieger (2002*b*) for an example of the latter approach.

[27] For a more advanced theoretical treatment of queues with time-varying parameters, refer to Brémaud (1981, section VI.2).

and u_t and v_t are unobserved heterogeneity terms with distribution[28]

$$f(u,v)=\mathcal{G}(\gamma,\sigma_u^2 v^\tau;u)\mathcal{G}(\delta,\sigma_v^2;v),\quad \gamma,\delta,\sigma_u^2,\sigma_v^2>0 \tag{5}$$

where $\mathcal{G}$ is the gamma pdf

$$\mathcal{G}(a,b;x)=\frac{x^{a-1}e^{-x/b}}{b^a\Gamma(a)}. \tag{6}$$

In addition to the restrictions on the parameters in (5), it is also necessary that $\tau>-(2\sigma_v^2)^{-1}$ for the variance of u to be finite. To ensure that $E(u)=E(v)=1$, set

$$\delta = \sigma_v^{-2} \tag{7}$$

$$\gamma = \frac{\Gamma(\delta)}{\sigma_u^2\sigma_v^{2\tau}\Gamma(\tau+\delta)} \tag{8}$$

These normalizations ensure that $E(\lambda_t)=\lambda_{0t}$ and $E(\mu_t)=\mu_{0t}$, which is required for identification of the intercept terms in $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$. With these restrictions, $Var(v)=\sigma_v^2$, $Var(u|v)$ is linear in σ_u^2, and $Var(u)$ is affine in σ_u^2.[29] Correlation between u and v, ρ, is governed by τ:

$$\rho=\tau\sigma_v\left(\frac{g(2)}{g(1)}\left[\frac{g(0)}{g(1)}+\sigma_u^2\sigma_v^{2\tau}\right]-1\right)^{-1/2} \tag{9}$$

where g is as defined in note 29. The correlation has the same sign as τ, can take the full range of values on $[-1,1]$,[30] is zero if and only if $\tau=0$, but is not in general monotonic in τ.

From (5) it is clear that v has a marginal Gamma distribution, whereas u has a Gamma distribution only when conditioning on v.[31] In particular, the marginal distribution of u is not Gamma distributed. We choose a conditional Gamma distribution for u purely for convenience; it allows the unobserved heterogeneity in the entry process to be integrated out analytically. Numerical integration is thus required only to integrate out v, a single integral rather than a double integral.[32]

[28] This distribution is from Gran (1992, sec.2.7.5).

[29] In particular, $Var(u|v)=\sigma_u^2\sigma_v^{-2\tau}v^{2\tau}g(0)/g(1)$ and $Var(u)=g(2)\left[g(0)/g(1)+\sigma_u^2\sigma_v^{2\tau}\right]/g(1)-1$, where $g(a)=\Gamma\left(a\tau+\sigma_v^{-2}\right)$.

[30] For example, when $\tau=1$, $\rho\to 1$ as $\sigma_u^2\to 0$. If $\sigma_u^2=\tau^2\sigma_v^2$, then $\rho\to -1$ as $\tau\to 0$ from below and $\sigma_v^2\to 0$.

[31] No structural interpretation is assigned to this formulation (i.e., that entry depends on exit but not vice versa). Of course v also has a distibution conditional on u.

[32] There is no bivariate distribution with correlation for which both the marginal and conditional distributions are Gamma (Arnold, Castillo and Sarabia, 1999, sec.4.6).

Gamma mixing in Poisson and exponential distributions is commonly used, because it leads to closed-form likelihoods and has well-known properties. A Gamma-Poisson mixture results in a negative binomial random variable that allows for overdispersion (for which the Poisson distribution alone cannot account). A Gamma-exponential mixture results in a Pareto distribution, and relaxes the exponential's imposition of a constant hazard rate.[33] As is true with any mixture of exponentials, the hazard rate for a Gamma-exponential mixture is decreasing, which implies that there is (unconditional) negative duration dependence and overdispersion. In particular, one can show that mean time remaining to exit, conditional on survival to t, increases linearly in t. Dubey (1966) also uses Gamma-exponential mixtures for firm lifetime data.

The heterogeneity in the model thus exhibits properties that fit the stylized facts of firm entry and exit mentioned in section 3: overdispersion to account for the large variance in entry and exit rates across industry groups, correlation between the entry and exit rates, and duration dependence in the life of the firm. The $CM_t/CM_t/\infty$ model thus combines flexibility through the random effects to account for these features, with the analytical convenience of a Markovian queuing system. The former is desirable to fit the stylized facts; the latter is necessary to find a (near) closed form for the likelihood.

From the model specified above, the likelihood of the data can be obtained. The derivation is in the appendix. Finding the pdf of $n_t|n_{t-1}$, denoted $f(n_t|n_{t-1})$, requires integrating out the unobserved heterogeneity. In particular, $f(n_t|n_{t-1})$ is

$$f(n_t|n_{t-1}) = E_{u,v}\left[f\left(n_t|n_{t-1}, u_t, v_t\right)\right] = \int_0^\infty f(n_t|n_{t-1}, v_t)\mathcal{G}(\delta, \sigma_v^2; v)dv_t, \tag{10}$$

where

$$f(n_t|n_{t-1}, v_t) = E_{u|v}\left[f\left(n_t|n_{t-1}, u_t, v_t\right)\right] = \left[\kappa_{0t}\sigma_u^2 v_t^{\tau-1}\left(1 - e^{-\mu_t}\right) + 1\right]^{-\gamma} \sum_{m=0}^{M_t} C_{mt}, \tag{11}$$

[33] See Johnson, Kotz and Balakrishnan (1995, p.574).

$$C_{mt} \equiv B_{mt}\left[\frac{\Gamma\left(n_t - m + \gamma\right)}{\Gamma\left(\gamma\right)}\left(\frac{\sigma_u^2 v_t^{\tau-1}}{\kappa_{0t}\sigma_u^2 v_t^{\tau-1}\left(1-e^{-\mu_t}\right)+1}\right)^{n_t-m}\right], \tag{12}$$

$$B_{mt} \equiv \binom{n_{t-1}}{m}\frac{\kappa_t^{n_t-m}}{(n_t-m)!}e^{-\mu_t m}\left(1-e^{-\mu_t}\right)^{n_t+n_{t-1}-2m}, \tag{13}$$

$\mathcal{G}$ is as in (6), $M_t \equiv \min\{n_{t-1}, n_t\}$, $\kappa_0 = \lambda_0/\mu_0$, and restrictions (7)–(8) are imposed.

As can be seen from (10), the u_t term can be integrated out analytically, while the v_t term cannot, leaving a unidimensional integral in the expression for $f(n_t|n_{t-1})$. In the application, we use Gauss-Laguerre quadrature to numerically integrate this expression.

To find the joint likelihood of the data $(n_t)_{t=1}^T$, note that $N(t)$ is a Markov process. Therefore $f\left(n_1, \ldots, n_T|n_0\right) = \prod_{t=1}^T f\left(n_t|n_{t-1}\right)$. Now we may introduce the cross-section dimension of the panel, and write n_t as n_{tjk}, the number of firms in year t in size group j in county k. In some specifications, as described in the next section, the j dimension collapses because n is the total number of firms of all sizes. Assuming that (u_{tjk}, v_{tjk}) are independent across time, size group, and county, the log likelihood function for the parameter vector $\boldsymbol{\theta}$ is determined from (3), (4), and

$$l_{\boldsymbol{\theta}}\left(\boldsymbol{\theta}|n_0, (((n_{tjk}, \mathsf{X}_{tjk}, \mathsf{Z}_{tjk})_{t=1}^T)_{j=1}^J)_{k=1}^K\right) = \sum_{j=1}^J\sum_{k=1}^K\sum_{t=1}^T \log f\left(n_{tjk}|n_{(t-1)kl}\right) \tag{14}$$

where $f\left(n_{tjk}|n_{(t-1)kl}\right)$ is from (10).

Let $\hat{\boldsymbol{\theta}}$ be the ML estimate obtained from maximizing $l_{\boldsymbol{\theta}}$. Because the Hessian of (10) is complicated and expensive to calculate, maximization techniques and variance estimators that require only the gradient are an appealing choice here. We use the BFGS variant of the DFP algorithm in the application, and report BHHH standard errors.

6 Data and Empirical Results

One would expect that if the ADA impacted any firms, it would be those in the retail sector. Retail firms are exposed to costs under both Title I through employment and Title III through access by customers to their premises. The retail sector has many small firms operating on thin margins,[34] and is also involved in many of the ADA lawsuits. The dependent variable in the estimations here is therefore the number of retail establishments by major SIC group within a county; the data cover the whole U.S. except Alaska.[35] Summary statistics of the data are presented in Table 2.

To get a sense of the overall trends in the data, consider Figure 1 , which shows the percentage changes in the total number of retail establishments by two-digit SIC code. Some subsectors are growing and some are shrinking, but (with several exceptions) each line in the graph generally trends down. Except for SIC 52 (building materials and garden supplies) and 53 (general merchandise stores), every group saw decreased growth rates in 1993, the first full year the ADA was in effect, compared to the previous year. In all but one of these cases (SIC 58, eating and drinking places), growth was negative in 1993. Given that the ADA may be a relatively minor determinant of the number of firms, however, compared to changes in demand and other costs, and given the dynamic industry behavior predicted by the model in section 4 even in the absense of the ADA, Figure **1** should not be read as strong evidence by itself for impacts of the ADA. Instead, it may mainly show the trends that we will have to difference out in the analysis.

Although results from all retail subsectors are summarized below, we focus on SIC 54, food stores (the heavy line in Figure **1**).[36] Food stores were chosen for three reasons. First, they have relatively small, local markets, for which counties may be an adequate approximation. Establishments in other retail groups, such as SIC 53 (which includes department stores) and 54 (which includes automotive dealers) are more likely to have market areas that span multiple counties.

[34] By 1980, 93.4% of the sector was effectively competitive, based on concentration ratios (Shepherd, 1982).

[35] The data are from the U.S. Census Bureau, *County Business Patterns CD-ROM*, years 1987-1997. Although establishments are not the same as firms, the establishment seems to be the best unit to match to the "employer" in the language of the ADA, in terms of how the courts have interpreted Title I. Even if an establishment does not exist as its own legal entity, it may be judged an "employer" separate from related establishments according to a legal test considering (1) interrelation of operations, (2) common management, (3) centralized control of labor relations and (4) common ownership or financial control (EEOC v. St. Francis Xavier Parochial School, 326 U.S. App. D.C. 67).

[36] SIC major group 54 includes retail stores primarily engaged in selling food for home preparation and consumption (grocery stores). It excludes restaurants and liquor stores. The other major retail groups are 52 (building materials & garden supplies), 53 (general merchandise stores), 55 (automotove dealers & service stations), 56 (apparel and accessory stores), 57 (furniture and homefurnishings stores), 58 (eating and drinking places), and 59 (miscellaneous retail).

Second, in comparison to restaurants (in SIC 58), the other natural choice by the first criterion, the relatively smaller number of food stores per county makes the estimation of the heterogeneous models more feasible.[37] Third, demand for food consumed at home, which these stores sell, is consistently estimated in the literature to be inelastic (e.g., Barnes and Gillingham, 1984). Restricting investigation to a good with inelastic demand allows part 1 of Theorem 2 to be applied.[38]

We use three empirical specifications to identify potential effects from the ADA on the number, entry rate, and exit rate of firms. The specifications enable increasingly stringent tests of the effects of the ADA, moving from differences in means pre- and post-ADA to differences-in-differences specifications.

6.1 Specification A: differences in means

The simplest specification, A, uses the number of firms of all sizes per county in a year and focuses on pre- and post-ADA comparisons. The index $X_{tk}'\beta$ in each specification can be used for the standard count models for the number of firms, in which the mean is an exponential function of $X_{tk}'\beta$, or for the entry and exit rates λ and μ in the $CM_t/CM_t/\infty$ model (i.e., $X_{tk}'\beta$ stands in for the indices $\mathsf{X}_t'\boldsymbol{\alpha}$ and $\mathsf{Z}_t'\boldsymbol{\beta}$ in the notation of section 5). The index for year t and county k, is specified as

$$X_{tk}'\beta = \beta_0 + \upsilon_r + \varphi_p + \pi' W_{tk}$$

where υ_r is a Census region fixed effect and φ_p is a period fixed effect. The three periods are $p = 1$, the pre-ADA period 1988-1992, $p = 2$, the initial ADA period 1993-1994, and $p = 3$, the subsequent ADA period, 1995-1998. Period 2 spans the first full year that the ADA was fully in effect for any size firm (1993) and the end of the phase in period (1994; refer to section 2). The region dummy υ_{EAST} and φ_1 are normalized to zero. Covariates W include county land area, population, conty

[37] The summation in (30) implies that estimation time is roughly proportional to the sum of the dependent variable, not the number of observations. Some of the heterogeneous specifications for SIC 58 took weeks to run, which limited the number of specifications it was feasible to try.

[38] This is another reason not to use SIC 58. Food consumed away from home is often estimated to have price elastic demand (Barnes and Gillingham, 1984).

per capita income, labor cost (average real wage and salary disbursements per job), and capital cost (proxied by the Moody's Baa bond rate, net of the inflation rate[39]), all in logs. The specification of the entry and exit rates are identical (in this and all specifications); there is no exclusion restriction required for identification, and any variable affecting profitability will affect both entry and exit decisions of firms. In specification A, the only evidence for the ADA's effect comes from φ_t for the two ADA periods, which capture changes in the number of firms, entry, or exit after the act was in effect. Such evidence can only be suggestive, since the period indicators may merely pick up trends unrelated to the ADA.

The first results are from standard count models for the number of establishments. Recall from part 3 of Lemma 1 that the number of firms could rise or fall from the ADA, given that smaller firms can replace larger ones. Thus we have no *a priori* expectation for the signs of the ADA-related variables in these estimations, although the most natural expectation[40] is that if the ADA increased costs then the number of firms should fall. For each specification, the four models mentioned in section 5 are estimated.

The results from specification A are in Table 3. The coefficients are elasticities when the variable is in logs (all except indicator variables). The negative coefficients on the indicators for the ADA periods (in all models) implies that the number of firms decreased in the ADA periods, even after controlling for changes in the economic variables. The economic covariates have the expected signs[41] and are significant at the 1% level, except for capital costs.[42] Although the magnitudes of some of the estimates vary a bit across estimations, for the most part the estimates are similar. The simple Poisson model is rejected in favor of each of the heterogeneous models (both by the significance of the overdispersion parameters and by likelihood ratio tests). This is the expected

[39] This follows Assadian and Ford (1997) and many other studies

[40] And the most common outcome from simulation of the theoretical model.

[41] The coefficient on area fluctuates sign, but is always less than the coefficient on population, which implies that the implied coefficient for population density is consistently positive.

[42] In many estimations in other SIC groups, capital costs also had the wrong sign. This is probably because the variable is a poor proxy for the true opportunity cost of capital or that it is acting as a peculiar type of time trend (recall the capital cost variable varies only over time, not in the cross section).

result if the true likelihood is given by (10); the data should display overdispersion (relative to a Poisson distribution) if they are in fact generated from the $CM_t/CM_t/\infty$ model. The results from the other retail groups are qualitatively very similar with these results from food stores.[43]

The theoretical model in section 4 shows that examining entry and exit in addition to the number of firms can provide insight into how the ADA affects firms' costs. We turn now to the results from the $CM_t/CM_t/\infty$ entry and exit model from section 5. The results from specification A are in Table 4, both with and without random effects (heterogeneity). Several results stand out from these estimations. Entry rates were significantly lower and failure rates were significantly higher in the ADA periods than the pre-ADA periods in both specifications (the *competitor neutral* case, if all such changes can be ascribed to the ADA, which is doubtful in this specification for the reasons discussed above). The estimates from other retail SIC groups, with some exceptions, display the same pattern as these results for food stores.[44] The economic coefficients have the expected signs in the entry rate (larger area, more population and higher per capita income all increase the arrival rate; higher labor costs decrease the entry rate) except for capital costs in the homogeneous specification (see footnote 42).

In the failure rate part of the homogeneous specification, the population coefficient has an unexpected sign: more populous counties have *higher* failure rates. The heterogenous specification reverses the sign on the population failure rate coefficient. The homogeneous specification is soundly rejected in favor of the random effects version, whether by significance tests on σ_u^2, σ_v^2, and τ, or by likelihood ratio tests. The evidence thus indicates that the random effects are an important addition to the model and may be required to get sensible estimates from the $CM_t/CM_t/\infty$ model. Correlation between the arrival and exit rates is estimated to be negative, possibly due to omitted

[43]The exceptions are $\hat{\varphi}_2$ in the negative binomial model for SIC 57, which is significant only at the 5% level, and $\hat{\varphi}_2$ and $\hat{\varphi}_3$ in all models for SIC 58, which are positive.

[44]The exceptions: for entry, 4 out of the 14 ADA period indicators from all other SIC groups are significant and positive (homogeneous specification); for exit, 3 out of the 14 ADA period indicators are significant and negative. The unlikely case (positive for entry and negative for exit) never occurs.

variables that affect the profitability of the market.[45] Correlation is consistently estimated to be negative in every specification we estimated.

6.2 Specification B: ADA-specific covariates

Specification B uses the same dependent variable as specification A, total firms of all sizes. New here are the addition of ADA-specific covariates. From section 4 we know that marginal cost increases with x, Λ_T, and Λ_V, that fixed cost increases with Λ_H and Λ_F, and that Λ_F and Λ_V increase with y. Since the litigation variables Λ_T, Λ_V, Λ_H , and Λ_F are not directly observed, we proxy them with related observables. The index is specified as

$$X'_{tk}\beta = \beta_0 + \upsilon_r + \varphi_p + \eta_p e_{st-1} + \zeta_p c_{st-1} + \omega_p d_{st-1} + \xi_p f_s + \pi' W_{tk} \tag{15}$$

where W includes all the variables from specification A. Both Λ_H and Λ_T, the employment litigation costs, increase with the probability of litigation (ℓ_H and ℓ_T, resp.). We proxy these probabilities by the EEOC charge rate in state s, lagged one year. The charge rate variable e_{st-1} (with coefficient η_p) is the number of EEOC ADA Title I charges in the state, as a fraction of prime working age disabled population (aged 21-58), times 1,000.[46] Hiring and termination charges are not distinguished in the EEOC data; evidence on which places greater costs on firms can come only from Theorem 2.

Similarly, Λ_F and Λ_V, the accessibility litigation costs, increase with the number of suits (s_F and s_V, respectively). Instead of proxying the number of suits (which is highly correlated with population), we proxy the probability of accommodation suit-filing. The case rate variable c_{st-1} (with coefficient ζ_p) is the number of Title III-related federal court cases in state s and year $t-1$, as a fraction of disabled adult population (aged 15+ years), times 1,000.[47] As with the EEOC

[45] The may also be a causal explanation, if firms want to enter markets in which they expect to last longer.

[46] The EEOC data were obtained as summary counts per state through a Freedom of Information Act request. The disability data (here and elsewhere) are from the U.S. Census' Current Population Survey, following Acemoglu and Angrist (2001).

[47] The case data were obtained from a search of the Lexis database (all federal trial, appellate, and Supreme Court cases) for cases matching keywords "ADA" and "public accommodation" or "Title III". Although this is not as accurate a means of classification as reviewing each case by hand (which is infeasible due to the large number of court cases), a check of the cases thus matched showed this method to be fairly accurate.

charges, it is not clear from the case data whether the Title III cases increase marginal or fixed costs; again inference will be based on Theorem 2. The coefficients for the charge and case rate variables are semi-elasticities.[48]

Finally, because the variables x and y are highly correlated, we include a single variable d_{st-1} to proxy both. This variable (with coefficient ω_p) is the log fraction of adult population (aged 15+ years) in the state that is disabled in year t (times 100), lagged one year.

All these coefficients are allowed to vary over periods; since the Title I and Title III variables are not observed in period 1, we normalize $\zeta_1 = \eta_1 = 0$. In the results, we report differenced estimates (i.e., *increments* over the period 1 effect) where applicable; for ω_p we report $\hat{\omega}_1$, $\hat{\omega}_2 - \hat{\omega}_1$, and $\hat{\omega}_3 - \hat{\omega}_1$, for example.

There is also a difference-in-differences (D-D) measure in specification B. The variable f_s is a dummy for states that had a Fair Employment Practice (FEP) law with enforcement and penalties before the ADA ($f_s = 1$ if the state had a pre-ADA FEP law, 0 if not).[49] Title I of the ADA was less of an innovation in these states, and the ADA should have had less of an impact. If there is less entry in the non-FEP states after the ADA, for example, then $\hat{\xi}_2$ and $\hat{\xi}_3$ will be positive in the entry index. The results in Tables 5 and 6 are reported as D-D estimates: $\hat{\xi}_2 - \hat{\xi}_1$ and $\hat{\xi}_3 - \hat{\xi}_1$, the difference (between FEP and non-FEP states) in the difference in $X'_{tk}\beta$ before and after the ADA.

Although all the variables in specification A are included in specification B, only the ADA-specific coefficients are reported in Tables 5 and 6. Of interest here are the difference and D-D estimates. For the count models in Table 5, with the exception of the Title III case rate in the first ADA period, all of these estimates have signs (positive for the FEP state indicator, negative for the others) associating the ADA with a decreased number of firms. Increases in the percentage of disabled adults reduce the number of firms, relative to this variable's pre-ADA effect. The

[48] To convert semi-elasticities to elasticities, multiply the coefficient by the sample mean of the relevant variable in Table 1.

[49] Although every state had some sort of FEP law before the ADA, most did not have provisions for disabled workers that were actively enforced with penalties. These data are from Percy (1989).

EEOC charge rate and the Title III case rates (period 3 only for the latter) have negative effects on the number of firms in the ADA periods. These signs are robust across models, and with a few exceptions are all significant at the 1% level. The Title III case rate coefficient for the initial ADA period is negative but insignificant in the Poisson regression, but positive in the other models. We defer interpreting the magnitudes of the estimates until the end of this section. The results from the other retail groups are generally in accord with these results from SIC 54.[50]

Table 6 has the results from specification B for the $CM_t/CM_t/\infty$ model. The versions with and without heterogeneity are generally in agreement; there are no (statistically significant) sign changes of the estimates between versions. Of the significant estimates,[51] the EEOC charge rates in both ADA periods and the percentage of adults disabled 1993-1994 show incumbent-favoring behavior. From Theorem 2, this implies that these variables (on net) raise fixed costs.[52] For the charge rates variable, this result would imply that the ADA raised hiring costs (through the ℓ_H and Λ_H variables of section 4) more than termination costs (through ℓ_T and Λ_T). This seems unlikely; Moss *et al.* (1999) report that fewer than 10 percent of the ADA charges filed with the EEOC concern hiring discrimination. We return to this issue in the next specification.

Recall that the disability variable d_{st} stands in for the disability variables x and y of section 4. These variables raise fixed costs by increasing Λ_H, the cost of hiring discrimination suits (through x) and by increasing Λ_F, a component of the cost of accessibility suits (through y). Setting aside the possibility of significant impacts through hiring-related suits, the incumbent-favoring impact of the disability variable may imply that accessibility suits by "serial suers" (or other such suits not related to the scale of the businesses) have significant impacts on entry, through s_F and Λ_F. Another explanation for the incumbent favoring, apart from the implications of Theorem 2, may

[50] The exceptions are the FEP coefficients, which have mixed signs, and the disability coefficients for the latter ADA period, which are more often positive than negative.

[51] The estimates discussed here are those for which either the arrival or failure coefficient was significant. All of these are pairwise (i.e., the arrival or failure coefficients of a single covariate) jointly significant at the 1% level, except for % adults disabled (1995-97) in the heterogeneous estimation, which is significant at the 5% level.

[52] The results of Theorem 2 apply to marginal univariate increases in c or ϕ. Given that both may have actually increased, I interpret the evidence as indicating that the effects of the increase in ϕ outweigh the effects of any increase in c.

be that negative impacts from the disability variable show up on entry and not exit if potential entrants perceive the costs from ADA suits to be larger than incumbents actually find them to be.

The other significant estimates, the Title III case rate in the latter ADA period and the FEP D-D estimates in both periods, show entrant-favoring behavior.[53] From Theorem 2, this implies that these variables raise marginal costs. For the case rate variable, this result is evidence that the ADA imposed real litigation costs from accessibility suits from customers, through ℓ_V and Λ_V. Coupled with the results discussed in the previous paragraph, this bolsters the conclusion that accessibility suits from both customers and activists measurably raised firms' costs. The results for the FEP variables indicates that marginal costs increased more in states for which the ADA was more of an innovation above existing laws. The estimates from other retail SIC groups, with few exceptions, are in accord with these results for food stores.[54]

6.3 Specification C: difference-in-differences

In specification C, we split the dependent variable into size groups. Here the dependent variable is the number of firms within each size group: small (1-19 employees), medium (20-49 employees), and large (50+ employees), and the independent variables are as in specification B. Estimations for the different size firms are run separately, which effectively adds a size subscript $j = S, M, L$ to all the variables in (15). This allows all the ADA-related variables to be differenced over firm sizes as well as over time, and is the most demanding test of the ADA's effect. In specification C, we require not only that the ADA-related variables affect the number of firms, entry, or exit, but that the impacts be greater on the small firms that are most vulnerable to the ADA. By looking for impacts on small firms, net of trends for large firms, potentially spurious trends affecting all sizes of firms are differenced out. Recall from section 2 that the smallest firms (those with fewer than 15

[53] Some of the main effects for the FEP and disabled variables, applying to all years, are also significant. These do not require interpretation, because they are baseline effects included only to allow differencing.

[54] The significant exceptions (homogeneous specification) are: in SIC 56 (apparel stores), EEOC charge rates favor entry in period 3 and non-FEP status favors incumbents period 2; in SIC 59 (miscellaneous retail), disabled adults favor entry in period 3. The unlikely case never appears in any SIC group for any variable.

employees) are exempt from Title I employment discrimination obligations. Therefore for the Title I variable e_{st} we will also look at differences of medium size firms from large firms. The FEP state D-D specification in specification B now becomes a triple differencing (D-D-D): over firm sizes as well. This allows the D-D estimate for large firms to be a baseline, against which the incremental effects for small firms can be compared.

The results are reported as D-D or D-D-D estimates. The D-D estimate labeled *% adult disabled, 1993-94* in the first row of Table 7, for example, is $(\hat{\omega}_{2S}-\hat{\omega}_{1S})-(\hat{\omega}_{2L}-\hat{\omega}_{1L})$: the difference (between small and large firms) in the difference in $X'_{tk}\beta$ from a unit change in d_{st} before and after the ADA. Similarly, the D-D-D FEP state estimate labeled *FEP state, 1993-94* is $(\hat{\xi}_{2S}-\hat{\xi}_{1S})-(\hat{\xi}_{2L}-\hat{\xi}_{1L})$: the difference (between small and large firms) in the difference (between FEP and non-FEP states) in the difference in $X'_{tk}\beta$ before and after the ADA.

Table 7 presents the results from specification C for the standard count models. The table reports only the D-D and D-D-D calculations; each are the medium or small firm estimates net of the large firm estimates. Of the significant estimates for small firms, all have signs consistent with the ADA decreasing the number of firms. The Title III case rate coefficient for the initial ADA period again stands out; it is positive but insignificant in all regressions. The D-D-D coefficients for the FEP state variables are positive in Table 7. These D-D-D estimates imply that not only did the number of firms fall in non-FEP states after the ADA (from the D-D estimates in Specification B) but that the trend is more marked for the ADA-vulnerable small firms than for large firms. The lower part of Table 7 has the D-D estimates of the EEOC charge rate coefficients for medium firms. These estimates are all negative, and most of them are significant at the 1% level. Taken altogether, the evidence points to the ADA as causing the number of establishments to fall. While causality is not directly proven here, in the D-D and D-D-D settings any alternative explanations become increasingly complicated.

Table 8 contains the estimates of interest from the $CM_t/CM_t/\infty$ model. All of the incumbent- or entrant-favoring behavior found in specification B carries through to the small firm D-D and

D-D-D estimates, with the exception that the title III case rate in the latter ADA period no longer has a significant effect. Thus not only are effects from these ADA-related variables significant, they show up strongest for the small firms likely to be most susceptible to the costs of the ADA.

The suspect finding from specification B that EEOC charge rates appear to increase fixed costs is still present here. However, because of the exemptions for small firms, medium size firms provide a cleaner test of the effect of the Title I variables. The bottom part of Table 8 has the results for the EEOC charge rate D-D estimates for medium firms (net of large firms). Here, the Title I variable exhibits entrant-favoring effects in both ADA periods, which implies from the theoretical model that the costs of termination suits (and possibly other suits from employees regarding accommodation[55]) have more of an impact than hiring suits. Given that over 81 percent of charges filed with the EEOC concern termination or accommodation of employees, this is a plausible finding.

A caveat applies to specification C when estimating the entry and exit model. Given the anonymous nature of individual firms in the establishment counts, true exits cannot be distinguished from size group switching. E.g., if a firm grows from 10 to 40 employees one year to the next, the econometric model treats it as an exit of a small firm and *de novo* entry of a medium firm. Thus, entry and exit may be overcounted in specification C and the magnitudes of the coefficients must be interpreted with caution. By comparing $\hat{\lambda}$ from specification B with the sum of the $\hat{\lambda}_j$ for all size groups from specification C, one can estimate the extent of the overcounting. Arrival rates are overcounted 22–25% in the ADA periods in specification C; similar calculation for the failure rate shows overcounting of 19–23% in the ADA periods. These figures provide rough upper bounds on the mismeasurement of the coefficients; in a best-case scenario the category switching is not related to the variables of interest, the estimate of the constant absorbs the mismeasurement, and the other coefficients are correctly estimated.

Because differences in differences of elasticities and semi-elasticities are hard to interpret, we

[55] Although not included in the model, suits from non-terminated employees would increase marginal costs similarly to termination suits.

demonstrate the magnitudes of the effects of the ADA variables in Table 9. Two counterfactuals are considered. In the first four columns, the figures are the impacts on the number of firms, entry, and exit of a one standard deviation increase above the actual value of the ADA covariate in each county. These impacts are summed over all counties, so that the figures may be read as changes in the national number of firms in a year (subject to the caution about potential overcounting in the $CM_t/CM_t/\infty$ model mentioned above).[56] In the rightmost columns, the counterfactual is the impact of raising the row variable from zero to its actual value in each county. This counterfactual applies to the Titles I and III variables, and is meant to assess the total impact of the ADA through these channels, since without the ADA neither EEOC charges nor Title III suits would have been possible. The first column in each counterfactual is calculated from the Poisson regression reported in the first column of Table 7; this specification was chosen for its robustness. The next three columns in each counterfactual are based on the estimations from Table 8 (no-heterogeneity version[57]) for the entry and exit rates, and the implied change in the number of firms given those rates. The number of exiting firms is calculated by applying the exit rate, which is a per-firm rate, to the number of firms in the county at the end of the previous period. The change in the number of firms implied by the entry and exit model is the change in the number of entering firms less the change in the number of exiting firms.

In most cases where either the entry or exit estimate is significant, the signs of the direct and implied estimates of ΔN match, which serves as a basic reality check of the $CM_t/CM_t/\infty$ model. For the single non-matching case (EEOC charge rate 1993-94), the entry estimate is not significant and the exit estimate is only marginally significant, so there is no convincing evidence of model misspecification here. The magnitudes of the direct estimate of ΔN can be quite different than the implied estimate. This is particularly true for the FEP state estimates, where the direct estimates of ΔN are several orders of magnitude higher than the implied estimates. Given the lack of precision

[56] The notation ΔN in Table 8 is to be read in the comparative static sense, not as $N_t - N_{t-1}$.

[57] The results from the heterogeneity version are less precisely estimated but qualitatively similar.

in the estimates, it is impossible to judge whether this discrepancy results from misspecification of the $CM_t/CM_t/\infty$ model. The value of the $CM_t/CM_t/\infty$ model in this specification may be not so much the magnitudes of the estimates but, instead, the corroboration lent to the entry and exit patterns found in specification B.

The largest impact comes from the FEP state variables. Net of trends for large firms in pre-ADA FEP states, there are over 15,000 fewer small firms in the ADA periods in states without pre-ADA FEP laws (from the direct estimate). This figure is about 10 percent of the average number of small firms over the period of the sample. The entry and exit estimates indicate that the reduction occurred through failure of existing firms, and was partially offset by increased entry. The magnitudes of the effects of the other variables are smaller. To highlight one other result, consider the Title I variable. In the counterfactual in which there are no EEOC charges filed, there are an estimated 1,120–1,149 more medium size firms (net of trends for large firms) in the ADA periods. These figures represent an increase of 7.2–7.4% in the number of medium size firms. Again, the entry and exit estimates indicate that the reduction occurred through failure of existing firms (at least in the latter ADA period), and was partially offset by increased entry.

7 Concluding Remarks

Overall, then, there is some evidence that the ADA had real impacts on the number, entry, and exit of firms. Although the evidence is not entirely consistent in every specification and in every SIC group, some general conclusions can be drawn from the empirical explorations. In the ADA period, there were fewer retail establishments than before, and the drop was larger in states in which the ADA was more of a legal innovation, and in states that had more disabled people, more ADA-related lawsuits, and more ADA-related labor complaints. The same conclusions hold when baseline trends for larger establishments (those least vulnerable to the costs imposed by the ADA) are differenced out. These results on the changes in the number of firms are also consistent across different specifications of the count model. There is also evidence that employment and access discrimination suits raised the marginal costs of retail stores, encouraging exit. At the same time that the suits spurred exit, however, they are also associated with increased entry, which may imply that stores less able to adapt to the new requirements made room for the entry of stores better able to adapt. So, while predictions that the ADA would cause firms to fail may have proven correct, the decline in the number of firms was partially offset by new entry.

Apart from this specific application to the impact of the ADA, the econometric model is useful for many other empirical applications in economics when each of many events of interest is followed by a duration. For example, consider the study of labor contract strikes. One may be interested in the number of strikes beginning within a period, the number of strikes ongoing at a point in time, or the duration of individual strikes. Clearly these quantities are related, and a researcher may suspect that a change in labor law affects all three. Queuing theory provides a framework for unified analysis of the phenomenon. Other examples from economics include the analysis of the number and duration of visits to recreational facilities and the number and time to regulatory approval of patents or pharmaceuticals. When the start and end of the spells are observed, one can estimate the model with the techniques used in Prieger (2001; 2002*a*; 2002*b*). This paper extends the estimability of the model to cases in which only the count of pending spells are observed. Such data arise whenever census methods report stock levels (e.g., population, pending stock trades, monetary aggregates, number of patients on a waiting list) and not flows.

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8 Appendix

Derivation of the likelihood of the $CM_t/CM_t/\infty$ queuing system.

In this section we treat all expressions as conditional on (u, v); in the following section we integrate out the unobserved heterogeneity. From the properties of Poisson and exponential processes, when $(s, s+\Delta s)$ is strictly within a period we have the following (where $o(x)$ denotes order smaller than x):

$$\Pr\{1 \text{ arrival in interval } (s, s+\Delta s)\} = \lambda_t \Delta s + o(\Delta s) \tag{16}$$

$$\Pr\{0 \text{ arrivals in interval } (s, s+\Delta s)\} = 1 - \lambda_t \Delta s + o(\Delta s). \tag{17}$$

where $s \in [t-1, t)$. For any particular server we have:

$$\Pr\{1 \text{ exit in interval } (s, s+\Delta s)\} = \mu_t \Delta s + o(\Delta s) \tag{18}$$

$$\Pr\{0 \text{ exits in interval } (s, s+\Delta s)\} = 1 - \mu_t \Delta s + o(\Delta s). \tag{19}$$

The probability of any compound event (e.g., an arrival and an exit) is $o(\Delta s)$.

From (16)–(19) one can derive the probability of the number of units in service at time t. Most queuing studies focus on the limiting behavior of the system, but here we are interested in the transient behavior; in application there is no reason to assume that the system is in steady state (or even that the system is ergodic). We begin by deriving the likelihood for n_{t+1} given that $N(t) = n_t$.

Restrict attention for the moment to behavior within a period t, during which λ and μ are constant, and suppress the dependence on t in the notation for λ, μ, and n. Let $P_n(s)$ be the probability that $N(s) = n$. Then from (16)–(19) one can derive a recursive equation for the probability that there are n units in the system at time s:

$$\frac{d}{dt}P_n(s) = -P_n(s)(\lambda + n\mu) + P_{n+1}(s)(n+1)\mu + P_{n-1}(s)\lambda, \quad n \geq 0; \tag{20}$$

see (Kalashnikov, 1994, p.276). Add the initial condition

$$P_n(t-1) = \delta_{n_{t-1}n} \tag{21}$$

where $\delta_{n_{t-1}n}$ is the Kronecker delta (δ_{xy} equals 1 if $x = y$ and 0 otherwise). Equations (20)–(21) form a differential difference equation known as the *forward Kolmogorov equation*, which admits a solution, after employing a generating function that reduces the problem to a linear partial differential equation.

Define the generating function of the sequence $\{P_n(s)\}_{n=0}^{\infty}$ as[58]

$$P(z,s) \equiv \sum_{n=0}^{\infty} P_n(s) z^n, \tag{22}$$

where $z \in \mathsf{C}$, $\|z\| < 1$. $P(z,s)$ allows us to restate (20)–(21) as an initial value partial differential equation:

$$P(z,0) = z^{n_{t-1}} \tag{23}$$

$$\frac{\partial P}{\partial s} = (1-z)\left[\mu \frac{\partial P}{\partial z} - \lambda P(z,s)\right]. \tag{24}$$

The solution to this partial differential equation is

$$P(z,s) = c \exp\left[-\kappa(1-z)\right] \tag{25}$$

where c is an arbitrary function ϕ of $(z-1)e^{-\mu s}$ and $\kappa \equiv \lambda/\mu$ is the *traffic intensity.* To determine c, use (23) to find that

$$\phi(z-1)\exp\left[-\kappa(1-z)\right] = z^{n_{t-1}} \Rightarrow \tag{26}$$

$$\phi(w)e^{\kappa w} = (w+1)^{n_{t-1}} \Rightarrow \tag{27}$$

$$\phi\left((z-1)e^{-\mu s}\right) = \exp\left[\kappa(1-z)e^{-\mu s}\right]\left[1-(1-z)e^{-\mu s}\right]^{n_{t-1}} = c \tag{28}$$

[58] In the rest of this section, s should, strictly speaking, be Δs, the time elapsed in the current period.

Thus the particular solution of (25) that matches the boundary condition (28) is given by

$$P(z,s) = \left[1 - e^{-\mu s}(1-z)\right]^{n_{t-1}} \exp\left[-\kappa A(s)(1-z)\right], \tag{29}$$

where $A(s) = 1 - e^{-\mu s}$. Now expand the first term and use the power series expansion of the exponential term to rewrite (29) as

$$P(z,s) = \exp\left[-\kappa A(s)\right] \left[\sum_{m=0}^{n_{t-1}} \begin{pmatrix} n_{t-1} \\ m \end{pmatrix} \left(e^{-\mu s} z\right)^m A(s)^{n_{t-1}-m}\right] \left[\sum_{n=0}^{\infty} \frac{z^n \left[\kappa A(s)\right]^n}{n!}\right]$$

$P_n(s)$ is equal to the coefficient on z^n in $P(z,s)$. When s has run to the end of the period, this coefficient gives us the probability of observing n_t units in service at the end of period t. It is therefore the density for n_t, conditional on its lagged value n_{t-1} and on (u_t, v_t), which enter only through λ and μ. Denote this pdf $f(n_t|n_{t-1}, u_t, v_t)$. It is

$$f(n_t|n_{t-1}, u_t, v_t) = \exp\left[-\kappa_t\left(1 - e^{-\mu_t}\right)\right] \sum_{m=0}^{M_t} B_{mt}, \tag{30}$$

where $M_t \equiv \min\{n_{t-1}, n_t\}$ and B_{mt} is defined in (13). Finding the $f(n_t|n_{t-1})$ requires integrating out the unobserved heterogeneity:

$$f(n_t|n_{t-1}) = E_{u,v}\left[f(n_t|n_{t-1}, u_t, v_t)\right] = E_v\left\{E_{u|v}\left[f(n_t|n_{t-1}, u_t, v_t)\right]\right\} \tag{31}$$

Begin with the inner expectation and integrate out u from λ in (30). Due to the assumption that u has a gamma distribution, conditional on v, the inner expectation may be found in closed form, leading to (11). The outer expectation in (31) cannot be solved analytically, and so numerical integration or simulation may be used to evaluate the density (10).

Table 2: Description of Data

Variable	mean	s.d.
Adult population disabled (percentage, log)	2.36	0.22
Area (log sq. miles)	6.51	0.76
Capital cost (real, x 100, log)	1.71	0.09
EEOC charge rate (x 1000), 1992-1993	0.18	0.59
EEOC charge rate (x 1000), 1994-1996	0.60	1.12
FEP (state had pre-ADA disability law, 1=yes, 0=no)	0.32	0.47
Labor cost (real, in thousands, log)	2.58	0.20
Per capital income (real, in thousands, log)	2.46	0.22
Population (log)	10.17	1.38
Region: Midwest (1=yes, 0=no)	0.34	0.48
Region: South (1=yes, 0=no)	0.45	0.50
Region: West (1=yes, 0=no)	0.14	0.34
SIC 54 establishments, large, 1988-1997	5.62	17.68
SIC 54 establishments, large, 1988-1991	5.46	17.67
SIC 54 establishments, large, 1992-1993	5.65	17.52
SIC 54 establishments, large, 1994-1997	5.85	17.78
SIC 54 establishments, medium, 1988-1997	5.09	12.81
SIC 54 establishments, medium, 1988-1991	5.33	13.47
SIC 54 establishments, medium, 1992-1993	4.91	12.14
SIC 54 establishments, medium, 1994-1997	4.81	12.08
SIC 54 establishments, small, 1988-1997	48.46	149.09
SIC 54 establishments, small, 1988-1991	49.33	149.30
SIC 54 establishments, small, 1992-1993	48.23	150.33
SIC 54 establishments, small, 1994-1997	47.17	147.90
SIC 54 establishments, total, 1988-1997	59.17	177.33
SIC 54 establishments, total, 1988-1991	60.13	178.52
SIC 54 establishments, total, 1992-1993	58.79	177.67
SIC 54 establishments, total, 1994-1997	57.83	175.10
Title III case rate (x 100,000), 1992-1993	0.01	0.08
Title III case rate (x 100,000), 1994-1996	0.12	0.35

Note: unit of observation is a U.S. county, over years 1988-1997.

Table 3: Count Model Estimation Results—Specification A

	Poisson Regression		Negative Binomial Regression		Fixed Effects Poisson Regression		Random Effects Poisson Regression	
	estimate	s.e.	estimate	s.e.	estimate	s.e.	estimate	s.e.
Difference-in-mean estimates								
years 93-94	-0.060**	(0.002)	-0.061**	(0.005)	-0.060**	(0.002)	-0.053**	(0.002)
years 95-97	-0.102**	(0.002)	-0.104**	(0.004)	-0.104**	(0.002)	-0.091**	(0.002)
Other variables								
area	-0.041**	(0.001)	0.028**	(0.003)	-0.049**	(0.001)	0.042**	(0.008)
population	0.942**	(0.001)	0.885**	(0.002)	0.932**	(0.001)	0.850**	(0.004)
per cap income	0.158**	(0.005)	0.234**	(0.011)	0.221**	(0.005)	0.089**	(0.020)
capital cost	0.001	(0.009)	0.000	(0.020)	0.004	(0.009)	-0.004	(0.009)
labor cost	-0.140**	(0.008)	-0.223**	(0.014)	-0.180**	(0.008)	-0.080**	(0.025)
midwest	-0.276**	(0.002)	-0.333**	(0.006)	-0.085**	(0.015)	-0.363**	(0.022)
south	-0.100**	(0.002)	-0.092**	(0.006)	0.026**	(0.009)	-0.143**	(0.021)
west	-0.188**	(0.003)	-0.257**	(0.008)	0.065**	(0.013)	-0.317**	(0.026)
constant	-6.101**	(0.021)	-5.843**	(0.050)	-6.110**	(0.024)	-5.533**	(0.089)
Overdispersion parameter								
α			0.045**	(0.001)			0.073**	(0.002)
Log likelihood	-130,016.3		-102,431.3		-120,086.8		-87,542.1	
Pseudo R^2	0.942		0.329		0.947		0.058	

* = 5% significance level; ** = 1% significance level.

Notes: Dependent variable is total number of food stores (SIC 5400) in county in year. N = 30,578 in all estimations. The excluded period dummy is the pre-ADA period 1988-1992. When α is zero, the second and fourth models reduce to the simple Poisson model. The fixed effects regression includes state-level dummy variables. For the random effects regression, the county-level random effect is gamma distributed.

Table 5: Count Model Estimation Results—Specification B

	Poisson Regression		Negative Binomial Regression		Fixed Effects Poisson Regression		Random Effects Poisson Regression	
	estimate	s.e.	estimate	s.e.	estimate	s.e.	estimate	s.e.
Difference estimates								
% adults disabled, 1993-94	-0.031**	(0.010)	-0.007	(0.022)	-0.058**	(0.011)	-0.053**	(0.011)
% adults disabled, 1995-97	-0.031**	(0.009)	-0.023	(0.020)	-0.046**	(0.010)	-0.043**	(0.010)
EEOC charge rate, 1993-94	-0.043**	(0.002)	-0.032**	(0.004)	-0.015**	(0.002)	-0.012**	(0.002)
EEOC charge rate, 1995-97	-0.042**	(0.001)	-0.037**	(0.003)	-0.014**	(0.002)	-0.012**	(0.002)
Title III case rate, 1993-1994	-0.008	(0.007)	0.002	(0.020)	0.015*	(0.007)	0.014*	(0.007)
Title III case rate, 1995-1997	-0.010**	(0.003)	-0.004	(0.006)	-0.011**	(0.003)	-0.011**	(0.003)
Difference-in-difference estimates								
FEP state, 1993-94	0.022**	(0.004)	0.011	(0.010)	0.030**	(0.004)	0.029**	(0.004)
FEP state, 1995-97	0.018**	(0.004)	0.008	(0.008)	0.028**	(0.004)	0.025**	(0.004)
Main effects (apply to all years)								
% adults disabled	0.124**	(0.005)	0.046**	(0.012)	0.039**	(0.007)	0.034**	(0.007)
FEP state	0.049**	(0.002)	0.042**	(0.005)	0.154**	(0.015)	0.023*	(0.012)
Overdispersion parameter								
α			0.043**	(0.001)			0.071**	(0.002)
Log likelihood	-128,369.6		-102,253.1		-119,921.6		-87,412.2	
Pseudo R^2	0.943		0.330		0.947		0.060	

* = 5% significance level; ** = 1% significance level.

Notes: Dependent variable is total number of food stores (SIC 5400) in county in year. N = 30,578 in all estimations. All estimations include all controls from Specification A (previous table). All *Difference* estimates are differences from the pre-ADA period. See notes to previous table.

Table 7: Count Model Estimation Results—Specification C

	Poisson Regressions		Negative Binomial Regressions		Fixed Effects Poisson Regressions		Random Effects Poisson Regressions	
	estimate	s.e.	estimate	s.e.	estimate	s.e.	estimate	s.e.
Small firms differenced off large firms								
Difference-in-difference estimates								
% adults disabled, 1993-94	-0.048	(0.037)	-0.014	(0.048)	-0.124**	(0.038)	-0.131**	(0.038)
% adults disabled, 1995-97	-0.150**	(0.032)	-0.107*	(0.042)	-0.153**	(0.034)	-0.163**	(0.034)
EEOC charge rate, 1993-94	-0.060**	(0.007)	-0.047**	(0.009)	-0.030**	(0.007)	-0.026**	(0.007)
EEOC charge rate, 1995-97	-0.027**	(0.005)	-0.017**	(0.006)	-0.012*	(0.005)	-0.008	(0.005)
Title III case rate, 1993-94	0.027	(0.023)	0.026	(0.036)	0.028	(0.027)	0.023	(0.027)
Title III case rate, 1995-97	-0.003	(0.008)	0.007	(0.012)	-0.027**	(0.009)	-0.025**	(0.009)
Difference-in-difference-in-differences								
FEP state, 1993-94	0.025	(0.014)	0.021	(0.020)	0.028*	(0.014)	0.031*	(0.014)
FEP state, 1995-97	0.038**	(0.012)	0.041*	(0.017)	0.046**	(0.012)	0.045**	(0.012)
Medium firms differenced off large firms								
EEOC charge rate, 1993-94	-0.087**	(0.010)	-0.078**	(0.012)	-0.031**	(0.010)	-0.032**	(0.010)
EEOC charge rate, 1995-97	-0.042**	(0.007)	-0.020*	(0.008)	-0.026**	(0.007)	-0.022**	(0.007)

* = 5% significance level; ** = 1% significance level.

Notes: N = 30,578 in each estimation, using SIC 54 data. Estimates are differences across sizes of firms (as noted in first column) in differences over time (as noted in row headings; compared to the pre-ADA period). For each of the count models in the columns there are three underlying separate estimations (one for each of small, medium, and large firms). All variables from Specification B are included in each estimation; only the estimates of interest are reported above.

Table 4: Model A—Differences in Means Before and After the ADA

	No Heterogeneity		Heterogeneity	
	estimate	s.e.	estimate	s.e.
Entry rate parameters				
Difference-in-mean estimates				
years 93-94	-0.049**	(0.016)	-0.146**	(0.024)
years 95-97	-0.089**	(0.014)	-0.084**	(0.019)
Other variables				
Area	0.043**	(0.007)	0.015	(0.012)
Population	1.025**	(0.006)	0.708**	(0.009)
per cap income	0.013	(0.034)	0.235**	(0.051)
capital cost	0.674**	(0.066)	-0.096	(0.103)
labor cost	-0.160**	(0.052)	-0.226**	(0.064)
Midwest	-0.243**	(0.016)	-0.222**	(0.032)
South	0.152**	(0.016)	0.133**	(0.031)
West	-0.233**	(0.022)	-0.070	(0.040)
Constant	1.299**	(0.017)	0.761**	(0.032)
Failure rate parameters				
Difference-in-mean estimates				
years 93-94	0.102**	(0.015)	0.210**	(0.021)
years 95-97	0.067**	(0.014)	0.131**	(0.019)
Other variables				
area	0.081**	(0.006)	-0.005	(0.011)
population	0.065**	(0.005)	-0.153**	(0.008)
per cap income	-0.092**	(0.031)	-0.047	(0.045)
capital cost	1.147**	(0.059)	1.267**	(0.079)
labor cost	0.004	(0.048)	0.087	(0.058)
midwest	0.057**	(0.015)	0.170**	(0.025)
south	0.255**	(0.015)	0.208**	(0.025)
west	-0.022	(0.020)	0.146**	(0.032)
constant	-1.910**	(0.016)	-2.532**	(0.027)
Nuisance parameters				
σ_U^2			0.041**	(0.016)
σ_V^2			0.274**	(0.008)
ρ			-0.542**	(0.158)
correlation			-0.687	
Log likelihood	-77836.48		-73989.15	
Pseudo R^2	0.446		0.090	
N	30,578		30,578	

* = 5% significance; ** = 1% significance.

Note: Dependent variable: total number of food stores (SIC 5400) in county in year. The excluded period dummy is the pre-ADA period 1988-1992. Heterogeneous likelihood evaluated by 20 point Gauss-Laguerre quadrature. Pseudo R^2 is $1\text{-}L1/L0$, where L0 is an intercepts (plus σ_U^2, σ_V^2, and ρ in the heterogeneous model) only model and L1 is the full model.

Table 6: Model B—ADA-Specific Variables and FEP Diff-in-Diff

	No Heterogeneity		**Heterogeneity**	
	estimate	*s.e.*	*estimate*	*s.e.*
Entry rate parameters				
Difference estimates				
% adults disabled, 1993-94	-0.672 **	(0.066)	-0.357 **	(0.111)
% adults disabled, 1995-97	0.040	(0.072)	-0.017	(0.093)
EEOC charge rate, 1993-94	-0.327 **	(0.013)	-0.064 **	(0.020)
EEOC charge rate, 1995-97	-0.036 **	(0.009)	-0.015	(0.013)
Title III case rate, 1993-1994	-0.090	(0.046)	-0.054	(0.072)
Title III case rate, 1995-1997	0.142 **	(0.019)	0.101 **	(0.033)
Difference-in-difference estimates				
FEP state, 1993-94	-0.101 **	(0.033)	-0.070	(0.050)
FEP state, 1995-97	-0.037	(0.027)	-0.077	(0.040)
Main effects (apply to all years)				
% adults disabled	0.111 **	(0.041)	0.126 *	(0.054)
FEP state	-0.006	(0.018)	0.013	(0.025)
Failure rate parameters				
Difference estimates				
% adults disabled, 1993-94	-0.467 **	(0.060)	-0.539 **	(0.090)
% adults disabled, 1995-97	-0.037	(0.068)	-0.218 **	(0.083)
EEOC charge rate, 1993-94	-0.524 **	(0.013)	-0.477 **	(0.018)
EEOC charge rate, 1995-97	-0.019 *	(0.009)	0.004	(0.012)
Title III case rate, 1993-1994	0.009	(0.056)	-0.153	(0.114)
Title III case rate, 1995-1997	0.138 **	(0.016)	0.149 **	(0.025)
Difference-in-difference estimates				
FEP state, 1993-94	-0.162 **	(0.029)	-0.123 **	(0.038)
FEP state, 1995-97	-0.010	(0.025)	0.024	(0.034)
Main effects (apply to all years)				
% adults disabled	-0.007	(0.040)	0.146 **	(0.051)
FEP state	-0.036 *	(0.017)	-0.044 *	(0.023)
Includes Controls from Model A	Yes		Yes	
Pseudo R^2	0.451		0.095	
Log likelihood	-77078.11		-73547.72	

* = 5% significance; ** = 1% significance. N = 30,578. Dependent variable: total number of food stores (SIC 5400) in county in year. The excluded period dummy is the pre-ADA period 1988-1992. Specification also includes all variables in specification A, previous table.

Table 8: Model C

	No Heterogeneity		Heterogeneity	
	estimate	*s.e.*	*estimate*	*s.e.*
Small firms differenced off large firms				
Entry rate parameters				
Difference-in-difference estimates				
% adults disabled, 1993-94	-0.750 **	(0.170)	-0.506 *	(0.205)
% adults disabled, 1995-97	0.122	(0.156)	0.063	(0.181)
EEOC charge rate, 1993-94	-0.230 **	(0.033)	-0.022	(0.039)
EEOC charge rate, 1995-97	0.010	(0.022)	0.021	(0.026)
Title III case rate, 1993-94	-0.342	(0.199)	-0.261	(0.221)
Title III case rate, 1995-97	0.061	(0.049)	0.048	(0.059)
Difference-in-difference-in-differences				
FEP state, 1993-94	-0.184 *	(0.075)	-0.127	(0.090)
FEP state, 1995-97	0.057	(0.063)	0.044	(0.076)
Failure rate parameters				
Difference-in-difference estimates				
% adults disabled, 1993-94	-0.558 **	(0.184)	-0.665 **	(0.215)
% adults disabled, 1995-97	-0.113	(0.159)	-0.268	(0.183)
EEOC charge rate, 1993-94	-0.366 **	(0.035)	-0.316 **	(0.041)
EEOC charge rate, 1995-97	0.003	(0.025)	0.005	(0.028)
Title III case rate, 1993-94	-0.271	(0.207)	-0.301	(0.246)
Title III case rate, 1995-97	0.025	(0.049)	0.038	(0.058)
Difference-in-difference-in-differences				
FEP state, 1993-94	-0.351 **	(0.078)	-0.308 **	(0.092)
FEP state, 1995-97	0.067	(0.067)	0.107	(0.079)
Medium firms differenced off large firms				
Entry rate parameters				
EEOC charge rate, 1993-94	0.039	(0.037)	0.044	(0.042)
EEOC charge rate, 1995-97	0.017	(0.027)	0.030	(0.030)
Failure rate parameters				
EEOC charge rate, 1993-94	0.081 *	(0.040)	0.092 *	(0.046)
EEOC charge rate, 1995-97	0.075 **	(0.028)	0.063	(0.032)

* = 5% significance; ** = 1% significance. *N* = 30,578. Dependent variable: total number of food stores (SIC 5400) in county in year. The excluded period dummy is the pre-ADA period 1988-1992. Specification also includes all variables in specification A, Table 5.

Table 9: Magnitude of the Estimates from Specification C—Effect on the Nationwide Number of Firms, Entry, and Exit

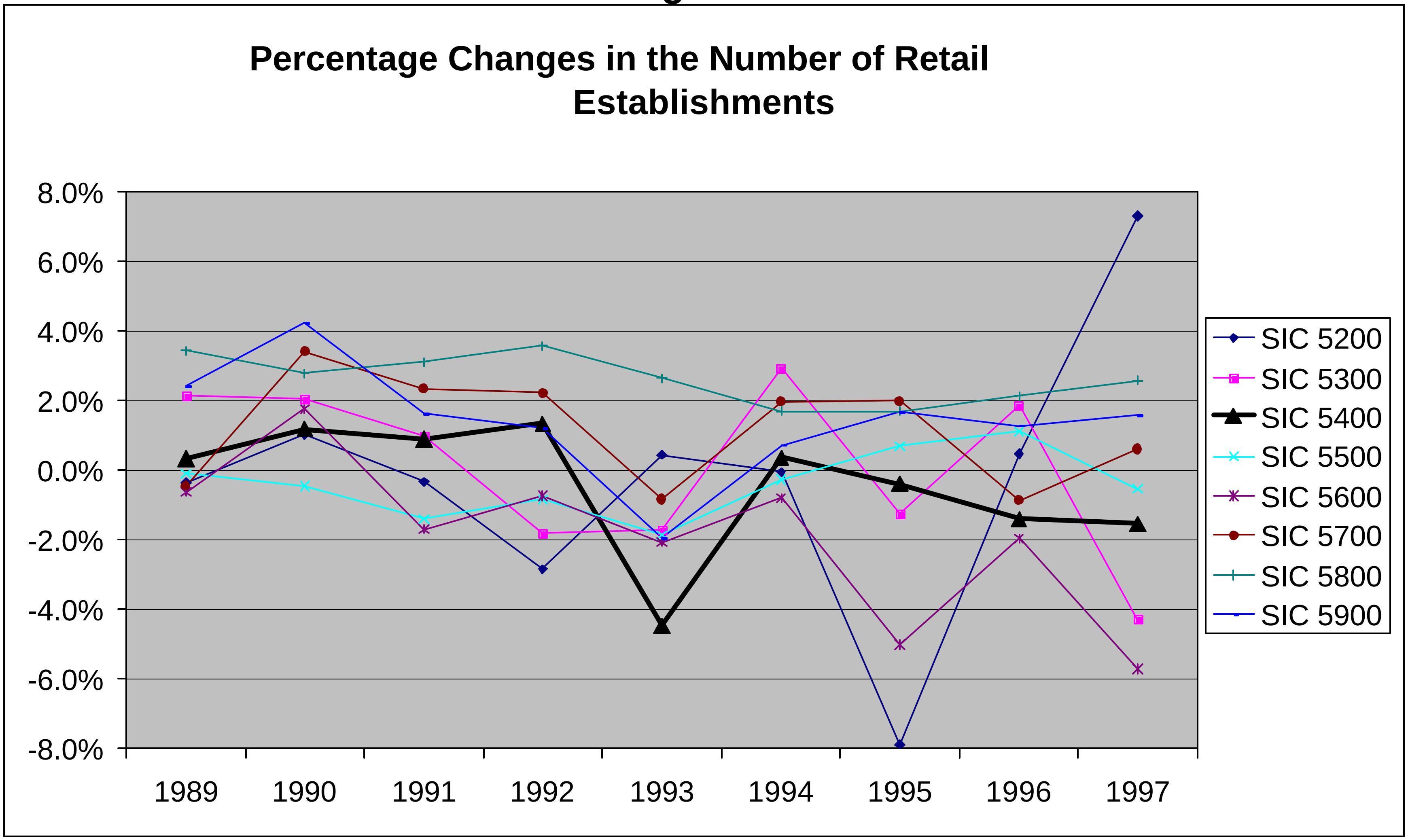
	Effect of a 1 std. dev. increase in the row variable				Effect of a "0 to actual value" increase in the row variable			
	Δ***N*** (Direct Estimate)	Δ**Entry**	Δ**Exit**	Δ***N*** (Implied)	Δ***N*** (Direct Estimate)	Δ**Entry**	Δ**Exit**	Δ***N*** (Implied)
Small firms differenced off large firms								
Difference-in-difference estimates								
% adults disabled, 1993-94	-1,689.2	-3,008.3**	-1,179.5**	-1,828.8				
% adults disabled, 1995-97	-2,148.4**	845.4	271.7	573.6				
Title III case rate, 1993-94	-147.6	-908.1	-200.2	-708.0	-61.0	-378.8	-81.4	-297.3
Title III case rate, 1995-97	-1,054.2	2,152.0	1,186.9	965.0	-775.1	1,531.7	852.4	679.3
Difference-in-difference-in-differences								
FEP state, 1993-94†	15,631.6	-2,807.8*	-3,198.8**	391.0				
FEP state, 1995-97†	15,335.0**	-395.3	-859.2	463.9				
Medium firms differenced off large firms								
EEOC charge rate, 1993-94	-1,339.1**	76.6	3.4*	73.2	-1,149.0**	70.1	10.7*	59.4
EEOC charge rate, 1995-97	-643.5**	29.2	185.2**	-156.1	-1,119.9**	53.6	282.0**	-228.4

† Effect of a zero to one change in the row variable.

* = 5% significance; ** = 1% significance; based on significance of estimates in Tables 4 and 7.

Notes: all figures are numbers of firms. *ΔN (Direct Estimate)* is based on coefficients from the estimations from Table 4. *ΔEntry* and *ΔExit* are based on coefficients from the estimations from Table 7, "no heterogeneity" specification. *ΔN (Implied)* is calculated as *ΔEntry* minus *ΔExit*. All figures are calculated using actual values of the covariates for each county (except for the row variable, as noted in the column headings), and aggregated up to the national level. All period differences are with respect to the pre-ADA period.

Figure 1



Percentage Changes in the Number of Retail Establishments
8.0%
6.0%
4.0%
2.0%
0.0%
-2.0%
-4.0%
-6.0%
-8.0%
1989
1990
1991
1992
1993
1994
1995
1996
1997
SIC 5200
SIC 5300
SIC 5400
SIC 5500
SIC 5600
SIC 5700
SIC 5800
SIC 5900