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Changing Behavior: Applicant Sensitivity to Patent Fees

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Abstract: The America Invents Act (AIA) gave the US Patent and Trademark Office (PTO) authority over the setting of fees for all patent and trademark applications. Fee collections are required to be set at aggregate cost recovery, but the act gives the PTO significant autonomy in the composition of fees. Thus, fee-setting authority contains both a responsibility and an opportunity. First, in order to make conscientious policy choices, the PTO has the responsibility to understand how applicants respond to fees. Second, the PTO has an opportunity to influence patent pendency through wise choices in the pricing of fees throughout patent prosecution. This paper represents the first large-scale analysis of patent prosecution fees. In particular, we focus on how applicants respond to changes in fees with regard to their filing of requests for continued examination (RCEs). The use of RCEs has risen dramatically since their introduction in the late 1990s. RCEs represent an important way for applicants to extend patent prosecution. As such, they have been found to be a primary source of delay in the patent system (Mitra-Kahn, et al (2013)). Despite this growth and the importance of RCEs as part of the patent prosecution process, their use has received relatively little attention from scholars. In this paper, we examine the sensitivity of RCE filing behavior to several environmental factors, focusing on the fees that applicants must pay for an RCE, or its primary alternatives (appeals and traditional continuations). We use micro-level patent prosecution data to estimate duration models of time-to-RCE filing. We find that applicants are sensitive to RCE fees, with applicants becoming more sensitive to fees as patent prosecution continues. At the same time, there is a positive relationship between the appeal fee and the use of RCEs, indicating that the two options are demand substitutes. Traditional continuations also appear to be demand substitutes for RCEs, but as prosecutions move through multiple final rejections, they switch to being complements. Early in prosecution, we do not find small entities to be more price sensitive than large entities. Surprisingly, they appear to become less price-sensitive than large entities at later stages of prosecution. The results have implications for understanding applicants' use of RCEs and traditional continuations, and how the PTO can use its new fee-setting authority to influence the RCE-filing behavior of applicants.

Keywords: Patents, continuations, patent quality, patent prosecution, price elasticity

JEL: O3, L1.

RESULTS ARE PRELIMINARY. DO NOT CITE.

1 Introduction

Section 10 of the America Invents Act (AIA) gave the US Patent and Trademark Office (PTO, or Office, or Agency) greater authority over the setting of all patent and trademark fees charged under Title 35 of the U.S. Code and the Trademark Act of 1946. One constraint that the PTO faces when setting fees is that total revenue from the patent fees may only recover the total estimated costs (including administrative costs) of patent operations and the total revenues from the trademark fees may only recover the total estimated costs (including administrative costs) of the Office's trademark operations. However, the AIA allows the PTO to set fees in such a way as to influence the behavior of applicants. Given the new fee setting authority, it is appropriate to examine the sensitivity of patent applicant behavior to changes in the different fees over which PTO has authority.

More specifically, the work presented in this paper focuses on how applicants respond to changes in relevant fees with regard to their filing of requests for continued examination (RCEs). RCEs were first introduced into the US patent system in 1999 with the passage of the American Inventors Protection Act (AIPA).[1] The RCE is a form of non-serialized continuation[2] that allows further prosecution of a patent application even after the prosecution has been technically closed by the examiner.[3] In general, continuations allow applicants to continue the examination process on an application, and importantly protect the original priority date of the earlier application (Hegde, Mowery, and Graham 2009).

There are several reasons why an applicant may choose to file an RCE. First, in the event of a final rejection (where all claims have been rejected), filing an RCE allows the applicant to re-open the prosecution so as to amend claims and/or submit evidence or new prior art.[4] Other options available to the applicant at this point include filing an appeal for quasi-judicial Agency review[5] or filing a traditional serialized continuation.[6] Applicants may also find it useful to file an RCE when some but not all of the claims have been allowed in the current examination, but the applicant wants to amend one or more of the remaining claims to allow all claims to be

[1] They replaced a previous form of continuation called Continued Prosecution Applications (CPAs) for all applications filed after June 8, 1995.
[2] They are "non-serialized" in the sense that they do not obtain a new serial number. In addition, they generally remain with the same examiner, and they stay on a different docket from new applications.
[3] RCEs generally may not be filed after the application has been abandoned or issued as a patent.
[4] In some cases, examiners will consider these items without requiring that an RCE be filed.
[5] The AIA created a new entity, the PTAB, which replaced the earlier Board of Patent Appeals and Interferences (BPAI).
[6] Serialized continuations are treated like new applications which claim priority to the original application.

(ultimately) issued as part of the same patent. In some cases, an applicant will file an RCE after an allowance in order to fix mistakes or file an information disclosure statement (IDS) disclosing prior art that may have come to the attention of the applicant. In any case the RCE has to be filed before the patent is issued. Another stated reason is that applicants use the RCE procedure to purchase more time and attention from an examiner, particularly in complex or time-consuming examinations.[7]

As originally envisioned, RCEs are an important part of the patent application process.[8] They can act as a form of error correction (one that may be less costly than the appeal process).[9] Additionally, RCEs may enable applicants to narrow the claims of the application in order to comply with examination standards. On the other hand, like traditional continuations, RCEs can be criticized based on their potential for strategic manipulation on the part of applicants, particularly for delay (Graham and Mowery 2004). Also, it is possible that RCEs can be used by applicants in a "war of attrition" with examiners resulting in the granting of patents of dubious quality (Quillen and Webster 2001). RCEs have traditionally also cost the Office more to complete than the fees charged for them, draining away examination resources.[10] Similarly, because RCEs divert resources away from new applications, they have been identified as one of the major causes of delay faced by later-incoming applications (Mitra-Kahn, et al 2013). Whether RCEs more frequently operate to narrow patent claims or to simply extend the delay in patent prosecution is an open research question. In either case, given the relevance of RCE behavior to PTO operations and the functioning of the patent system generally, it is important to know how RCE filing responds to fees.

The use of RCEs is economically relevant, having increased dramatically since they were introduced as shown in Figure 1. The number of monthly RCE filings grew from several hundred at the beginning of the period to over 5,000 by the end of 2005.[11] By the beginning of 2009, monthly filings had doubled to over 10,000 and have fluctuated between 12 and 14 thousand

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[7] [For a cite to this notion, see the comments offered by the PPAB and comments to the first roundtable on fee setting]

[8] The history of the continuation process in the U.S. originates in a Supreme Court case from 1863. See … [the case is cited in Graham/Mowery 2004]

[9] In 2010, a survey of patent practitioners reported that on average they charge $4,000 (appeal with no oral argument) and $7,500 (appeal with oral argument). AIPLA (2011).

[10] [The cite to this notion would be the materials posted on the AIA website from the PTO at the time of the first fee-setting proposal, citing the unit-cost of RCEs, and showing that the fees to do recoup that cost]

[11] Looking at the figures, we see a large spike in RCE-filing activity in October 2007. This was the result of a proposed policy change, which was to take effect in November and would have made it much more difficult for applicants to file RCEs and serialized continuations. The policy change was never implemented, but the possibility of the change was enough incentive for applicants who were considering filing an RCE to do so before the end of October. We control for this period of increased RCE activity in our analyses that follow.

since the middle of 2010. This trend has not merely been the result of the increased volume of applications being filed with the PTO, since even when we consider the number of RCEs per pending application we get a similar result (Figure 2). Given this increasing use, a main motivation for this report is to determine which factors are the most important drivers of RCE filings.

Overall, the purpose of this research study is to investigate the sensitivity of RCE-filing activity to several factors with a special focus on the fees charged by PTO. Using micro-level data on patent application prosecution histories in the population of U.S. patent filings since 2005 we are for the first time able to investigate the prosecution choices of individual applicants. Employing duration model analyses enable us to investigate how RCE propensity responds to several environmental factors as well as applicant and application characteristics. In particular, we examine the sensitivity of RCE filing behavior to PTO fees, including RCE fees, appeal fees, and fees charged for traditional continuations.

Our results show that the demand for RCEs is sensitive to price, especially in cases where at least one previous RCE had been filed during the prosecution of the application. Cross-price elasticities show that patent-office appeals tend to be demand-substitutes for RCEs. However, at least in the later stages of prosecution, traditional continuations appear to become demand-complements with RCEs.

The balance of the paper is organized as follows. Section 2 provides a brief review of the literature on the impact of fees on patenting behavior. In section 3 we provide an overview of the methods used in our analyses. Section 4 provides a description of the data and the variables included in the analyses. Section 5 provides a description of the empirical results. Finally, Section 6 provides concluding remarks.

2 Literature Review

Although we are aware of no other scholarship rigorously examining the effect of PTO fees on RCE filing behavior, the results of several studies indicate that applicant behavior in general responds, albeit modestly, to changes in patent office fees. Archontopoulos and colleagues (2007) noted that the increase in claims-based fees as the PTO in 2004 (from $18 to $50 per claim in excess of 20) had a substantial downward impact on the average number of claims filed per patent. In the time period prior to the fee increase the average number of claims was roughly 28. This average number of claims fell to about 23 in the time period following the fee increase indicating a price elasticity of roughly -0.20, meaning that one would expect a 1 percent increase in the fee to lead to a 0.2-percent decrease in the number of excess claims filed.

Several other studies have examined the impact of various fees on the demand for patents. Nicholas (2011) examined the change in total applications in Great Britain after the passage of the 1883 Patents Act, which lowered patent fees from £25 to £4. The number of patents filed

jumped by roughly 150 percent, indicating a price elasticity of -0.66. In another study, Moser (2012) examined inventions that were exhibited at 19th- and 20th-century world fairs. Comparing the share of the American inventions patented (15 percent) with that of British inventions (11 percent), Moser noted a large difference in the fees for carrying a patent to full-term between the two countries: $37,000 in Britain and $612 in the United States (in constant 2010 dollars). Based on these figures, Moser estimated a price elasticity of demand for patents of roughly -0.15 in 1851.

More econometrically rigorous studies of patenting behavior at the PTO such as those done by Adams and colleagues (1997) and Landes and Posner (2004) have also estimated fairly modest price elasticities of -0.12 and -0.03, respectively. Considering a large number of patent offices around the world, de Rossenfosse and van Pottelsberghe (2012) estimated the price elasticity at the European, Japanese, and US patent offices over a 26-year period using a panel data approach. The authors obtained a long-term price elasticity of roughly -0.30.

Since patent offices generally require the periodic payment of fees to keep a granted patent in force, other researchers have been able to examine the effect that differences in renewal fees have on patent maintenance behavior. A study by Harfhoff and colleagues (2009) considered the impact of fees on the national-validation behavior of applicants to the European Patent Office (EPO). Their study relies on the requirement that applicants, after receiving a successful examination at the EPO, must "validate" the patent by paying fees in each of the various European countries in which they want protection. . These validation fees, as well as renewal fees charged in the first several years, vary across the different countries. Taking advantage of this variation, they estimate the impact of these fees on which countries applicants chose to validate their patents. The results support the notion that fees influence the validation behavior of applicants, with the elasticity of validation fees estimated at roughly -0.10 and that of renewal fees at roughly -0.30. Similarly, Danguy and van Pottelsberghe (2009) estimated the impact of renewal fees on maintenance rates at several European patent offices. Their results suggest that the price elasticity for maintenance becomes less inelastic as time wears on, reporting an elasticity estimate of -0.3 at year 6, -0.08 at year 10, -0.25 at year 15, and -0.80 at year 20.

While these studies are useful as background and to provide a basis for comparison, few of them look specifically at patent office fees in the United States, and none focus the elasticity associated with pre-grant fees charged for a continuation of patent-office examination.[12] Given that prior scholarship has suggested that delay in the patent examination process may allow for

[12] While continuation practice is largely the province of the US patent system, a lesser-used variant is allowed through the "divisional application" at the European Patent Office. Graham et al (2003).

undesirable strategic behavior (Graham and Mowery 2004) and impose costs on the patent offices and other innovators (Mitra-Kahn, et al 2013)), it is relevant to understand the relationship between fees and the demand for continuation. We now turn to our empirical tests.

3 Empirical Specification

This study uses duration model analysis to estimate the effects of PTO fees and other factors on the time that lapses between the mailing by an examiner of a "final rejection" to a patent applicant and the subsequent filing of an RCE by the applicant in response. One could use a Cox or other type of proportional hazard model if the effects of the factors included in the model on the hazard of filing an RCE did not vary over time. While the Cox model has some advantages for the researcher,[13] the proportional hazards assumption was not met for several of the variables included in the models, so we rejected the Cox model in favor of an accelerated failure time (AFT) model.[14]

Using AFT models require us to make parametric assumptions concerning the shape of the baseline hazard. In our case, because the hazard tends to rise (slowly at first and then more dramatically) and then fall over time, we chose to represent the hazard using a log-logistic model.[15] The log-logistic hazard function is:

$$h(t) = \frac{\lambda^{\frac{1}{\gamma}} t^{1-\gamma}}{\gamma\left(1 + (\lambda t)^{\frac{1}{\gamma}}\right)}$$

The model is implemented by parameterizing $\lambda = e^{-xb}$, where **x** is a vector of explanatory variables and b is a vector of parameters indicating the effects of changes in the explanatory variables on the hazard rate. The γ is a scale parameter estimated from the data.

To control for any unobserved heterogeneity in RCE filing behavior across applications handled by different patent examiners, we included examiner-level random effects. Duration models with random effects are referred to as shared-frailty models in the literature. A frailty is defined as a latent multiplicative effect on the hazard function, h(t), and is assumed to have a mean equal to one and a variance parameter, usually referred to as θ, that is estimated along with the other parameters in the model. In shared frailty models, the frailty is assumed to be common among

[13] Advantages include not needing to make parametric assumptions and results that are relatively easy to interpret.
[14] A discussion of AFT models is provided in Kalbfleisch and Prentice (1980).
[15] Diagnostic testing indicated that the log-logistic model outperformed other candidates such as the lognormal and weibull models.

groups of observations – in our case, final rejections issued by the same examiner – but randomly distributed across the groups.

The results of AFT models with shared frailty are not easy to directly interpret, but, given the results, one can predict an expected likelihood of observing an RCE filing within some period of time. In this study, we choose to use the model to predict the probability that an applicant will file an RCE within 180 days of the mailing by the patent office of a notice of final rejection. As an example, consider our use of the following method to determine the impact of a 10-percent increase in the RCE filing fee on this likelihood. After estimating the model, we first generate a predicted 180-day survival probability for each subject in our sample, using the existing data values on the explanatory variables. Accordingly, the probability of an RCE filing is simply one minus the probability of survival.

Next, to investigate the sensitivity to changes in fees, we replace the existing data on RCE filing fees with new values equal to the original values increased by 10 percent (multiplied by 1.10). Using these new values, we next generate a new predicted 180-day survival probability and RCE filing probability for each application. We are thereby able to examine the average change between the original (at fees = x) and new predicted RCE filing probabilities (at fees = $1.1x$).

In our case, we generate the elasticity of the 180-day RCE filing probability with respect to each of the three following fees: (1) the RCE filing fee, (2) the appeal fee, and (3) the fees associated with filing a traditional continuation. In so doing, we are able to determine the impact of a 10-percent increase in the relevant fee as a percentage change in the 180-day RCE filing probability. Straightforwardly, we then divide this percentage change by 10 to generate the elasticity estimate.

In order to estimate the 95-percent confidence interval for each elasticity, we bootstrap the model using 1,000 replications, calculating the confidence intervals using the percentile method. In our case, after 1,000 replications, we sorted the elasticity estimates from the lowest to highest. The lower bound for the confidence interval was estimated as the 25th lowest value of the 1,000 estimates (lowest quartile) while the upper bound was the 25th highest value (upper quartile).

4 Data

The data we employed in this study are generated from the PTO's internal Patent Application Location and Monitoring (PALM) system. The PALM system, used by patent examiners to monitor the progress of patent application prosecution, contains the full prosecution history of

applications including all actions taken by both the applicant and the examiner(s). For instance, the file includes data on when each application was submitted, when it was placed on an examiner's docket,[16] the nature and date of each "office action" taken by the examiner, and the nature and date of each response from or action by the applicant. The examiners' "office actions" regarding an application include, but are not limited to, non-final rejections, final rejections, and allowances. The applicant responses can include the filing of RCEs, information disclosure statements, amendments, and appeals, as well as abandonments. PALM also includes information on application type (based on priority, such as regular, PCT, foreign, or provisional), invention type (utility, design, etc.), whether the application is a continuation of a previous patent application, the technology "art unit" to which the application is assigned[17], and fees paid by the applicant.

4.1 Sample

By their nature, RCEs can only be filed after the prosecution of an application has been "closed." By far, the two most common actions that result in the closing of prosecution are final rejections and allowances. Because it is very uncommon for an RCE filing to following an examiner's notice of allowance, the focus of our analysis is on RCEs filed in response to final rejections.[18] Accordingly, the unit of analysis in our study is the application-final rejection. More specifically, our initial sample consists of all final rejections on regular utility patent applications mailed between January 1, 2005 and February 29, 2012.[19] We collected our data from prosecutions in the following PTO technology centers:[20]

- 1600 – Biotechnology
- 1700 – Chemical and Materials Engineering
- 2100 – Computer Architecture, Software, and Information Security
- 2400 – Computer Networks, Multiplex Communication, Video Distribution and Security
- 2600 – Communications
- 2800 – Semiconductors, Electrical and Optical Systems and Components

[16] The "docket" is the virtual file representing those cases (applications) available for the examiner to work upon.
[17] An art unit is a specialized administrative examination subunit based on technology.
[18] At the very least, one would expect different drivers of RCE filings after allowance than for filings after final rejections.
[19] We limit our sample to final rejections mailed from 2005 onward because we want to generate elasticity estimates that reflect current conditions. RCE filing behavior may have been quite different in the few years after its implementation since the program was not mature and applicants had limited information about what to expect from using it.
[20] Examination at the PTO is grouped into art units identified by 4 digits, aggregated hierarchically. The hierarchy in the first two digits is called the technology center, while the first digit hierarchy is called the discipline.

- 3600 – Transportation, Construction, Electronic Commerce, Agriculture, National Security and License & Review
- 3700 – Mechanical Engineering, Manufacturing, Products

We identify final rejections in the PALM data, finding 1,040,910 unique applications on which were processed a total of 1,417,708 final rejections, suggesting that a small share of applications experienced more than one final rejection during the time period considered. The explanatory variables we describe below are all measured at the mailing date of the final rejection. Because statutory law requires the applicant to respond within six months, we estimate the duration model for six months after the final rejection.

4.2 Dependent variable

The dependent variable in our analyses is the amount of time elapsed between the mailing of a final rejection and our observation of an RCE filing. For each application-final rejection in our sample, we look forward in time to determine which of the following events occurred first:

- the applicant filed an RCE
- the examiner issued another final rejection
- the examiner issued an allowance
- the application was abandoned

Based on which event occurred first, we generate two relevant variables: (1) a dichotomous indicator variable equal to one if the first event was an RCE filing and zero otherwise, and (2) the date of the "next" event. These two variables, along with the date of the mailing of the final rejection, are necessary inputs to the duration analysis described in Section 3 above. To provide context, we provide two hypothetical examples detailing how the variables are created.

- *Example 1.* Consider a case in which an examiner issues a final rejection that is mailed on January 1, 2008. Suppose that the next relevant event to occur is another final rejection mailed on July 1, 2008. The indicator variable described above would be set to zero and the date for the "next" event would be set equal to July 1, 2008. In this case, it appears that after the first final rejection – since we observe another final rejection was forthcoming –the applicant used another approach, such as an IDS or amendment filing or appeal, to gain additional examination efforts at the PTO. No RCE has been filed before the next final rejection and, as of the date of the second final rejection in July, the applicant would no longer be at risk of filing an RCE in response to the original first January 1 final rejection.
- *Example 2.* Consider a similar case where an examiner issues a final rejection that is mailed on January 1, 2008. This time, the next relevant event to occur is an RCE filing on March 25, 2008. The indicator variable would be set equal to one and the date for the "next" event would be set equal to March 25, 2008.

- *Example 3.* Lastly, suppose that the examiner issues a final rejection that is mailed on January 1, 2008. The applicant does not respond within the statutory response time (six months) and the application is therefore considered abandoned as of July 1, 2008. The RCE indicator variable would be set equal to zero and the date for the "next" event would be set equal to July 1, 2008 – in this case the abandonment.

4.3 Explanatory variables

We include several factors that may differentially influence the amount of time observed between the mailing of a final rejection and an RCE filing. While the fees themselves may play a role, we also include several application characteristics and broader environmental variables representing PTO-specific and economy-wide factors. These include:

Fees

- the real fees (adjusted for inflation) that the PTO charges for RCE filings as well as the real fees for substitute actions (appeals and traditional continuations).[21]

Application characteristics

- the technology center to which the application was assigned;
- the number of previous final rejections (zero, one, two, or three or more);
- the number of claims included in the initial application;
- the seniority of the examiner assigned to the application at the time of the final rejection;
- the type of priority document claimed by the application: foreign or PCT application, US application, US provisional application, or no claimed priority;
- the first-action pendency (the amount of time that the applicant had to wait for a "first action on the merits" ("FAOM" or "first action"));
- the number of RCEs previously filed during the prosecution of the application.

Environmental variables

- the number of pending applications at their various stages in the prosecution process for the discipline to which the application was assigned at the time of the final rejection;
- the numbers of junior and senior level examiners in the discipline at the time of the final rejection;

[21] Note that there are no fees for amendments to the application. However, amendments are different from RCEs. Once prosecution is closed, the examiner need not consider amendments. At that point the applicant must either file an RCE or appeal in order to continue prosecution for that application.

- the number of pending appeals in the relevant technology-center pair at the time of the final rejection;
- the change in the nation's real gross domestic product in the 12 months prior to the final rejection;
- the allowance rate in the relevant technology center in the six months previous to the final rejection.

4.3.1 Fees

The applicable fees were collected on a monthly basis, based on all applications that had paid the relevant fee each month. For the purposes of the regression, we use the median fee payment across all applications that were subject to the fee. While the median fee payments are, not surprisingly, generally equal to the fees published by the PTO for each month, we nevertheless use the observed fee payments for a number of reasons. First, it enables us to be precise about the specific date that the fee was effective. Second, the method allows us to obtain a longer time series than we could from published fee tables. We convert the nominal fees to constant dollars using monthly values of the consumer price index. All fee variables enter the regressions as natural logs.

4.3.2 Application characteristics

Because applicants in different technology areas may have different preferences over the timeliness of examination, we include a series of fixed effects to control for technology.[22] We do so by entering each of the eight utility-patent technology centers (TCs) as a series of indicator variables.

Because RCE filing behavior may change during the course of the patent prosecution process, we also generate a series of indicator variables representing the number of prior final rejections the applicant had received during the prosecution of the application. We used the PALM to generate these indicator variables.

The number of claims included in the initial application is routinely entered into the PALM system. We include the natural log of this variable in our models. This inclusion is meant to control for the complexity of the invention and/or the application. Since the number of hours allowed to an examiner per application is fixed, more complex inventions may require more rounds of examination and may accordingly be associated with a higher probability of RCE filing. Complexity may also affect timing, since it may take an applicant longer to file an RCE if

[22] Product life cycles differ, and some technologies – like pharmaceuticals – face non-market sources of delay (for drugs, regulatory requirements).

the initial application is more complex. While we remain agnostic as to the affect complexity may have, we nevertheless consider it an important variable for which to control.

We also include the number of RCEs previously filed during prosecution as a control. Observing prior RCE filing may demonstrate a propensity or preference in the applicant for the use of RCE filings. The number of RCEs previously filed during prosecution is generated from the PALM file.

Because RCEs are a species of continuing application, we control for a propensity or preference for continuity by including three indicator variables for each application's claimed priority to previous applications. The first indicator variable is set equal to one if the application claims priority to a previous US provisional application and zero otherwise. The second is set equal to one if the application claims priority to a previous foreign or PCT application and zero otherwise. The third is set equal to one if the application claims priority to a previous US regular (non-provisional) application and zero otherwise.[23]

A measure of the volume of pending applications (the "stocks" variables described below in Section 4.3.3) is meant to control for the effect of expected future examination pendency on RCE filing behavior. Our theory for including this measure is to account for any changes in applicant behavior based on expected congestion. To control for any past delay (or lack thereof) faced by each individual applicant, we include a measure of first-action pendency ("FAOM pendency"). The FAOM pendency variable is generated by comparing the date of each application's FAOM with the date that the application was received by the PTO. The difference is measured in days and the natural log of the difference is included in the duration analyses.

We also control for examiner seniority. Officials from the PTO's Office of Patent Information Management indicated that RCE filing behavior is partially driven by the seniority of the examiner assigned to the individual application. In particular, their expectation is that applicants assigned to a less-senior examiner are more likely to file an RCE. To generate the examiner seniority variables, we determine the examiner assigned to each application when the final rejection was mailed, and use examiner promotion data to determine the federal General Schedule (GS) scale level that the examiner had attained at that time.[24] The examiner seniority variables enter as a series of dichotomous indicator variables.

[23] The omitted, or comparison, group is the set of applications not claiming priority to any previous application.
[24] The federal government's General Schedule (GS) scale is hierarchical and correlated with seniority and tenure.

4.3.3 Environmental variables

Two sets of variables – the numbers of pending applications and junior and senior examiners – are included to account for the pendency that applicants can expect prospectively, as well as if the applicant were to file a traditional continuation. These variables represent the stocks (cumulative daily volume) on a monthly basis at the discipline level, and enter the analysis in the month of final rejection and the discipline of the application. All of the stocks enter as natural logs in our duration analyses.

To better understand how PTO backlogs in the various examination stages may differentially affect the incentives of applicants to file RCEs, we separate the stocks of pending applications are broken out into four groups proposed by Mitra-Kahn, et al (2013). These include applications that have not been docketed to an examiner (Stock 1), applications that have been docketed but had not received a first action (Stock 2), applications that have received a first action but have not filed an RCE (Stock 3a), and applications that have received a first action and have filed at least one RCE (Stock 3b).

As regards employee stocks, we define "senior level" examiners as those at grade level GS-14 and higher. All other examiners are defined as as "junior level." The volume of senior and junior examiners is measured in terms of full time equivalent employees (FTEs) and enters as a natural log.

Because economic conditions may also affect applicant behavior, we control for the level of general economic growth in the U.S. by including a measure of the change in the real US gross domestic product for the 12 months prior to the quarter in which the final rejection was mailed. This variable enters as a natural log. We use quarterly real GDP as reported by the Bureau of Economic Analysis.

Because technology centers are "paired" for the purposes of appeal hearings, we also collected data on the number of pending appeals by pairs of TCs for each month beginning in January 2005.[25] Because applicant incentives to file appeals may affect those to file RCEs, these stocks are used to control for the "appeal pendency" that applicants may expect were they to file an appeal. These stocks enter as natural logs for the TC-pairing associated with the focal application, in the month of the final rejection.

The TC's 6-month allowance rates are generated for each month starting in January 2005. We define the allowance rate as the total number of allowances divided by the sum of total

[25] The four technology center pairs are: (1) 1600 and 1700, (2) 2100 and 2400, (3) 2600 and 2800, and (4) 3600 and 3700.

allowances plus total final rejections issued in a particular technology center during the six months prior to the focal month. This rolling measure can affect our results on applicants' RCE filing behavior in two ways. First, a higher lagged allowance rate may indicate that the resulting sample of final rejections constitutes a weaker pool of applications, which may be more likely to be abandoned. On the other hand, to the extent that applicants can observe allowance rates, a recent history of relatively high allowance in a TC may increase the likelihood of applicants filing RCEs in hopes of getting claims allowed in their next rounds of examination.

4.3.4 Additional Control Variables

In addition to the explanatory variables discussed above, we also include several control variables. First, we enter both year and calendar month fixed effects to control for any overall time trend and possible seasonal variation. Second, given the evidence in Figures 1 and 2 of a clear surge in RCE filings associated with a proposed rule to limit to RCEs expected during November 2007, we create an indicator variable set equal to 1 if the final rejection occurred during the six months prior to November 2007 and zero otherwise to control for associated applicant behavior. In the summer of 2007, the PTO published the so-called "Tafas rules" intended to help improve examination efficiency, enhance the quality of examination, and manage the growing backlog of unexamined applications by limiting continuation practice, but the rules never took effect.[26]

5 Results

5.1 Descriptive Results

Our sample consists of 1,073,152 final rejections issued to applicants paying large-entity fees and 344,090 final rejections issued to applicants paying small-entity fees between January 2005 and February 2012. The PTO allows applicants to self-declare whether they fit the definition of a "small entity" (i.e., fewer than 500 employees) in order to pay discounted fees.[27]

Figure 3 illustrates how the inflation-adjusted fees for RCEs, appeals, and continuations changed over time.[28] In inflation-adjusted terms, each of the fees has tended to fall over time until a correction at the end of our study period. In particular, the RCE and appeal fees have followed very similar paths, with the major difference being a fee increase for appeals in October 2008 (from $510 to $540). Because there was no corresponding fee increase for RCEs at that time, this

[26] While the patenting community widely expected them to take effect, the rules were not implemented. *Tafas v. Dudas* (E.D. Va. October 31, 2007) (District court grants injunction preventing PTO from implementing the rule).
[27] Consequences of misrepresenting can include losing the patent for committing a fraud on the Office.
[28] We include only the large-entity fees in figure 3. The small-entity fees are half tot large-entity fees.

one-time increase importantly allows us to identify an RCE-fee elasticity separately from an appeal-fee elasticity.

Figures 4 and 5 illustrate how the RCE filing behavior of "large" and "small" entities evolved over this time period.[29] The figures provide information on what percentage of final rejections resulted in RCE filings in the following four cohorts: within 90 days, from 91 to 120 days, from 121 to 150 days, and from 151 to 180 days. The first thing to note is that large entities are more likely to file RCEs for each of the years considered in our study. Consider the RCE filing behavior in 2011 as an example. As of the end of the third month after the final rejection, 19 percent of all large entities filed an RCE as compared to a little under 12 percent of the small entities. As of the end of the fourth month, 40 percent of the large entities compared with 25 percent of the small entities had filed an RCE. By the end of the sixth month, 53 percent of the large entities had filed an RCE whereas roughly 40 percent of the small entities had done so.

Another thing to note is that for both types of entities, the likelihood of filing an RCE within 6 months of receiving a final rejection increased by 35 percent between 2005 and 2011. For large entities, the likelihood was 40 percent in 2005 and 53 percent in 2011. For small entities, the likelihood increased to 40 percent in 2011 compared with 29 percent in 2005. The likelihood of filing an RCE within 3 months increased at an even higher rate, doubling from 9.5 percent in 2005 to 19 percent in 2011 for large entities. For small entities over the same time period, the likelihood of filing an RCE within 3 months grew by roughly 70 percent – from 7 percent to nearly 12 percent.

We also observe that RCE filing behavior appears to change as applicants move through the prosecution of their applications. Figure 6 illustrates how moving forward from one final rejection to the next final rejection affects large entity RCE behavior. Among these filers, 49 percent of all first final rejections between 2005 and February 2012 resulted in an RCE filing within 180 days. When applicants face a second final rejection the likelihood falls to 46 percent. Upon facing additional final rejections, the probability drops to 44 percent. The results are quantitatively similar when we examine the behavior of small entities (not shown). We are unable to determine whether this diminution is due to the resolving of uncertainty, loss of commercial opportunities, attrition, or some other effect.

5.2 Regression Results

Because they face different fee schedules, we estimate separate duration models for applicants paying large- and small-entity fees. We also estimate separate models based on previous RCE

[29] We leave out the estimates for 2006, 2008, 2010, and 2012 in order to generate a clearer chart. The results for these years follow the general pattern found in the existing chart.

activity. Overall, we include a pooled model of all final rejections as well as separate models for the following subpopulations of final rejections, based on the observed prior prosecution history:

- No previous RCEs
- Exactly one previous RCE
- Two or more previous RCEs

The purpose in estimating separate models is to test whether the coefficients change across entity types and across prosecution history. In particular, we are interested in discovering whether different applicant types are more or less price sensitive to RCE fees, and whether price sensitivity changes during different stages of the prosecution process. While the test could be accomplished by using interaction terms, our sample is large enough to accommodate separate regressions for which interpretation is more straightforward.

The duration model results for large and small entities are presented in Tables 1 and 2, respectively. Care should be taken when interpreting the coefficient estimates. In AFT models, negative coefficients indicate a shorter duration until "failure" (a failure in this case represents an RCE filing). Accordingly, negative coefficients indicate a greater probability of observing the filing an RCE, or at least an earlier filing. Positive coefficients indicate a longer lag to filing, or a lower probability of observing a filing by a certain point in time, such as by six months.

5.2.1 Fees

The results for the four large-entity models are presented in Table 1. In each model the coefficient on the RCE fee is positive, indicating that higher RCE fees are associated with a longer time lag to RCE filing for large entities (regardless of the number of RCEs that applicants have filed in the past). We also observe that the coefficients on the appeal fees are negative, meaning that higher appeal fees for are associated with a shorter time to filing (again regardless RCE filing history). These results support an (expected) inverse relationship between RCE fees and the use of RCEs, and provide evidence suggesting that applicants treat appeals and RCEs as substitutes.

The qualitative effect of traditional continuation fees differs by large-entity applicants' RCE filing history. For final rejections where fewer than two previous RCEs had been filed, our results show that the continuation fee has no real impact on the decision to file an RCE. For cases where two or more previous RCEs had been filed during prosecution, the coefficient on the continuation fee is positive, indicating that increasing the price charged for a traditional continuation increases the time an applicant takes to file an RCE. This finding suggests that, conditional on applications reaching the later rounds of prosecution, large entity applicants begin to view traditional continuations as *complements* to RCEs.

Our results for the four small-entity models are presented in Table 2. Findings associated with the various fees are qualitatively similar to those for the large entities, although we are unable to estimate the effects with enough precision to make confident statements regarding the sizes, or

even the signs, of the effects. Still, our results suggest the intuitive inverse relationship between the RCE fee and small-entity applicants' RCE filing behavior. They also support the notion that filing an appeal is a substitute for filing an RCE among small entities.

5.2.1.1 Large versus small entities

As stated previously, we estimate separate duration models for large- and small-entity fee payers. To help in comparing the relative sensitivities of the large and small entities to fee changes, for each type of entity we generate elasticities around the values of the fees paid by the large entities. The elasticities are calculated for each of the models.

The fee elasticities generated based on the results of the duration analyses are presented in Table 3. Note that the elasticities are defined as the percentage change an observer can expect in the probability that an RCE is filed within 180 days given a 1 percent change in the particular fee.

There are several interesting results in Table 3. First, the elasticities associated with the first RCE filing are similar for the large and small entities, and the demand for RCE filing is very inelastic with respect to all of the fees. In applications where at least one RCE has been previously filed, large entities appear to become more sensitive to fee changes than similarly-situated small entities. For example, the RCE fee elasticity for large entities with exactly one previous RCE is nearly -1.9 whereas the point estimate for the small entities is closer to -1.2. We see a similar result for the appeal fee elasticities, at 1.48 for large entities and 1.26 for small entities. The elasticities on fees related to small entities' behavior are estimated without much precision, so we cannot say with much statistical confidence that the elasticities - in cases where exactly one previous RCE has been filed - differ by size of entity, but the point estimates suggest that they may. The same can said for the elasticity estimates for cases with 2 or more previous RCE filings. The point estimates suggest that in such cases the large entities are more sensitive t the fees charged by PTO, but the lack of precision of the estimates for the small entities make it impossible to find a statistically significant difference.

Another noteworthy finding is that applicants' RCE filing behavior becomes more sensitive to fees (both RCE and appeals fees) as more RCEs are filed in the prosecution history. While we observe this effect across both large and small entities, the elasticity estimates for the small entities are less precise. Using our large-entity findings as an example, the own-price elasticity estimate for RCE filing is quite inelastic (elasticity = -0.16) following (i) final rejections where no previous RCEs were observed, but is much greater (-1.87) for (ii) those with exactly one previous RCE, and greater still (-2.34) for (iii) final rejections with two or more prior RCEs. Based on the precision of the elasticity estimate, we can reject the null hypothesis that the second of these own-price elasticities (ii) is equal to the first (i), but we cannot reject the hypothesis that the own-price elasticity for the one-previous RCE (ii) case is equal to the elasticity in the third case (iii) with two or more previous RCEs.

Again restricting ourselves to the results for large entities, we observe the cross price elasticity of appeal fees for applicant RCE filing is relatively small and inelastic (0.12) among (i) final rejections with no previous RCEs, but much more greatly inelastic (1.48) for (ii) final rejections with exactly one previous RCE, and greater still (2.07) for (iii) final rejections with two or more previous RCEs. As with our own-price elasticity findings, the elasticity measure of 1.48 (ii) is significantly different from the elasticity measure of 0.12 (i), but the difference between the latter two elasticities (ii and iii) is not significant (1.48 versus 2.07).

Finally, our results indicate that applicant RCE filing behavior is not sensitive to changes in fees charged for traditional continuations for early rounds of RCE filings, but shows a statistically significant effect for late-stage prosecutions in which we observe at least two previous RCEs. Taking large entities again as an example, the cross-price elasticity with respect to traditional continuation fees is very small and statistically insignificant for cases with no previous RCEs (i) and with one previous RCE (ii). But the elasticity becomes significant at the 5-percent level for those cases with 2 or more previous RCEs (iii) with a point estimate equal to -0.35, indicating a fairly inelastic response. More interesting however is the negative sign on the estimate, consistent with the notion that at the later rounds of examination, large-entity applicants begin to view traditional continuations as complements to RCEs rather than as substitutes. While the point estimates for the small entity models do not suggest the same type of pattern, the estimates are not as precise so we cannot be as confident – in a statistical sense – regarding these results.

5.2.1.2 Technology effects

Table 4 provides elasticity estimates among the large-entity fee payers applying in each of the technology centers.[30] In several of the TCs sample sizes were not large enough to support highly precise estimates. For instance, for all TCs with the exception of 3600 and 3700, we find only a handful of estimates significantly different from zero. Confidence intervals include the zero value despite many of the point estimates being of high magnitude. For instance, the model for cases with two or more previous RCEs (iii) in TC 1600 yields point estimates of the RCE- and appeal-fee elasticities that are well over 4.0 (in absolute magnitude), but neither is statistically significant.

However, in the instances when the model reports statistically significant elasticities estimates, the findings tend to make sense. All of the significant RCE fee (own-price) elasticities are negative, which we would expect. Also, all of the significant appeal fee (cross-price) elasticities are positive, in keeping with the notion that RCEs and appeals are demand substitutes. Even among the insignificant elasticity estimates only a few have the unexpected sign.

[30] All of the coefficient estimates for these models can be found in the appendix (forthcoming, Stu).

The general trends we found in the pooled models (Tables 1 and 2) also tend to be displayed in the TC-specific models shown in Table 3. In most cases, either the RCE fee or appeal fee elasticity (or both) increases in magnitude as prosecutions become more long-lived and result in more RCEs.[31] We also generally observe (for seven of the eight TC-specific models) that when applications show two or more previous RCEs (iii), point estimates of the continuation-fee elasticity are negative, a showing consistent with our pooled model. However, in only one of the models is the elasticity estimated with enough precision to be statistically significant.

5.2.2 Application characteristics

The TC processing the application appears to matter for cases with no previous RCEs. Here, we find that time to filing was shortest for cases from TCs 2400 (Communications) and 2100 (Computer networks, multiplex communication, video distribution, and security) but longest for TC 1600 (Biotechnology, which was the omitted category). For large entities, the TC effect is less pronounced for cases with at least one previous RCE. For small entities, the TC effect is more pronounced for cases with at least two previous RCEs.

The number of previous final rejections has a very large impact on lag time to RCE filing after controlling for other factors in the models. For example, in cases where applicants had filed no previous RCEs (column 2 of Table 1), those with no previous final rejections had the shortest time to filing, those with one previous final rejection had the next-shortest time to filing, and those with three or more final rejections had the longest time to filing. The results are similar in the models for cases with one previous RCE and two or more previous RCEs and are consistent across both large and small entities.

The changing number of initial claims in the application also appears to have an effect on time to filing. The results indicate that increases in the number of initial claims, which we associate with greater initial complexity, are associated with shorter times to filing an RCE. The result becomes less pronounced as one gets to later stages of prosecution (as we move from column 2 to column 3 to column 4 in Tables 1 and 2). This may not be surprising, since we are including the number of claims at filing, and it is possible that the number of claims at later stages of prosecution could be quite different, since the number may become winnowed down as the applicant interacts with the examiner. In other words, the number of claims at filing may not be a good measure for the number of claims at later stages of prosecution, thus weakening any relationship between the measure and time to filing in these cases. Again, this qualitative finding is generally consistent across large and small entities.

[31] The only exceptions are TCs 2600 and 3700.

In all models where we find a significant relationship between time to filing and examiner seniority, the results indicate that applicants may be more willing to file RCEs when the case is being handled by more junior examiners, all else equal. Among small entities' RCE filings, the results on examiner seniority are fairly robust across the four small-entity models: In each model, cases handled by examiners with lower seniority (below GS-14) show a shorter time to RCE filing than those cases handled by more senior (GS-14) examiners. For large-entity applicants in cases with no previous RCE filings, there appears to be no significant relationship between examiner seniority and time to filing. For cases with at least one previous RCE filing, the results are consistent with those of the small entity models.

Different types of priority claimed in the application also have varying impact on time to RCE filing across all of the models. For instance, in the model for cases with no previous RCEs, applications claiming priority to U.S. provisional applications and regular applications tend to be correlated with longer time to filing in general, relative to those not claiming an earlier priority. This result is consistent across both large and small entities.

When priority is claimed to PCT or foreign applications, however, the results are not consistent across entity size. When priority is of these types, large-entity applicants show a longer time to RCE filing than for applications claiming no priority whatsoever. Among small-entity applications claiming priority to a PCT or foreign application, RCE filing tends to take longer when the applicant previously filed two or more previous RCEs, but takes less time when the applicant has file no previous RCEs during the prosecution of the focal application.

Moreover, longer first-action pendency is associated with an increased time to filing for applications with no previous RCEs, and with decreased time to filing for cases with more than one previous RCE (both "one" and "two or more" show significant coefficients). This result is consistent across results for large and small entities. Noting that previous research shows that abandonment is positively correlated with higher first-action pendency (Mitra-Kahn, et al, 2013), the sensitivity we show to first-action pendency for applications with no previous RCE may be due in part to a higher abandonment rate for those applications. Conversely, once an applicant has chosen to pursue RCEs, longer first-action pendency is associated with faster filing. The number of previous RCEs also impacts time to filing.[32] More previous RCEs in an application are associated with a shorter time to the next RCE filing, all things equal.

[32] The number of previous RCEs is correlated with the number of previous final rejections. However, they are not identical.

5.2.3 Environmental variables

Across all kinds of applicants, we find that larger stocks of pending applications in the system (overall) tend to be associated with a longer time to RCE filing. In almost all models where coefficients on "stock" variables are significant, the coefficients are positive indicating a longer time to RCE filing. The only exception occurs among large entities prosecuting applications with no previous RCEs. Examining that case more closely, we observe that a larger number of pending applications in the system having at least one prior RCE (Stock 3b) is associated with faster RCE filing. Among small entities, the point estimates all indicate a similar relationship (faster RCE filing in the face of larger Stock 3b), but none of the estimates are significant. In terms of PTO labor, controlling for the sizes of the stocks and other factors, we observe that larger numbers of examiners (at the discipline level) tend to be associated with a shorter time to RCE filing. These results are quite consistent between large and small entities.

Somewhat surprisingly, as the number of pending appeals increases, we observe an increase in the lag time to RCE filing among applications with at least one previous RCE filed by large entities. Because the number of pending appeals is meant to control for the pendency before the appeal board, one would expect a greater stock to increase the attractiveness of RCEs relative to appeals. Thus, one would expect a negative coefficient (a higher hazard of RCEs and a shorter duration). Among the small entities, however, we find no such significant relationship between the number of pending appeals and the time to RCE filing.

In the models for both large and small entities, the point estimates indicate that higher levels of economic growth, as measured by the 12-month change in real GDP, may be associated with a longer time to file RCEs among applications with no previous RCEs (column 2 in Table XX) and a shorter time to file in cases with at least one previous RCE (columns 3 and 4). Among small entities, the effect is significant only in the model for cases with no previous RCEs. For the large entities, the effects are significant only in the models for cases with more than one RCE (for both "one" or "two or more"). As one might expect, we find that a higher allowance rate in the preceding 6-month period is associated with a shorter time to filing an RCE for large entities, consistent with the notion that applicants are responding to the greater perceived chance of allowance by filing RCEs to keep their applications in play. However we find no significant effect in the small-entity models.

5.2.4 Fixed Effects

The results for the year fixed effects (not shown) indicate that even controling for other factors, there is a strong positive time trend associated with RCE filing behavior. The results show that time to filing decreased in each year from 2005 through the 2009/2010 timeframe and then stayed fairly constant through the beginning of 2012. These results are consistent with the results illustrated in figures 4 and 5. Not surprisingly, the RCE "policy control" variable captures the spike in RCE filings for the time period prior to the proposed change in RCE filing rules described in section 4.3.4.

6 Conclusions

The results of this study indicate that the PTO could use its new fee setting authority to influence the RCE-filing behavior of patent applicants. Raising RCE filing fees would decrease the likelihood of RCE filings in general, with a greater impact on the probability of multiple RCE filings. Lowering the fees charged for appeals would have a similar effect on RCE-filing behavior.

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Tables and Figures

Table 1: Results of Examiner-Level Frailty Models for Time-to-RCE-Filing, Large Entities

Variable	All Cases		No Previous RCEs		1 Previous RCE		2 or More Previous RCEs	
PTO Fees								
Log RCE Fee	0.697	**	0.277	**	1.778	**	2.185	**
Log Appeal Fee	-0.700	**	-0.216		-1.721	**	-2.567	**
Log Continuation Fees	0.007		-0.046		-0.081		0.353	**
Application Characteristics								
Tech Center (omitted category: 1600)								
1700	-0.303	**	-0.304	**	-0.154	**	-0.148	**
2100	-0.473	**	-0.487	**	-0.165	**	-0.185	*
2400	-0.481	**	-0.500	**	-0.152	**	-0.175	*
2600	-0.430	**	-0.436	**	-0.123	**	-0.179	*
2800	-0.379	**	-0.387	**	-0.102	*	-0.168	*
3600	-0.399	**	-0.398	**	-0.207	**	-0.195	**
3700	-0.398	**	-0.392	**	-0.202	**	-0.182	**
Number of Previous Final Rejections (omitted category: Three or More)								
None	-0.287	**	-0.391	**				
One	-0.181	**	-0.230	**	-0.208	**		
Two	-0.092	**	-0.121	**	-0.063	**	-0.064	**
Log Claims	-0.005	**	-0.005	**	-0.004		0.000	
Seniority of Examiner (omitted category: GS-14)								
GS-5 or GS-7	0.005		-0.006		-0.050	**	-0.071	**
GS-9	0.008	**	0.000		-0.049	**	-0.060	**
GS-11	0.002		-0.002		-0.041	**	-0.080	**
GS-12	0.003		0.000		-0.025	**	-0.046	**
GS-13	-0.003		-0.007	**	-0.016	**	-0.027	**
GS-15	0.007		0.014		0.022		0.107	**
Claimed Priority Status (omitted category: None)								
U.S. Provisional	0.026	**	0.031	**	0.008		-0.005	
U.S. Application	0.037	**	0.049	**	-0.003		-0.010	
PCT/Foreign	0.056	**	0.055	**	0.013	**	0.014	**
Log First-action pendency	0.003	*	0.006	**	-0.006	*	-0.017	**
Number of Previous RCEs	-0.072	**					-0.040	**
Environmental Variables								
Log Stock 1	0.035	**	0.024		0.049		0.015	
Log Stock 2	0.062	**	0.027		0.143	**	0.012	
Log Stock 3a	0.045	*	0.035		-0.067		0.120	
Log Stock 3b	-0.028		-0.045	*	-0.076		0.160	*

Log Junior Examniers	-0.070	**	-0.028	*	-0.136	**	-0.194	**
Log Senior Examiners	-0.029	**	-0.019		-0.085	**	-0.118	**
Log Pending Appeals	0.013		-0.005		0.041	*	0.120	**
Change in Log Real GDP	-0.179	*	0.151		-1.167	**	-1.154	**
Allowance Rate	-0.027	*	-0.051	**	-0.075	**	-0.059	
Other Control Variables								
RCE Policy Control	-0.092	**	-0.029	**	-0.220	**	-0.299	**
Year Fixed Effects	Yes		Yes		Yes		Yes	
Month Fixed Effects	Yes		Yes		Yes		Yes	

** Indicates coefficient is significant at the 0.01 level.

* Indicates coefficient is significant at the 0.05 level.

Note: A negative coefficient indicates the variable is correlated with a shorter duration to RCE filing, and a higher hazard rate of RCE filing.
A positive coefficient indicates the variable is correlated with a longer duration to RCE filing, and a lower hazard rate of RCE filing.

Table 2: Results of Examiner-Level Frailty Models for Time-to-RCE-Filing, Small Entities

Variable	All Cases		No Previous RCEs		1 Previous RCE		2 or More Previous RCEs	
PTO Fees								
Log RCE Fee	0.145		-0.005		0.845		0.838	
Log Appeal Fee	-0.100		0.080		-0.954		-0.966	
Log Continuation Fees	-0.087		-0.095		0.075		-0.115	
Application Characteristics								
Tech Center (omitted category: 1600)								
1700	-0.113	**	-0.112	**	-0.071	**	-0.053	**
2100	-0.267	**	-0.255	**	-0.233	**	-0.417	**
2400	-0.267	**	-0.252	**	-0.239	**	-0.431	**
2600	-0.225	**	-0.215	**	-0.193	*	-0.371	*
2800	-0.235	**	-0.217	**	-0.232	**	-0.456	**
3600	-0.151	**	-0.132	**	-0.152	**	-0.200	**
3700	-0.158	**	-0.144	**	-0.161	**	-0.207	**
Number of Previous Final Rejections (omitted category: Three or More)								
None	-0.301	**	-0.449	**				
One	-0.188	**	-0.296	**	-0.168	**		
Two	-0.099	**	-0.177	**	-0.047	*	-0.067	**
Log Claims	-0.020	**	-0.023	**	-0.013	**	-0.009	
Seniority of Examiner (omitted category: GS-14)								
GS-5 or GS-7	-0.073	**	-0.071	**	-0.064	**	-0.047	
GS-9	-0.059	**	-0.056	**	-0.057	**	-0.089	**
GS-11	-0.054	**	-0.047	**	-0.062	**	-0.116	**
GS-12	-0.034	**	-0.031	**	-0.026	**	-0.064	**
GS-13	-0.029	**	-0.028	**	-0.024	**	-0.033	**
GS-15	0.006		-0.007		0.041		0.052	
Claimed Priority Status (omitted category: None)								
U.S. Provisional	0.010		0.011	**	0.003		0.010	
U.S. Application	0.016		0.025	**	-0.013		-0.014	
PCT/Foreign	-0.013		-0.015	**	-0.012		0.031	*
Log First-action pendency	0.005		0.008	**	-0.008		-0.014	
Number of Previous RCEs	-0.082						-0.058	**
Environmental Variables								
Log Stock 1	0.045	*	0.040		0.074		0.091	
Log Stock 2	0.086	**	0.068	**	0.187	*	0.197	
Log Stock 3a	0.056		0.025		0.170		0.264	
Log Stock 3b	-0.041		-0.014		-0.136		-0.104	
Log Junior Examniers	-0.021		-0.011		-0.094		-0.108	
Log Senior Examiners	-0.041	*	-0.024		-0.093	*	-0.024	
Log Pending Appeals	-0.005		-0.004		0.004		0.000	

Change in Log Real GDP	0.322	*	0.507	**	-0.133		-0.677	
Allowance Rate	0.014		0.009		-0.021		0.068	
Other Control Variables								
RCE Policy Control	-0.061	**	-0.028	**	-0.197	**	-0.191	**
Year Fixed Effects	Yes		Yes		Yes		Yes	
Month Fixed Effects	Yes		Yes		Yes		Yes	

** Indicates coefficient is significant at the 0.01 level.

* Indicates coefficient is significant at the 0.05 level.

Note: A negative coefficient indicates the variable is correlated with a shorter duration to RCE filing, and a higher hazard rate of RCE filing.
A positive coefficient indicates the variable is correlated with a longer duration to RCE filing, and a lower hazard rate of RCE filing.

Table 3: Elasticity Estimates for the PTO Fees

Variable	All Cases	No Previous RCEs	1 Previous RCE	2 or More Previous RCEs
Large Entities				
RCE Fee	**-0.36**	**-0.16**	**-1.87**	**-2.34**
	(-0.45, -0.27)	(-0.27, -0.04)	(-2.30, -1.37)	(-3.08, -1.48)
Appeal Fee	**0.31**	0.12	**1.48**	**2.07**
	(0.24, 0.39)	(0.01, 0.22)	(1.05, 1.77)	(1.40, 2.24)
Continuation Fee	-0.003	0.03	0.08	**-0.35**
	(-0.04, 0.02)	(-0.01, 0.05)	(-0.18, 0.17)	(-0.70, -0.16)
Small Entities				
RCE Fee	-0.20	0.01	-1.17	-1.11
	(-0.68. 0.32)	(-0.60, 0.51)	(-2.32, 0.13)	(-3.47, 0.39)
Appeal Fee	0.14	-0.11	1.26	1.22
	(-0.44, 0.62)	(-0.67, 0.51)	(-0.04, 2.57)	(-0.30, 3.41)
Continuation Fee	0.12	0.13	-0.10	0.15
	(-0.05, 0.29)	(-0.08, 0.30)	(-0.59, 0.37)	(-0.83, 0.61)

Note: bootstrapped 95-percent confidence intervals in parentheses (percentile method)

Table 4: Elasticity Estimates for the PTO Fees by Technology Center, Large Entities

Variable	All Cases	No Previous RCEs	1 Previous RCE	2 or More Previous RCEs
TC 1600				
RCE Fee	-0.14	0.93	-2.69	-4.26
	(-1.45, 0.95)	(-0.65, 2.23)	(-4.96, 0.34)	(-7.62, 0.91)
Appeal Fee	0.015	-0.95	2.21	4.84
	(-1.33, 1.42)	(-2.38, 0.67)	(-0.96, 4.60)	(-0.84, 7.54)
Continuation Fee	0.44	0.27	**1.28**	-0.65
	(-0.08, 0.98)	(-0.22, 0.69)	(0.22, 2.36)	(-3.02, 0.94)
TC 1700				
RCE Fee	0.042	0.39	-0.70	**-3.50**
	(-0.51, 0.61)	(-0.25, 0.88)	(-2.62, 0.57)	(-5.92, -0.52)
Appeal Fee	-0.14	-0.45	.41	**2.93**
	(-0.80, 0.41)	(-1.14, 0.32)	(-1.34, 2.02)	(0.60, 4.02)
Continuation Fee	**0.24**	0.13	.035	0.56
	(0.06, 0.40)	(-0.06, 0.33)	(-0.29, 0.95)	(-0.55, 1.20)
TC 2100				
RCE Fee	-0.11	-0.06	-0.53	-0.35
	(-0.30, 0.08)	(-0.31, 0.14)	(-1.87, 0.40)	(-2.22, 0.92)
Appeal Fee	**0.16**	0.01	**0.92**	1.00
	(0.02, 0.34)	(-0.21, 0.21)	(0.02, 1.63)	(-0.52, 1.80)
Continuation Fee	-0.04	0.03	-0.23	-0.11
	(-0.09, 0.02)	(-0.05, 0.08)	(-0.68, 0.09)	(-0.77, 0.37)

Note: bootstrapped 95-percent confidence intervals in parentheses (percentile method)

Table 4: Elasticity Estimates for the PTO Fees by Technology Center, Large Entities (Continued)

Variable	All Cases	No Previous RCEs	1 Previous RCE	2 or More Previous RCEs
TC 2400				
RCE Fee	-0.15	0.04	**-1.58**	-2.07
	(-0.35, 0.04)	(-0.20, 0.23)	(-3.08, -0.24)	(-4.24, 0.05)
Appeal Fee	0.16	-0.07	**1.35**	**1.66**
	(-0.01, 0.33)	(-0.33, 0.19)	(0.34, 1.82)	(0.001, 1.91)
Continuation Fee	-0.04	-0.01	0.005	-0.43
	(-0.10, 0.02)	(-0.09, 0.06)	(-0.52, 0.25)	(-1.02, 0.20)
TC 2600				
RCE Fee	**-0.26**	**-0.24**	-0.63	-0.17
	(-0.47, -0.09)	(-0.47, -0.03)	(-1.72, 0.26)	(-1.75, 0.75)
Appeal Fee	**0.24**	**0.19**	0.57	0.31
	(0.09, 0.39)	(0.02, 0.37)	(-0.30, 1.38)	(-1.02, 1.27)
Continuation Fee	-0.06	-0.03	0.05	-0.27
	(-0.11, 0.002)	(-0.10, 0.03)	(-0.43, 0.25)	(-0.81, 0.23)
TC 2800				
RCE Fee	-0.10	0.01	-1.04	-2.26
	(-0.32, 0.06)	(-0.18, 0.18)	(-2.34, 0.26)	(-4.42, 0.54)
Appeal Fee	0.13	0.02	0.88	1.80
	(-0.03, 0.30)	(-0.17, 0.19)	(-0.04, 1.63)	(-0.16, 2.16)
Continuation Fee	**-0.05**	-0.03	-0.01	-0.54
	(-0.11, -0.01)	(-0.08, 0.02)	(-0.49, 0.27)	(-1.39, 0.01)

Note: bootstrapped 95-percent confidence intervals in parentheses (percentile method)

Table 4: Elasticity Estimates for the PTO Fees by Technology Center, Large Entities (continued)

Variable	All Cases	No Previous RCEs	1 Previous RCE	2 or More Previous RCEs
TC 3600				
RCE Fee	**-0.28**	-0.15	**-2.27**	-1.65
	(-0.57, -0.02)	(-0.51, 0.34)	(-4.45, -0.44)	(-5.22, 1.11)
Appeal Fee	**0.29**	0.13	**2.02**	2.39
	(0.04, 0.51)	(-0.43, 0.51)	(0.40, 3.02)	(-0.01, 3.49)
Continuation Fee	0.02	0.07	0.61	**-1.34**
	(-0.08, 0.08)	(-0.11, 0.15)	(-0.14, 0.99)	(-2.59, -0.41)
TC 3700				
RCE Fee	**-0.57**	**-0.83**	**-2.38**	-0.93
	(-0.94, -0.24)	(-1.42, -0.18)	(-4.05, -0.64)	(-4.20, 1.36)
Appeal Fee	**0.45**	**0.60**	**2.23**	1.90
	(0.17, 0.66)	(0.03, 0.98)	(0.58, 2.95)	(-0.90, 3.38)
Continuation Fee	0.06	0.15	-0.01	-0.31
	(-0.03, 0.17)	(-0.03, 0.29)	(-0.76, 0.59)	(-1.49, 0.62)

Note: bootstrapped 95-percent confidence intervals in parentheses (percentile method)

Figure 1

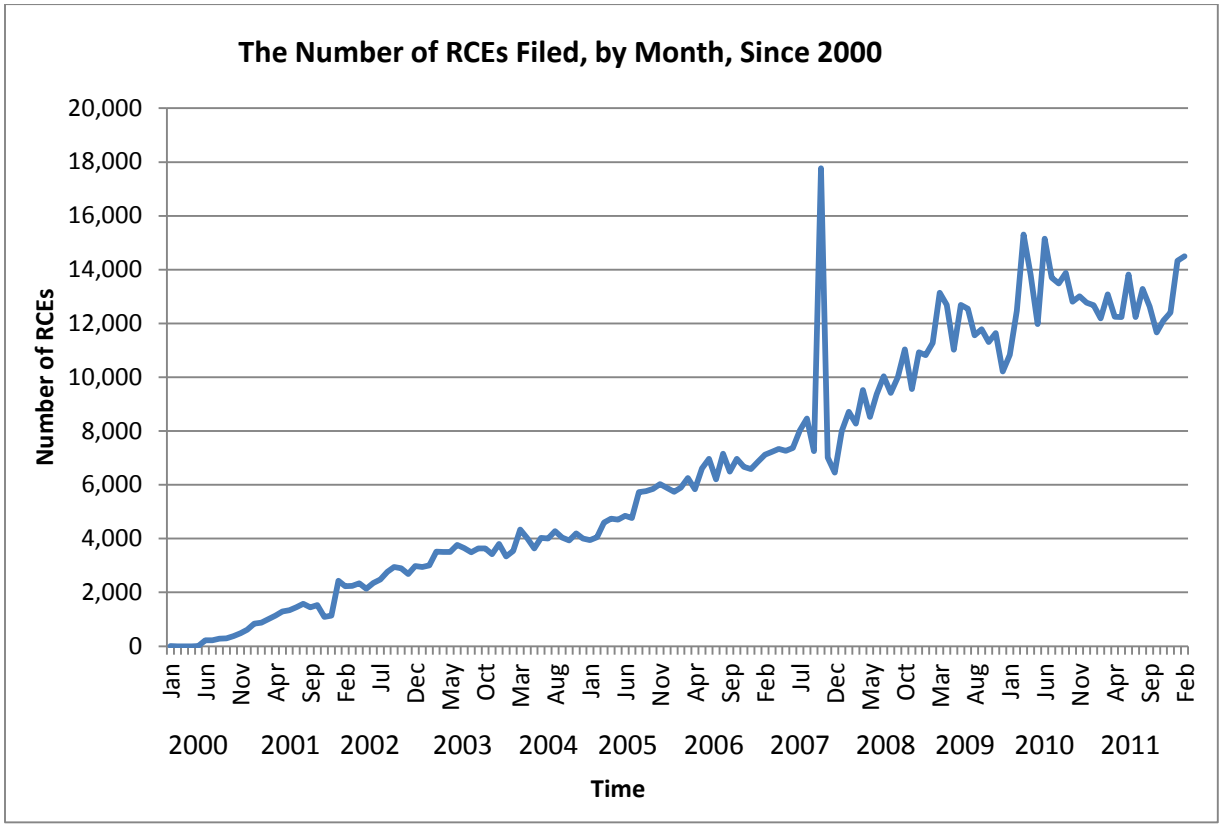

The Number of RCEs Filed, by Month, Since 2000
Number of RCEs
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Jan Jun Nov Apr Sep Feb Jul Dec May Oct Mar Aug Jan Jun Nov Apr Sep Feb Jul Dec May Oct Mar Aug Jan Jun Nov Apr Sep Feb
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
Time

Figure 2

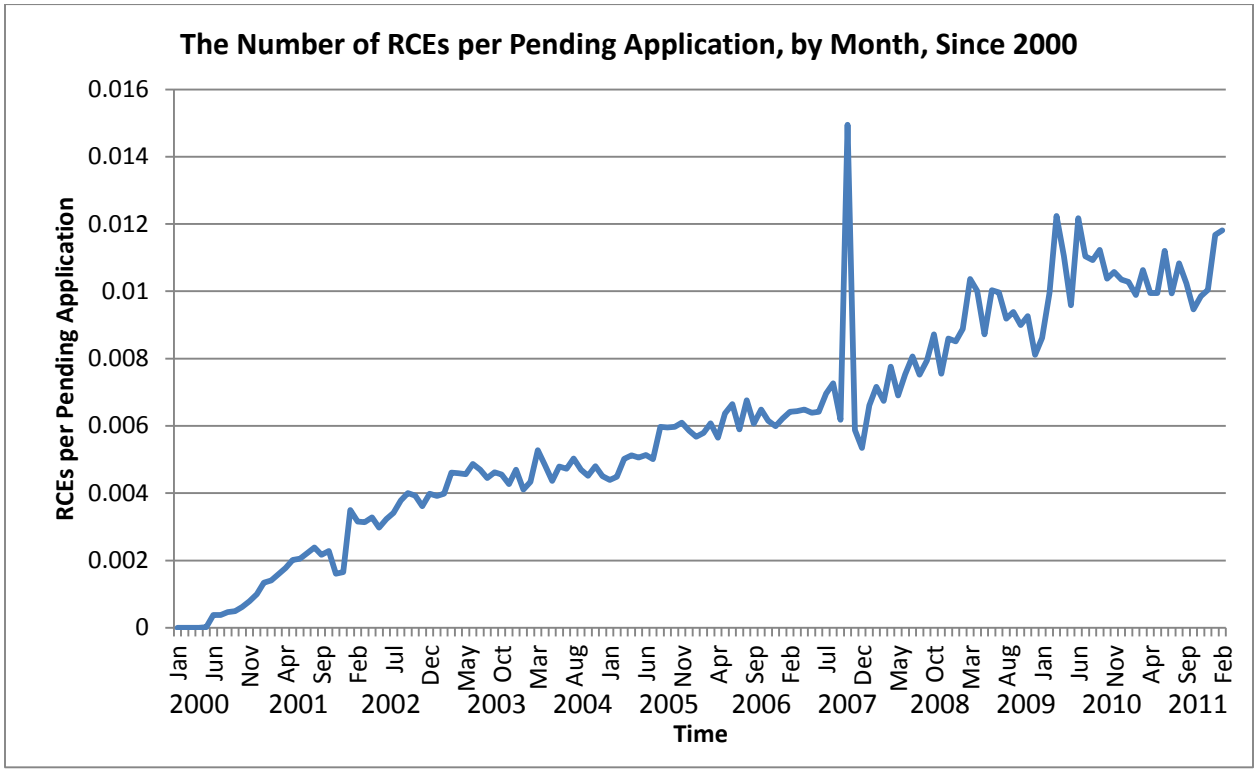

The Number of RCEs per Pending Application, by Month, Since 2000
RCEs per Pending Application
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Jan Jun Nov Apr Sep Feb Jul Dec May Oct Mar Aug Jan Jun Nov Apr Sep Feb Jul Dec May Oct Mar Aug Jan Jun Nov Apr Sep Feb
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011
Time

Figure 3

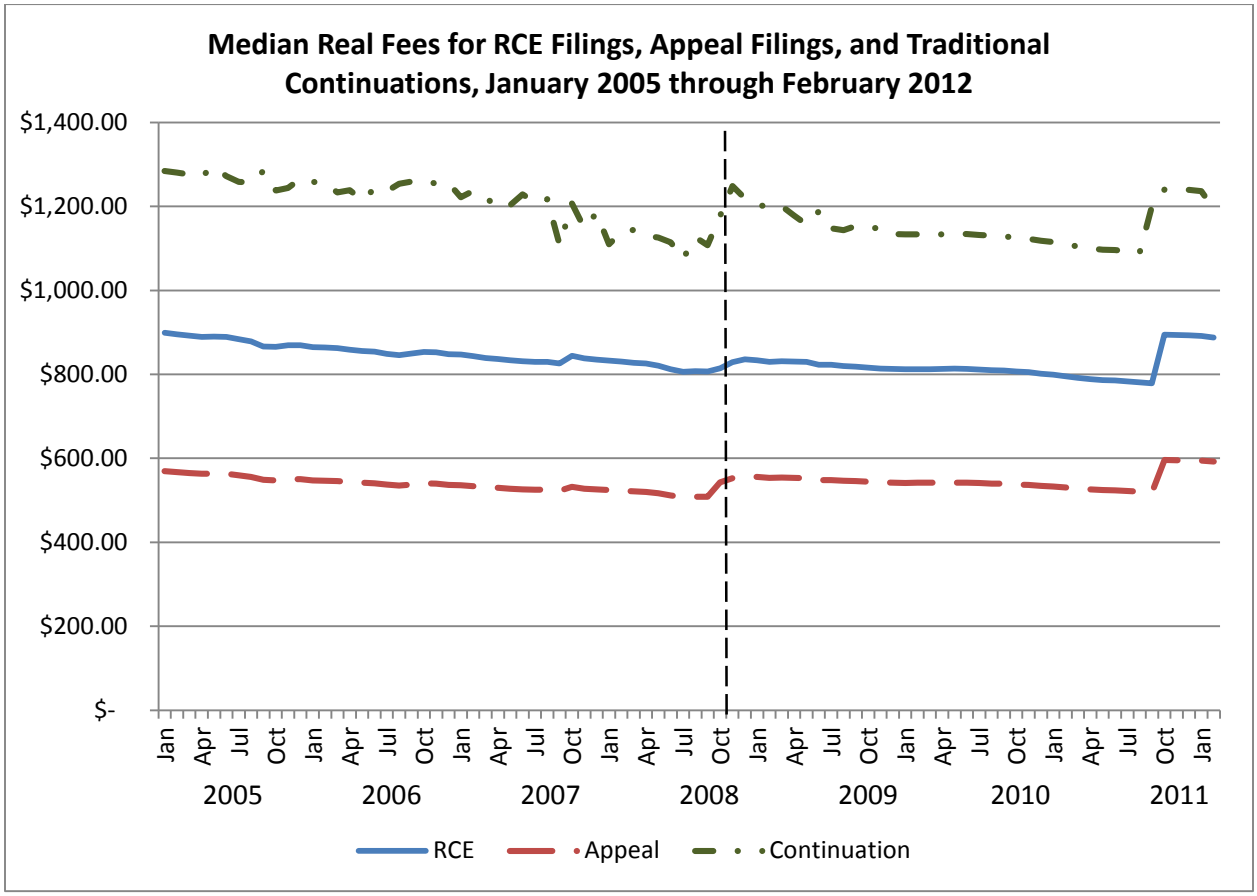

Median Real Fees for RCE Filings, Appeal Filings, and Traditional Continuations, January 2005 through February 2012
$1,400.00
$1,200.00
$1,000.00
$800.00
$600.00
$400.00
$200.00
$-
Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan Apr Jul Oct Jan
2005 2006 2007 2008 2009 2010 2011
RCE
Appeal
Continuation

Figure 4

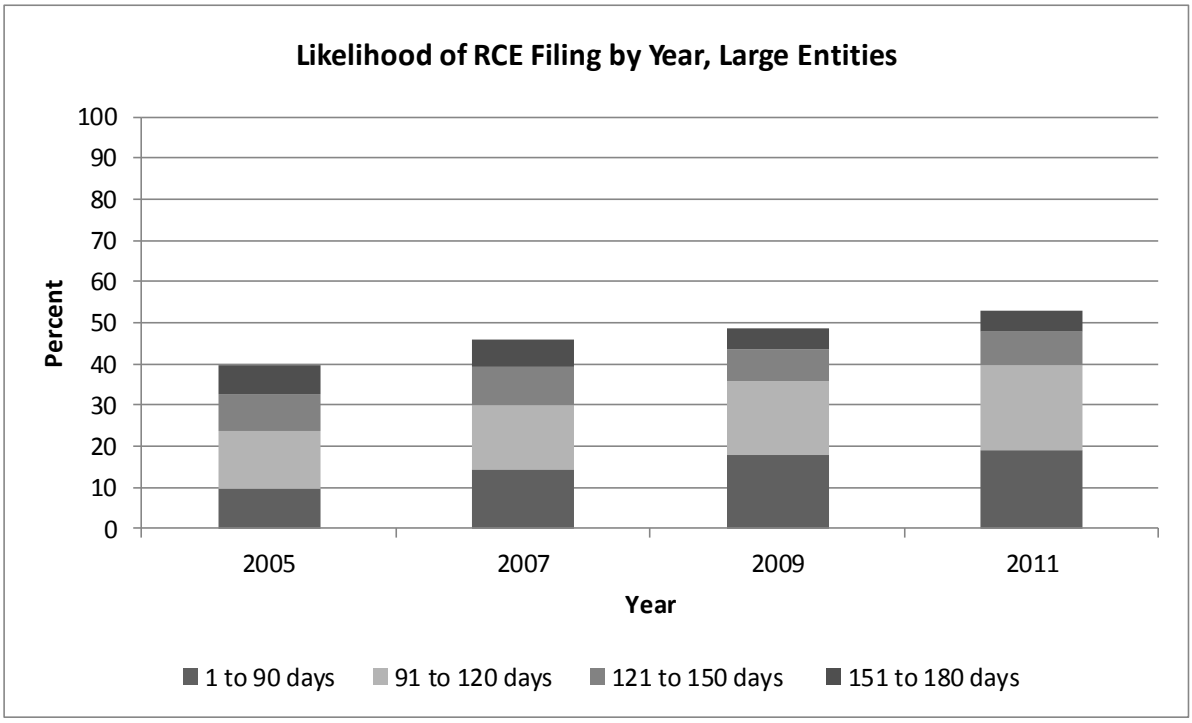

Likelihood of RCE Filing by Year, Large Entities
100
90
80
70
60
50
40
30
20
10
0
Percent
2005
2007
2009
2011
Year
1 to 90 days
91 to 120 days
121 to 150 days
151 to 180 days

Figure 5

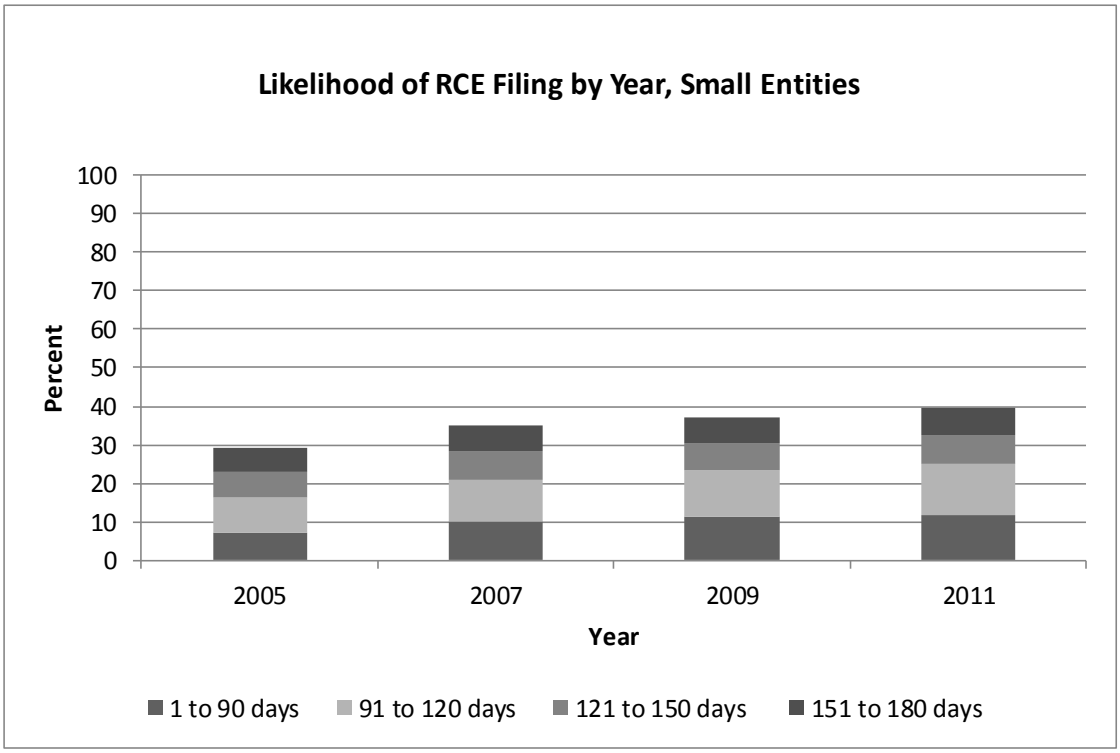
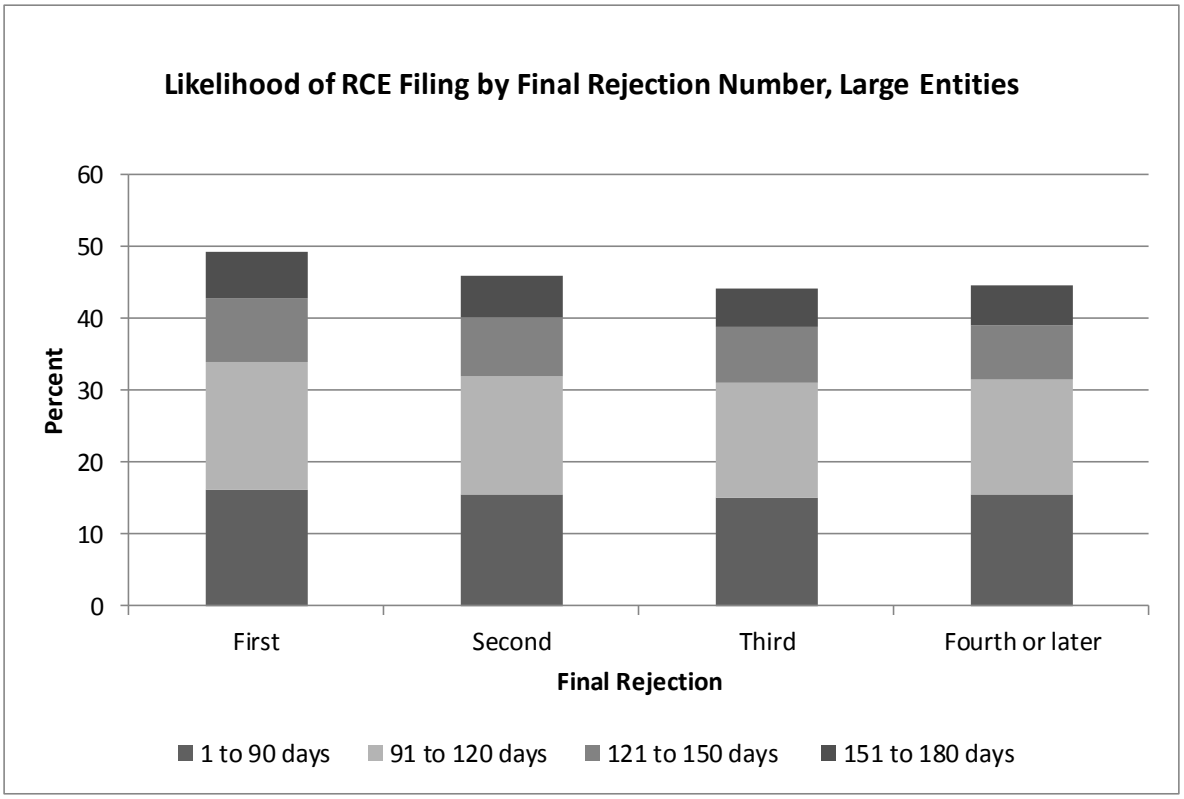

Likelihood of RCE Filing by Year, Small Entities
Percent
100
90
80
70
60
50
40
30
20
10
0
2005
2007
2009
2011
Year
1 to 90 days
91 to 120 days
121 to 150 days
151 to 180 days

Figure 6


Likelihood of RCE Filing by Final Rejection Number, Large Entities
60
50
40
30
20
10
0
Percent
First
Second
Third
Fourth or later
Final Rejection
1 to 90 days
91 to 120 days
121 to 150 days
151 to 180 days