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ESTIMATING A PCT FEE ELASTICITY

Document prepared by the International Bureau

SUMMARY

1. The present document sets out the study requested by the Working Group on how responsive PCT filings are to changes in the international filing fee. Using a discrete choice model of an applicant's decision whether to file through the PCT or through the Paris route, it estimates a highly inelastic – but statistically significant – fee responsiveness. Moreover, the estimation results suggest that the international filing fee matters most when applicants seek patent protection in exactly three foreign Offices, and that universities and public research organizations (PROs) are somewhat more price sensitive.

2. In addition to providing evidence on the fee responsiveness, the estimations also shed empirical light on a number of other determinants of PCT use. In particular, they indicate that applicants tend to rely to a greater extent on the PCT in good economic times, that PROs and especially universities are more likely to choose the PCT, and that – all else equal – pharmaceuticals and other discrete product technologies are more inclined to rely on the PCT than complex product technologies.

INTRODUCTION

3. At the sixth session of the Patent Cooperation Treaty (PCT) Working Group, Member States asked the Economics and Statistics Division to conduct a study to estimate fee elasticities for the PCT system, especially as they pertain to universities and research institutes and, possibly also, small- and medium-sized enterprises (SMEs).[1]

4. In economics, an elasticity measures how sensitive one variable is to a change in another variable. In the specific context of the patent system, a fee elasticity measures how responsive applicants are to changes in the application fee. In particular, it predicts by what percentage filing volumes would increase, if the application fee were lowered by a certain magnitude.

5. Among other things, an estimate of the fee elasticity can inform decision-makers on how changes to application fees affect future filing levels as well as the revenue generated by those filings. A low value of the fee elasticity means that a fee change will have little impact on filings; the fee responsiveness is then said to be "inelastic". A high value of the elasticity means that a fee change has a strong effect on filings; the fee responsiveness is then considered to be "elastic". In the former case, an increase (decrease) in the fee will lead to higher (lower) revenues. In the latter case, an increase (decrease) in the fee will have an ambiguous effect on revenues, as the fall (rise) in the filing volume could outweigh the revenue effect of higher (lower) per-unit fee payments.

6. No estimate of the PCT fee elasticity is currently available. Some estimates exist for initial application fee elasticities and maintenance fee elasticities for national and regional patent offices.[2] However, there are good reasons to believe that the PCT fee elasticity should be different. PCT filings are a selected set of patent applications for which applicants seek protection in more than one jurisdiction. Thus, the importance of PCT fees in the overall cost of international patenting will differ from that of national fees in a national or regional patenting context.

ESTIMATION STRATEGY

7. In order to empirically estimate the fee elasticity for PCT filings, one needs to rely on historical variation in the international filing fee faced by applicants. Such variation is, at first, not obvious. In 2004, Member States established an initial filing fee of CHF 1,400 and this fee has only been revised once, in 2008, when it was lowered to CHF 1,330.[3] In addition, applicants pay a transmittal fee, which depends on where they file their PCT application, but the variation introduced by this additional fee element is relatively minor.[4,5]

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1 See Summary by the Chair (PCT/WG/6/23).

2 For a review of the literature, see de Rassenfosse, G. and B. van Pottelsberghe. (2012). "The role of fees in patent systems: Theory and evidence." *Journal of Economic Surveys*, 2(5), p. 806.

3 Before 2004, the international filing fee depended on the number of countries designated in the PCT application. Starting in 2004, all applications designate all PCT member states and a uniform international filing fee applies. Given this structural break, this study only employs data from 2004 onwards.

4 Unfortunately, historical data on the transmittal fee are not easily available. This study thus ignores the transmittal fee. However, since the receiving Offices set this fee in the local currency, exchange rate variations do not introduce fee changes over time; the origin fixed effects included in the probit regression should therefore control for their effect.

5 Applicants can benefit from a discount between CHF 100 and 300 when they file their PCT application electronically. This study ignores this fee discount, because the sample underlying the econometric investigation includes patent applications for which applicants do not file PCT applications and one does not observe whether those applicants would have filed electronically.

8. More substantial variation stems from the conversion of the Swiss franc international filing fee into the currencies in which applicants from around the world pay the filing fee. To understand the source of this variation, it is first important to understand how the conversion process functions. PCT rules distinguish between freely convertible currencies and other currencies.[6] For freely convertible currencies, WIPO fixes equivalent amounts with effect from January 1 every year that reflect the market exchange rates *vis-à-vis* the Swiss franc prevailing on the first Monday of October of the previous year. In addition, if in the course of the year, a currency's exchange rate *vis-à-vis* the Swiss franc is, for more than four consecutive Fridays, five percent lower or higher than the previous exchange rate applied, WIPO establishes a new equivalent amount for that currency, which becomes effective after about two months.

9. National and regional patent offices who receive PCT filings ("receiving Offices") – determine the currency in which they accept payment for those filings. Receiving Offices in jurisdictions with a freely convertible currency typically require payment in their home currency. Receiving Offices in other jurisdictions follow one of two approaches: they can either require payment in one of the freely convertible currencies – in practice, the euro, the Swiss franc, or the US dollar; or they can require payment in the local currency in an amount which, on the date of filing, is equivalent to the Swiss franc fee. In either case, applicants in those latter offices face a fee payment that, in local currency terms, depends on the exchange rate *vis-à-vis* the Swiss franc or another freely convertible currency. Thus, depending on the exchange rate regime in place, the application fee in local currency terms may vary on a daily basis.

10. The variation in the local currency value of the PCT filing fee – whether established through equivalent amounts or market exchange rates – can be substantial. Figure 1 depicts the evolution of the international filing fee for selected currencies since 2004. In particular, it shows how the sharp appreciation of the Swiss Franc *vis-à-vis* most currencies in the course and aftermath of the financial crisis prompted sizeable increases in the filing fee, especially for the US dollar, the British pound, and the Korean won.

11. Having established the variation in the filing fee, the next question is which econometric model to adopt. One approach adopted in the economic literature is to directly investigate whether fee variations can explain variations in the volume of applications received. One drawback of this approach is that one does not observe decisions not to file and therefore lacks a counterfactual against which to compare filing decisions.[7] However, given that PCT applications, in the overwhelming number of cases, are based on a prior national application, one can make use of such a counterfactual. In particular, one can estimate the probability of a priority application being converted into a PCT application in a discrete choice framework, whereby the international filing fee faced by applicants is one of the explanatory variables. In other words, the discrete choice framework focuses on the choice international patent applicants face between the so-called Paris route and the PCT route. It ignores the possibility that the PCT international filing fee affects applicants' decision on whether to seek patent protection beyond the office of priority filing – a matter that we hope to investigate in future work.[8]

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[6] Freely convertible currencies include the Australian dollar, the Canadian dollar, the Danish krone, the euro, the Icelandic krona, the Japanese yen, the New Zealand dollar, the Norwegian krone, the South African Rand, the Swedish krona, the Swiss franc, the UK pound, and the US dollar.

[7] In addition, PCT filing volumes are unlikely to be stationary over time, raising difficult econometric questions.

[8] This approach also ignores the possibility that the PCT filing fee affects applicants' decisions on whether to file a priority application in the first place. However, given that PCT filings are optional and the PCT international filing fee is typically small in relation to the overall costs of patenting, this approach seems defensible.

12. In particular, adopting patent families as the unit of analysis, we assume that the choice of PCT versus Paris route is determined as follows:

$$pct_{ijt} = \begin{cases} 0 \text{ if } pct^{*}_{ijt} \leq 0 \\ 1 \text{ if } pct^{*}_{ijt} > 0 \end{cases} ,$$

whereby pct_{ijt} is equal to 1, if patent family *i* of origin *j* includes a PCT application filed during calendar month *t*, and 0 if the patent family opted for a Paris-route filing, whereby *t* then corresponds to the month of the first Paris-route filing. The variable pct^{*}_{ijt} is unobservable and is itself determined through:

$$pct^{*}_{ijt} = \alpha \ln f_{jt} + \beta \ln unemp_{jt} + \gamma\, mem_{jt} + \delta\, \Omega_i + \mu_j + \theta_t + \varphi\, mkt_{j(t-12)} + \varepsilon_{ijt} ,$$

whereby f_{jt} captures the local currency filing fee faced by the family's patent applicant, which varies by origin and month; $unemp_{jt}$ captures the state of the economy at origin *j* and month *t*, as captured by the unemployment rate; mem_{jt} is a dummy variable that is 1 if residents of origin *j* were eligible to file under the PCT in calendar month *t*, and zero otherwise; Ω_i is a set of family-specific controls, which includes the size of the family, dummy variables for technology fields, and dummy variables for different applicant types; μ_j and θ_t are origin and calendar month fixed effects, respectively; $mkt_{j(t-12)}$ is the 12-month lag of the moving average of the PCT market share for origin *j*; ε_{ijt} is an i.i.d. error term; and α, β, γ, δ, and ϕ are (vectors of) coefficients to be estimated.[9]

13. Three explanatory comments are in order. First, it seems important to control for the business cycle in the estimation, but at the outset it is not clear whether the state of the economy affects an applicant's decision on whether to choose the PCT route positively or negatively. On the one hand, an underperforming economy may lead companies to shun the PCT and opt for a smaller-family Paris route strategy. On the other hand, it could also lead applicants to prefer the PCT route as a way to postpone national and regional filing expenses.

14. Second, we include the PCT membership dummy, as patent families from origins that are not members of the system may well use it. In particular, we derive a patent family's origin by the origin of the first-named applicant. However, a patent family may have co-applicants of different origin and, in order to qualify under the PCT, it is sufficient for one applicant origin to be a member of the system.

15. Third, we include the $mkt_{j(t-12)}$ variable as a control for autonomous changes in the propensity to use the PCT system over time. In particular, most origins have seen an increase in the PCT market share due to shifting company strategies, increased awareness, greater attractiveness of the system due its growing membership, and possibly other factors. To the extent that these influences are origin-specific, the inclusion of calendar month fixed effects does not fully control for them. We lag the PCT market share variable by 12-month, as the fee level and unemployment rate may influence the concurrent market share.

DATA

16. We derive our patent family data from the European Patent Office's *PATSTAT* database. In particular, we focus on all families that have equivalents at two offices or more, or one equivalent plus a PCT filing. In other words, we ignore "domestic only" families as well as "PCT only" families, as applicants in these cases do not face the PCT versus Paris choice underlying the discrete choice model. We extract all patent families that meet this definition and that have

[9] A dummy variable – also known as an indicator variable – is one that indicates the absence or presence of some categorical effect that may be expected to shift the outcome.

a first filing date of January 1, 2003 or later. We also extract information on the size of the patent family as well as the technology field(s) covered by the application.[10] Finally, we employ a keyword-based search algorithm to identify applications for which the first-named applicant is a university or public research organization (PRO).[11] Unfortunately, it is not possible to identify applicants representing SMEs through similar techniques and patent documents generally do not contain any further information through which one could determine the size of company applicants.

17. We rely on the PCT's historical fee schedule to derive monthly local currency fees by origin, from 2004 to 2012. The fee schedule provides information on the amount of the international filing fee in Swiss francs well as the equivalent amounts for freely convertible currencies. These fees can be directly applied to jurisdictions with a freely convertible currency. For other jurisdictions, we use information on the fee policy of receiving Offices available in the PCT Applicant's Guide as well as monthly market exchange rates from the International Monetary Fund's *International Financial Statistics* to calculate local currency equivalent fees.[12]

18. This approach implicitly assumes that applicants of any given origin file at their home receiving Office. In practice, this assumption does not always hold, for two reasons. First, applicants of certain European origins have the choice between filing a PCT application at their national office or at the European Patent Office. To the extent that the applicant resides in a Eurozone member country, this is not a problem – the same euro fee applies. However, applicants residing outside the Eurozone – for example, in Switzerland or the UK – would either pay in their local currency at the home office or in euros at the EPO. For these cases, we use the local currency fee at the home office, noting that the regular adjustment of equivalent amounts preempts large differences between the local currency fee and the local currency equivalent of the euro fee.

19. Second, as already pointed out, we derive a patent family's origin by the origin of the first-named applicant. However, if the family has a co-applicant of different origin, the application may well be filed at an office other than the home office of the first-named applicant. Indeed, this will always be the case when the first-named applicant is neither a national nor a resident of a PCT member country. For such cases, we use – for the same reasons – the local currency fee at the home office or, for non-PCT member countries, the local currency equivalent of the Swiss franc fee. In any case, the number of applications with more than one applicant is relatively small.

20. We deflate the nominal fees using monthly consumer price index (CPI) data by origin from the IMF's *International Financial Statistics*. Note that this introduces (minor) variation in real fees faced by applicants in Eurozone member countries. Unfortunately, CPI data are missing for a considerable number of origins, though the implied reduction in the sample size is small as CPI data exist for the largest patent-filing origins.

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[10] In assigning technology fields, we rely on the concordance between International Patent Classification (IPC) symbols and 35 technology fields developed by WIPO (see http://www.wipo.int/ipstats/en/statistics/technology_concordance.html). Where a patent application relates to multiple fields of technology, we assign technology fields on a "fractional" basis, calculating equal shares, each representing one field of technology.

[11] For a description of the methodology, see Chapter 4, Methodological Annex, in WIPO (2011), "World Intellectual Property Report: The Changing Face of Innovation," (WIPO, Geneva).

[12] The PCT Applicant's Guide is available at http://www.wipo.int/pct/en/appguide/index.jsp. For countries that joined the euro after 2004, we used the official euro conversion rates fixed at the time of accession to extend the local currency series.

21. Finally, we extract data on monthly unemployment rates from the *LABORSTA* database of the International Labour Organization (ILO). Like for the CPI data, unemployment data are missing for many origins, though again the implied reduction in sample size is small.

RESULTS

22. We estimate the discrete choice model described in Section 2 using a probit maximum likelihood approach. Table 1 set out in the Annex presents the main estimation results.[13] In column (1), we include all model variables except the unemployment rate and the patent family size. The estimation is based on a total of 1,375,911 patent families. The results show a negative and statistically significant coefficient on the fee variable and a positive and statistically significant coefficient on the dummy variable for PCT membership. In addition, the dummy variables for university and PRO applicants show a positive and statistically significant coefficient, with a much higher coefficient value for university applicants.[14]

23. We proceed by including the unemployment rate in column (2) of Table 1. Due to missing data for this variable, the sample size falls somewhat, but the coefficient estimates for most variables do not change.[15] One important exception is the fee coefficient, which decreases from -0.121 to -0.077, although it remains statistically significant. The decrease in the coefficient value is due to the relatively strong correlation between the unemployment rate and the PCT local currency fee, which reflects the simultaneous influence of exchange rate movements.[16] The coefficient on the unemployment rate itself is negative and statistically significant, suggesting that a poorly performing economy lowers the probability that an applicant opts for the PCT route.

24. In column (3) of Table 1, we introduce the size of the patent family into the estimation. This requires us to drop 211,367 families that opted for the PCT route, but did not subsequently see any national phase entry, as we do not observe the "anticipated" family size in these cases.[17] We introduce family size by including dummy variables for different sizes, starting with equivalents at 2 offices, 3 offices and so on, and ending with a dummy variable for families with equivalents at 6 offices or more. This dummy variable approach allows for a flexible functional impact of the family size. Note that the number of offices includes the office of first filing.

25. The estimation results suggest that bigger families are more likely to opt for the PCT. In particular, the coefficient estimates on the dummy variable rise from -0.654 for families with only 2 offices to 0.551 for families with 6 or more offices.

26. In the final two columns in Table 1, we explore to what degree the effect of the fee variable depends on the family size and on the applicant type. In particular, in column (4), we interact the fee variable with the 5 size dummy variables, thus allowing the coefficient on the fee variable to differ according to the size of the underlying family. The results first show a rising effect of the fee, with families that include 4 offices exhibiting the largest effect. The fee effect then declines and the coefficient is not any more statistically significant for families with

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13 We also estimated all the specifications shown in Table 1 using a logit maximum likelihood approach and obtained almost identical results as far as coefficient signs and levels of statistical significance are concerned.

14 Throughout all probit estimations, the lagged PCT market share variable shows a positive and statistically significant coefficient – as one would expect.

15 The coefficient on the PCT membership dummy variable is not any more statistically significant, which reflects the exclusion of observations from origins that are not PCT members.

16 The bivariate correlation coefficient between the fee and unemployment variables stands at -0.69.

17 The exclusion of these 211,367 observations also forces us to drop the PCT membership dummy variable, as there are no more origins in the sample that are not members of the PCT.

equivalents at 6 or more offices. One way to interpret this result is that the Paris and PCT routes are especially close substitutes when applicants seek patent protection in exactly three foreign offices, in which case the filing fee matters the most in applicants' filing decision.

27. Finally, in column (5) of Table 1, we interact the fee variable with the dummy variable for university and PRO applicants as well as a dummy variable for all remaining applicants. The results show a much higher fee effect for PRO and especially university applicants. One possible reason for this result is that these types of applicants face stricter budget constraints in managing their patent portfolios, so that the level of the PCT international filing fee exerts a stronger effect on filing decisions.

28. How large are the estimated effects? Table 2 set out in the Annex presents the marginal effects associated with the probit coefficient estimates obtained in column (3) of Table 1.[18] One can interpret these marginal effects as percentage probabilities of opting for the PCT. Thus, the marginal effect on the fee variable suggests that a 10 percent increase in the international filing fee would imply a 0.138 percent decrease in the probability that a foreign-oriented patent family chooses the PCT route. Since the PCT market share stands at roughly 50 percent for the sample underlying the estimation, the implied value of the PCT fee elasticity is -0.0278. In other words, a 10 percent increase of the international filing fee would lead to a 0.278 percent decline in the PCT filing volume – suggesting a highly inelastic response. The marginal fee effects for universities and PROs – derived from the estimation in column (5) of Table 1 and not shown in Table 2 – take on values of -0.0338 and -0.0248, respectively; they confirm that universities and PROs are more responsive to fee changes, but even these higher values indicate an overall inelastic fee responsiveness.

29. The marginal effect on the unemployment rate suggests a more sizeable effect of the state of the economy. Thus, a doubling of the unemployment rate would lower the probability of choosing the PCT by 3 percent, implying a roughly 6 percent decline in filing volumes.[19]

30. Moving on to the effect of the applicant type, being a university applicant increases the probability of choosing the PCT route by almost 25 percent. This high probability estimate may reflect the special benefits of the PCT to universities; in particular, the typically 18-month international phase[20] offers universities valuable time to consider whether they wish to continue into the national phase based on information obtained from the international search report and written opinions, and to find a commercial partner willing to further invest in the patenting process and in a technology's development. In addition, universities mainly engage in "upstream" innovation and may thus possess relatively less information about the commercial potential of their inventions; this also favors the "wait and see" strategy offered by the PCT. Being a PRO similarly increases the probability of choosing the PCT, though the effect is quantitatively less important.

31. The impact of family size is also substantial. All else equal, families with equivalents at only 2 offices are 19 percent less likely to opt for the PCT, whereas families with equivalents at 6 or more offices are 16 percent more likely to choose the PCT.

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18 We computed these marginal effects using the "margins, dydx(*variable*)" command in STATA.

19 It is important to point out that these elasticities assume no change in the population of foreign-oriented patent families. This is a strong assumption, especially when considering the influence of the business cycle.

20 The international phase lasts until 30 months from the priority date with most international applications claiming priority from an earlier national application.

32. Finally, Table 2 lists the marginal effects associated with the technology field fixed effects, in declining order of these effects. Thus, pharmaceutical patent families are most likely – all else equal – to opt for the PCT. Interestingly, the eight "most PCT-inclined" technology fields are all associated with discrete product technologies. A second interesting finding is that those technology fields that account for most PCT applications – notably digital communications; medical technology; electrical machinery, apparatus, energy; and computer technology – are not the "most PCT-inclined" fields. Note that the order of technology fields should not be due to the larger family size (possibly) associated with patent filings in different fields, as the marginal effects shown control for family size as captured by the 6 size dummy variables. Factors that may influence the order of technology fields and that the econometric analysis does not control for include the uncertainty and length of the research and development cycle.

CONCLUSION

33. This study presents the first estimate of how responsive PCT filings are to changes in the international filing fee. Using a discrete choice model of an applicant's decision whether to file through the PCT or through the Paris route, it estimates a highly inelastic – but statistically significant – fee responsiveness. Moreover, the estimation results suggest that the international filing fee matters most when applicants seek patent protection in exactly three foreign offices, and that universities and PROs are somewhat more price sensitive.

34. In addition to providing evidence on the fee responsiveness, the estimations also shed empirical light on a number of other determinants of PCT use. In particular, they indicate that applicants tend to rely to a greater extent on the PCT in good economic times, that PROs and especially universities are more likely to choose the PCT, and that – all else equal – pharmaceuticals and other discrete product technologies are more inclined to rely on the PCT than complex product technologies.

35. The Working Group is invited to take note of the contents of the present document.

[Annex follows]

Figure 1: Exchange Rate Movements Introduce Substantial Variation in the PCT Filing Fee

International filing fee in selected currencies (index, 2004=100)

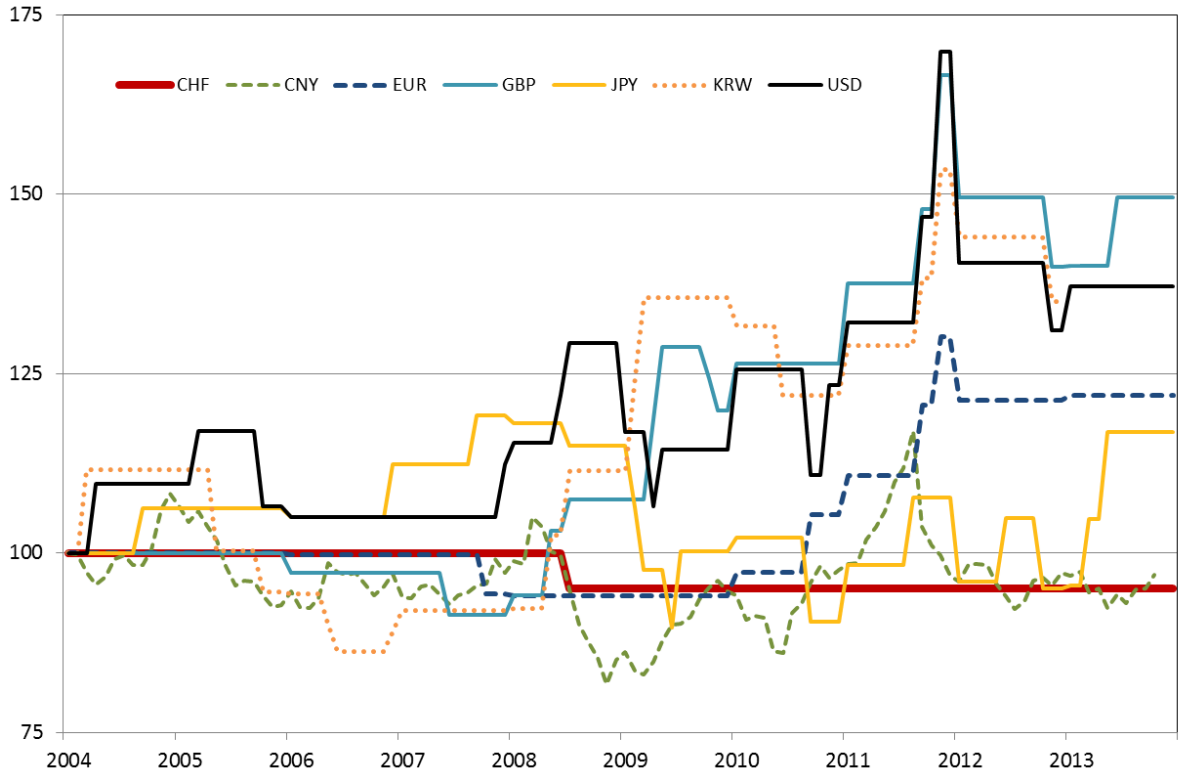

Table 1: Probit Estimation Results

	(1)	(2)	(3)	(4)	(5)
$\ln f_{ijt}$	-0.121*** (-7.10)	-0.077*** (-4.25)	-0.047** (-2.30)		
mem_{jt}	0.404* (1.67)	0.081 (0.18)			
$\ln unemp_{jt}$		-0.149*** (-20.29)	-0.104*** (-12.57)	-0.104*** (-12.61)	-0.106*** (-12.83)
University applicant	0.828*** (74.92)	0.826*** (73.24)	0.848*** (63.73)	0.845*** (63.52)	1.261*** (49.08)
PRO applicant	0.249*** (23.30)	0.215*** (19.67)	0.357*** (29.11)	0.344*** (27.98)	0.624*** (26.97)
2 offices			-0.654*** (-4.20)	-0.651*** (-4.17)	-0.705*** (-4.52)
3 offices			-0.288* (-1.85)	-0.240 (-1.54)	-0.342** (-2.19)
4 offices			0.026 (0.16)	0.156 (1.00)	-0.029 (-0.18)
5 offices			0.248 (1.59)	0.301* (1.93)	0.194 (1.24)
6 or more offices			0.551*** (3.54)	0.460** (2.95)	0.499*** (3.20)
$\ln f_{ijt}$ *** (2 offices)**				-0.048** (-2.36)	
$\ln f_{ijt}$ *** (3 offices)**				-0.059*** (-2.87)	
$\ln f_{ijt}$ *** (4 offices)**				-0.076*** (-3.69)	
$\ln f_{ijt}$ *** (5 offices)**				-0.060*** (-2.90)	
$\ln f_{ijt}$ *** (6 or more offices)**				-0.021 (-1.02)	
$\ln f_{ijt}$ *** (University applicant)**					-0.115*** (-5.53)
$\ln f_{ijt}$ *** (PRO applicant)**					-0.084*** (-4.08)
$\ln f_{ijt}$ *** (Other applicant)**					-0.034* (-1.66)
$mkt_{j(t-12)}$	1.342*** (29.38)	1.355*** (28.92)	0.746*** (13.98)	0.742*** (13.87)	0.772*** (14.47)
Technology field fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Origin fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Time fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	1,375,911	1,339,373	1,128,006	1,128,006	1,128,006
Log-likelihood	-758,194.1	-739,586.0	-586,857.8	-586,489.4	-586,564.3

Note: z-statistic in parentheses; ***,**, and * indicate statistical significance at 1, 5, and 10 percent, respectively.

Table 2: Marginal Effects Associated With Probit Estimates

Main variables	
$\ln f_{ijt}$	-0.0138
$\ln unemp_{jt}$	-0.0305
University applicant	0.2493
PRO applicant	0.1049
2 offices	-0.1924
3 offices	-0.0848
4 offices	0.0075
5 offices	0.0730
6 or more offices	0.1620
Technology fields	
Pharmaceuticals	0.1609
Biotechnology	0.1007
Analysis of biological materials	-0.0433
Macromolecular chemistry, polymers	-0.0458
Basic materials chemistry	-0.0826
Organic fine chemistry	-0.0865
Materials, metallurgy	-0.1208
Food chemistry	-0.1387
Digital communication	-0.1474
Medical technology	-0.1593
IT methods for management	-0.1639
Surface technology, coating	-0.1812
Chemical engineering	-0.1833
Environmental technology	-0.2249
Other consumer goods	-0.2360
Thermal processes and apparatus	-0.2758
Handling	-0.2839
Telecommunications	-0.2850
Furniture, games	-0.3016
Measurement	-0.3024
Other special machines	-0.3071
Machine tools	-0.3103
Electrical machinery, apparatus, energy	-0.3130
Control	-0.3217
Mechanical elements	-0.3219
Micro-structural and nanotechnology	-0.3252
Civil engineering	-0.3257
Computer technology	-0.3421
Transport	-0.3517
Audio-visual technology	-0.3609
Engines, pumps, turbines	-0.3690
Semiconductors	-0.3841
Basic communication processes	-0.3891
Textile and paper machines	-0.4174
Optics	-0.4266

Note: the marginal effects shown relate to the coefficient estimates of column (3) in Table 1.

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