

Allocation of online appointments: A system to deter black-market profiteers

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Many administrative appointments are now allocated online through booking platforms. The allocation system often works on a "first come, first served" basis, whereby applicants log in to the platform and book the slots that are still available at the time they log in. In several jurisdictions and countries, it has recently become apparent that this system is vulnerable to time-slot trafficking. Scalpers use bots to book slots faster than applicants. Their speed allows them not only to capture all the slots when they are posted, but also to associate their customers' identities with them later, thus adapting to the constraint created by identity checks. Through their practices, scalpers undermine the equality of access to public service that is expected to prevail. Based on the work of Hakimov et al., [2021](#), in this policy brief we present an alternative slot allocation system that discourages scalpers. This simple system works "in batches": a batch of slots is put online. Requests for this batch are collected during a given period. At the end of this period, slots are randomly allocated to the collected requests. If a secured appointment is cancelled, it is not put back online directly but allocated to one of the subsequent batches. In this system, scalpers have the same chance as applicants to get a slot, so applicants no longer turn to scalpers. We briefly discuss the potential benefits of such a system for allocating prefecture appointments for foreigners.

- The "first come, first served" allocation system for online appointments is vulnerable to scalping.
- We present an alternative allocation system that works "in batches". This system discourages scalping through two key features.
- First, requests for available slots are collected over a given period of time. Thus, speed is no longer an advantage.
- Second, appointments that are cancelled cannot be rebooked directly. There is therefore no advantage for the scalper to flood the platform with requests under identities that are not those of his clients.
- In some prefectures, it has become very difficult for foreigners to get appointments to obtain or renew residence permits. Slot trafficking is an additional obstacle that the "batch" system can address.



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Booking appointments online: The growth of the black market

There are goods and services that cannot be allocated using prices to coordinate supply and demand. This is the case, for example, for administrative appointments. These appointments are a prerequisite for accessing many public services such as the provision of a driver's license, renewal of a passport, or review of a request for regularization. The slots are allocated free of charge in order to ensure equal access to public services for all. Often, online reservation systems are used to allow applicants to book their appointments in advance and avoid waiting in line. The digitalization of certain administrative procedures has advantages for a large part of the population, particularly during epidemics, but can create problems of access to administrative services. One of the objectives of this policy brief is to show that **the way in which online appointments are allocated plays an important role in terms of equal access to public services.**

First come, first served

Online appointment systems often work as follows: Appointment slots are put online by an administration. Each appointment seeker then logs on to the booking platform and chooses from the appointment slots still available at the time of logging on. This is a "first come, first served" model. Such systems seem simple and egalitarian if the population can access the internet and navigate easily. However, such systems are vulnerable to slot trafficking as recently highlighted by Hakimov et al., 2021. **Scalpers use bots to book the slots as soon as they appear on the platform, faster than humans can. Then, these scalpers resell the appointment slots to applicants.** When there is a black market for appointment slots, applicants who cannot afford to buy the slots are excluded from the public service. Scalpers illegally make a profit and their actions often lead to the waste of slots that are not sold.

Recently, a number of such black-market schemes have come to light in various administrations, companies, and countries. In Ireland, the introduction of an online booking system for appointments at the Irish Naturalization and Immigration Service Center has led to slot trafficking that has forced the reopening of certain offices.¹ Applicants for visa appointments at German consulates in Beirut, Tehran, and Shanghai have had to pay up to US\$500 for such an appointment.² Similar problems have been observed in obtaining a driver's license slot in some US

states.³ In particular, the state of California passed a law in 2019 against the resale of such slots without succeeding in preventing the phenomenon, as resellers simply claim to offer a service to future drivers. In France, bots are also used by traffickers to obtain and resell appointments at prefectures for obtaining or renewing residence permits.⁴ We will come back to this issue in the last section of this policy brief.

Linking identities with time slots

When it comes to administrative appointments, a key point is obviously that the identity under which the appointment slots are booked must match the identity of the person who then presents themselves to the administration. This constraint does not prevent slot trafficking in most current systems. To begin with, scalpers often book appointments under false identities (since most systems are able to identify whether multiple appointments have been booked under the same identity, but not whether these identities are genuine). Subsequently, scalpers change these identities to those of their clients. This is made possible by the fact that cancelled appointments often reappear directly on the booking platform. They can then be re-booked almost instantly by the scalpers, who then associate them with the real names of their clients. **Thus, while one might think that identity checks prevent appointment trafficking, this is not the case in "first come, first served" systems because scalpers are also the quickest to rebook the slots they cancel.** In fact, even if cancellations and re-bookings are not possible, a scalper who always books all the slots the moment they are put online becomes an inescapable intermediary for the applicants who must transmit their identities to the scalper in advance. In this sense, even without the possibility of changing the names associated with reserved slots, the "first come, first served" system is vulnerable to scalping.

An appointment allocation system that discourages scalpers

We will now describe a method of time-slot allocation that makes scalping unprofitable. This method is probably not the only possible method to discourage profiteers, but we believe it has the advantage of being **simple and technically feasible.**

³See "DMV [Department of Motor Vehicles] investigates startup that has disrupted appointment process" in *The San Francisco Chronicle*, December 1, 2020.

⁴See, for example, the articles in *Le Monde* entitled "Titres de séjour : le prospère business de la revente de rendez-vous en préfecture" or "Titres de séjour : le trafic lucratif des rendez-vous" on June 1, 2019 and February 14, 2021 respectively.

¹See "Bots used to block immigrants in Ireland from making visa appointments," in *The Irish Times*, December 1, 2020.

²See for example "Ein Termin in der deutschen Botschaft? Das kostet!" in *Der Spiegel*, July 6, 2015.

Instead of an allocation system that operates on a "first come, first served" basis, the allocation system we will describe operates on a "batch" basis.⁵

- At a given point in time, the administration offers a certain **batch of time slots for reservation**.
- The platform then collects requests for this batch of slots **during a given period**, such as a day or a week.
- **At the end of this period, all the slots in the batch are allocated to the applicants whose requests have been collected.** If there are more applicants than slots available, the slots are allocated randomly to the applicants, i.e. the computer randomly and fairly selects the applicants who will get an appointment.
- **If one of the applicants cancels their allocated appointment, this time slot is then placed in the batch of slots that will be allocated to the next period.** In this way, scalpers cannot change the identity associated with a cancelled appointment as they might do in a "first come, first served" system.

Before discussing the practical aspects of the implementation of this "batch" system, we will explain why it discourages scalpers *a priori*. In particular, one may ask whether, with the "batch" system, it is not in the interest of the scalper to flood the platform with requests during the period of their collection in order to increase his chances to obtain slots. The answer is no, provided that only one request per identity can be issued. This condition is easy to meet: The platform just has to eliminate requests that have been registered under the same identity, which is what most platforms do today. With the "batch" system, a slot that is not obtained under the correct identity cannot be associated with a new name as in the "first come, first served" system. So if the scalper registers applications under false identities, he automatically decreases the chances that the real customers he registered will be selected. Ultimately, the scalper has, for each real identity, the same chance of being selected as any applicant who registers directly. The latter has no interest in using a scalper. These arguments are based on a theoretical model, detailed in the below box 1, which allows us to compare the behavior of applicants and scalpers in "batch" and "first come, first served" allocation systems.

Finally, it should be noted that the proposed system has two important features that differentiate it from "first come, first served" allocation systems. **It eliminates the advantage of speed and removes the possibility for scalpers to change the identity associated with a secured slot without losing it.** Both of these aspects are important in discouraging scalping in goods or services allocated on

online platforms. Let's take the example of some important sports events, such as the Olympic Games or the FIFA World Cup. Lotteries are widely used to allocate tickets to people who register their requests. With this method, the speed of booking is not important anymore, but because identity checks are not always reliable or possible at the entrance to major sporting events, scalpers flood the platforms with requests and sell the resulting tickets on the black market.

An experimental test of appointment allocation systems

A laboratory experiment is conducted in Hakimov et al., 2021 to test the theory that the "batch" allocation system discourages scalpers as explained above and in Box 1. A total of 240 subjects were recruited and participated in an experiment in which they played the role of appointment seeker or scalper. In the experiment, both applicants and scalpers test four situations:

- A "first come, first served" allocation system is used and the demand for slots is high, i.e. there are more users wishing to obtain slots than there are slots available;
- A "first come, first served" allocation system is used and demand is low, i.e. there are more slots available than there are users wishing to obtain them;
- A "batch" allocation system is used and demand is high;
- A "batch" allocation system is used and demand is low.

Each of the participants tests the four situations sequentially. In each situation, as in the theoretical model, the scalpers first decide whether or not to enter the market, which is costly for them.⁶ If they enter, they decide the price at which they offer their services and ultimately the number of slots they book (in the "first come, first served" system) or try to obtain (in the "batch" system). Applicants derive a monetary benefit from obtaining appointments. In the experiment they choose either to try to get the appointments themselves or to go through the scalpers for a fee.

In the laboratory, in the first situation - "first come, first served" system and high demand - scalpers are active and make profits. When demand becomes lower, scalpers become less active. When the researchers then replace the

⁵A "batch" system has also been proposed by Budish, Cramton, and Shim, 2015 for financial markets.

⁶In reality, this cost to the scalpers corresponds mainly to their investment in a computer system that allows them to reserve slots quickly and to the constant updating of the bots. In the experiment, scalpers must pay a portion of their initial cash holdings to enter the market.

Box: The theoretical model of Hakimov et al., 2021

Consider that there are m appointment slots and n applicants. Each applicant i places a positive value v_i on getting an appointment. A scalper can enter the slot market at cost c and sell the slots at a price p . If the scalper enters the market, his revenue is given by $m'p$ where m' is the number of slots he sells. Each applicant i earns a profit v_i from obtaining a slot. If she obtains this slot through the scalper, she has to pay him the price p . It is assumed that the profit of an applicant who does not obtain a slot is zero. The game proceeds as follows:

1. The scalper decides whether or not to enter the market. If he enters, it costs him c and he sets a price p .
2. Each applicant decides whether to go to the scalper for a slot or to try to get a slot directly.
3. The scalper learns how many applicants n_d approach him and decides how many slots he reserves or how many requests he submits.
4. The system allocates the slots. Each applicant who got a slot from the scalper pays him the price p .

"First come, first served" allocation system

In this system, recall that the scalper can book any appointments he wants and later change the identities associated with them. In the model, this possibility is captured by the fact that the scalper learns the number of requests that come to him before booking the slots. A first observation is that, if the scalper enters the market, it is optimal for the scalper to book all m available slots regardless of p . A second observation is that, given that the scalper books all slots and the price set is p , it is optimal for an applicant i to turn to the scalper if $v_i > p$. These observations lead to the following result:

Proposition - First come, first served system: Let p^* be the price that maximizes the scalper's profit. In equilibrium, the scalper does not enter the market if his revenue is less than c , and enters the market otherwise. In the latter case, he reserves the m available slots. Only those applicants i for whom $v_i > p^*$ approach him; the others get no slots.

"Batch" allocation system

In this system, recall that the scalper cannot change the identities for the slots he has obtained. A first observation is that, if the scalper enters the market, it is optimal for him to submit exactly n_d requests (if $n_d > 0$) regardless of p . Indeed, if he submits more requests, he decreases the chances of obtaining a slot for his customers. Since the scalper has the same chance of obtaining a slot as the applicant, it is optimal for the applicant to try to obtain a slot directly. These observations lead to the following result:

Proposition - Batch system: There exists an equilibrium in which the scalper does not enter the market and all applicants try to obtain a slot directly. This equilibrium is unique under parameter conditions detailed in Hakimov et al., 2021.

"first come, first served" system with the "batch" system, scalpers initially try to reserve slots but quickly learn that this is not profitable and become inactive. **The behavior of the scalpers observed by the researchers thus confirms the above analysis that the "batch" system discourages scalping.** In the experiment, the welfare of the applicants (measured by the difference between the benefits that the applicants derive from the secured appointments and the price paid to obtain them) is higher when allocation is via a "batch" system rather than a "first come, first served" system. Figure 1 shows the proportion of scalpers who entered the market in the four situations.

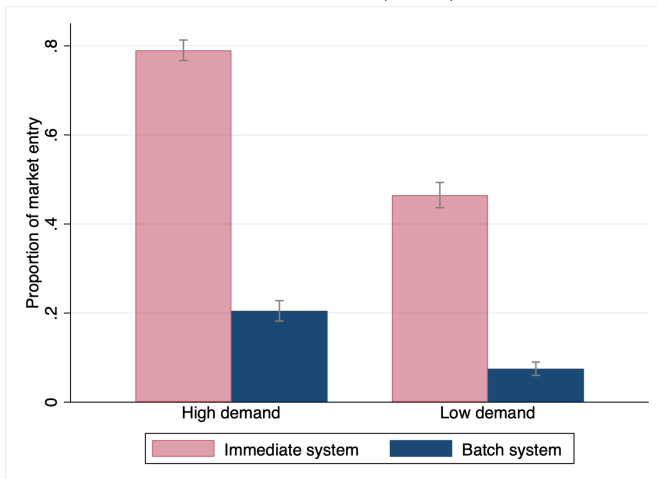
In theory, in the "first come, first served" system, the scalper has an incentive to enter the market and book all appointments as soon as the cost of doing so is covered by the price paid by the applicants. In this sense, scalping can take place whether demand is high or low. However, it is clear that the lower the demand, the lower the potential profits for the scalper. It is clear from the experiment and Figure 1 that **scalpers enter the market less when demand is low.**

Practical aspects of the implementation of "batch" allocation: The case of prefecture appointments for foreigners

In this last section, we will discuss certain aspects of the implementation of the "batch" allocation system by taking as an example the particular case of prefecture appointments for foreigners in France. For these people, obtaining an appointment at the prefecture is essential to apply for or renew a residence permit. This request is a legal obligation, without which movement on French territory is forbidden and deportation is possible. For the past few years, the process of obtaining these appointments has moved increasingly online. Cimade, a French association that supports migrants, refugees, and foreigners in irregular situations, has identified the difficulty of making prefecture appointments for foreigners as a national concern since 2016.⁷ One of the main problems encountered by

⁷The time it takes to obtain appointments differs greatly depending on the type of appointment but also depending on the prefecture in question. For a first application for a residence permit, many prefectures

Figure 1: Proportion of scalpers who enter the market in the four situations implemented in the laboratory by Hakimov et al. (2021)



Source : Hakimov et al. (2021)

Interpretation: When demand for slots is high, 79% of scalpers enter the market in the "first come, first served" system and 47% in the "batch" system. When demand is low, the entry proportions are 20.5% and 7.5% respectively.

foreigners in accessing prefectures is of course access to the internet. Another problem is undoubtedly the excess of requests for appointment slots compared to the available slots, but the gap between the supply and demand for appointments is difficult to quantify and very heterogeneous throughout France. **The problem of appointment scalping then adds to the long list of obstacles for foreign applicants for prefecture appointments.**

Not all prefectures allocate appointments in the same way but the "first come, first served" system is common. Switching to a "batch" system seems technically straightforward. When designers choose the length of time that applicants can register for slots in a batch, they must ensure that it is long enough to give applicants time to log in, and that it is not too long so that applicants learn quickly whether they have been granted a slot. In the case of prefecture applications for foreigners, data collection during a one-week period might be appropriate.

In addition to discouraging scalping, the "batch" system could have several advantages for applicants for prefecture appointments and for the prefectures themselves. To begin with, in "first-come, first-served" allocation systems, available slots are sometimes posted at fixed times (e.g., midnight on Sunday). When demand for these slots is high, the large number of simultaneous connections to the platform poses real technical problems. Applicants wait for hours for slots to be put online but their logins are not ultimately successful, which is often a source of distress. The solution is obviously not to put the slots online at random and changing times, as this would give the scalpers an even greater advantage over the applicants

who are not able to automatically detect when the slots are put online. The "batch" allocation system collects requests during a given period. It therefore **allows for connections to the platform to be spread out over time** and potentially reduces the stress for applicants who are given a reasonable amount of time to register their requests.

Second, the collection of requests during a given period could **provide precise information on the number of requests sent to the various prefectures, and the type of these requests.** Such information could be useful to better adapt the offer of prefecture appointments to the demand. In the current "first come, first served" systems, it is theoretically possible to record the number of simultaneous connections to the reservation platform, except when there are too many and they are not successful.

Finally, **an applicant registered for slots in a batch could obtain proof of his attempt.** Today, it has become so difficult in some prefectures to obtain appointments that foreign applicants are forced to go to the administrative tribunal to obtain a slot. To do so, it is essential to be able to prove that they have tried to log in without success for several weeks.⁸ However, we caution that, by collecting applications in advance in the "batch" system, the platforms could have access to information that would allow them to make an initial sorting of applicants. This is obviously not the idea of the "batch" system, which consists of randomly allocating slots to registered applicants.

Like all applicants for prefecture appointments, foreign applicants often have family or professional constraints, and therefore preferences regarding appointment times. The "batch" system does not prevent these preferences from being taken into account. In addition to registering their requests on the platform, applicants could rank the available slots according to their preferences. Then, instead of a lottery that simply allocates slots to applicants regardless of their preferences, the designer can use the "random priority" system. The lottery would randomly determine which applicant has priority and allocate their preferred slot; then the lottery would randomly determine which applicant comes second and allocate their preferred slot from those still available, and so on.⁹

Conclusion

The online appointment allocation mechanism has an important effect on the emergence of appointment scalping.

⁸The Council of State, in a decision on June 10, 2020, ruled: "When the appointment can only be obtained by connecting to the prefecture's website, if the foreigner establishes that they were unable to obtain an appointment date, despite several unsuccessful attempts during the same week, they may ask the judge [...] to order the prefect to communicate an appointment date to them within a certain time limit."

⁹See Satterthwaite and Sonneschein, 1981, for details on the random priority mechanism.

in France have no available dates or a wait of more than two months. For more details, see for example the Cimade report, "À guichets fermés", published in 2016, or the website dedicated to this issue, aguichetsfermes.lacimade.org

When scalping occurs, equal access to appointments, especially administrative ones, is no longer guaranteed because slots become payable. We explain that a "batch" allocation system can discourage scalpers, as demonstrated by the theoretical model and experiment reported in this policy brief.

In the "batch" allocation system, access to appointments is based on collecting requests during a given period and then using a random lottery to allocate slots to the collected requests. In addition, it is possible to modify this lottery; for example, to increase the chances that an applicant will get an appointment when they have already registered many requests, if this seems more egalitarian or urgent. Unsuccessful requests could also be redirected to the next batch by default.

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References

- Budish, E., P. Cramton, and J. Shim (2015). "The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response". In: *Quarterly Journal of Economics* 130, pp. 1547–1621.
- Hakimov, R., C-P. Heller, D. Kübler, and M. Kurino (2021). "How to avoid black markets for appointments with online booking systems". In: *American Economic Review* forthcoming.

- Satterthwaite, M.A. and H. Sonneschein (1981). "Strategy-Proof Allocation Mechanisms at Differentiable Points". In: *Review of Economic Studies* 48, pp. 587–597.