Uncertainty and Immigrant Entrepreneurship: Evidence From Brexit

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Abstract

Immigrant entrepreneurs are a major driver of economic growth, and their decisions about where to locate can greatly affect the entrepreneurial ecosystem of a country. Meanwhile, increasingly uncertain immigration environments might discourage immigrants from establishing new ventures in host countries. This paper exploits the unexpected result of the Brexit referendum to investigate the relationship between immigration uncertainty and the entry of immigrant-founded ventures of different quality. We propose a model of immigrant entrepreneurial entry and introduce a new measure of venture quality at founding. We find that a surge in uncertainty decreases the growth rate of new immigrant-founded firms by 3.2%. The reliance on other immigrant actors exacerbates the negative effect that uncertainty has on entry. Moreover, low- and high-quality firms are the most affected, while the effect for medium-quality firms is negligible. Back-of-the-envelope calculations suggest that Brexit discouraged the entry of around 620 low-quality and 250 high-quality firms. Our model suggests that while founders of low-quality ventures might decide to take up employment, founders of high-quality ventures might be better off establishing their companies in another country.

Keywords: entrepreneurship, immigration, uncertainty, Brexit, mobility.
JEL classification: L26, J61, M13, D81.

1. Introduction

Immigrant-founded startups account for a disproportionately large share of new firms in developed countries. In the UK and the United States, they make up a quarter of all new companies.[1] The importance of immigrant entrepreneurship for receiving countries is undeniable: immigrants create businesses at a higher rate than natives (e.g., Fairlie & Lofstrom, 2015; Kerr & Kerr, 2020), and they do so at every point of the size distribution (Azoulay et al., 2022). Moreover, immigrants have been found to establish more than half of startup companies valued at $1 billion or more (Anderson, 2018).

In general, a vast literature has focused on the impact of environmental characteristics on immigrant firm entry and performance. While some works have focused on the entry decision of foreign companies in host countries (e.g., Kulchina, 2016b; Conti & Guzman, 2019; Hernandez & Kulchina, 2020; Kulchina & Oxley, 2020), others have specifically focused on new immigrant-founded firms, investigating how different environmental aspects–ranging from location to the presence of ethnic social networks–can influence entry decisions (e.g. Aldrich & McEvoy, 1984; Aldrich & Waldinger, 1990; Waldinger et al., 1990; Waldinger, 1993; Kalnins & Chung, 2006).

One important feature of the environment surrounding organizations is uncertainty. Besides the uncertainty that is usually related to businesses' choices and processes (Stinchcombe, 1965), immigrant entrepreneurs face an additional layer of uncertainty: that is related to their as well as other immigrant actors' ability to stay in the host country for a prolonged period of time. Besides the entrepreneur's, the status of other actors that can be vital for the survival of the immigrant firm, such as immigrant employees, suppliers, and customers, can also be uncertain. As several governments around the world have recently tightened their immigration policies (Hatton, 2016; Choudhury, 2021), the impact of an increasingly uncertain immigration environment on the entry decisions of immigrant entrepreneurs has not been explored. Shedding light on this relationship is important not only for the

[1] The share of immigrant population in both countries is around 15%. Source: authors' calculations, Kerr and Kerr (2020), and the United Nations Population Division.

substantial economic consequences associated with the establishment of immigrant-based businesses but also because exploring this issue can offer new insights regarding the mechanisms underpinning entry and mobility decisions of immigrant entrepreneurs.

It is plausible that a surge in immigration uncertainty decreases the level of entrepreneurship through a possible increase in the expected cost of labor and inputs and lower expected market demand. As immigration uncertainty affects not only immigrant entrepreneurs but also various immigrant stakeholders embedded in the entrepreneurial network, the effects of uncertainty might vary depending on the level of reliance on these actors (i.e., immigrant employees, customers, and suppliers).

Moreover, we do not know how firms with different quality profiles and aspirations respond to immigration uncertainty. In general, shedding light on which entrepreneurs are mostly affected by an increase in uncertainty is important as different types of firms might have different effects on a country's economic growth and the long-term development of its entrepreneurial ecosystem (Schoar, 2010). After an uncertainty shock, potential entrepreneurs with low- and high-quality ideas alike could face a decrease in expected profits and might decide to join the labor market as employees or to establish their businesses in another country instead of founding them in the host country. Declining expected profits might quickly erode their margins, especially for lower-quality businesses. However, higher-quality ventures might be more exposed to an increase in uncertainty, as they tend to cater more to global customers and rely on high-skilled foreign labor. Overall, it is not clear how different types of firms will respond to an increase in immigration uncertainty.

The aim of this paper is twofold: (1) causally investigate the relationship between immigration uncertainty and immigrant entrepreneurship; and (2) uncover the underlying mechanisms driving our main results. In order to achieve this latter question, we start by examining whether reliance on foreign actors in the host country moderates the effect of uncertainty, as immigrant-reliant firms might be hit particularly hard. Afterward, we investigate how ventures of different quality levels react to a surge in immigration uncertainty.

To study these questions, we propose a theoretical model of immigrant entrepreneurial entry where founders with different entrepreneurial quality and reliance on other immigrant actors in the host country face an increase in immigration uncertainty. Our model suggests that an increase in immigration uncertainty will have a negative effect on entry. Our model also suggests that lower dependence on immigrant actors can weaken the negative effects of an increase in uncertainty on immigrant entrepreneurial entry. When looking at how firms of different quality might react, we predict that uncertainty prevents potential low- and high-quality entrepreneurs from establishing their firms. While potential low-quality entrepreneurs might prefer to seek paid employment, potential high-quality entrepreneurs might decide to open their ventures elsewhere.

In order to test our model's predictions, we focus on the impact of Brexit on immigrant entrepreneurship using evidence from the Brexit announcement in June 2016. In a referendum that month, the UK voted to leave the European Union (EU) by a margin of 52% to 48%. This widely unexpected outcome gives us a quasi-experimental variation to study the impact of a threat of a more-restrictive immigration policy on the entry of new immigrant-founded firms. In particular, we compare the growth in the number of new firms created by EU-immigrants[2] to those created by non-EU immigrants. Differently from non-EU immigrants, EU nationals in the UK were arguably exposed to an increase in immigration uncertainty, which did not affect the former group. As other forces, such as higher economic or trade uncertainty, might affect all immigrants similarly, regardless of their nationality, the comparison between EU- and non-EU immigrants allows us to exclusively capture the effect of immigration uncertainty on entrepreneurship.

We use a newly collected dataset that encompasses the whole population of incorporated firms in Great Britain. As our data contain the nationality of each founder, they allow us to perfectly identify immigrant-founded businesses. The presence of this information is a rare exception in the literature

[2]Throughout the paper, we refer to EU or European Union as the 27 member countries of the European Union excluding the UK.

on immigrant entrepreneurship. Most of the time, researchers can rely only on immigrant names to infer nationality (e.g., Kerr & Lincoln, 2010), while in other cases, the difficulty lies in distinguishing founders from employees (e.g., Kerr & Kerr, 2020). In addition, our data show a perfectly accurate picture of the British entrepreneurial ecosystem: all firms are included, regardless of their number of employees or VAT contribution. Finally, by having information about businesses' exact incorporation date, we are able to examine changes at a monthly level rather than relying on yearly data.

Beyond the variation stemming from the Brexit referendum, the UK—specifically Great Britain—represents the ideal setting for our study for several reasons. First, the UK is an important destination country for European immigrants: roughly 41% of immigrant residents in the UK between 2013 and 2015 came from the EU, compared to an average of 31% for the other EU countries.[3] Second, Great Britain is arguably the most vibrant entrepreneurial hub in Europe. The country leads in terms of VC-backed exits and VC funding; it also has a large pool of skilled talent, with roughly 422,000 professionals in tech-related fields such as data analytics, artificial intelligence, blockchain, and quantum computing.[4] Moreover, the UK is one of the top three EU countries when it comes to the ratio of foreign doctoral students, knowledge-intensive services exports, ease of starting a business, and many other innovation-related indicators.[5] Finally, the UK's progressive policies regarding high-tech sectors have also played an important role in the development of its entrepreneurial ecosystem.[6] Therefore, the country has been extremely attractive to European and foreign entrepreneurs: before the Brexit announcement, 25% of firms had at least one foreign founder, and half of these had at least one European (EU, non-UK) foreign founder.

We find three main results. First, Brexit decreased the growth of new European-founded firms by 3.2%, relative to the growth of non-European immigrant-founded firms, which translates into the loss

[3]Source: Eurostat, Table migr_imm1ctz, available at: https://tinyurl.com/euroimmig.
[4]Source: 2019 UK Tech Talent Tracker Report by Accenture.
[5]Source: European Innovation Scoreboard.
[6]For example, consider the Regulatory Sandbox, an initiative of the Financial Conduct Authority (FCA) that allows fintech firms to test their business models, products, and services in a market with real consumers under the supervision and guidance of the FCA.

of just over 900 firms in the two years following the event. This result is causal and robust to several checks, including pre-trends tests, the exclusion of the London area, and the use of alternative control groups, among other specifications. Second, we find that a high reliance on immigrant actors in the host country exacerbates the negative effect of higher uncertainty compared to companies that have a low dependence on such actors. In particular, immigrant entrepreneurs who can leverage a wider network of suppliers, employees, and customers are able to partially offset this negative effect brought. Third, when looking at firm quality, we find that most of the negative effect on entry comes from both low- and high-quality firms, while the effect for medium-quality firms is negligible. Consistently with our theoretical predictions, we find that founders of low-quality firms may prefer to transition into employment in the host country, while founders of high-quality firms might be better off establishing their venture in another country.

Our findings contribute to four main strands of the literature. First, we contribute to research connecting environmental factors and immigrant entrepreneurial entry by shedding light on the role of immigration uncertainty on immigrant entrepreneurship. While there is a vast literature examining how push- and pull-factors can explain the over-representation of immigrants in entrepreneurship, our paper documents how uncertainty might discourage them to become entrepreneurs. Second, this paper is connected to the research documenting the effects of immigration-policy changes on the economy of the receiving country. Different from past works, our paper focuses on immigration uncertainty preceding potential changes in immigration policies. Third, our paper contributes to the literature studying entrepreneurial mobility as we document a shift in incorporation patterns among European countries. Finally, we also add to the increasing research regarding the effects of Brexit on the economy.

The rest of the paper proceeds as follows. In Section 2, we briefly describe the Brexit event. In Section 3, we present our theoretical framework. In Section 4, we describe our data and present descriptive statistics, while in Section 5, we describe and our empirical strategy. In Section 6, we test the prediction of our model by showing how Brexit has affected the creation of immigrant-founded

firms and by exploring which firms have been affected by this announcement. Section 7 concludes.

2. Brexit and Its Consequences for Immigrant Entrepreneurs

In January 2013, David Cameron promised that if the Conservative Party won the 2015 General Election, he would hold an in-or-out referendum on the UK's continuity in the EU. Cameron's party won the election in May 2015, and the newly appointed premier upheld his promise: on February 20, 2016, a referendum on whether Great Britain should remain in the EU was announced. Four months later, the referendum was held—52% of Britons voted to leave the EU. This result came as a shock; most polls and betting markets predicted that voters would vote to remain.

The result of the referendum cast a shadow on the ability of EU and UK citizens to maintain their right to freely move between these regions, one of the pillars on which the EU was founded. Freedom of movement allows citizens of EU member states to reside, work, and retain equal treatment in terms of working conditions and social rights in any member state. The fate of prospective immigrants to the UK, as well as EU citizens already in the country, was now under threat.

The referendum was followed by a long period of uncertainty when it was unclear whether the UK wanted to leave the EU's single market and abandon freedom of movement. This decision was eventually confirmed by Theresa May in January 2017, even though no clear path for immigration policy was traced. Shortly after, the government issued an official notification that it was leaving the EU, triggering Article 50 of the Treaty of Lisbon.[7] Not until January 2020 was a definite withdrawal agreement approved and signed. After a transition period, the UK left the EU at the end of 2020. Overall, the post-referendum period was full of messy political events, including the resignations of David Cameron and his successor (Theresa May) and other failed withdrawal agreements, which generated a high and persistent uncertainty (Bloom et al., 2019). We include a detailed Brexit timeline in Table A-1 from Appendix A4.

[7]The Article 50 of the Treaty of Lisbon regulates the exit process of EU member states that wish to voluntarily withdraw from the Union.

Brexit created a great deal of confusion and uncertainty for immigrant entrepreneurs. For instance, the possibility of trade tariffs, which were almost nonexistent in the pre-Brexit era for EU countries, loomed for the post-Brexit future, potentially raising the cost of inputs and hurting the demand from EU countries. Trade uncertainty also hit other non-European immigrants as the existing contracts with non-EU countries–formerly regulated through the European Union–were suddenly up for renegotiation. This resulted in increased trade uncertainty for European and non-European immigrants alike. Nonetheless, immigration was one of the major sources of uncertainty for European immigrant entrepreneurs. Before the final Brexit agreement was signed in January 2020, it was unclear whether European immigrant entrepreneurs or employees could lawfully remain in the UK after Brexit and what the residency requirements would be.

3. Theoretical Considerations

Entrepreneurship is by nature an uncertain endeavor (Stinchcombe, 1965). By definition, the distribution of the rewards associated with the introduction of a new good or production process cannot be known ex-ante (Knight, 1921). While starting a company is already a challenging process, immigrant entrepreneurs must face additional uncertainty related to their own and their co-nationals' immigration status. This has become more relevant recently as several developed countries have been tightening their immigration policies, making it harder to immigrate or maintain a valid immigration status. Stricter policies do not only translate in a more uncertain future immigration status for the entrepreneur, but they are also reflected in the immigration status of potential immigrant customers, employees, and suppliers, hence likely affecting market demand as well as the supply of inputs and labor. As immigrant entrepreneurs are more likely to cater to and hire other immigrants (Portes, 1981), stricter policies might have a substantial negative impact on their expected profits.

To analyze how immigration uncertainty can impact the entry decision of immigrant entrepreneurs, we propose a simple model of entrepreneurship that builds on Lucas Jr (1978) and Evans and Jovanovic

(1989). We extend their model to consider the possibility of entrepreneurial mobility across countries in the case of a prospective entrepreneur facing uncertainty, which varies depending on the firm's reliance on other immigrant actors. For simplicity, assume a mass of prospective immigrant entrepreneurs who are already in the UK, and assume there are two countries: the UK and Europe (E). Potential entrepreneurs must choose between opening a firm in the UK, opening it in Europe, or participating in the local labor market as employees of an existing firm. If they decide to join the labor market, they receive a wage w, which we assume to be exogenous.

If an entrepreneur decides to open a business, she will draw a quality level q from a quality distribution. A firm with higher quality has higher potential earnings and higher labor productivity. In particular, entrepreneurial earnings are given by: $y = qf(l) = ql^{\alpha}$, where l is the number of workers the firm hires at wage w, and $\alpha \in [0, 1]$. However, revenues are uncertain. In particular, after hiring its workers, an entrepreneur's firm in location i will survive with probability $\mu_i > 0$. We assume that this probability depends negatively on the uncertainty faced by the entrepreneur, which we denote by ν_i. At the same time, we assume that this uncertainty depends positively on the firm's reliance on immigrant actors, which we denote by $\kappa \geq 1$. In particular, firms that heavily depend on immigrant actors for their survival could be more exposed to an uncertainty shock that might threaten immigrants' legal status in the host country.

Therefore, a firm with quality q and reliance on immigrant actors κ survives with a probability $\mu_i(\nu_i(\kappa)) > 0$, with $\mu_i'(\nu_i(\kappa)) < 0$ and $\nu_i'(\kappa) > 0$. If the firm survives, the entrepreneur will receive all of the earnings; if not, she will receive zero earnings. We assume that before Brexit and for a given level of κ, uncertainty and the survival probability are the same in both countries[8]. However, as the Brexit referendum might have affected the perception of survival and failure in the UK, uncertainty and survival probabilities will differ after this event.

A potential entrant in the UK has to choose the number of workers that maximizes its expected

[8]This assumption implies $\nu_{0,UK}(\kappa) = \nu_{0,E}(\kappa) = \nu_0(\kappa)$, and $\mu_{0,UK}(.) = \mu_{0,E}(.) = \mu_0(.)$

income net of labor costs ($\max_l E\Pi^{UK} = \mu_0(\nu_0(\kappa))ql^\alpha - wl$).[9] The solution to this problem yields the following equation for the expected profits of a firm with quality q in the UK:

$$E\Pi^{UK} = (1-\alpha)\left[\mu_0(\nu_0(\kappa))q\left(\frac{\alpha}{w}\right)^\alpha\right]^{\frac{1}{1-\alpha}} \tag{1}$$

Note that the expected profits depend positively on the survival probability and the quality of the firm, and depend negatively on wage and uncertainty, thus, on the reliance on immigrant actors. Moreover, these expected profits are also a convex function of the firm's quality.

On the other hand, if a potential entrepreneur already living in the UK wants to open a firm in another European country, she would have to pay a moving cost $m > 0$. This encompasses numerous factors such as moving costs per se, forgone income, and costs associated with identifying labor and market opportunities in the new location. In particular, she would face the following optimization problem:$\max_l E\Pi^E = \mu_0(\nu_0(\kappa))ql^\alpha - wl - m$, which leads to expected profits of:

$$E\Pi^E = (1-\alpha)\left[\mu_0(\nu_0(\kappa))q\left(\frac{\alpha}{w}\right)^\alpha\right]^{\frac{1}{1-\alpha}} - m \tag{2}$$

For simplicity, we assume that wages are the same in both UK and E.[10] Given the profit functions in both locations, a potential entrepreneur will choose to open a firm in the UK if her expected profit from doing so is larger than the wage she would receive from working and larger than the expected profits she would get as an entrepreneur in E. The first condition ($E\Pi^{UK} > w$) implies that we can find a quality cutoff q^* for which every potential entrepreneur with a firm below that cutoff will decide to join the labor market as an employee, while every entrepreneur with a firm above that cutoff will join it as an entrepreneur/employer:

$$q^* = \frac{w}{(1-\alpha)^{1-\alpha}\alpha^\alpha\mu_0(\nu_0(\kappa))} \tag{3}$$

[9] We include uncertainty as a multiplicative term within the production function, as in Baron, 1970, Kihlstrom and Laffont, 1979, and Evans and Jovanovic, 1989. An alternative way to study the effect of uncertainty is to analyze the variance of the profit function. We can show that in our model, under data-driven parameter values, the variance of the profit function also increases with the parameter μ.

[10] Despite the existence of a common labor market in the EU, we recognize that wages across countries can be different for a variety of reasons, such as different regulations and levels of taxation.

Notice that this cutoff, which is inversely related to the number of new firms in the UK, increases when uncertainty increases and when there is a larger reliance on immigrant actors. Under the current assumptions, the second condition ($E\Pi^{UK} > E\Pi^{E}$) always holds: a potential entrepreneur always prefers to open her firm in the UK rather than in E. This pre-Brexit scenario is captured in the left panel of Figure 3.

In general, past literature has found that immigrants are subject to different labor market constraints than natives. Notably, immigration policies and, in particular, visa-related regulations might influence immigrants' ability and choice to become entrepreneurs (Roach & Skrentny, 2019; Agarwal et al., 2022). Interestingly, in our context, there were no changes in immigration policy between the Brexit referendum (June 2016) and the day when the Brexit deal was signed (January 2020). However, Brexit may have substantially increased the immigrants' expected labor market constraints through a surge in immigration uncertainty. As the work of Agarwal et al., 2022 implies, such an increase could have discouraged entrepreneurial entry following a decline in expected profits, making paid employment more attractive.

In our context, since EU27 immigrant entrepreneurs were now unsure about their own as well as the other EU27 immigrants' future status in the country, the Brexit referendum might have lowered immigrant entrepreneurs' expected profits. As the probability of survival for the rest of the EU remained unchanged, we expect that after Brexit, $\mu_{1,UK}(.) < \mu_{1,E}(.)$ for a given value of κ. A change in the survival probability in the UK directly affects the expected profits of a potential entrepreneur there. Therefore, now a potential entrepreneur will open a firm in the UK if $E\Pi^{',UK} > w$ and $E\Pi^{',UK} > E\Pi^{',E}$, where the apostrophe denotes the post-Brexit period. This leads to our first hypothesis:

Hypothesis 1: *Increases in immigration uncertainty result in lower immigrant entrepreneurial entry.*

As homophily facilitates the creation of ties among similar individuals (McPherson et al., 2001;

Currarini et al., 2009), immigrants often benefit from privileged channels of knowledge transfer and learning from other immigrants (Kalnins & Chung, 2006; Hernandez, 2014). As a consequence, the rate of economic interactions among immigrants is often a prevalent feature of immigrant businesses. In practice, this translates into a higher propensity of immigrant companies to employ more immigrant employees (Kerr & Kerr, 2021), source their inputs from local–yet immigrant–suppliers, or cater their products to immigrant customers (Portes, 1981). However, firms that are more reliant on other immigrant actors (captured by κ) might also experience higher uncertainty. Thus, after an increase in immigration uncertainty, the decrease in the probability of survival would be larger for these firms. If this is the case, their expected profits from opening a firm in the UK would be lower. In terms of the model, before Brexit, a larger κ would lead to a larger gap between $E\Pi^{UK}(q)$ and $E\Pi^{E}(q)$, and to a larger share of entrepreneurs in the country. Since the cutoff q^* depends positively on κ, an uncertainty shock will have a weaker effect on the entry of firms that rely less on immigrant actors. Therefore, we state our second hypothesis as:

Hypothesis 2: *A lower reliance on immigrant actors weakens the negative effect of higher uncertainty on immigrant entrepreneurship.*

Besides the consequences that reliance on immigrant actors has on uncertainty and entry, we are also interested in understanding how firms of different quality will respond. In addition to shedding more light on the determinants of our main results, examining this question might be of interest to policymakers and entrepreneurial scholars alike due to the different effects that firms of different qualities have on the aggregate economy (e.g. Schoar, 2010; Pugsley & Hurst, 2011; Guzman & Stern, 2020). Lower-quality firms are likely to have low growth prospects. These firms tend to have highly localized markets. A small family-based restaurant that caters to local customers with meager growth prospects can be considered a good prototype of a low-quality firm. For this group of firms, higher uncertainty can be associated with higher expected costs of running a business or with a reduced demand; hence potential entrepreneurs might decide to take up employment instead.

Potential entrepreneurs of low-quality firms could also establish their businesses in another country. However, their expected profits from doing so might not compensate for their relocation costs.

High-quality firms—which are usually associated with higher growth potential—might experience an increase in uncertainty in different ways. In general, this type of firm embodies the high-risk, high-growth entrepreneurial nature of the classical high-tech startup. On one hand, these startups might have higher expected revenues than low-quality ventures, which could compensate for the lower survival probability brought by higher uncertainty. On the other hand, the nature of a high-quality firm makes it more exposed to an increase in uncertainty-related costs. For starters, high-quality startups are dependent on the availability of a larger pool of highly specialized workers. High-quality ventures also tend to have more global demand than the average business. For instance, roughly one-third of high-growth startups in London in 2017 catered to global customers.[11] For most high-quality firms, timing is also a crucial factor, as the launch of new pioneering products tend to have a narrower "strategic window" that can be exploited (Lilien & Yoon, 1990). Because high-quality entrepreneurial ideas tend to have high expected profits, the opportunity cost of forgoing this idea is high (Arora & Nandkumar, 2011; Braguinsky et al., 2012), and paid employment is unlikely an economically valid substitute for this kind of entrepreneurship. All these factors might cause these potential entrepreneurs to avoid entry into the UK and possibly move to another country inside the EU to establish their firm, even if this decision is costly.

To shed some light on how different firms will respond to the uncertainty generated by Brexit, we derive a range of quality values $q \in [q_1^*, q_2^*]$ for which potential entrepreneurs will choose to open a

[11] Source: Global Startup Ecosystem Report 2017 (https://tinyurl.com/2u7aytcc).

firm in the UK after this event. In particular, from the entry conditions, we find:

$$q_1^* = \frac{w}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}\mu_{1,UK}(\nu_1(\kappa))} \tag{4}$$

$$q_2^* = \left(\frac{w}{\alpha}\right)^{\alpha}\left\{\frac{m}{(1-\alpha)\left[\mu_{1,E}(\nu_0(\kappa))^{\frac{1}{1-\alpha}} - \mu_{1,UK}(\nu_1(\kappa))^{\frac{1}{1-\alpha}}\right]}\right\}^{1-\alpha} \tag{5}$$

Three results arise from this interval. First, q_1^* is larger than the cutoff from equation (3). Therefore, our model predicts that after Brexit, fewer low-quality firms will enter. Second, the differences in the probabilities of survival across locations give rise to the upper cutoff q_2^*, above which entrepreneurs will decide not to open in UK but rather to open in E, even if they have to incur a moving cost m. Therefore, our model also predicts that Brexit negatively affects the entry of high-quality firms. Third, a range in the middle of the quality distribution will still see entry after Brexit.[12] These companies are widely heterogeneous. One example of a middle-quality firm can be a mid-market company operating in skill- and labor-intensive sectors (e.g., accounting, financial intermediation, etc.) catering to local customers. We depict these three results in the right panel of Figure 3, which shows the Post-Brexit scenario and summarize it with the following hypothesis:

Hypothesis 3: *The effect of an increase in uncertainty on immigrant entrepreneurship follows an inverted U-shape regarding firm quality: a strong negative impact for low- and high-quality firms but a weak effect for medium-quality firms.*

Finally, as differences in the reliance on immigrant actors affect the initial gap between the expected profits in the UK and in other countries, it will also affect the cutoffs resulting in equations (4) and (5). In particular, a larger κ would negatively affect the lower cutoff q_1^* and positively the upper cutoff q_2^*. In other words, once Brexit affects uncertainty and the survival probabilities, the negative effect on entry should be weaker for entrepreneurs with lower dependence on immigrant actors, both in the lower- and the upper-tail of the quality distribution.

[12] In other words, we observe the effect on the tails of the quality distribution. This result is somewhat similar to what Åstebro et al. (2011) describe for the distribution of skills and earnings among entrepreneurs.

4. Data and Empirical Strategy

In order to empirically test the main hypothesis of the theoretical model, we leverage a newly built dataset encompassing the whole population of firms in Great Britain. In this section, we present these data as well as some basic descriptive statistics.

4.1 Data Description

Our data come from Companies House UK, an executive agency sponsored by the Department for Business, Energy, and Industrial Strategy. As the official business registry of the UK, the agency provides information about the incorporation and dissolution of firms. Besides including basic information such as name, date of incorporation, date of dissolution (if any), address, and industry, it also contains details about the board of directors, owners, and financial reports. All companies are required by law to file and update their information.

One extremely important feature of our dataset is the presence of information about founders' nationalities. This allows us to precisely identify immigrant-founded companies. This task has always been problematic in the entrepreneurship literature as most datasets do not explicitly report this information. Scholars have often relied on alternative, less-precise methods for identifying foreign-founded firms, such as analyzing the name of the founder or using payroll information (e.g., Kerr & Lincoln, 2010; Kerr & Kerr, 2016).

The sample we use for our analyses includes firms that have been incorporated since 1995 and were alive at any point between December 2012 and December 2018 in Great Britain (GB), even though we focus on new firms incorporated at any time during that period. We geolocate each firm to travel-to-work areas (TTWA).[13]

We also add information on the founders' nationality and industry groups (UK Standard Industrial

[13] We use TTWAs because they are good approximations of self-contained labor markets, similar to commuting zones in the United States. They were developed by the Office for National Statistics using the 2011 Census, considering commuting flows between wards of work and residence. In a TTWA, at least 75% of residents work in the area, at least 75% of workers live in the area, and there is a working population of at least 3,500.

Classification 2003).[14] Since around 40% of the firms have multiple founders, sometimes with different nationalities, we assign to each firm the most common nationality present in the founding team. In case of a tie, we assign the country that is closer to the UK, as British and European nationals may have some implicit advantages in creating new firms in the country. Section A1 in the Appendix provides more information on how we assign nationalities to firms. Our final sample contains ≈5.6 million unique firms. Using all the data, we build a four-level dataset—TTWA, sector, nationality of the founders, and quarter—that contains the number of new firms as well as the total number of firms in each bin between December 2012 and December 2018.

4.2 Descriptive Statistics

Out of the approximately 5.6 million unique–and active–firms in our sample, almost 44% belong to the real estate, renting, and business services sector, followed by retail and wholesale (12%) and other social and personal services (10%). Around 57% of the companies in our sample have only one founder, 27% have two founders, and the remaining have more than two founders. In terms of nationalities of the founders, most of the companies in our sample (79%) were established by British citizens, 10% by EU citizens, and the remaining by rest-of-the-world citizens.

Regarding firm entry, Table 1 presents some descriptive statistics showing the mean number of new firms, before and after Brexit, created by founders from EU27 countries and the rest of the world, together with the average year-to-year growth rate. Panel A shows that founders from EU27 countries created more new businesses than founders from the rest of the world: 620.5 vs. 98.1 on average before Brexit. This makes sense, as migration from EU27 countries to the UK is significantly easier in terms of distance and legal status. Similarly, Panel B shows that in the average country-sector-TTWA triplet before Brexit, 0.88 new firms were created by founders from EU27 countries and 0.58 new firms were created by founders from the rest of the world. Moreover, both panels evidence how the

[14] Founders are defined as directors who have been appointed within one year after the incorporation of the company.

average growth fell relatively more for firms founded by EU27 citizens, relative to rest-of-the-world entrepreneurs.

When considering the incorporation patterns of EU-founded and other firms in light of the Brexit referendum, some clear trends emerge. Figure 1 shows the ratio of the number of new firms founded by EU-citizens relative to the number of new firms founded by citizens from the UK and the rest of the world. The grey area in the Figure shows the period between the announcement of the referendum and the voting day (between February and June of 2016). While the relative number of EU firms was increasing in the pre-Brexit period, it came to a sudden stop and started to decrease slightly once Brexit was announced. The London area, together with Manchester, Sheffield, and a large number of TTWAs in Scotland and Wales, are the main contributors to the overall decreasing trend of new incorporations (see Figure A-1 in the Appendix).

5. Empirical Strategy

To evaluate the effect that the Brexit referendum had on the entry of new firms created by immigrants (Hypothesis 1), we start by estimating a difference-in-difference specification at the TTWA-sector-nationality level. In this specification, we exploit the quasi-experimental variation brought by the widely unexpected results of the referendum to study the differences in entry rates between EU- and non-EU immigrants. We argue that EU nationals in the UK were more threatened by potential changes in immigration policy after Brexit compared to immigrants from somewhere else, as immigration policies were not likely to change for this latter group.[15] By comparing EU- to non-EU immigrants, we are able to estimate the effect of immigration uncertainty alone, net of other types of economic uncertainties—such as uncertainty related to trade, labor markets, etc.—that play a role in every immigrant's entry decision. Furthermore, as immigrant entrepreneurs exhibit a quite distinct set

[15] For instance, a potential entrepreneur coming from South America could expect that her opportunities as an immigrant or her costs of having formal status in the UK would not change after Brexit, as immigration policies for non-EU countries were already regulated by the UK and not imposed by the EU.

of characteristics compared to natives,[16] we compare immigrant groups with different exposure to immigration uncertainty instead of comparing immigrants with native entrepreneurs. Nonetheless, our results are robust to the inclusion of native entrepreneurs in the control group.

In particular, we estimate the following equation:

$$Entry_{csrt} = \alpha T_c + \beta T_c \times PostBrexit_t + \gamma F_{csrt} + \delta_t + \phi_s + \psi_r + \varepsilon_{csrt} \tag{6}$$

where $Entry_{csrt}$ is the year-to-year growth rate of the number of incorporations, measured as the change in the inverse hyperbolic sine transformation ($arcsin$) of the new number of businesses in sector s and TTWA r created by founders from country c, between quarters t and $t-4$;[17] T_c is a dummy variable that equals one if its founder (or at least half of them if there is more than one) is from an EU country; $PostBrexit_t$ is an indicator variable that equals one from the second quarter of 2016 onward, which is when the Brexit referendum took place; F_{csrt} denotes the total number of firms in that country-sector-TTWA triplet in quarter t; δ_t represents quarter fixed effects; ϕ_s are one-digit sector fixed effects; ψ_r are TTWA fixed effects; ε_{csrt} is the error term. Our parameter of interest is β, which measures the differences in the entry of new firms from EU founders after Brexit relative to the entry of new firms from other immigrant founders. In all the estimations, we cluster the standard errors at the region×sector level to account for correlated errors at this level. Moreover, we drop all the TTWA-sector-nationality triplets for which the number of new firms is always zero between 2013 and 2018 since those observations do not bring any new variation to our estimation, and they would reduce the size of our estimated coefficients and deflate the standard errors.

[16] Among other things, immigrant entrepreneurs have been found to export more goods and services than native entrepreneurs (Wang & Liu, 2015), rely on market connections to market their products (Wahba & Zenou, 2012), benefit from local immigrant communities for expanding into new markets (Hernandez, 2014) and surviving (Kalnins & Chung, 2006; Hernandez & Kulchina, 2020), have access to unique capital resources (Kulchina, 2016a), identify entrepreneurial opportunity differently (Wang, 2020), and are more likely to engage in international activities, meaning that they might be more exposed to uncertainty brought about by Brexit than their native counterparts. Also, immigrant-founded firms have, in general, fewer employees than native-founded firms, but they tend to have higher productivity and higher rates of growth and survival (Kerr & Kerr, 2020).

[17] The inverse hyperbolic sine transformation has gained popularity in recent years because it has some of the desired properties of the natural logarithm, and it allows zero- and negative-valued observations, which tend to convey important information that the log or the log+1 transformations ignore (Bellemare & Wichman, 2020).

Since the nationality of the entrepreneurs is arguably exogenous, we are confident that we are estimating the causal effect of Brexit on entrepreneurship from European immigrants. However, we need to analyze whether there are significant differences in the quarterly growth rates of new firms between EU and non-EU immigrants before Brexit, that is, whether there are parallel trends between treatment and control groups. To see this, we estimate the following event study specification:

$$Entry_{csrt} = \alpha T_c + \sum_{u=13q1}^{15q4} \beta_u T_c \times 1_{\{t=u\}} + \sum_{u=16q2}^{18q4} \beta_u T_c \times 1_{\{t=u\}} + \gamma F_{csrt} + \delta_t + \phi_s + \psi_r + \varepsilon_{csrt} \quad (7)$$

where $1_{\{t=u\}}$ is an indicator variable that equals one for quarter u, and the rest of the notation follows equation (6). If there are parallel trends, β_u would be statistically equal to zero for every quarter in 2013, 2014, and 2015. Moreover, this specification allows us to study the medium-run effects of the Brexit referendum until the fourth quarter of 2018 through the estimated coefficients of β_u for $u > 2016q2$.

Finally, we test Hypothesis 2 and 3 by estimating the heterogeneous effect of Brexit on different groups of firms, either by quality or by their reliance on immigrant actors, by estimating equation (6) for different groups of firms separately. We follow this strategy because these variables vary at the firm level, and thus, it is not possible to estimate a triple-differences model.

6. Empirical Results

In this section, we present the main empirical result of our paper, i.e., the effect of Brexit on immigrant entrepreneurship. Moreover, we present empirical tests of the main mechanisms suggested by our model, including the heterogeneous effects of this event by firms of different quality and reliance on immigrant actors, as well as our empirical measures for these variables.

6.1 The Impact of Uncertainty on Firm Entry

In Table A-3 in the Appendix, we show that our main result is robust to a variety of checks and alternative specifications. In particular, one might worry that using population at the country of

nationality as a weight is not appropriate for this specification since some nationalities have historically different entrepreneurial rates and dispositions toward entrepreneurship (e.g., Aldrich & Waldinger, 1990). Therefore, in column (1), we weight our regressions using the number of self-employed people in the country of nationality. In column (2), we show that our results are robust to the addition of British firms in the control group. Since roughly 30% of new firms are created in London, we might worry that the decrease in entry observed comes exclusively from the London area. The specification in column (3), which excludes the TTWAs from the London area, shows very similar coefficients. In column (4), we include sector×date fixed effects to control for any time-varying unobservables at the sector level that might play a role in the entry decisions of immigrant entrepreneurs, such as trade uncertainty generated by Brexit. One might also be concerned that our results are still driven by within-sector variation if the one-digit sector fixed effects we include in the regressions are unable to capture enough time-invariant sector-level variation. Therefore, in column (5), we estimate our preferred specification, including two-digit sector fixed effects. Notice that the estimators that result from these multiple robustness checks are statistically equal.[18]

Finally, as we do not observe entry for several nationality-sector-TTWA-quarter combinations, another threat to our empirical strategy might be the large number of zeros in our dependent variable. Moreover, it might be that the use of the inverse hyperbolic sine tends to emphasize bins with small counts. To investigate whether these factors represent a problem, we estimate the regression using a Poisson model and the number of new businesses as the dependent variable. The results from this specification, shown in column (6), suggest a decrease of 0.19 new firms from treated nationality-sector-TTWA triplets after Brexit.[19] Overall, the main results are robust to the use of this specification as well as other checks.[20]

[18] If migrants that are still in their home country were considered, it is possible that the Brexit referendum made the UK a less attractive destination. This implies that potential entrepreneurs will need a stronger incentive to move to the UK, meaning that our estimate is most likely a lower bound of the actual effect of Brexit on immigrant entrepreneurship.

[19] Given the large number of treated triplets (19,088), an effect of –0.19 could suggest a loss of 3,665 new firms in the two years after Brexit; around four times larger than the magnitude previously predicted.

[20] Results are also robust to the inclusion of immigrant businesses in the Agriculture and Mining sectors, which we

To study whether the parallel-trends assumption holds and to investigate the effects of the Brexit referendum over time, we estimate equation (7). Figure 2 shows the estimated coefficient for the interaction $T_c \times PostBrexit_t$ over time (quarters) relative to the first quarter of 2016. Before the Brexit event, we see no statistical difference in the growth rate of new firms in the treatment relative to the control group. The absence of pre-trends before the Brexit event helps validate our difference-in-difference setup, highlighting how both groups followed a similar growth pattern before the advent of the Brexit referendum. After Brexit, the growth rate of EU-founded businesses is significantly lower than zero for most of the quarters. Thus, this figure shows that the impact of the Brexit referendum on the entry rate of EU firms was not something temporary, but it led to a persistent decrease in the entry of EU-founded businesses over time. It is worth noticing how this result should be interpreted as an effect over the medium run, as we do not know whether the final Brexit agreement–and the consequent immigration policies implemented by the UK in 2021–have led to an increase or a decrease in immigrant entrepreneurship.[21]

We also use equation (6) to perform some initial heterogeneity analysis of our results. For instance, when looking at geographical areas, Table A-4 shows not only that England was exposed to the decline in immigrant-based entry, but Scotland and Wales were also heavily affected. Moreover, Table A-5 shows that Brexit had a larger negative effect on entrepreneurial entry in the Greater London area but also affected entry in all cities and towns, regardless of their size, with the exception of rural areas. Finally, when looking at the Brexit referendum vote, both types of areas (regardless of whether they predominantly voted "Stay" or "Leave") experienced a decline in entry, even though the anti-Brexit areas faced a harsher reduction in immigrant-based businesses.

originally dropped. These results are available upon request. One might also worry that the rise of right-wing governments right before or after the Brexit event, such as Donald Trump's election in the US in November 2016, might be driving our results as they could have changed the perception of immigrants about immigration policy. We are confident that our results are not directly affected by this event. First, in our event study (Figure 2), the coefficient for the fourth quarter of 2016 is not significant, while the coefficient for the third quarter of 2016 is significant, suggesting that the negative effects of Brexit started before Trump's election. Second, Table A-12 in the Appendix shows that the exclusion of firms founded by Americans and individuals from the countries targeted by Trump's Muslim ban does not impact our coefficients.

[21] Figure A-2 shows a similar plot using monthly data instead of quarters.

6.2 Uncertainty and Reliance on Immigrant Actors

The second hypothesis emerging from our theoretical model suggests that businesses that are over-reliant on immigrant actors might experience a much higher level of uncertainty as immigration policies get stricter. Although it is challenging to capture reliance on immigrant actors, in this paper, we attempt to measure it through multiple variables.

First, we leverage information about immigrants' past entrepreneurial experience in Great Britain. Because our data allow us to track the whole founding history in Great Britain for all immigrant entrepreneurs going back to 1995, we can precisely identify firms that have at least one founder with some past entrepreneurial experience. The rationale underlying this measure is that experienced entrepreneurs might be able to exploit a wider and, possibly, a more diverse network than non-experienced entrepreneurs, which might be more reliant on immigrant actors (Shane & Cable, 1998; Batjargal & Liu, 2004; Kalnins & Chung, 2006). Results in Table 3 show that founding teams without previous entrepreneurial experience are indeed driving our results. In fact, the effect for this group is five times as large as the effect for entrepreneurs with previous entrepreneurial experience.

Second, we use team size as an alternative measure of immigrant reliance, as larger founding teams are more likely to have at least one founder who was not exposed to the uncertainty brought by the Brexit event. Table A-7 in the Appendix shows that the negative effect on entry comes mainly from firms with one founder, followed by firms with two founders; the effect on firms with three or more founders is not significantly different from zero. Third, we use the average age of the founding team, as older entrepreneurs might have a wider network of contacts than younger entrepreneurs; thus, they might be more embedded in the host country (Speare Jr et al., 1982). Table A-8 shows how only relatively young founding teams (i.e., a founding team with an average age under 42) experienced a decline in entry.

Finally, we leverage information about industries, as some sectors are historically more reliant on

immigrant actors (Kerr & Kominers, 2015). Table A-9 in the Appendix shows how firms belonging to wholesale, retail, hotels and restaurants, transport and communication, finance, and business services were the ones hit hardest by Brexit. This is broadly consistent with our hypothesis as sectors that might heavily cater to immigrant customers (e.g., retail, wholesale, and restaurants) or might employ more immigrant employees (e.g., finance and business services) might have been more exposed to the increase in uncertainty. Overall, all these results point to how companies that are more dependent on other immigrant actors experience a sharper decrease in entry after Brexit than companies less dependent on immigrant stakeholders.

6.3 Immigrant Entrepreneurship, Quality, and Uncertainty

The model presented in Section 3 predicts that the negative effect on the entry of EU-founded firms observed after the Brexit referendum comes from low- and high-quality firms while having a weak effect for medium-quality firms (Hypothesis 3). In this section, we empirically test these hypotheses in order to get at the mechanisms underlying our results, and we provide further descriptive evidence that helps to validate our theoretical framework.

6.3.1 Venture Quality

Measuring venture quality at birth is one of the main challenges we face when empirically validating the predictions of our model. This has been a long-standing problem in the entrepreneurial literature, and until only recently, scholars have been able to produce measures that capture this concept. A breakthrough has been provided by Guzman and Stern (2020), who assign a quality score to the whole population of US startups depending on the presence of certain characteristics at founding that are strongly correlated with a future IPO or an economically significant M&A.

In this paper, we propose a different approach: we argue that the incorporation document filed at the time of founding can reveal a great deal about the potential and growth prospects of a business. Founders of a high-quality startup might be more explicit in their incorporation document in

an attempt to foresee specific contingencies and events that could happen in a non-distant future. Moreover, since these firms tend to involve a great deal of intellectual property and specific assets—which are relatively hard to define, measure, and control—their incorporation document may include more-complex language, particularly for firms where venture capitalists are involved or are predicted to be involved in a near future. Therefore, the length of the incorporation document could be a good proxy for initial quality, as it might be correlated with some of the fundamental variables determining it.[22] As such, we use the number of pages of incorporation documents filed within one year since the incorporation date of the firm as a quality measure.[23] Section A3 describes our variable more in detail and shows how it is highly correlated with more traditional quality measures (e.g., financial performance, patents, presence of investors, etc), which are usually observed later in the life of a company.

Using the length of the incorporation document as our measure of quality, we separate all new firms into three groups: (1) low-quality firms, those below the 20th percentile of the length distribution (1–7 pages); (2) medium-quality firms, whose incorporation documents are 8 to 26 pages long (between the 20th and 80th percentiles); and (3) high-quality firms, which are above the 80th percentile of the distribution, i.e., their document has at least 27 pages. For each group, we estimate equation (6) separately.

Table 4 shows that after Brexit, there was a strong reduction in the entry of both low- and high-quality firms. Specifically, there was a 2.9% reduction in the growth rate of new low-quality firms and a 2.6% reduction for high-quality firms. Both of these coefficients are significantly different from the estimate for middle-quality firms, which is statistically equal to zero. Following back-of-the-envelope

[22] Developing the literature on endogenous incomplete contracts, Tirole (2009) further argues that "the pursuit of individual interests may make contracts too complete." Therefore, if we consider that high-quality startups have higher expected profits, they will tend to write longer, more complete incorporation documents. See also Bolton and Faure-Grimaud (2010) for further analysis of this literature.

[23] Firms can rectify or add to the incorporation document anytime during their life. We consider incorporation documents within one year from the incorporation date. Our results are robust even if we consider only the initial documents filed at incorporation, as almost all firms do not modify or file further incorporation-related documents within one year.

calculations similar to the one in Section 2, these percentages imply that there were approximately 616 low-quality and 245 high-quality firms that were not incorporated in the UK after Brexit. Moreover, notice that the coefficient for middle-quality businesses, while negative, is statistically equal to zero, suggesting a null effect of entry for firms in this category. In general, our results support the main predictions of our theoretical model.[24]

6.3.2 Low-Quality Immigrant Entrepreneurs and the Labor Market

The model also predicts that prospective entrepreneurs with low-quality ideas could be better off taking up paid employment rather than establishing their businesses in the host country. Because it is extremely challenging to identify prospective founders with low-quality ideas in any dataset, we proxy the quality of prospective entrants using the skill level of the workforce in the UK (Van der Sluis et al., 2008). In particular, we leverage the Labor Force Survey (LFS)[25] to understand whether there was a surge in the fraction of low-skilled people seeking paid employment after the Brexit referendum.

Leveraging the LFS data, we look at the number of people, by educational achievement and nationality, who are looking to be paid employees and those looking to be self-employed. We define "low-skilled" workers as those who hold no degree (i.e., who have not earned at least a bachelor's degree or equivalent.), and estimate the following difference-in-difference equations:

$$\begin{aligned} \frac{E_{ct}}{L_{ct}} &= \alpha T_c + \beta T_c \times PostBrexit_t + \gamma X_{ct} + \delta_t + \phi_c + \varepsilon_{ct} \\ \frac{S_{ct}}{L_{ct}} &= \alpha T_c + \beta T_c \times PostBrexit_t + \gamma X_{ct} + \delta_t + \phi_c + \varepsilon_{ct} \end{aligned} \tag{8}$$

where $\frac{E_{ct}}{L_{ct}}$ represents the share of low-skilled people from country c in the UK who are looking for a job in quarter t out of all low-skilled people from c; likewise, $\frac{S_{ct}}{L_{ct}}$ represents the share of low-skilled people from country c in the UK who are looking to be self-employed in quarter t; T_c is a dummy

[24] Our model also predicts that lower reliance on other immigrant actors in the host country should weaken the effect of uncertainty regardless of firm quality. We test this prediction by estimating equation (6) separately for four groups of firms, according to their previous experience (has or does not) and quality level (low or high). In Table A-11, we show support for this theoretical prediction: the negative effect on entry for low- and high-quality businesses is driven mainly by firms that show a high reliance on other immigrant actors in the host country.

[25] This quarterly survey of households living in the UK is managed by the Office for National Statistics, and it contains information regarding their labor-market participation.

variable that equals one if the country belongs to the EU, and zero if it belongs to the rest of Europe; $PostBrexit_t$ is an indicator variable that equals one starting in 2016q3; X_{ct} is a set of controls at the country-of-origin level;[26] δ_t represents period fixed effects; ϕ_c represents country of origin fixed effects; and ε_{ct} is the error term. As before, we estimate the regression using the population of the country of origin of the founder as weights.

The results from this estimation suggest that in the post-Brexit period, the share of low-skilled individuals from EU27 countries looking for employment rose, while the share of individuals from EU27 countries seeking self-employment fell. In particular, the share of low-skilled EU27 citizens looking to be employees increased by 25 percentage points, while the share of them who wanted to be self-employed decreased by 20 percentage points. These results, presented in Table 5, are consistent with the prediction of our model. An alternative version of this table, considering three levels of education, is included in Table A-13 in the Appendix.

6.3.3 High-Quality Immigrant Entrepreneurs and Entrepreneurial Mobility

We also check whether the data support the prediction regarding high-quality ventures, i.e., that some of the decrease in entry found in Section 6.1 stems from high-quality firms that move to another country. Finding data that track immigrants over time and across different countries and reporting information about their entrepreneurship activity is especially arduous. Nonetheless, we can still provide some circumstantial evidence by analyzing whether EU countries have experienced a post-Brexit surge in the incorporation of high-growth startups, which could be suggestive evidence of a possible shift of incorporations from Great Britain to these countries.

To assess whether this is the case, we use a difference-in-difference specification similar to the one from equation (6). However, we now use data from Eurostat at the country, industry, and year levels between 2012 and 2019,[27] and define EU27 countries as the treatment group and non-EU27 European

[26] In our regression, we include GDP per capita, percentage of the population who are self-employed, unemployment, and percentage of the population who completed secondary education. Source: World Bank.

[27] Source: Eurostat Table bd_9pm_r2, available at https://appsso.eurostat.ec.europa.eu.

countries as the control group.[28] To capture high-quality startups, we define them as those ventures with an average annualized employment growth greater than 10% per year over a three-year period. In particular, we estimate the following specification:

$$Entry_{ct} = \beta T_c \times PostBrexit_t + \gamma X_{ct} + \delta_t + \phi_c + \varepsilon_{ct} \tag{9}$$

where $Entry_{ct}$ is the inverse hyperbolic sine of the number of high-quality businesses in country c in year t; T_c is a dummy variable that equals one if the country belongs to the EU, and zero otherwise; $PostBrexit_t$ is an indicator variable that equals one for 2016, 2017, and 2018; X_{ct} is a set of controls that includes the ones described in equation (8), and the startup costs of businesses (as % of gross national income per capita) and business taxes (as % of profits) from the World Bank, which are meant to capture the attractiveness and the incorporation costs in each country; δ_t represents period fixed effects; ϕ_c represent country fixed effects; and ε_{ct} is the error term. We estimate the regression using the population of the country of origin of the founder as weights. Since our data do not allow us to track the movements of prospective immigrant entrepreneurs across countries, we do not consider our estimates to be causal, but we believe that they show important correlations that support the predictions of our model.

Table 6 shows the estimation results of equation (9). Overall, countries that are members of the EU show faster growth in the incorporation of high-quality businesses following the Brexit referendum, compared to other European countries that are not members. In particular, the growth of high-quality ventures in EU-member countries increases by 12.5% relative to non-EU members. We also estimate equation (9) using the share of high-growth firms in each country as the dependent variable. The results show that after the Brexit referendum, the share of high-growth firms increased by 2.3% in EU27 countries relative to non-EU27 European countries. It is interesting to note that we can observe a similar pattern even when considering VC investment in EU27 countries versus non-EU27 European

[28] This group includes countries such as Iceland, Norway, Switzerland, and Turkey. The results are robust to the inclusion of the UK in the control group.

countries (see Table A-16 in the Appendix)

Figure 4 sheds light on which EU27 members have experienced the largest increases in the number of new incorporations. Specifically, we plot the share of new high-quality businesses over total businesses each year, relative to the share in 2016. The country with the greatest surge, compared to the pre-Brexit period, is the Netherlands, followed by Slovenia, Estonia, France, and Finland. This is not particularly surprising, as these countries are either geographically close to the UK, and research has shown how the availability of transport infrastructure can increase information flows (Agrawal et al., 2017), or have adopted aggressive policies to boost their entrepreneurial ecosystem (e.g., Estonia and Finland).

7. Discussion

In this paper, we study the consequences of an increase in uncertainty on the entry rate of immigrant entrepreneurs. We shed light on this question by exploiting the unexpected result of the Brexit referendum, which suddenly increased immigration uncertainty faced by EU immigrants in the UK. Using a novel data set that includes the universe of new firms in Great Britain, together with information about their founders, we test whether the Brexit referendum in 2016 affected the entry rate of firms founded by immigrants from the EU. We propose a model of immigrant entrepreneurial entry where founders with varying entrepreneurial quality and different levels of reliance on immigrant actors decide whether to establish their venture in Great Britain, join the labor market as employees, or establish their venture in an EU country. We test the model predictions empirically by leveraging a novel measure of venture quality that considers the incorporation document of the venture at founding.

Our results suggest that the Brexit referendum decreased the growth rate of new immigrant-based firms by 3.2%, which roughly translates to just over 900 firms in the two years following the event. When examining the mechanisms, we find that immigrant-based companies that are dependent on other immigrant actors are more impacted by increases in immigration uncertainty. When looking at

venture quality, the firms most affected by Brexit are either low-quality or high-quality firms, while the effect on middle-quality firms is not significant. In particular, we estimate the loss of around 620 low-quality firms and around 250 high-quality firms. We argue that these results can be explained by the different sorting behaviors of prospective founders. On one hand, individuals with low-quality ideas are better off taking up paid employment, as the expected profits from their venture would be lower than the wage they could get as employees. At the same time, profits from a low-quality venture might not justify the costs of moving to an EU country. On the other hand, prospective founders of high-quality ventures might not find a job that would deliver better-expected rents than those generated by their venture and might decide to establish their venture elsewhere.

Our paper contributes to previous research connecting environmental factors and immigrant entrepreneurial entry by shedding light on the role of immigration uncertainty on immigrant entrepreneurship. Numerous papers focus on the impact of environmental features on firm entry and performance (e.g., Romanelli, 1989; Dahl & Sorenson, 2012). Others focus on the role of location and agglomeration economies on entrepreneurship (e.g., Glaeser et al., 1992; Delgado et al., 2010; Kerr & Kominers, 2015) and, specifically, on immigrant-based businesses (Kalnins & Chung, 2006; Kulchina, 2016b; Hernandez & Kulchina, 2020). Our study contributes to this last stream of the literature by shedding light on an unexplored environmental feature, i.e., immigration uncertainty, and its influence on immigrant entrepreneurial entry. Our paper also relates to works documenting the effects of changes in immigration policy on the economy of the receiving country. Several scholars have found that immigration policies can have a profound influence on patenting activity Kerr and Lincoln (2010), firm profits (Mayda et al., 2020), tech-related employment (Peri et al., 2015), and immigrant entrepreneurial entry decision (Agarwal et al., 2021). Differently from these works, our paper focuses on immigration uncertainty preceding a potential change in policy.

This paper is not exempt from limitations. First, our uncertainty event, the Brexit referendum, is an exceptional occurrence, which created a sudden and strong shock in uncertainty. Future work

should exploit uncertainty events in other countries and replicate our results. Second, we cannot fully unpack the mechanisms underlying an increase in uncertainty and how businesses in different sectors can be affected by it. Future work should shed light on this aspect using qualitative or survey-based research. Finally, our analysis considers only the short-term effects of the Brexit referendum on entrepreneurship. It is challenging to evaluate the longer-term effects of Brexit as the COVID-19 pandemic becomes a major confounder starting in 2020.

Due to the growing importance of immigrant entrepreneurship to the economic growth of host countries, our findings offer important implications. From a managerial point of view, our work is the first to highlight the role of immigration uncertainty in immigrant entrepreneurs' entry decisions. In particular, these results might inform prospective immigrants of the negative effects of uncertainty on their propensity to become entrepreneurs. Immigrant-based firms whose survival depends on other immigrant actors (i.e., firms that tend to have immigrant suppliers, employees, and customers) are especially hard-hit by uncertainty, as the immigration status of these stakeholders is in danger. Also, depending on the quality of their venture, prospective immigrant entrepreneurs could be better off taking up employment or moving to other countries. In general, we highlight how uncertainty could lead to sub-optimal entrepreneurial entry decisions, as some prospective immigrant founders are discouraged to enter to avoid the costs associated with higher uncertainty. Our paper also shows how social capital and a wide and diverse entrepreneurial network may be important weapons for mitigating the negative effects of uncertainty.

From a policy point of view, our results suggest that increases in uncertainty in the immigration environment might discourage some potential immigrant entrepreneurs from establishing their firms in the host country. While several studies inform policymakers about policies that aim to allow or limit the entry of new immigrants into a country, our paper speaks to policies that tend to limit the status and ability to stay of immigrants that are already in a country, which have become increasingly

common in the past few years[29]. While the setting in our paper is the European Union, which benefits from extensive immigration freedom, we believe this paper also speaks to immigration policies in other countries. For instance, the increasingly long time needed to be granted a green card in the US and the administrative hurdles associated with it can be assimilated to events that affect the kind of uncertainty we study in this paper (e.g., Kahn & MacGarvie, 2020). Our paper also finds that potential founders of high-quality firms might decide to leave the country and establish their business elsewhere. Despite being relatively few in number, these ventures might exert a disproportionate effect on the growth of regional economies of their host countries (Moretti, 2012), and their loss might have devastating effects on the entrepreneurial ecosystem of a country.

[29]For instance, consider the rise in the denial rate of H1B visa extension during the Trump administration. Other examples include the block of green cards during the COVID-19 period and the changes to the DACA program.

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Figures and Tables

TABLE 1: Average Number of New Firms by Country, Before and After Brexit

	Country Level				Country-Sector-TTWA Level			
	New Firms		Growth Rate		New Firms		Growth Rate	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
EU27	620.5	693.8	13.6%	1.0%	0.88	0.98	4.16%	1.03%
Rest	98.1	116.9	8.1%	5.7%	0.58	0.69	2.28%	0.88%

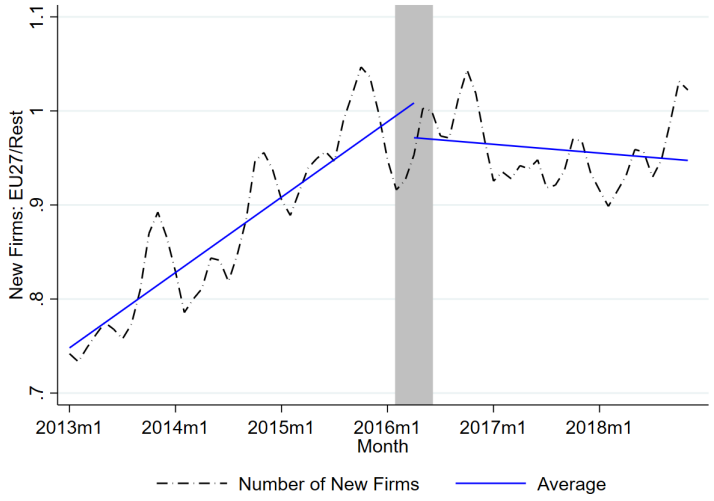
Notes: This table shows the average number of new firms and the average growth rate (across quarters year-to-year), before and after Brexit, created by founders from EU27 countries and the rest of the world. The first four columns present these statistics at the country-of-nationality level. The last four columns present them at the nationality—one-digit sector—TTWA level. We dropped all country-sector-TTWA triplets that were zero for every quarter in the last panel.

TABLE 2: Brexit and Entry Rate of European Firms

	(1)	(2)	(3)
	Dv: Growth in the Number of New Firms		
Control Group:	All	All	All
Specification:	OLS	OLS	OLS
Sample:	All	All	All
EU-27	0.021***	0.026***	0.033***
	(0.002)	(0.003)	(0.003)
EU27*Post	-0.017***	-0.032***	-0.031***
	(0.003)	(0.005)	(0.005)
Observations	933,340	931,480	913,532
Sector FE	YES	YES	YES
TTWA FE	YES	YES	YES
Date FE	YES	YES	YES
Controls	NO	NO	YES
Weight	NO	Pop	Pop

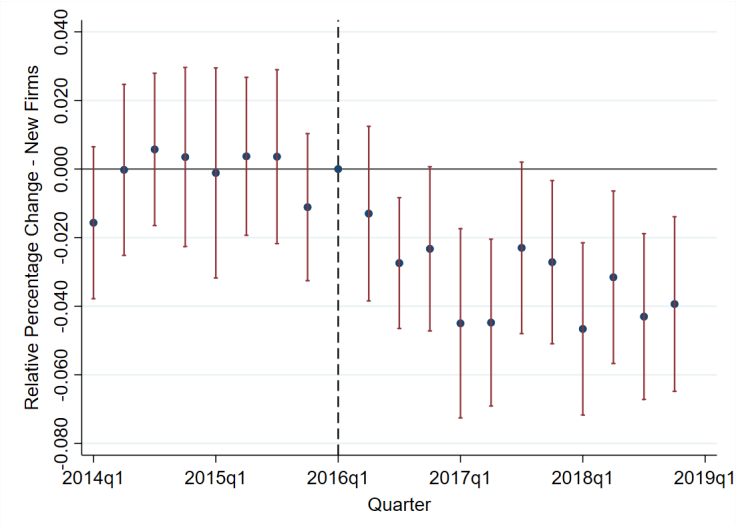
Notes: This table includes the coefficients from different regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Column (1) and (2) do not include controls. In column (3), we include a large set of controls at the TTWA level (sectoral employment shares in 2007, employment rate, share of population with a college degree, share of White UK-born population) and at the country-of-nationality-of-the-founders level (GDP per capita, population, unemployment rate, and self-employment rate). Columns (2) and (3) weight the regression using the population of the country of nationality of the founders (i.e., the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

FIGURE 1: EU Firm Entry Versus Entry From the Rest of the World Pre- and Post-Brexit



Note: This figure plots the number of new EU firms (i.e., firms whose founders are EU nationals) relative to the number of native and rest-of-the-world firms (i.e., firms whose founders are British nationals or belong to a rest-of-the-world country). Series are smoothed using a three period moving average. The gray band denotes the relevant months of the Brexit event (i.e., announcement of the referendum and the vote).

FIGURE 2: Difference-in-Difference Treatment by Year



Notes: This figure shows the coefficients of the interaction of the variable EU×Post across time (quarters) from the specification described in Eq. 6. The interaction is equal to one in the quarter indicated for EU firms, and zero otherwise. Solid lines refer to 90% confidence intervals obtained using clustered standard errors at the region and sector levels.

TABLE 3: Entry by Past Entrepreneurial Experience

	(1)	(2)
Dv: Growth in the Number of New Firms		
Past experience	Yes	No
EU27	0.006**	0.031***
	(0.003)	(0.003)
EU27*Post	-0.007	-0.035***
	(0.005)	(0.005)
N	641,260	781,860
Sector FE	YES	YES
TTWA FE	YES	YES
Date FE	YES	YES
Controls	NO	NO
Weight	Pop	Pop

Notes: This table includes the coefficients from regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by past entrepreneurial experience. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE 4: Entry by Firm Quality

	(1)	(2)	(3)
	Dv: Growth in the Number of New Firms		
Firm quality	Low	Medium	High
EU27	0.022***	0.015***	0.015***
	(0.004)	(0.003)	(0.003)
EU27*Post	-0.032***	-0.004	-0.029***
	(0.008)	(0.005)	(0.004)
N	471,920	728,260	488,260
Sector FE	YES	YES	YES
TTWA FE	YES	YES	YES
Date FE	YES	YES	YES
Controls	NO	NO	NO
Weight	Pop	Pop	Pop

*Notes:*This table shows the coefficients from different regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by firm quality (proxied with the length of their incorporation document). The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE 5: Share of Low-Skilled Job Seekers Before and After Brexit

Dv:	(1) Low-skilled seeking a job as employees	(2) Low-skilled seeking a job as self-employed
EU27*Post	0.247***	-0.196***
	(0.000)	(0.000)
Observations	263	226
R Squared	0.328	0.363
Country of Origin FE	YES	YES
Quarter FE	YES	YES

Notes: This table contains the coefficients from two regressions showing the change after the Brexit referendum in the share of (1) low-skilled people seeking a job as an employee (column 1) and (2) low-skilled people seeking to be self-employed (column 2) in the UK. Our treatment group includes the countries in the European Union, while the rest of the countries in Europe constitute the control group. Regressions are weighted using population of the country of origin and include the following controls: GDP per capita, percentage of self employed and unemployed population, and percentage of people with secondary education. Data from these regressions come from the 2015–2017 Quarterly Labor Force Survey and are aggregated at the country-of-origin and quarter level. Robust standard errors are reported in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE 6: High-Growth Startups in EU27 Countries After Brexit

	(1) Growth of High-Growth firms	(2) Share of High-Growth firms
EU27*Post	0.125**	0.023***
	(0.050)	(0.005)
Observations	1,962	1,893
R Squared	0.993	0.882
Country*Sector FE	YES	YES
Year FE	YES	YES

*Notes:*This table includes the coefficients from different regressions showing the effect of the Brexit referendum on the number of high-growth firms in the European Union (UK excluded). The dependent variable in column (1) is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the number of high-growth ventures. The dependent variable in column (2) is the share of high-growth businesses on the total number of businesses. Regressions are at the industry and country levels. Regressions are weighted using country population and include the following controls: GDP per capita, percentage of self employed and unemployed population, percentage of people with secondary education, start-up costs and business taxes. Clustered standard errors at the industry and country levels are in parentheses: (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

FIGURE 3: Model-based Scenarios

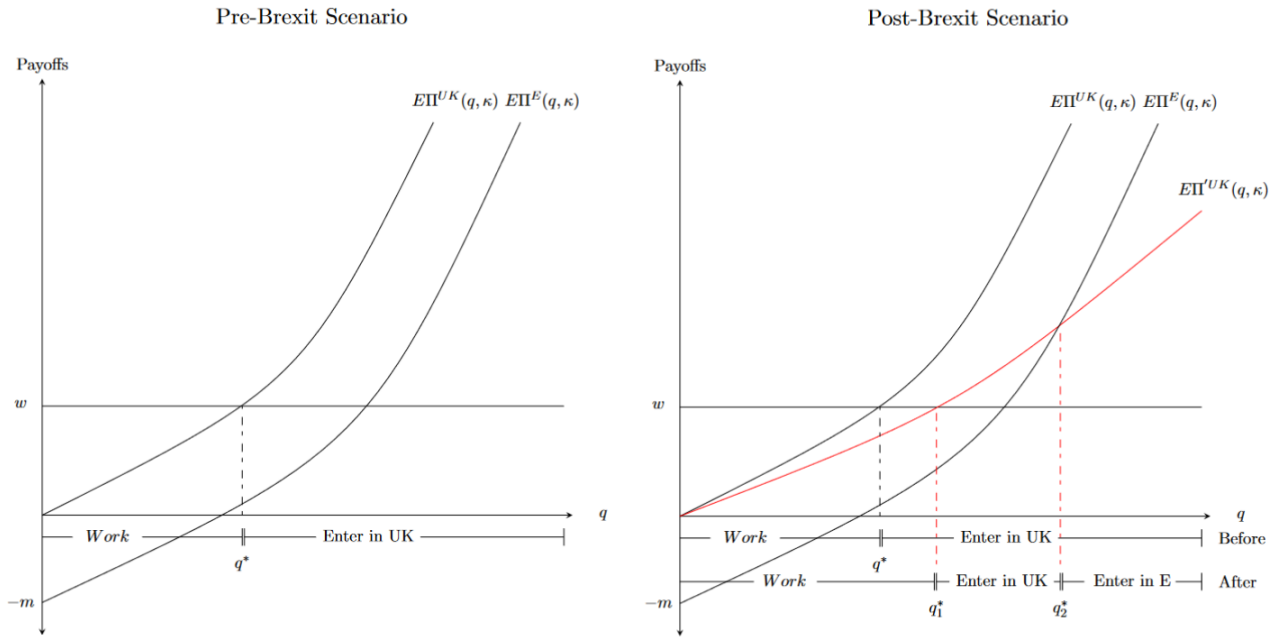
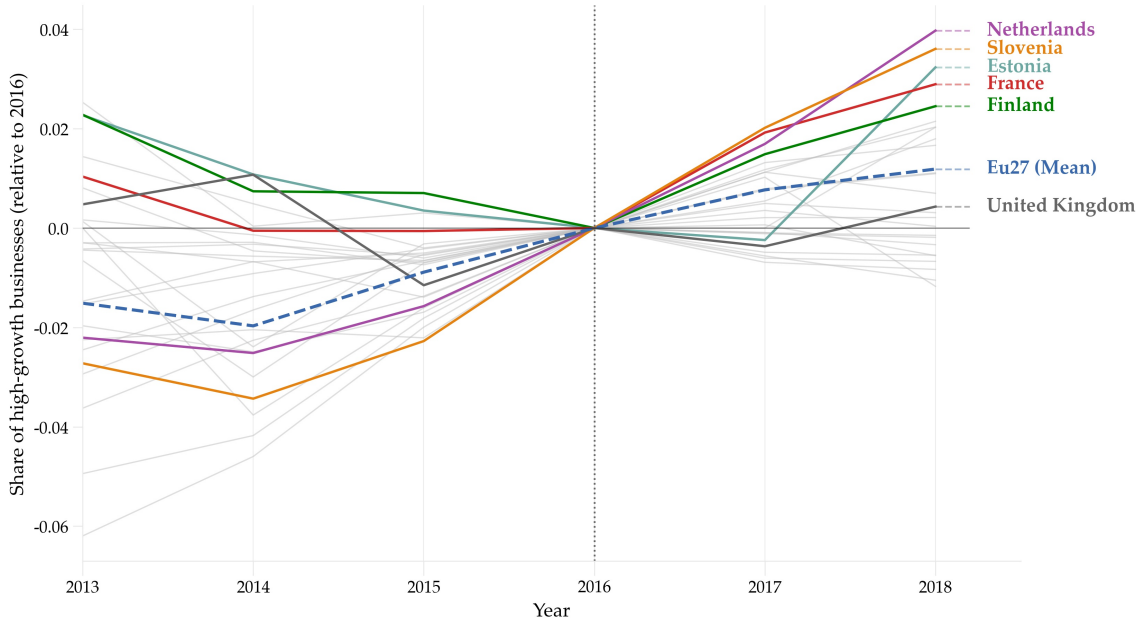


FIGURE 4: High-Quality Entrepreneurship in EU Countries After Brexit



Note: This figure shows the share of high-quality businesses in European countries and in Great Britain relative to 2016.

Uncertainty and Immigrant Entrepreneurship: Evidence From Brexit

Appendix

(for online publication)

A1. The Entrepreneurship Dataset

A1.1 Data Aggregation

Data on incorporations in Great Britain are provided by Companies House, the UK business registry. One of this dataset's main advantages is that it does not suffer from under-representation of small firms: all companies are tracked from their incorporation until their dissolution, regardless of their financial figures or the number of employees, which allows us to precisely track entry and exit of all firms in the economy. This is often not the case with other widely used datasets (e.g., Business Structure Database, VAT registrations), which tend to include only firms that surpass some employment or turnover threshold. Overall, business registry data allow researchers to get an accurate image of a country's entrepreneurial landscape, which is why they have increasingly gained momentum in the literature studying entrepreneurship (e.g., Guzman & Stern, 2020).

We collect information on every firm that has been active at any point in our period of interest (i.e., from December 2012 to December 2018 included). From this initial set of firms, we exclude some particular types of firms such as partnerships, insurance companies, European companies (i.e., European Economic Interest Grouping, Societas Europaea), royal charters, ICVCs (Investment company with variable capital), and industrial/provident companies. We also exclude dormant firms, i.e., firms that are incorporated but not actively trading on the market.[30] We also discard ≈421,000 firms that belong to specific sectors (i.e., agriculture, hunting, and forestry; fishing, mining, and quarrying; utilities; public administration and defense; extraterritorial organizations; and private households with employees) and ≈26,000 firms that appointed other firms as directors. Our final sample contains ≈5.6 million unique firms.

It is worth noticing that roughly 600,000 firms in our data do not have information about the industry as companies are not required to report it when they register but within one year after

[30] This group includes firms that are classified as dormant, as well as firms that were created at some point in our period but have not filed any financial records for more than four years after their incorporation.

the incorporation date. We exploit firms' names and fill in the missing values by using a prediction algorithm that exploits the fact that the firms' names can give information about their industry. For instance, a company named "Matt's Pizza" has a higher chance of belonging to the "Hotels and Restaurants" industry than others. More information about this prediction exercise is available in Marinoni (2020).

A1.2 Assigning Nationalities to Firms

In order to assign nationalities to firms, we proceed by collecting every nationality for each founder of each firm. It might be that an individual holds multiple passports, i.e., belongs to different nationalities. In this case, we assign a unique nationality by giving precedence to the UK, EU, and the rest of the world, respectively. For instance, if a founder is British and French, we assign a British nationality; if the founder is French and American, we assign a French nationality; finally, if a founder belongs to two rest-of-the-world countries, we assign the nationality located closer to the UK.

We proceed in this way in order to give priority to the "most relevant" nationality for our case. For instance, if an individual is both a British and French citizen, she will not be affected by Brexit, as she can easily rely on her British passport, so we would code her as British. We then go ahead and assign a "firm nationality" based on the nationality that most appears in the founding team. In case of ties (i.e., two founders with different nationalities), we prioritize European countries over rest-of-the-world countries. We also rank nationalities depending on the geographical distance between the UK and the country (i.e, if there is an Italian founder and a Dutch founder, we prioritize the Dutch nationality). We build this variable using all 220 foreign nationalities present in our data.

A2. Weighting and Heteroskedasticity

We argue that a weighted regression is necessary for our context because of the presence of heteroskedasticity. This can manifest in two ways. First, less populous countries might have a lower

variance in terms of firms than more populous countries since their population is lower. Second, there might be heteroskedasticity in changes, i.e., an increase in a few firms implies a large percentage change for less populous countries, but for a lot of bins, there will be no change (high variance). For more populous countries, the percentage changes will be small for all bins (low variance). Following (Solon et al., 2015) and (Wooldridge, 2015), we perform a Breusch-Pagan test where the residuals from an unweighted OLS regression are regressed on the inverse within-group sample size (i.e., country population). The result of this test confirms our hypothesis of significant heteroskedasticity across groups in our context (see Table A-2), thus motivating our use of weights.

A3. Validation of Our Novel Venture Quality Measure

We propose a new measure to capture firm quality *at founding* that leverages the incorporation document that each firm must submit at the moment of incorporation. The information required in this document is usually quite basic, and founders are usually required to indicate only the company name, incorporation date, company address, founders' information, and the number and allocation of the initial shares in the firm. However, high-quality high-growth companies tend to include more clauses and rules that will be applicable in different scenarios according to several contingencies in an attempt to better protect their assets. For instance, they might insert clauses related to decision-making, or they might create different types of shares that hold different types of voting and redeeming rights. Since companies are allowed to amend the clauses in the initial incorporation contract, we will take into account the incorporation document and all the amendment documents filed within one year of the incorporation of the company.[31] Figure A-3 shows the table of contents of the incorporation document of Deepmind, a London-based AI startup that was bought by Google for $400 million. This document will be very different from the incorporation papers of a low-quality startup with no growth prospects and which is probably just a substitute for paid employment.

[31] We will use the mean of the documents to calculate the length of the incorporation document.

For example, by examining the incorporation document of DeepMind—an AI-based startup established in the UK in 2010 and eventually bought by Google for $400 million—we notice that at the time of its founding, the company had already set up several rules dealing with contingencies related not only to ownership shares but also to voting and decision-making rights (Figure A-3 in the Appendix shows the table of contents of their 50-page incorporation document). Instead, only basic and strictly necessary elements, such as the list of founders and the number of shares emitted, are included in incorporation documents of lower-quality firms, which are usually only a few pages long.

Table A-15 shows some basic descriptive statistics of this variable for all the firms in our sample, irrespective of their founders' country of origin. In general, companies tend to have short incorporation documents, with an average of 18.35 and a median of 15. The distribution of this variable, just like other quality-based measures, tends to be quite skewed (see Figure A-4).

Given the novelty of our variable, it is useful to verify whether our measure for initial quality is correlated with a more standard measure of "future" quality (i.e., standard measures used by scholars to establish the quality of a firm at every point of its life after incorporation). We then consider four different measures:

- *Size of the financial accounts* in the final year of the firm (censored to the end of 2018). This variable, which can take values ranging from 1 to 3, is a proxy for the underlying financial values of a firm. The UK business registry requires firms to file their financials depending on their size (the larger the firm, the more detailed the financial documents need to be), and all firms need to be categorized. To determine which category each firm belongs to, there are thresholds related to the value of turnover, assets (fixed plus current), and the number of employees.

- *Length of the financial document* filed in the final year of the firm (censored to the end of 2018). This measure exploits the fact that larger firms are required to file more accurate and detailed financials by law by the registry. Thus, higher-quality, successful firms with high underlying

financials tend to have longer balance sheets and income statements than low-quality firms.

- *Patents.* We match all our firms with patent data coming from the PATSTAT dataset. We match all patents that have been granted in Great Britain from 1995 to 2018 to our firms using a fuzzy matching algorithm on both the historical and the most recent name and address. Also, we made sure that the filing of the patent happened in a period when the firm was existent. We build a dummy variable that takes the value one if the company has been granted at least one patent and zero otherwise.

- *Presence of an investor.* Higher-quality ventures might be more likely to have investors. On one hand, investors might be attracted by high-quality firms that have the potential to grow; on the other hand, high-quality firms might also need more investment to start with in order to pursue their ambitious goals. We check the presence of investors by looking at the list of reported activities that each company has to file by law with the UK business registry. In particular, we check for the issuance of new shares of the company, followed by the appointment of a new director on the board within six months. This combination of actions strongly indicates the presence of a venture capital investor (or similar), as the company might need to issue a particular type of share (e.g., series A), and the investor might require a seat on the board of directors (which is almost always the case in investment deals involving venture capital).

Table A-10 shows the results of various regressions where the variables listed above are regressed on our quality measure based on the incorporation document. Overall, all measures are strongly and positively correlated, reassuring the validity of our novel variable. The magnitude of the coefficients is also economically significant. As our quality measure is defined as the number of pages in the incorporation document, the coefficients are to be interpreted as the association between an increase in one page of the incorporation document and the other quality-based measures. When looking at Column (4), for instance, we find a coefficient of 0.19, and its odd ratio corresponds to 1.21. Then

the interpretation of this specification is that a startup with a 1-page longer incorporation document is 1.21 more likely to have a patent granted. This magnitude is quite significant if we consider that it stems from one additional page. For instance, if we compare a low-quality firm (with a 7-page long document, which is the average within this category) with a high-quality firm with a 35-page long document, which is the average within this category), this odds ratio corresponds to an increase of 34 times in the odds of having a patent granted. Figure A-5 shows binscatter plots for some of these regressions.

It is important to note that our measure differs from the variables traditionally used to gauge firm quality (e.g., VC-backing, financial performance) as it captures quality at founding. As such, it is a noisier measure of quality. Although this measure will be correlated with the type of entrepreneurial opportunities pursued and founders' quality in general, there is no certainty that the high-risk high-reward potential of the venture will be realized. This implies that it is not necessary for firms to score in the top 1 or 5 percentiles in order to have some growth potential. For instance, OakNorth, one of the most famous fintech companies in the UK, has an incorporation document of 28 pages, which is right above the 80th percentile of our distribution. A similar pattern can be observed with other start-ups which later became unicorns (e.g., Farfetch.com and Funding Circle). Thus, for our analysis, we choose a quite conservative threshold to define high-quality firms, which corresponds to the 80th percentile of the distribution.

A4. Additional Figures and Tables

TABLE A-1: Brexit Timeline

Date	Event
January 23, 2013	David Cameron declares he is in favor of an EU referendum
April 14, 2015	Launch of the Conservative Party Manifesto for the 2015 General Election, committing to hold an in-out referendum on our membership of the EU before the end of 2017
May 7, 2015	Election of Cameron on Manifesto containing referendum promise
September 7, 2015	European Union Referendum Act passed in parliament
Feb 20, 2016	Date of referendum confirmed
June 23, 2016	EU Referendum
July 13, 2016	Cameron steps down, Theresa May becomes Prime Minister
March 29, 2017	Invocation of Article 50
June 8, 2017	Snap General Election
January 15	First failed vote on withdrawal deal
January 16	2019 Government wins vote of no confidence
March 12, 2019	Second failed vote on withdrawal deal
March 14, 2019	Vote to request extension of Article 50 (to April 12 if no deal agreed or May 22 if deal agreed)
March 29, 2019	Third failed vote on withdrawal deal and originally planned leaving date
April 10, 2019	The UK and EU27 agree to extend Article 50 until October 31, 2019
May 24, 2019	Theresa May gave official notice of her resignation
June 24, 2019	Boris Johnson elected Prime Minister by conservative party members

Source: Brexit timeline taken from Javorcik et al. (2020), which is based on events leading to the UK's exit from the European Union, Commons Briefing papers CBP-7960, Nigel Walker, https://researchbriefings.parliament.uk/ResearchBriefing/Summary/CBP-7960.

TABLE A-2: Heteroskedasticity test (Wooldridge, 2015)

Dep.Var.	(1) OLS Residuals
Inverse within-group sample size (population)	-910.019** (356.341)
Constant	0.000 (0.001)
Observations	931,480
R-squared	0.000

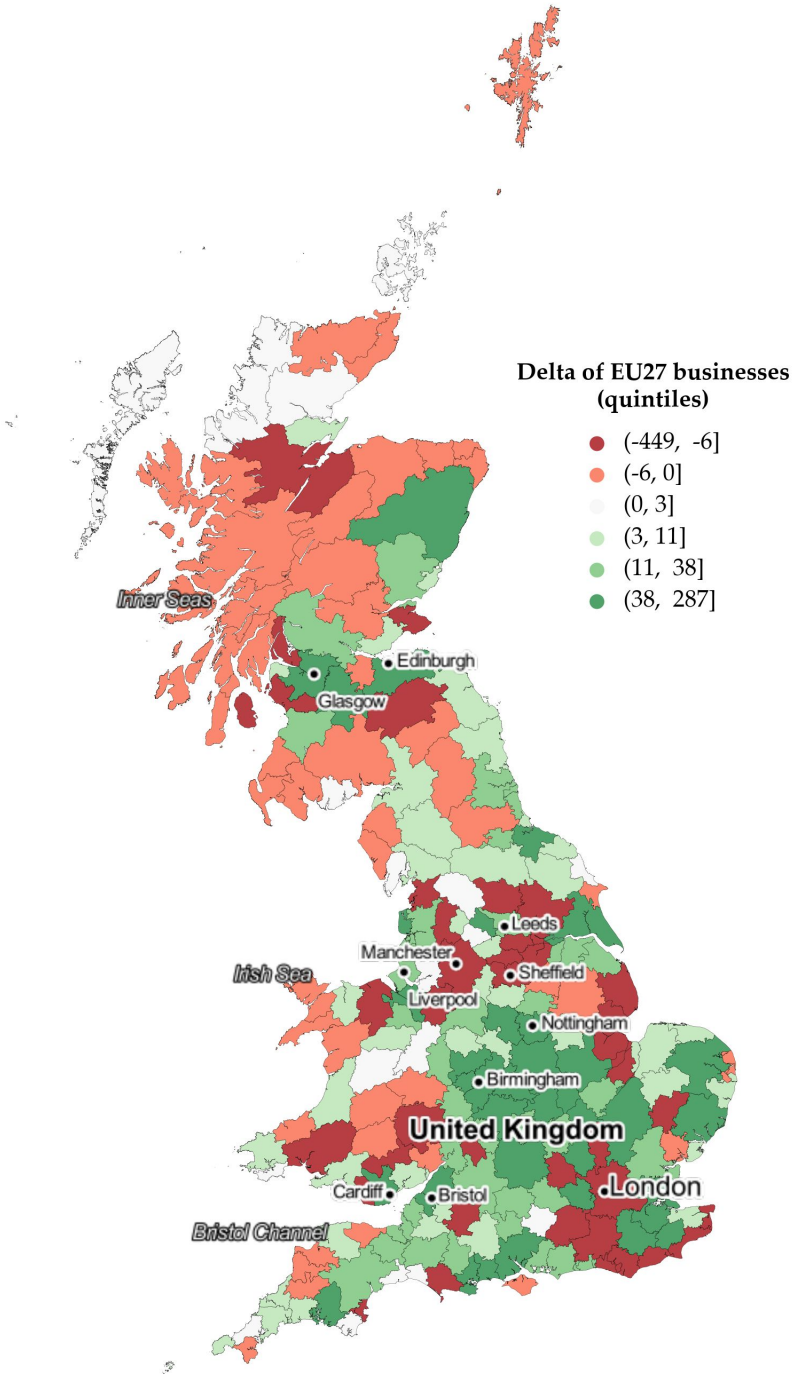
Notes: This table shows the result of a Breusch-Pagan test where the inverse within-group sample size is regressed on OLS residuals in order to check for heteroskedasticity across countries (as suggested by Solon et al. (2015) and Wooldridge (2015)). A significant coefficient indicates the presence of significant heteroskedasticity, suggesting that the regression needs to be weighted. Standard errors are in parentheses: (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-3: Brexit and Entry Rate of European firms — Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
	Dv: Growth in the Number of New Firms					
Control Group:	All	All+UK	All	All	All	All
Specification:	OLS	OLS	OLS	OLS	OLS	Poisson
Sample:	All	All	No London	All	All	All
EU-27	0.032***	0.025***	0.026***	0.025***	0.012*	0.886***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.095)
EU27*Post	-0.034***	-0.031***	-0.031***	-0.030***	-0.027***	-0.192**
	(0.006)	(0.005)	(0.005)	(0.005)	(0.010)	(0.079)
Observations	925,520	974,740	901,080	931,480	1,935,320	933,340
Sector FE	YES	YES	YES	YES*Date	YES (2D)	YES
TTWA FE	YES	YES	YES	YES	YES	YES
Date FE	YES	YES	YES	YES*	YES	YES
Controls	NO	NO	NO	NO	NO	NO
Weight	SelfEmpl	Pop	Pop	Pop	Pop	NO

*Notes:*This table includes the coefficients from different robustness checks for our main regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Column (1) uses the number of self-employed people in the country of nationality of the founders (i.e., the most represented nationality in the founding team) as the weight. In the other columns, except column (5), we use instead the population in the country of nationality of the founders (i.e., the most represented nationality in the founding team) as the weight. In column (2), we include firms founded by UK nationals in the control group alongside firms established by rest-of-the-world founders, which is our control group in all the other columns. In column (3), we drop the London Travel to Work Area from our estimations as an additional robustness check. In column (4), we include sector*date fixed effects, while column (5) uses two-digit SIC codes as sector fixed effects. Column (6) shows a Poisson model using the count of new firms as the main dependent variable. Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

FIGURE A-1: Delta of New EU Firms Pre- and Post-Brexit, by TTWA



Note: This map shows the difference of new EU firms (i.e., firms whose founders are EU nationals) established a year before and after the Brexit event.

TABLE A-4: Entry by Country

	(1)	(2)	(3)
	Dv: Growth in the Number of New Firms		
Country	England	Wales	Scotland
EU27	0.025***	0.039***	0.031***
	(0.003)	(0.011)	(0.004)
EU27*Post	-0.029***	-0.057***	-0.037**
	(0.006)	(0.017)	(0.012)
N	806,960	47,580	76,940
Sector FE	YES	YES	YES
TTWA FE	YES	YES	YES
Date FE	YES	YES	YES
Controls	NO	NO	NO
Weight	Pop	Pop	Pop

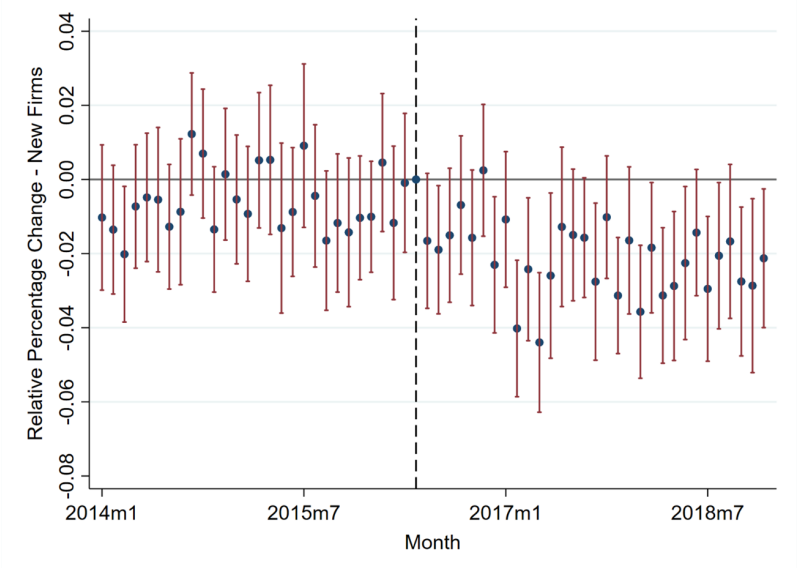
Notes: This table includes the coefficients from regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by country. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-5: Entry by Type of Area

	(1)	(2)	(4)	(4)	(5)
	Dv: Growth in the Number of New Firms				
	Rural TTWA	Small Town TTWA	Large Town TTWA	Major Conurbation TTWA	Greater London
EU27	0.001	0.020***	0.030***	0.044***	0.094***
	(0.004)	(0.004)	(0.004)	(0.008)	(0.012)
EU27*Post	-0.009	-0.032***	-0.036***	-0.035**	-0.141***
	(0.008)	(0.007)	(0.007)	(0.014)	(0.014)
N	77,500	159,340	469,940	224,700	49,900
Sector FE	YES	YES	YES	YES	YES
TTWA FE	YES	YES	YES	YES	YES
Date FE	YES	YES	YES	YES	YES
Controls	NO	NO	NO	NO	NO
Weight	Pop	Pop	Pop	Pop	Pop

Notes: This table includes the coefficients from regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by the mean age of the founding team. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

FIGURE A-2: Difference-in-Difference treatment by Year (monthly)



Note: This figure shows the coefficients of the interaction of the variable EU×Post across time (months) from the specification described in Eq. 6. The interaction is equal to one in the quarter indicated for EU firms, and zero otherwise. Solid lines refer to 90% confidence intervals obtained using clustered standard errors at the region and sector levels.

TABLE A-6: Entry by Brexit Result

	(1)	(2)
	Dv: Growth in the Number of New Firms	
Brexit result	Leave	Remain
EU27	0.022***	0.039***
	(0.003)	(0.004)
EU27*Post	-0.026***	-0.049***
	(0.005)	(0.008)
N	643020	288460
Sector FE	YES	YES
TTWA FE	YES	YES
Date FE	YES	YES
Controls	NO	NO
Weight	Pop	Pop

Notes: This table includes the coefficients from regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by the result of the Brexit referendum. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-7: Entry by Size of the Founding Team

	(1)	(2)	(3)	(4)
	Dv: Growth in the Number of New Firms			
N founders	1	2	3	4+
EU27	0.028***	0.008***	-0.001	0.003
	(0.003)	(0.003)	(0.004)	(0.004)
EU27*Post	-0.031***	-0.012**	-0.004	-0.009
	(0.005)	(0.005)	(0.007)	(0.007)
N	769,440	570,960	195,220	121,660
Sector FE	YES	YES	YES	YES
TTWA FE	YES	YES	YES	YES
Date FE	YES	YES	YES	YES
Controls	NO	NO	NO	NO
Weight	Pop	Pop	Pop	Pop

Notes: This table includes the coefficients from different regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by the size of the founding team. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-8: Entry by Mean Age of the Founders Team

	(1)	(2)	(4)	(4)
	Dv: Growth in the Number of New Firms			
Founders' age	35-	36-41	42-49	50+
EU27	0.033***	0.011***	0.001	-0.002
	(0.004)	(0.003)	(0.003)	(0.003)
EU27*Post	-0.026***	-0.023***	-0.006	0.002
	(0.006)	(0.005)	(0.005)	(0.005)
N	589,300	520,200	462,840	362,760
Sector FE	YES	YES	YES	YES
TTWA FE	YES	YES	YES	YES
Date FE	YES	YES	YES	YES
Controls	NO	NO	NO	NO
Weight	Pop	Pop	Pop	Pop

Notes: This table includes the coefficients from regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by the mean age of the founding team. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-9: Entry by Sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dv: Growth in the Number of New Firms								
	Manufacturing	Construction	Wholesale Retail	Hotels Restaurants	Transport Comm	Finance	Business/ Real E	Education	Health
EU27	0.014**	0.024***	0.033***	0.010	0.062***	0.018*	0.045***	0.008	0.011
	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.005)	(0.009)
EU27*Post	-0.025	-0.015	-0.043**	-0.020**	-0.063***	-0.037**	-0.062***	-0.005	0.012
	(0.015)	(0.012)	(0.016)	(0.008)	(0.013)	(0.013)	(0.012)	(0.010)	(0.012)
N	81,640	70,420	133,780	108,540	80,080	42,900	175,880	31,140	96,920
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
TTWA FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Date FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Controls	NO	NO	NO	NO	NO	NO	NO	NO	NO
Weight	Pop	Pop	Pop	Pop	Pop	Pop	Pop	Pop	Pop

Notes: This table includes the coefficients from regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union by sector. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-10: Validation of Quality Measure

	(1)	(2)	(3)	(4)
Dep Var:	Financial Account Size	Financial Account Length	Patents	Share Emission + Investor Appointment
Specification:	Ologit	OLS	Logit	Logit
Incorporation-based quality measure	0.019***	0.066***	0.011***	0.019***
	(0.000)	(0.000)	(0.002)	(0.000)
Observations	2,079,267	2,079,151	5,545,203	5,556,663

Notes: This table shows results of multiple regressions where traditional quality measures are regressed on our quality-at-founding measure based on the incorporation documents. The unit of analysis is at the firm level. The dependent variable in column (1) is the size of the financial account (with values ranging from 1 to 3) in the last year of activity of the firm (censored to 2018). Column (2) considers the length of the financial accounts in the last year of activity of the firm (censored to 2018). Column (3) takes into account whether the firm has at least one patent. Finally, the dependent variable in column (4) tries to capture the presence of an investor in the firm by relying on the firm's activities with the business registry. All regressions include year, industry, and TTWA fixed effects. Robust standard errors are reported: (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-11: Entry of High-Quality Firms by Founders' Past Entrepreneurial Experience

	(1)	(2)	(3)	(4)
	Dv: Growth in the Number of New Firms			
Firm quality	Low	Low	High	High
Past experience	No	Yes	No	Yes
EU27	0.028***	-0.005*	0.013***	0.005***
	(0.004)	(0.003)	(0.002)	(0.002)
EU27*Post	-0.044***	0.011**	-0.022***	-0.013***
	(0.007)	(0.005)	(0.004)	(0.003)
N	471,920	471,920	488,260	488,260
Sector FE	YES	YES	YES	YES
TTWA FE	YES	YES	YES	YES
Date FE	YES	YES	YES	YES
Controls	NO	NO	NO	NO
Weight	Pop	Pop	Pop	Pop

Notes: This table shows the coefficients from different regressions showing the effect of the Brexit referendum on the growth rate of the number of new high-quality firms from the European Union by founders' past entrepreneurial experience. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders level. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-12: Brexit and Entry Rate of European Firms – Robustness with no US founders and without founders from the 7 countries affected by Trump's Muslim ban

	(1)	(2)
	Dv: Growth in the Number of New Firms	
Control Group:	All	All
Specification:	OLS	OLS
Sample:	No Americans	No nationalities involved in Trump's Ban (7)
EU-27	0.027***	0.026***
	(0.003)	(0.003)
EU27*Post	-0.034***	-0.032***
	(0.005)	(0.005)
Observations	910,000	896,340
Sector FE	YES	YES
TTWA FE	YES	YES
Date FE	YES	YES
Controls	NO	NO
Weight	Pop	Pop

Notes: This table includes the coefficients from different regressions showing the effect of the Brexit referendum on the growth rate of the number of new firms from the European Union while excluding 1- Americans in Column (1), 2- the countries affected by Trump's Muslim ban (through the Executive Order 13780), i.e., Iran, Iraq, Libya, Somalia, Sudan, Syria, and Yemen in Column (2). The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-13: Share of Low-, Medium- and High-Skilled Job Seekers Before and After Brexit

Dv:	(1) Low-skilled seeking a job as employees	(2) Medium-skilled seeking a job as employees	(3) High-skilled seeking a job as employees
EU27*Post	0.385***	0.037***	-0.196***
	(0.000)	(0.000)	(0.000)
Observations	253	173	226
R Squared	0.347	0.366	0.363

Notes: This table contains the coefficients from two regressions showing the change after the Brexit referendum in the share of low-skilled people seeking a job as an employee (column 1), medium-skilled people seeking a job as an employee (column 2), and high-skilled people seeking a job as an employee (column 3). Our treatment group includes the countries in the European Union, while the rest of the countries in Europe constitute the control group. Regressions are weighted using population of the country of origin and include the following controls: GDP per capita, percentage of self employed and unemployed population, and percentage of people with secondary education. Data from these regressions come from the 2015–2017 Quarterly Labor Force Survey and are aggregated at the country-of-origin and quarter level. Educational categories are the following: university degree or equivalent; higher education or other qualifications; GCE A level or equivalent and lower qualifications. Robust standard errors are reported in parentheses: (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

TABLE A-14: Entry of New Firms by Quality and Size of the Founding Team

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dv: Growth in the Number of New Firms							
Firm quality	Low	Low	Low	Low	High	High	High	High
N founders	1	2	3	4+	1	2	3	4+
EU27	0.024***	-0.002	-0.002	-0.001	0.013***	0.004**	0.001	0.001
	(0.004)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
EU27*Post	-0.037***	0.004	0.002	0.002**	-0.023***	-0.011***	-0.003**	-0.003**
	(0.008)	(0.004)	(0.002)	(0.001)	(0.004)	(0.003)	(0.001)	(0.001)
N	471,920	471,920	471,920	471,920	488,260	488,260	488,260	488,260
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES
TTWA FE	YES	YES	YES	YES	YES	YES	YES	YES
Date FE	YES	YES	YES	YES	YES	YES	YES	YES
Controls	NO	NO	NO	NO	NO	NO	NO	NO
Weight	Pop	Pop	Pop	Pop	Pop	Pop	Pop	Pop

Notes: This table shows the coefficients from different regressions showing the effect of the Brexit referendum on the growth rate of the number of new low- or high-quality firms from the European Union by the size of the founding team. The main dependent variable is growth rate, which is measured as the change in the inverse hyperbolic sine transformation (arcsin) of the new number of European businesses. Regressions are at the sector, TTWA, quarter, and country-of-nationality-of-the-founders levels. Regressions are weighted by the population of the country of nationality (the most represented nationality in the founding team). Clustered standard errors at the region and sector levels are in parentheses. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)

FIGURE A-3: Table of Contents of Deepmind's Incorporation Document

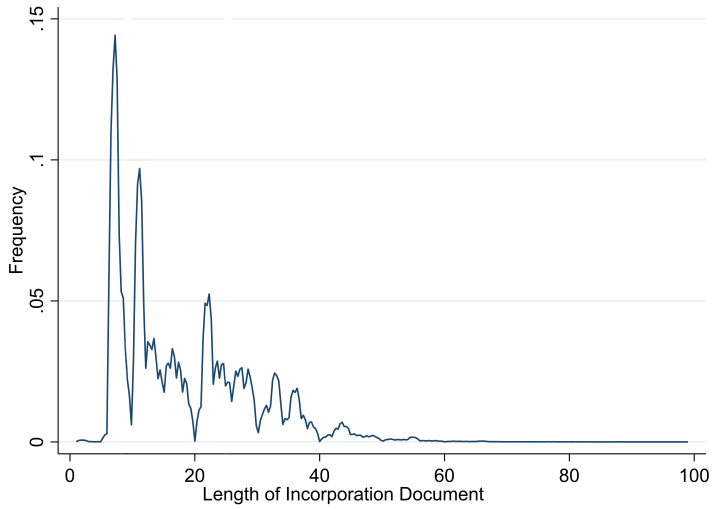
CONTENTS

TABLE A-15: Descriptive Statistics of our Quality Variable (Length of Incorporation Documents)

Mean	18.35
Min	1
20th percentile	7
Median	15
80th percentile	26
99th percentile	51
Max	991
St.Dev.	11.34
N	5,556,663

Notes: Descriptive Statistics of our quality variable (length of incorporation documents) using our full sample of firms (all nationalities).

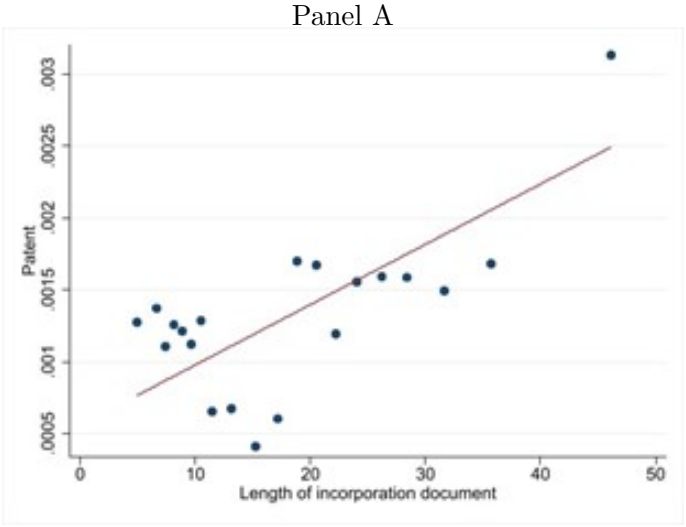
FIGURE A-4: Distribution of the length of incorporation documents



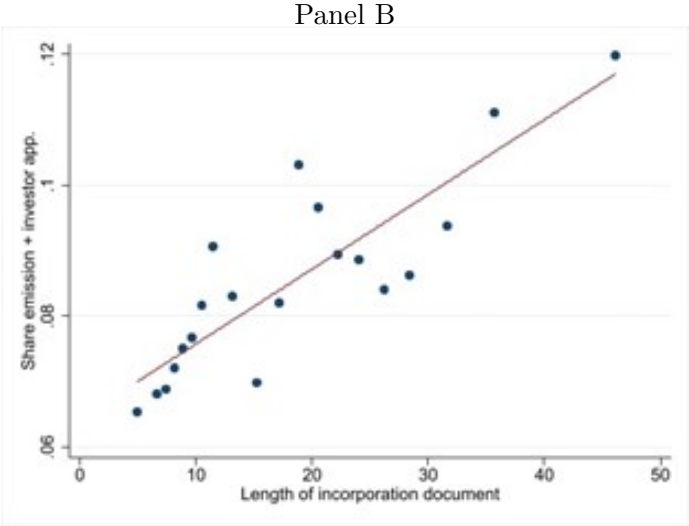
Note: This figure shows the distribution of the length of incorporation documents. The maximum has been cut to the 99.93 percentile of the distribution (around 100 pages).

FIGURE A-5: Binscatter plots: length of incorporation documents and patent activity (Panel A), length of incorporation documents and presence of investors (Panel B)

Panel A



Panel B



Note: Binscatter plots include the usual controls added in Table A-10.

TABLE A-16: VC investments in EU27 Countries After Brexit

	(1) VC investments on GDP	(2) VC investments on GDP
EU27*Post	0.014***	0.011***
	(0.004)	(0.004)
Observations	213	185
R Squared	0.836	0.869
Country FE	YES	YES
Year FE	YES	YES
Controls	NO	YES

This table includes the coefficients from regressions showing the effect of the Brexit referendum on the amount of VC investment on GDP (source: OECD) in the European Union (UK excluded). Regressions are at the year and country levels. Regressions are weighted using country population. Column (1) does not include any contols, while Column (2) includes the following: GDP per capita, percentage of self-employed and unemployed population, percentage of people with secondary education, start-up costs and business taxes. Robust standard errors are reported: (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$)