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The effect of uncertainty on entrepreneurial activity*

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Abstract

Although uncertainty is an important concept in entrepreneurship research, its impact on entrepreneurial activity has not been explored. We examine whether, and under what conditions, uncertainty affects entrepreneurial activity. Using data from 52 countries over 16 years, we find no evidence that uncertainty affects entrepreneurial activity. However, we find evidence that potential entrepreneurs start their businesses in uncertain circumstances if institutions are in place that reduce the cost of starting a business. These results suggest that it may not be external factors such as uncertainty that influence potential entrepreneurs' decisions, but internal factors.

Keywords: uncertainty, entrepreneurial activity, bankruptcy laws
JEL classification: L26, M13, D81

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1. Introduction

We are living in an age of uncertainty. According to Ahir et al. (2022), global uncertainty has been increasing since 2012 and was reaching a historical peak in 2020. In such an uncertain environment, some entrepreneurs start businesses while others do not. They might view uncertainty negatively and "wait and see" until the uncertainty is resolved, or they might "start up" by viewing uncertainty as an opportunity. Although uncertainty is a crucial concept in entrepreneurship research, the effect of uncertainty on entrepreneurial activity has not been fully explored (Bylund and McCaffrey, 2017; McKelvie et al., 2011; McMullen and Shepherd, 2006; Tajaddini and Gholipour, 2021). Under what condition does uncertainty foster entrepreneurship? What factors enhance entrepreneurial activity under uncertainty? It is imperative that we investigate these inquiries to show how related conditions can help stimulate the economy.

We examine the relationship between uncertainty and entrepreneurial activity using data from 52 countries for the period 2005–2020. Unlike previous studies that find a negative relationship between uncertainty and corporate investment as predicted by real options theory (Gulen and Ion, 2015), for entrepreneurial activity we find no evidence of an effect of uncertainty. However, since the "means" of each country such as demographics, technology regimes, and sociopolitical institutions vary (Sarasvathy, 2001), we expect each country to have a different entrepreneurial response to uncertainty. In order to investigate the sources of such differences, we consider sociopolitical institutions and institutional regime (Dew et al., 2009b). In this paper, we focus on bankruptcy law as an institution. Entrepreneur-friendly bankruptcy laws can lower the cost of failure (Lee et al., 2007), which in turn lowers entry barriers to entrepreneurship (Peng et al., 2010; Lee et al., 2011). From the affordable loss principles (Dew et al., 2009b; Sarasvathy, 2001), potential entrepreneurs will start a business only if the cost of new ventures—not only the cost of starting a business, but also the cost of failure, as well as non-monetary costs—does not exceed an upper boundary of willingness to lose.[1]

[1] In this paper, we use the term "potential entrepreneurs" to refer to individuals who have not yet embarked on entrepreneurial activities in the entrepreneurial process (Reynolds et al., 2005).

Reconciling the real options theory and affordable loss predictions, we develop a new framework to explain such phenomena that are observed identically but occur by different mechanisms. That is, a framework built on the value of reliable information in the plunge decision[2] under uncertainty. The more accurate the information used to estimate the option value, the more accurate the decision-making. It is more difficult, however, to estimate components that affect the option value, such as cash flow forecast, the top line for calculating the cash flow, and the probability of whether it occurs as uncertainty increases. On the other hand, calculating affordable loss does not require computing outcome and preference probabilities (Sarasvathy, 2009). The information used in effectuation is the willingness to lose, which is estimated independently of uncertainty and determined by potential entrepreneurs themselves. Our conceptualization assumes that potential entrepreneurs use these two types of information in their decision-making, weighting them according to the level of uncertainty.

This paper contributes to the literature in at least three ways. First, we strive to construct a theoretical approach that explains the choice between real options and effectuation under varying degrees of uncertainty. Second, while prior studies (Lee et al., 2011) do not consider uncertainty, we examine the effect of bankruptcy laws under uncertainty. Third, we empirically address the gap in effectuation research by incorporating uncertainty at the economy level. To the best of our knowledge, this study will be among the first that provide empirical evidence of the role of effectuation at the economy level.

2. Theory and hypotheses

According to the Global Entrepreneurship Monitor (GEM) Global Report 2020/2021 (GERA, 2021), there are both agreements and disagreements, even contradictions, to the statement, "The coronavirus pandemic has provided new opportunities that you want to pursue with this business." In addition, the percentage of all adults starting or running new businesses and agreeing to this statement varies

[2] Following Dew et al. (2009b), in this paper, we use the term "plunge decision" interchangeably with the terms "entry into entrepreneurship," the "self-employment decision," and whether or not to "start up."

across countries. How do potential entrepreneurs decide to take the plunge to start new businesses under uncertainty? Dew et al. (2009b) propose three decision-making tools: net present value (NPV), real options, and affordable loss. Since the first two approaches deal with decision-making based on NPV, we combine these as the real options approach[3] and contrast them with the third approach, which utilizes the effectuation framework, specifically the affordable loss principle. Thus, in this section, we develop hypotheses based on real options theory and the affordable loss principle, and we reconcile the two approaches that explain different responses to uncertainty.

2.1. The average effect of uncertainty on entrepreneurial activity

Real options theory

A real option is the right to make decisions about strategic investment, such as the option to wait before starting a business, the option to expand if things go well, and the option to abandon if things go badly. Simply put, a real options approach reflects the value of options in the conventional approaches such as the NPV rule. The NPV rule makes investment decisions based on NPV, i.e., if NPV is positive, the decision is made to invest. When individuals or firms face mutually exclusive investment opportunities due to limited resources being available, the investment that yields the highest NPV should be selected. For instance, if the NPV generated by a current job is greater than the NPV generated by a new venture, an individual will stay in the current job instead of starting a new business, even if the NPV of both options is positive.

Compared to the conventional approach, a real options valuation is more flexible because it incorporates the value of strategic options, namely, the value of delaying the start of a project until conditions become more favorable. For instance, a potential entrepreneur might find it more valuable to wait and see how the market develops rather than start a new venture today. Furthermore, this flexibility becomes more valuable when the investment is irreversible and undertaken under high

[3] Combining the two together has no impact on the discussion in this paper.

uncertainty. Because most investment expenditures associated with entrepreneurial activities are partially or completely irreversible and can be delayed, given these characteristics of entrepreneurial activity, it is reasonable view the entrepreneurial activity as a real option.

The value of the option is largely derived from the variance in expected cash flows generated by underlying assets. The higher the variance in expected cash flows, the higher the value of the option. Hence, an increase in uncertainty increases the range of cash flow expectations and thus increases the option value of waiting. Empirical evidence supports this prediction. Using a sample of public corporations in the United States, Gulen and Ion (2016) find that as policy uncertainty increases, firms defer capital investments; this is more pronounced when the investments are irreversible. Li and Chi (2013) find that when the volatility of industry portfolios, which is a proxy for industry-level uncertainty, is high, the propensity for venture capital (VC) firms to exercise the withdrawal option is lower. O'Brien et al. (2003) find that as industry-level uncertainty, which is measured as the volatility of each industry's gross product, increases, potential entrepreneurs are less likely to enter the target industry. In 2020, when COVID-19 began to spread around the world, VC firms reduced their investment; Gompers et al. (2021) argue that this change in VC investment behavior is consistent with uncertainty as a factor which increases the value of the option to wait.

When viewing decision-making under uncertainty through a real-options lens, we suggest that uncertainty can increase decision-makers' incentives to delay investment until some of the uncertainty resolves (even if uncertainty is never completely resolved). In sum, the real options theory predicts that potential entrepreneurs will postpone taking the plunge to start a venture when uncertainty is high. Therefore, we derive the following hypothesis:

H1: *As uncertainty increases, entrepreneurial activity decreases.*

Causation and effectuation under uncertainty

Real options treat an initial investment and cash flow generated by the venture as exogenous to the

decision-maker, with the plunge decision determined by the NPV (Dew et al., 2009b). Exogeneous information refers to the information required for the calculation of NPV or option value, or the information used to estimate it with accuracy, e.g., cash flow and variance in the value of the underlying asset. The conventional approach, and the real options approach for decision-making based on NPV (or expected return) maximization, can be referred to as causation.[4] Causation is most effective in a world where uncertainty is low and predictability is high. Causal logic is, however, less meaningful when predictability and/or accountability are unassured or insecure. In this case, effectual logic can be more appropriate. Simply put, effectuation is a theoretical approach that explains decision-making under uncertainty. The criterion for decision- making based on effectuation is not the maximization of expected return, but affordable loss, one of the principles of effectuation. Affordable loss concerns resources that a potential entrepreneur is willing to lose, and this loss can be estimated by using a smaller, more salient information set. Affordable loss focuses on the endogenous investment amount, with the plunge decision determined by an entrepreneur's willingness to lose this amount. Endogenous information refers to the information required to estimate the allowable loss.

Based on the different nature of information used for decision-making (i.e., exogenous versus endogenous), we conceptualize the choice of theories under uncertainty. Our conceptualization begins by making two assumptions about the relationship between uncertainty and the value of information as shown in Figure 1A. First, as uncertainty increases, the value of exogenous information decreases. Specifically, while elaborate market research, cash flow forecast, and expected scenarios are meaningful under low uncertainty, they are less meaningful under high uncertainty. Second, the value of endogenous information does not depend on uncertainty.[5] How

[4] To be precise, NPV is not synonymous with expected return. However, we use NPV and expected return interchangeably, following the practice of management and entrepreneurship journals (Dew et al., 2009b; Sarasvathy, 2009).

[5] Figure 1A shows a situation where the value of exogeneous information is higher than the value of endogenous information when there is no uncertainty at all. This can be interpreted as objective information being more valuable than subjective information. However, this is not an important assumption. Whether the value of endogenous information is higher or lower than the value of exogenous information, the same argument can be

much potential entrepreneurs are willing to lose depends on their life stages and circumstances, not on the venture (Sarasvathy, 2001; Dew et al., 2009b). Thus, uncertainty is irrelevant to the entrepreneur (Sarasvathy, 2009). Our theoretical assumptions are consistent with the empirical results of previous studies. Dew et al. (2009a) use protocol analysis and find that expert entrepreneurs do not believe predictive information such as forecast numbers; and while experts are more likely to care about costs, for example how much money was available to the venture, novices like MBA students are more likely to chase the largest expected return. Gompers et al. (2020) survey VC firms and find that 20% of their sample do not forecast cash flows when they make an investment, and that this result is more pronounced in early-stage VC firms. Empirical evidence suggests that forecasting is difficult to execute under higher uncertainty, and that even professionals such as expert entrepreneurs and early-stage investors do not use quantitative analyses or make decisions using such analyses.

Finally, we assume that potential entrepreneurs use both exogenous and endogenous information to make decisions, weighting information by its value or reliability with respect to any given uncertainty. Based on these assumptions, the relationship between the degree of uncertainty and the weight of information used by potential entrepreneurs can be drawn in Figure 1B. This figure shows that when uncertainty is low, the value of exogenous information is relatively high, so a potential entrepreneur is prone to use more causal logic such as real options theory; and when uncertainty is high, the value of endogenous information is relatively high, so a potential entrepreneur is likely to use more effectual logic. This is consistent with the argument that effectuation processes are more useful and more prevalent in a world with high uncertainty and low predictability (Sarasvathy, 2001); and potential entrepreneurs do not simply choose affordable loss, real options, or other tools. Instead, they use multiple rationales contingent on the particularities of their identity and venture ideas (Dew et al., 2009b). Furthermore, our theoretical predictions align with the empirical results of previous

obtained, as long as the value of exogenous information is reduced relative to that of endogenous information.

studies. Chandler et al. (2011) develop validated measures of causation and effectuation, and they find that uncertainty correlates negatively with causation measures and positively with experimentation as a sub-dimension of effectuation.

Although potential entrepreneurs rely more on endogenous information under high uncertainty, this does not necessarily stimulate entrepreneurial activity. From the perspective of affordable loss, if the cost of startups exceeds the affordable loss of potential entrepreneurs using effectual logic, they would not take the plunge into entrepreneurship. As shown in Figure 1A, since the value of endogenous information remains constant regardless of the degree of uncertainty, the affordable loss does not depend on uncertainty.

Alternatively, from the perspective of real options theory, an increase in uncertainty has little effect on entrepreneurial activity. This is because although the value of real options increases as uncertainty increases, potential entrepreneurs are less likely to use decision-making based on real options theory. In sum, regardless of which theory we apply – real options or affordable loss – our theoretical framework predicts that uncertainty would not affect entrepreneurial activity. Therefore, we derive the following hypothesis:

H2: *The increase of uncertainty is irrelevant to entrepreneurial activity.*

[Insert Figure 1 here.]

2.2. The cost of taking the plunge

Let us consider the situation of high uncertainty in Figure 1B, where potential entrepreneurs make a decision based on affordable loss. As a natural assumption, potential entrepreneurs have varying degrees of affordable loss (Dew et al., 2009b). Assuming that the minimum to maximum affordable loss of potential entrepreneurs is uniformly distributed, it can be represented as the diagonal line in Figure 1C. Figure 1C shows the relationship between affordable loss, the cost of starting a business

(including the cost of failure), and the decision to start a business. The horizontal axis shows the total number of potential entrepreneurs, and the vertical axis shows the scaled costs. Without loss of generality, the total number of potential entrepreneurs is normalized to one. In our framework, only those potential entrepreneurs whose cost of starting a business is within their affordable loss will start a business. For example, in Figure 1C, assuming that the cost of starting a business is 0.8, then the area represents the proportion of people who start their own business, and this case is shown as 0.2. Thus, 20% of potential entrepreneurs will start their own business. Next, we consider a situation where the cost of starting a business has decreased from 0.8 to 0.4. Since the cost of starting a business satisfies more potential entrepreneurs' affordable loss, they take the plunge into entrepreneurship. In this case, 60% of potential entrepreneurs will start their own business.

Our next challenge is to find out what would lower the cost of starting a business. Entrepreneur-friendly bankruptcy laws are valid candidates. There are several dimensions of entrepreneur friendliness in bankruptcy laws. Lee et al. (2007) propose the following five aspects: (1) the availability of a reorganization bankruptcy option; (2) the speed of the bankruptcy procedure; (3) the opportunity to have a fresh start in liquidation bankruptcy; (4) the opportunity to have an automatic stay of assets; and (5) the opportunity for managers to remain on the job after filing for bankruptcy. Peng et al. (2010) show the relation between dimensions of bankruptcy laws and new firm formation. Lee et al. (2011) conduct a formal empirical testing of Lee et al.'s (2007) propositions, and they find a positive relationship between the dimensions of entrepreneur-friendly bankruptcy law and entrepreneurial development, except for the dimension of stay of incumbent management. Among these dimensions, the construct "fresh start" fits our theoretical conceptualization of limiting the downside losses. When fresh start is protected, entrepreneurs must give up all assets they own, but all of their future earnings are exempt from the liability of an obligation to repay (Fan and White, 2003). Limiting financial loss through a fresh start can put the cost of starting a business within the boundary of a potential entrepreneur's affordable loss, and he/she may take the plunge into

entrepreneurship. Although potential entrepreneurs may not preview bankruptcy law ex-ante (Lee et al., 2007), exposure to information, media, and word-of-mouth could influence a potential entrepreneur's understanding of affordable loss.

The strength of fresh start protection varies widely across countries (Peng et al., 2010). For instance, in Chile, bankrupt entrepreneurs could still walk away with approximately 60% of their debt in 2019, although that percentage was lower than in prior years. By contrast, in Japan and Norway, entrepreneurs who file for bankruptcy are exempted from less than one-tenth of their debts, while creditors are guaranteed more than 90% of their debts. Considering the differences in the strength of fresh start protection by country, we expect that potential entrepreneurs are more likely to launch a new venture when start-up costs are low.

The predictions from real options theory and affordable loss are not mutually exclusive. Under high uncertainty where success or failure is unpredictable, entrepreneurs may start a business hoping for success if they have limited loss due to entrepreneur-friendly bankruptcy laws in case of failure. This is the key idea of real options reasoning: not avoiding failure but rather managing the cost of failure by limiting exposure to the downside risk while retaining upside gains (McGrath, 1999). Accordingly, the value of entrepreneur-friendly bankruptcy laws increases with uncertainty. When potential entrepreneurs make decisions based on affordable loss, they are more likely to start a business if the cost of starting a business is lower than their affordable loss. Therefore, we offer the following hypothesis:

H3: *Entrepreneurial activity increases when a fresh start is protected in situations of high uncertainty.*

3. Data, variables, and summary statistics

In this section, we describe our data sources, define variables, and present summary statistics for our sample.

3.1. Data

We use various sources combined. The main data sources are GEM, the World Uncertainty Index (WUI), and the World Bank and its Doing Business (DB) reports. The sample period is from 2005 to 2020, the period when these data overlap.[6] We exclude (1) countries with fewer than three observations in the sample period, (2) countries the IMF classification names as low-income economies, and (3) China and the United Arab Emirates due to issues with data reliability.[7] As a result, our sample consists of 52 countries for a total of 540 country-year observations, having an unbalanced structure.

3.2. Variables

Dependent variables

In this paper, the Total early-stage Entrepreneurial Activity (TEA) is used as a measure of entrepreneurial activity. TEA is defined as the percentage of the population aged 18 to 64 who are either nascent entrepreneurs or owner-managers of a new business. The TEA index is theoretically relevant because our interest is not in new business registrations, but in the startup decision, which is an early stage in the series of entrepreneurial activities. The data are obtained from GEM.

Independent variables

As an uncertainty variable, we use the World Uncertainty Index (WUI) constructed by Ahir et al. (2022). The WUI is an index constructed by counting the frequency of the words "uncertain," "uncertainty," and "uncertainties" as mentioned in the EIU country reports. The index is normalized by the total number of words in the reports and rescaled by multiplying by 1,000. A higher number

[6] While GEM data are available from 2001 and forward, Doing Business can only be available from 2004 since "*Doing Business* offers economic data from 2003 to the present." See https://www.doingbusiness.org/en/data.
[7] The World Bank states that there were irregularities in data for China, Saudi Arabia, Azerbaijan, and the United Arab Emirates in Doing Business 2018 and 2020. See the report by the Development and Economics Vice Presidency of the World Bank Group. Our sample did not include Saudi Arabia and Azerbaijan because other data necessary for the analyses in this paper are not available. If we use the corrected data for China and the United Arab Emirates and analyze the sample including these two countries, the results are almost the same.

means higher uncertainty and vice versa (Ahir et al., 2022). We take the arithmetic average of the WUI in year *t* because the original data for WUI are provided quarterly.

Another variable to focus on is *Entrepreneurial intentions*, which is the percentage of those aged 18 to 64 (excluding persons involved in any stage of entrepreneurial activity) who are latent entrepreneurs and who intend to start a business within three years. We use this variable as a proxy for the potential entrepreneur pool. This variable is from GEM, which is why we use the GEM data.

Finally, the factor of interest is entrepreneur-friendly bankruptcy laws as a proxy for start-up costs. Following Lee et al. (2011), we calculate the fresh start as 100 minus the Recovery rate (cents on the dollar), which is the rate recovered by secured creditors through judicial reorganization, liquidation, or debt enforcement (foreclosure or receivership) proceedings. The data are obtained from the World Bank's Doing Business report.[8]

Control variables

We include the following variables related to entrepreneurial behaviors and attitudes obtained from GEM data: (1) *Fear of failure*, which is the percentage of those aged 18 to 64 (excluding individuals at any stage of entrepreneurial activity) who indicate that fear of failure would prevent them from starting a business; (2) *Perceived opportunities*, the percentage of persons aged 18 to 64 (excluding those at any stage of entrepreneurial activity) who see good opportunities to start a firm in the area where they live; and (3) *Perceived capabilities*, the percentage of those 18 to 64 (excluding those in any stage of entrepreneurial activity) who believe they have the required skills and knowledge to start a business; and (4) *Good choice*, the percentage of those 18 to 64 who agree with the statement that in their country, most people consider starting a business as a desirable career choice.

As a macroeconomic performance, we include GDP per capita (*GDP per capita*) and GDP growth (*GDP growth*). We also add the unemployment rate (*Unemployment*), which is the share of the labor force that is without work but available for and seeking employment (World Bank).

[8] In September 2021, the World Bank announced it would discontinue the Doing Business report due to data irregularities and ethical matters that had come to light.

3.3. Summary statistics

Table 1 presents summary statistics for the variables used in our analysis. TEA is distributed with a mean of 10.69, a median of 8.85, and a standard deviation of 6.4. The mean value of the WUI is 0.22. The 95th percentile of the WUI is 0.49 and the maximum value is 1.34, indicating that the WUI contains extremely large values.

The mean value of fresh start is 43.65 and the median is 45.55. The fresh start variable changes greatly between countries but does not change much through time within a country. In our sample, the between-country standard deviation in the fresh start is 25.04, while the within-country standard deviation in the fresh start is 5.95. When we compare the value of fresh start with that of Lee et al. (2011), they are close. In Lee et al. (2011), for instance, the value of fresh start is 7.4 in Japan and 20.1 in the United States, while the values for our study are 7.5 and 19.7, respectively. However, some countries show the strength of the fresh start has declined significantly. The values of a fresh start decreased from 44.2 to 17.9 in Germany, from 52.4 to 39.3 in Italy, and from 59.4 to 40.4 in Thailand, respectively. Comparing fresh start strength of the 27 countries in common between Lee et al. (2011) and our study,[9] the value of fresh start (calculated as the sum of the differences between the values reported in the two studies or as a simple average of the differences) has declined, indicating that bankruptcy laws have become entrepreneur-unfriendly.

Figure 2 illustrates the relation between uncertainty and entrepreneurial activity, taking the change in uncertainty on the horizontal axis and the growth in entrepreneurial activity on the vertical axis. In Panels A and B (Panels C and D), we use WUI (EPU) as the uncertainty index. In the left panels (Panels A and C), we define the change as the logarithmic growth in the country's TEA from the previous year ($t-1$) to the current year (t); in the right panels (Panels B and D), we define it as the difference between the country's TEA in the previous year and the TEA in the current year. Each

[9] The countries we analyze do not include Austria and Hong Kong, which are included in the Lee et al. (2011) analysis, because the necessary variables are not available.

dot shows a pair of changes in WUI and TEA over the same period. In all panels, there is little maldistribution of dots, which indicates there is no positive or negative relationship. To confirm this more precisely, we calculate the correlation coefficients. The correlations between the changes are 0.075 (p-value = 0.086) for the left panel and 0.053 (p-value = 0.225) for the right panel, respectively.

[Insert Table 1 and Figure 2 here.]

4. Results

In this section, we examine the relationship between uncertainty and entrepreneurial activity after controlling for various factors. We first explain the estimation method and then present the results of the main regression analysis.

4.1. Specification

To test H1 and H2, we estimate the following model:

$$\ln\left(EA_{it}/EA_{i,t-1}\right) = \alpha \ln\left(Uncertainty_{it}/Uncertainty_{i,t-1}\right) + \mathbf{x}'\boldsymbol{\gamma} + \eta_i + \lambda_t + \varepsilon_{it}. \quad (1)$$

The dependent variable is the logarithmic growth in TEA for country i between $t-1$ and t. The key independent variable of interest is the uncertainty index. The vector **x** includes a series of control variables defined above. We also include country fixed effects, η_i, and year fixed effects, λ_t.[10] The error term is ε_{it}.

To test H3, we estimate the following model:

[10] Each country's national characteristics, such as uncertainty aversion (uncertainty avoidance index known as UAI developed by Professor Geert Hofstede) and legal origin (Djankov et al., 2007), are often used in cross-country analysis. These variables are treated as a constant over time for a country and thus included in country fixed effects.

$$
\begin{aligned}
&\ln\left(EA_{it}/EA_{i,t-1}\right) \\
&\quad = \beta_1 Uncertainty_{i,t-1} \times Entr.Intentions_{it} \times \Delta Fresh\ Start_{it} \\
&\quad + \beta_2 Uncertainty_{i,t-1} \times Entr.Intentions_{it} \\
&\quad + \beta_3 Uncertainty_{i,t-1} \times \Delta Fresh\ Start_{it} \\
&\quad + \beta_4 Entr.Intentions_{it} \times \Delta Fresh\ Start_{it} + \beta_5 Uncertainty_{i,t-1} \\
&\quad + \beta_6 Entr.Intentions_{it} + \beta_7 \Delta Fresh\ Start_{it} + \mathbf{x}'\boldsymbol{\gamma} + \eta_i + \lambda_t + \epsilon_{it}.
\end{aligned} \tag{2}
$$

The dependent variable is the logarithmic growth in TEA for country i from year $t-1$ to year t. The variable of interest is the triple interaction term between uncertainty, entrepreneurial intentions, and fresh start. These three factors are conditions for increased entrepreneurial activity derived from our theoretical framework. The term $\Delta Fresh\ Start_{it}$ represents the change in start-up costs from the previous year to the current year. A positive value of this variable means an increase in entrepreneurial friendliness, i.e., a decrease in start-up costs. We expect the estimated coefficient on the triple interaction term should be a positive.

In a data structure with repeated observations for several years on the same country, the error terms are likely correlated over time for a given country. Unless this correlation is not correctly adjusted, statistically significant results are likely to be obtained. Thus, we use clustered standard errors at the country and year levels to test for a significance level.

4.2. Regression analysis

Table 2 represents the regression results estimated by OLS. We report results using WUI and EPU as an uncertainty index. We also estimate models that include country fixed effects or time fixed effects, or both. In column 1, the coefficient of uncertainty growth is positive, which implies that an increase in uncertainty leads to an increase in entrepreneurial activity. However, we find no significance is observed in the other models. This result is rather indicative of H2 that the increase of uncertainty is irrelevant to entrepreneurial activity. At the same time, H1 that predicts a decrease in entrepreneurial activity with the increase of uncertainty is not supported.

[Insert Table 2 here.]

In Table 3, we examine the conditions that enhance entrepreneurial activity. In all models, the coefficient on the triple interaction term is positive. This result supports H3 that lower start-up costs under high uncertainty stimulate entrepreneurial activity.

[Insert Table 3 here.]

4.3. Do entrepreneurial activities show a reversal?

If the negative relationship between uncertainty and entrepreneurial activity shown in previous studies (Tajaddini and Gholipour, 2021) can be explained by real options theory, we expect to see more entrepreneurial activity when uncertainty is reduced. To test this expectation, we examine a reversal of entrepreneurial activity, although H1 is not supported. We first identify three *consecutive* years ($t-1$, t, and $t+1$) of variation in uncertainty for each country, with uncertainty increasing from year $t-1$ to year t and decreasing from year t to year $t+1$. As a fulfillment of this condition, we find that such cycles occurred a total of 120 times for 48 countries in the sample period. Using these observations, we then compare the growth in TEA from year $t-1$ to year t and the growth in TEA from year t to year $t+1$. If the decline in entrepreneurial activity in year t is due to postponing starting a business, a reversal should be observed in the following year $t+1$. In an untabulated result, the mean growth in TEA from $t-1$ to t is 1% and that from t to $t+1$ is 0.2%. A t-test cannot reject the null hypothesis that these values are equal to zero with the p-values 0.6 and 0.9, respectively. Furthermore, since the mean value of the increase in the uncertainty index (WUI) is 61% and that of the decrease is −54%, the heightened uncertainty has been completely resolved. These results show no evidence of a decrease in entrepreneurial activity under high uncertainty and no reversal effect, in that entrepreneurial activity increases when high uncertainty is resolved.

5. Discussion and conclusion

5.1. Contribution

This paper contributes theoretically and empirically to the literature in at least three ways. First, we conceptualize a choice between real options and affordable loss depending on the degree of uncertainty. Our theoretical approach explains that potential entrepreneurs can take advantage of effectual logic under high uncertainty, and that lowering the cost of failure promotes entrepreneurial activity. Our theoretical approach is related to, but different from, Dew et al. (2009b). Dew et al. (2009b) assume that decision-makers weight the upside and downside information unequally due to the salience of information: entrepreneurs underweight upside information and overweight downside information in the start-up decision. In contrast, our theoretical approach assumes that decision-makers weight exogenous and endogenous information by value, which suggests how reliable they are under uncertainty. We present empirical evidence to support the hypothesis derived from this assumption.

Second, we examine the effect of fresh start on entrepreneurial activity under uncertainty. Our paper is related to previous studies that examine the effect of bankruptcy law on entrepreneurship (Armour and Cumming, 2008; Estrin et al., 2017; Lee et al., 2011; Lee and Yamakawa, 2012; Paik, 2013). Although these studies deal implicitly with uncertainty by assuming entrepreneurial activity is a behavior that involves uncertainty, our study explicitly incorporates uncertainty into the analysis. This is a key difference between our paper and previous studies.

Third, we empirically test the effectuation framework (Sarasvathy, 2001). Although uncertainty is a core concept of effectuation and there has been much interest in these relationships (Alsos et al., 2020), empirical research on effectuation has rarely dealt with the effects of uncertainty. McKelvie et al. (2020) examine 81 empirical studies on effectuation and conclude that “relatively few directly address the notion of uncertainty in empirical context or as a core variable in the study [...] Although

uncertainty was central in Sarasvathy's original theorizing, it appears to be employed less over time (at least from an empirical standpoint)." Furthermore, although Sarasvathy (2001) posits that effectual logic can be applied at the economy level, most previous studies have analyzed from micro-perspectives (i.e., individual, team, or firm level) (Chandler et al., 2011; Dew et al., 2009a; Wiltbank et al., 2009; Yu et al., 2018). To the best of our knowledge, there is no study from macro-perspectives, and our study is the first to provide empirical evidence of the role of effectuation at the economy level. Specifically, we use bankruptcy law as an institutional regime (Sarasvathy, 2001; Dew et al., 2009b) and examine its effect on entrepreneurial activity.

The results of our analyses have implications for entrepreneurs and policymakers. For both groups, it is imperative to investigate under what circumstances which types of decision processes lead to startup. In regression analysis, we find no evidence that real options theory is less likely to be used for decision-making in entrepreneurial activities. One of the interests for policymakers is to foster entrepreneurial activity. Our theoretical framework proposes several conditions for increasing entrepreneurial activity. Since the pool of potential entrepreneurs in each country is different and the environment in which they operate is different, the means to increase entrepreneurial activity under uncertainty will also differ.

5.2. Limitations and opportunities for future research

This paper has at least the following four limitations. First, it is unlikely that fresh start is the only factor that lowers start-up costs. There are countries where entrepreneurial activity increases in response to increased uncertainty (i.e., countries with positive sensitivity) and countries where entrepreneurial activity decreases in response to increased uncertainty (i.e., countries with negative sensitivity) (GERA, 2021). There might be factors that explain the sign and the magnitude of sensitivity. For instance, patent protection, government policies, and financial systems (i.e., bank-based versus market-based financial systems) represent the institutional regime. It is necessary to

clarify not only whether uncertainty affects entrepreneurial activity, but also the conditions that affect it. In addition, it would be important to investigate factors that increase affordable loss for potential entrepreneurs (this is the perspective of changing the affordable loss line in Figure 1C). Our theoretical approach suggests that raising a potential entrepreneur's level of affordable loss can promote entrepreneurial activity. In this regard, Dew et al. (2009b) propose the use of mental accounting for weakly-coupled forms of payment. It would be interesting to test empirically whether this affects entrepreneurial activity. Research in this area has just begun, and further studies are needed.

Second, our theoretical framework needs to be tested at a more micro level. From a micro perspective, the effects of uncertainty are not uniform, and different industries and individuals can be expected to be affected heterogeneously. Since our analysis used country-level data, this paper does not directly observe the psychology and behavior of individuals. Understanding what types of individuals make decisions based on effectual logic under uncertainty, and what types of individuals have higher or lower affordable loss, is important to strengthen our theoretical approach. We ask scholars to explore this issue in the future.

Third, this paper analyzed the entry aspect of entrepreneurial activity, but not the exit aspect under uncertainty. As Sarasvathy (2001) proposes, if potential entrepreneurs start their businesses by using effectual logic, they might have failed earlier and/or with smaller investments. Analyzing these issues would offer relevant subjects for future research.

Fourth, this paper deals only with the uncertainty that cannot be controlled by an entrepreneur and does not consider uncertainty that can be controlled by an entrepreneur. The former type of uncertainty can be categorized as exogenous uncertainty, while the latter type of uncertainty can be categorized as endogenous uncertainty. Endogenous uncertainty is uncertainty that can be reduced (controlled) by one's actions. When this type of uncertainty is high, entrepreneurs might not wait but act immediately because their actions reduce uncertainty. Exogenous uncertainty cannot be reduced

(controlled) by one's actions. Although the theory might apply to endogenous uncertainty, it is not addressed in this paper. We encourage future researchers to explore the effects of different types of uncertainty on entrepreneurial activity.

5.3. Conclusion

In this paper, we conceptualize why effectual logic is used in situations of high uncertainty from the perspective of the value and nature of information. We tested our theoretical predictions using data on entrepreneurial activity from 52 countries over 16 years and found results supporting our arguments. From these empirical results, we conclude that potential entrepreneurs do not wait, that they do sail into the fog, but only if their losses in case of failure are limited.

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Figure 1. Conceptualization of the choice of theories under uncertainty

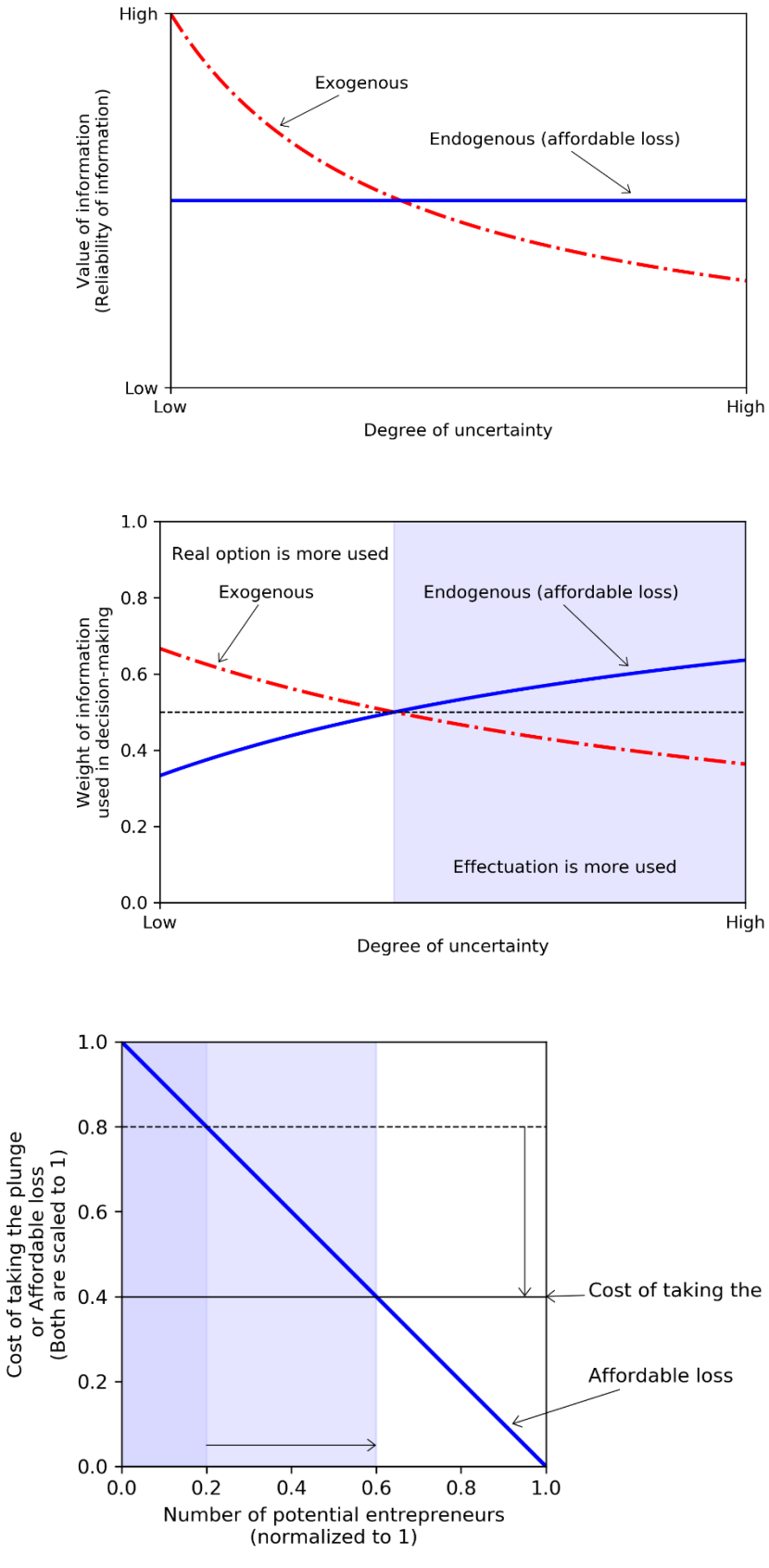

Figure 2. Scatter plots showing the relation between uncertainty and TEA

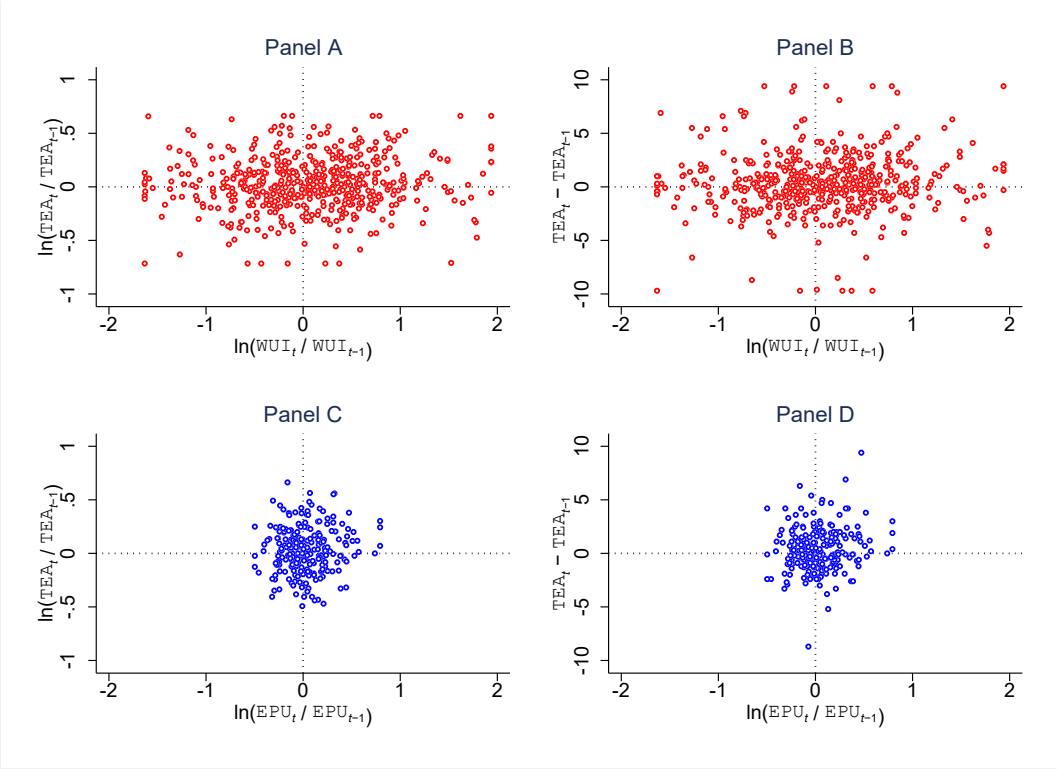

Table 1. Sample statistics

Variable	N	Mean	Std. Dev	Min.	5th pct.	Median	95th pct.	Max.
TEA	540	10.69	6.40	1.90	3.95	8.85	24.00	36.70
WUI	540	0.22	0.17	0.00	0.03	0.19	0.49	1.34
EPU	234	131.09	71.36	27.00	61.02	118.37	257.36	542.77
Entrepreneurial intentions	540	17.76	13.42	0.80	4.45	13.00	48.20	63.80
Fresh start	540	43.65	25.15	7.20	10.10	45.55	80.10	100.00
Fear of failure	540	36.05	8.52	7.10	23.85	35.10	51.75	64.20
Perceived opportunities	540	40.47	16.43	2.90	14.15	40.95	68.65	90.50
Perceived capabilities	540	48.80	13.34	9.00	28.05	48.25	72.75	86.40
Good choice	509	62.32	13.73	19.00	40.20	62.20	85.80	95.60
Unemployment	540	8.22	5.35	0.11	2.90	7.19	21.44	29.12
ln(GDP per capita)	511	9.85	0.95	6.91	8.27	9.92	11.09	11.54

Table 2. The effect of uncertainty on TEA growth

	Dependent variable: TEA growth					
	Uncertainty: WUI			Uncertainty: EPU		
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variable						
$\ln(\text{Uncertainty}_{it} / \text{Uncertainty}_{i,t-1})$	0.040**	0.034*	0.030	0.057	-0.111*	-0.103
	(0.016)	(0.018)	(0.020)	(0.062)	(0.059)	(0.080)
$\ln(\text{Uncertainty}_{i,t-1})$	0.049**	0.005	0.018	0.083	-0.008	0.011
	(0.022)	(0.017)	(0.031)	(0.051)	(0.035)	(0.069)
$\ln(\text{TEA}_{i,t-1})$	-0.609***	-0.230***	-0.652***	-0.566***	-0.177***	-0.594***
	(0.062)	(0.039)	(0.062)	(0.128)	(0.042)	(0.109)
g.Fear of failure	0.103	0.001	0.049	0.210**	0.074*	0.149*
	(0.086)	(0.056)	(0.078)	(0.081)	(0.041)	(0.080)
g.Perceived opportunities	0.042	-0.034	0.012	0.132	-0.002	0.082
	(0.071)	(0.055)	(0.075)	(0.087)	(0.069)	(0.089)
g.Perceived capabilities	0.572***	0.611***	0.629***	0.165	0.183	0.203
	(0.136)	(0.138)	(0.156)	(0.122)	(0.162)	(0.144)
g.Good choice	0.134	0.161	0.219	0.069	0.137	0.162
	(0.135)	(0.116)	(0.128)	(0.182)	(0.083)	(0.183)
g.Unemployment	-0.099	-0.022	-0.058	-0.299*	-0.487***	-0.310**
	(0.128)	(0.088)	(0.114)	(0.165)	(0.095)	(0.133)
g.GDP per caita	0.154	-0.004	-0.006	-0.077	-0.296	-0.206
	(0.158)	(0.229)	(0.258)	(0.164)	(0.279)	(0.237)
l.Fear of failure	0.154	-0.058	0.126	0.108	-0.124	0.081
	(0.107)	(0.046)	(0.113)	(0.152)	(0.096)	(0.153)
l.Perceived opportunities	0.101	0.016	0.023	0.234*	0.030	0.158
	(0.087)	(0.030)	(0.087)	(0.128)	(0.052)	(0.123)
l.Perceived capabilities	0.399**	0.209***	0.531**	0.194	0.125*	0.267
	(0.173)	(0.069)	(0.196)	(0.178)	(0.065)	(0.205)
l.Good choice	0.067	-0.013	0.198*	-0.011	-0.021	0.089
	(0.104)	(0.039)	(0.097)	(0.139)	(0.067)	(0.229)
l.Unemployment	0.076	-0.051***	-0.008	0.008	-0.051*	-0.044
	(0.049)	(0.015)	(0.059)	(0.072)	(0.028)	(0.091)
l.GDP per caita	0.335***	-0.036***	0.126	0.266***	-0.034*	0.171
	(0.087)	(0.011)	(0.072)	(0.073)	(0.018)	(0.098)
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Country fixed effects	Yes	No	Yes	Yes	No	Yes
Number of observations	454	454	454	218	218	218
R-squared	0.434	0.281	0.488	0.402	0.255	0.473

This table presents the results where the dependent variable is the logarithmic growth in TEA. Columns 1–3 are the results when WUI is used for the uncertainty index; columns 4–6 are the results when EPU is used for the uncertainty index. Standard errors are clustered at the country and year levels. The variable name "g" represents the logarithmic growth from year $t-1$ to year t; "l" represents the level of year $t-1$. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 3. The effects of the three factors on TEA growth

	Dependent variable: TEA growth					
	Uncertainty: WUI			Uncertainty: EPU		
	(1)	(2)	(3)	(4)	(5)	(6)
Explanatory variable						
$\ln(\text{Uncertainty}_{i,t-1}) \times \text{Entr.Intentions} \times \triangle\text{Fresh Start}$	0.009**	0.011**	0.008*	0.023***	0.022**	0.013**
	(0.004)	(0.005)	(0.004)	(0.007)	(0.010)	(0.005)
$\ln(\text{Uncertainty}_{i,t-1}) \times \text{Entr.Intentions}$	0.043*	0.044*	0.048*	0.064	0.160*	0.105
	(0.020)	(0.023)	(0.023)	(0.072)	(0.075)	(0.066)
$\ln(\text{Uncertainty}_{i,t-1})$	-0.030***	-0.029**	-0.028**	-0.050**	-0.041***	-0.026**
	(0.009)	(0.010)	(0.009)	(0.023)	(0.010)	(0.011)
$\text{Entr.Intentions} \times \triangle\text{Fresh Start}$	0.015	0.013	0.013	-0.101**	-0.098*	-0.053*
	(0.009)	(0.009)	(0.009)	(0.035)	(0.047)	(0.025)
$\ln(\text{Uncertainty}_{i,t-1})$	-0.071	-0.094*	-0.107*	-0.113	-0.425**	-0.292
	(0.046)	(0.047)	(0.053)	(0.161)	(0.186)	(0.169)
Entr.Intentions	0.326***	0.199***	0.305***	-0.070	-0.625	-0.272
	(0.065)	(0.045)	(0.069)	(0.325)	(0.374)	(0.312)
$\triangle$Fresh Start	-0.052**	-0.035	-0.047*	0.211*	0.177***	0.097
	(0.023)	(0.021)	(0.023)	(0.110)	(0.049)	(0.056)
$\ln(\text{Uncertainty}_{it} / \text{Uncertainty}_{i,t-1})$	0.041*	0.048**	0.035	0.023	-0.131*	-0.143
	(0.019)	(0.020)	(0.023)	(0.056)	(0.062)	(0.088)
$\ln(\text{TEA}_{i,t-1})$	-0.730***	-0.314***	-0.749***	-0.638***	-0.276***	-0.661***
	(0.071)	(0.047)	(0.071)	(0.119)	(0.071)	(0.112)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	Yes	No	Yes	Yes
Country fixed effects	Yes	No	Yes	Yes	No	Yes
Number of observations	454	454	454	218	218	218
R-squared	0.520	0.340	0.550	0.476	0.336	0.538

This table presents the results where the dependent variable is the logarithmic growth in TEA. Columns 1–3 are the results when WUI is used for the uncertainty index; columns 4–6 are the results when EPU is used for the uncertainty index. Standard errors are clustered at the country and year levels. “Controls” includes variables controlled in Table 2. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.