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Self-efficacy and entrepreneurial performance of start-ups

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Abstract Self-efficacy reflects the self-belief that one can persistently perform difficult and novel tasks while coping with adversity. As such beliefs reflect how individuals behave, think, and act, they are key for successful entrepreneurial activities. While existing literature mainly analyzes the influence of the task-related construct of entrepreneurial self-efficacy, we take a different perspective and investigate, based on a representative sample of 1,405 German business founders, how the personality characteristic of generalized self-efficacy influences start-up performance as measured by a broad set of business outcomes up to 19 months after business creation. Outcomes include start-up survival and entrepreneurial income, as well as growth-oriented outcomes such as job creation and innovation. We find statistically significant and economically important positive effects of high scores of self-efficacy on start-up survival and entrepreneurial income, which become even stronger when focusing on the growth-oriented outcome of innovation. Furthermore, we observe that generalized self-efficacy is similarly distributed between female and male business founders, with effects being partly stronger for female entrepreneurs. Our findings are important for policy instruments that are meant to support firm growth by facilitating the design of more target-oriented offers for training, coaching, and entrepreneurial incubators.

Plain English Summary The self-belief in own abilities to cope with adversity and succeed at an endeavor is called self-efficacy. This belief can outweigh other doubts or self-beliefs such that we can be resilient on our path to reaching goals. Can this belief influence the performance of entrepreneurs with nascent start-ups? Is this influence different for female and male entrepreneurs? Accounting for other factors that might influence business outcomes, we find that self-efficacy alone influences the chances of business survival, having employees, applying for patents or trademark protection, as well as the start-up generated income. On the other hand, we find similar levels of self-efficacy between female and male entrepreneurs, observing that self-efficacy affects the probability of growth-related outcomes for both females and males. This contributes to the understanding of what drives start-up growth and success, which is crucial for the development of target-oriented policies, including training measures, coaching offers, and business incubators.

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1 Introduction

Freshly ventured businesses are considered successful when they survive the start-up period, generate sufficient income to their entrepreneurs, and, even more so, when businesses start to grow in terms of job creation and innovation activities. In this context, personality characteristics are known to be one potential predictor in the sense that some of them influence entrepreneurial survival (see inter alia Ciavarella et al., 2004; Caliendo et al., 2014), others entrepreneurial income (Hamilton et al., 2018; De Meza et al., 2019), and firm growth (Baum et al., 2001). Self-efficacy, tracing back to the concept of Bandura (1977), is seen as one important personality characteristic in that regard. It reflects the self-belief that one will not just persistently perform difficult and novel tasks, but also that one can cope with adversity. As such beliefs reflect how individuals behave and act, they are critical for successful entrepreneurial activities (Rauch and Frese, 2007). Moreover, as self-efficacy is related to performing *novel* tasks, this personality characteristic also reflects the ability for innovativeness at the individual level and may, thus, be a well-suited predictor of venture growth (Baum & Locke, 2004). Therefore, in this paper, we analyze whether self-efficacy influences the performance of start-ups in these relevant dimensions of survival, entrepreneurial income, job creation, and innovation.

There are two ways of measuring self-efficacy (Bandura, 1997; Miao et al., 2017). It is either surveyed as a general measure, thus as *generalized self-efficacy (GSE)*, or related to a specific domain, in our context as *entrepreneurial self-efficacy (ESE)*. Thus far, it is the task-related ESE measure that is widely examined within the entrepreneurship literature (see Newman et al., 2019, for a recent overview). In contrast to this, the influence of generalized self-efficacy on business performance is less investigated in the context of entrepreneurship. Its main difference in comparison to ESE is that generalized self-efficacy is seen as a personality characteristic because it encompasses "a broad and stable sense of personal competence to deal effectively with a variety of stressful situations" (Luszczynska et al., 2005, p. 81). Hence, it is a more stable measure, as it captures self-efficacy independent of existing experience in a certain task, contrary to ESE, whose influence on entrepreneurial performance, as well as its stability, might be affected by factors like attitudes toward entrepreneurship, or cultural gender stereotypes (Díaz-García & Jiménez-Moreno, 2010; Tsai et al., 2016).

Up to now, only two studies investigate the extent to which generalized self-efficacy influences entrepreneurial performance. In a meta-study, Rauch and Frese (2007) show that self-efficacy is correlated with entrepreneurial entry, while Khedhaouria et al. (2015), in a cross-sectional study, observe that it also correlates with firm profit and sales of small business owners whose firms are already well established. Thus, to the best of our knowledge, there is no in-depth study that analyzes whether the generalized self-efficacy of *business founders* affects the development of their start-ups.

We close this gap by investigating how the level of generalized self-efficacy — mostly just referred to as self-efficacy in the literature — among business founders influences their start-up performance, when outcome measures do not just concentrate on standard variables of survival and income, but also on variables that indicate job creation and innovation. For this, we combine survey data with administrative data from the Federal Employment Agency in Germany. Our dataset comprises rich information about individuals who started their business either from a non-unemployed position or out of unemployment and who were asked about their generalized self-efficacy. We use a sample of 1,405 entrepreneurs whose business status was followed for 19 months following the launch of their businesses. Based on a theoretical concept, as developed by Bandura (1977; 1997), we first describe how self-efficacy may affect the performance of entrepreneurial start-ups. In our empirical analysis, we use a seven item battery of statements — similar to the operationalization of Jerusalem and Schwarzer (1992) — and aggregate them by factor analysis into one self-efficacy factor. We then investigate to what extent this factor influences various performance measures.

Our results show that generalized self-efficacy has a significantly positive influence on a broad spectrum

of entrepreneurial performance measures 19 months after businesses were ventured and after controlling for a large set of relevant covariates. The relative effect of a one standard deviation increase with respect to the mean is about 8% for outcome measures like entrepreneurial income and job creation, and even larger for the growth-oriented outcome of innovation. We further observe that the effects are partly driven by those individuals who score highest in self-efficacy. With respect to gender differences, we observe that generalized self-efficacy is, in contrast to ESE (Newman et al., 2019), remarkably similarly distributed between female and male entrepreneurs, as well as that the effects seem to be slightly stronger for female entrepreneurs for some outcome variables.

With our analysis, we contribute to the literature in three ways: By examining businesses for the first 19 months after start-up and by making use of a large number of control variables, we investigate whether self-efficacy unfolds an effect on a substantial set of entrepreneurial performance indicators, including not just start-up survival and entrepreneurial income, but also job creation and innovation. Secondly, we analyze effect heterogeneities with respect to gender. Existing research partly finds that, on average, females score lower with respect to task-related entrepreneurial self-efficacy than males and discusses reasons for these differences, such as entrepreneurial experience, attitudes toward entrepreneurship (see Newman et al., 2019), or cultural and social factors (Hopp & Stephan, 2012). However, less is known regarding gender differences with respect to generalized self-efficacy in the context of entrepreneurship. In that sense, we contribute to this discussion in an important way, as we observe that there are fewer gender differences with respect to this more general measure and that generalized self-efficacy influences entrepreneurial performance in the same way for the two genders. Thirdly, from a methodological point of view, compared to earlier studies investigating the relationship between self-efficacy and entrepreneurial performance, we are able to control for many potentially confounding factors, such as individual characteristics of the entrepreneur, business-related characteristics of the start-up, and local macroeconomic conditions.

Our contributions are of high relevance. From a practical point of view, given that policymakers are increasingly interested in how personality characteristics contribute to successful venture performance, we add to the literature investigating how this personality characteristic influences firm growth and innovation. Moreover, as a substantial share of entrepreneurs in general (Cassar & Friedman, 2007), including a substantial share of female entrepreneurs (Coleman, 2016), have no growth intentions for their businesses, our analysis allows for identifying whether this personality characteristic unfolds significant influence on the crucial decision to grow the firm. Similarly, as female entrepreneurs also have a lower survival probability than male entrepreneurs (Fairlie & Robb, 2009), we are able to identify an important determinant of firm survival for female entrepreneurs.

2 Conceptual framework and previous research

2.1 The influence of self-efficacy on start-up performance

In their review, Kerr et al. (2018) point to the renewed interest of researchers and politicians in how personality characteristics influence entrepreneurial behavior, but emphasize that more research is needed on which personality characteristics contribute to entrepreneurial survival, income, and firm growth. Self-efficacy, a widely studied characteristic across all domains of human endeavor that is considered as a consistent performance predictor, is one important personality characteristic. One advantage of using self-efficacy as a generalized personality measure over the domain specific entrepreneurial self-efficacy is that the generalized personality characteristic is stable for adults, at least within a few years (Obschonka and Stuetzer, 2017). Thus, generalized self-efficacy may have more predictive power than ESE and may positively influence a broader spectrum of entrepreneurship-related performance outcomes.

Generally speaking, a high score in this personality characteristic increases the likelihood that individuals will accomplish their intended actions (Bandura, 1994). They view challenging problems as tasks on which they need to perform well. Individuals scoring high in this personality characteristic develop stronger interests and commitment (Bandura, 1977) and, importantly for entrepreneurship, are open to innovation that might help them identify new products and markets (Cassar & Friedman, 2009). They also initiate goal-oriented behavior and persist in achieving

their goals despite uncertainty and scarce resources (Trevelyan, 2009), interpreting failures as learning experiences (Krueger & Brazeal, 1994). Such beliefs are highly relevant for entrepreneurs, who often work in a competitive environment, daily confronting uncertainty, and scarce resources. In that sense, self-efficacy is also in its general measure directly related to the expectations, goals, and motivations of entrepreneurs (Cassar & Friedman, 2009).

Self-efficacy and entrepreneurial survival As self-efficacy facilitates goal-setting, effort investment, persistence when facing barriers, and recovery from setbacks, it measures the perceived ease or personal capability of performing an intended behavior, even against resistance. Thus, if we understand entrepreneurial decisions and actions as planned intended activities, following Ajzen's (1991) theory of planned behavior, then higher self-efficacy should influence how individuals act when conducting entrepreneurial activities, how much effort they put into goal-relevant activities, and to what extent they persevere in their actions, even when they face obstacles. In that sense, individuals with high scores in self-efficacy should be better able to recognize entrepreneurial opportunities, execute their business strategies, and, consequently, increase the probability that they will achieve a better performance in terms of entrepreneurial survival (Bandura, 1994).

In contrast, individuals scoring low in this personality characteristic may doubt their capabilities and may rather avoid difficult tasks.[1] Their commitments to the entrepreneurial goals they aim to pursue will be rather weak. When confronted with difficult tasks, they would rather reduce their efforts or even withdraw from their entrepreneurial activities while pointing to adverse outcomes. Similarly, recovery from setbacks will be rather slow. Therefore, low scores in self-efficacy will be associated with a higher probability of a rather worse start-up performance and higher probabilities of exit from entrepreneurship (Bandura, 1991).

H_1: The higher individuals score in self-efficacy, the higher is their business performance in terms of entrepreneurial survival, even after controlling for other individual, business related, and macro-economic variables relevant for business performance.

[1] Kevill et al. (2017) argue that self-efficacy influences the use or enactment of entrepreneurial capabilities, to the point of being a determinant of them. Thus, without the perceived self-efficacy, there may be no such capabilities.

Self-efficacy and entrepreneurial income The level of self-efficacy of the individual entrepreneur will influence start-up performance in various ways. Creating a new business is often connected with handling obstacles and insecurity. When individuals start as entrepreneurs, they face uncertainty about the value of their idea, resulting in uncertainty about whether their newly established firm will generate sufficient sales in the market. Thus, there is uncertainty about their future entrepreneurial earnings. In the same way, once young entrepreneurs receive initial market feedback — coming in as profits or losses — it is difficult to infer from the level of profits and losses about the value of the own idea. At the beginning of an entrepreneurial activity, profits are often below expectations or below the earnings from the last salaried position (Manso, 2016). In such a context, the level of self-efficacy is crucial, as it refers to the belief of the affected individuals about "their capabilities to exercise control over their own level of functioning and over events that affect their lives" (Bandura, 1991 p. 257). Thus, individuals with higher levels of self-efficacy will have stronger goal commitment and more challenging growth expectations, helping them to withstand such set-backs and to persistently work toward solving those challenges and difficulties that typically arise having launched a new business (Bandura, 1997). They will continue managing their start-ups by investing sufficient efforts in their chosen business strategy in order to realize their business opportunity, thus leading to higher earnings as an entrepreneur.

H_2: The higher individuals score in self-efficacy, the higher is their business performance in terms of entrepreneurial income, even after controlling for other individual, business related, and macro-economic variables relevant for business performance.

Self-efficacy and job creation Similarly, a high level of self-efficacy is also an important signal for all stakeholders around the freshly ventured businesses, in particular when entrepreneurs hire employees.

Thus, highly self-efficacious entrepreneurs will be able to create a positive signal toward employees as they will be more confident about the survival and success probability of the start-up. In return, potential employees will be more willing to accept a job offer from such entrepreneurs and freshly hired employees will work with higher engagement in such businesses.

This will positively influence the probability that someone will be hired in the business as well as the subsequent successful alignment of such new employees in the business in the sense that hired employees may be able to increase firm productivity.

H_3: The higher individuals score in self-efficacy, the higher is their business performance in terms job creation, even after controlling for other individual, business related, and macro-economic variables relevant for business performance.

Self-efficacy and innovativeness Taking patent activities as one example of innovativeness as a further domain of performance outcomes, self-efficacy is again an important personality characteristic (Markman et al., 2002). For instance, successfully filing for a patent requires large, sustained efforts with uncertain outcomes. Once innovative results are produced, it is necessary to convince the relevant scientific community of their relevance; thus, individuals must be persistent when facing obstacles or even rejections, while being able to address challenges. At the same time, they must identify funding to facilitate the patent filing, when they aim to patent their idea which is an obstacle of its own if individuals lack funds. Furthermore, whether the patent produces valuable outcomes for the start-up remains uncertain. Thus, the whole process from having an initial idea to successful innovation is more easily mastered by individuals scoring highly with respect to self-efficacy (Gist & Mitchell, 2004).

H_4: The higher individuals score in self-efficacy, the higher is their business performance in terms of innovativeness, even after controlling for other individual, business related, and macro-economic variables relevant for business performance.

Self-efficacy and gender The influence of self-efficacy on the entrepreneurial development might be different between male and female entrepreneurs. Different levels of entrepreneurial experience, alongside different attitudes and motivation toward entrepreneurship, are shown to be determinants of significant differences in ESE between genders, as reported by (Newman et al., 2019). However, these differences in ESE can also be attributed to cultural practices and social norms. Gender stereotypes might negatively affect female ESE, hindering their performance (Sweida & Reichard, 2013), or might have a heterogeneous effect, such that entrepreneurs report higher ESE when their venture field matches what is socially expected for their gender (Díaz-García & Jiménez-Moreno, 2010). Therefore, it is important to explore this dimension under the lens of generalized self-efficacy. We investigate whether there are also gender differences with respect to the general measure of self-efficacy and whether generalized self-efficacy influences entrepreneurial performance in the same way for the two genders, as hypothesized in H_1 to H_4.

2.2 Previous empirical evidence

When applying self-efficacy as a personality characteristic, one way to measure it, as in psychological research, is by using a battery of up to ten items (Schwarzer & Jerusalem, 1995; Schwarzer et al., 1997).[2] To the best of our knowledge, so far only one study, by Khedhaouria et al. (2015), explicitly introduces this concept in order to investigate the influence of this personality characteristic on three specific outcomes of entrepreneurial performance. In their cross-sectional study of 256 French business owners, who run already well-established micro or small firms, they show that generalized self-efficacy is positively associated with their firm performance as measured by financial profit, market value, and sales volume. Moreover, Rauch and Frese (2007) consider, among several specific personality characteristics, self-efficacy in their meta-analysis, finding that high scores for this characteristic are correlated with entrepreneurial entry as well as with an unspecified measure of business success.[3]

[2] For an overview of similar measures, see Maurer and Pierce (1998).

[3] Three other papers concentrate on the effect of self-efficacy on business entry: Laguna (2013) examines both entrepreneurial and general self-efficacy, analyzing their respective roles in the entrepreneurial process for unemployed individuals. Entrepreneurial and generalized self-efficacy beliefs are both important predictors of start-up intention and significantly increase the probability of business start-up. Similarly, Markman et al. (2002) find that patent inventors who were planning to venture a business scored higher in generalized self-efficacy than patent inventors who had no such plans. Last, but not least, Obschonka and Stuetzer (2017) find that high scores in self-efficacy increase the probability of being self-employed. Moreover, in an earlier study, Utsch et al. (1999) observe that entrepreneurs score higher in generalized self-efficacy than managers.

Many studies focus on the analysis of ESE, which is captured, for instance, by a composite measure of five tasks around innovation, risk-taking, marketing, management, and financial control, where individuals are then surveyed regarding to what extent they believe they have sufficient abilities to perform entrepreneurial tasks in these areas (McGee et al., 2009). The main reason for choosing ESE is that it takes the specific context of entrepreneurship more directly into account (Morgeson et al., 2007). Accordingly, several studies demonstrate a positive relationship between ESE and new venture creation (e.g., Liñán and Chen, 2009; Zhao et al., 2005; Wilson et al., 2007; Townsend et al., 2010; Cassar & Friedman, 2009; for more details, see Newman et al., 2019).

As we concentrate in our analysis of self-efficacy on start-up performance, we restrict the further review of existing empirical evidence on the relationship between the scores of ESE of business founders and firm performance. Baum & Locke (2004), who focus in a longitudinal study on firms in the North American woodwork industry, observe a direct effect of ESE on venture growth in sales and employment. Further studies argue that ESE affects firm performance only indirectly, either being mediated by entrepreneurial orientation (Poon et al., 2006) or serving as a mediator for dispositional optimism and environmental dynamism (Hmieleski & Baron, 2008), or creativity and innovative capacity (Ahlin et al., 2014).

In their meta-analysis, Miao et al. (2017) find that ESE has a moderate influence on firm performance in terms of financial achievements among business founders and that the effect size is not significantly different from habitual entrepreneurs. McGee and Peterson (2019) use longitudinal data — more specifically, three waves of survey data — to explore the lagged influence of ESE on firm performance over a period of up to 5 years. They observe that ESE influences firm performance only in the short term. In their conclusion, they suggest "that a belief in one's ability to launch a new business, alone, is insufficient to ensure the firm's sustainability [...] and that ESE appears much better suited to capture the competencies necessary to launch a new venture but may be an inappropriate construct to explain variances in performance of post start-up firms because ESE is likely less stable than generalized self-efficacy and may change over time" (McGee & Peterson, 2019 p. 721), as individuals learn or gather more entrepreneurial experience and as it can be increased by training.[4] Thus, ESE cannot be seen as a stable personality characteristic (Eden, 1988).[5]

A second, related, issue concerns the specific group of entrepreneurs under investigation: nascent entrepreneurs and business founders, on whom we focus in our study. Often they may have little to no experience at the time when ESE is measured. Therefore, the relationship between ESE and firm performance might be weaker for nascent entrepreneurs when compared to habitual entrepreneurs, with earlier findings on the relationship between ESE and firm performance appearing to be inconsistent for nascent entrepreneurs (Miao et al., 2017).

As the evidence on generalized self-efficacy and entrepreneurial performance of start-ups remains scarce, we close this research gap with the present study. The potential disadvantage of generalized self-efficacy vis a vis ESE is that it is less context specific, thus leading to reduced validity in comparison to ESE when the influence of self-efficacy on firm performance is examined (Gist, 1987). However, the meta-study of (Miao et al., 2017) — comparing their results with the observations of (Rauch & Frese, 2007) on GSE — finds no support for the expectation that the ESE-firm performance relationship is stronger than the GSE-firm performance relationship. Therefore, by testing our hypotheses to what extent generalized self-efficacy influences the start-up performance of business founders, we will be able to further the understanding how this personality characteristic is associated with entrepreneurial activities.

[4] For instance, the ESE of entrepreneurs may increase once they receive positive feedback having successfully mastered previous entrepreneurial tasks.

[5] Kerr et al. (2018) also emphasize that ESE might rather be an endogenous variable and, thus, less suitable for the analysis of its influence on entrepreneurial performance, as it is sensitive to reverse causality and omitted variable bias concerns. This issue could be partly addressed if data on ESE is collected in a multi-wave survey and the influence of ESE is investigated with lagged correlations (McGee & Peterson, 2019).

3 Data, self-efficacy, and descriptives

We start this section with a data description, before presenting how self-efficacy is measured. We then discuss differences in self-efficacy between female and male entrepreneurs before presenting selected summary statistics on the outcome and control variables.

3.1 Data creation and estimation sample

The data set we use was initially collected by Caliendo et al. (2015; 2020b). They created a unique data set that allows for a comprehensive and in-depth comparison between start-ups out of unemployment and out of non-unemployment. Based on different data sources, they drew representative random samples of founders who started a full-time business in the first quarter of 2009 and the third quarter of 2010. The cohorts consist of initially unemployed individuals who received a start-up subsidy (*Gründungszuschuss*) from the Federal Employment Agency,[6] and of business founders who were not unemployed directly prior to start-up and did not receive the subsidy (see Caliendo et al., (2015) for details on data construction). The dataset is ideal for analyzing the performance of business start-ups in Germany, as it contains a large set of informative covariates, including self-efficacy, and a broad spectrum of outcomes. Since the data was initially collected to evaluate the effects of start-up subsidies for the unemployed in Germany, start-ups out of unemployment are somewhat over-represented. Whereas the share of start-ups out of unemployment is about 80% in our sample, it was approximately 46% in the general population of business founders in 2009. We keep this in mind throughout the analysis and also address this issue when discussing the limitations of our study in Section 4.5.

Generalized self-efficacy was collected for a roughly 40% random sample of all survey participants around 19 months after start-up. The interview focused on an extensive list of start-up characteristics, socio-demographics, previous labor market experiences, and intergenerational transmission. In addition to their labor market status and conditional on the ongoing business activity of their initial start-up, they were also interviewed about their business performance across various dimensions, including the number of employees and innovation. We pool both cohorts of founders and focus on their business outcome 19 months after start-up. This leaves us with a sample of 1,405 observations, where roughly 39% (553) are female, which is very close to the share of female founders in the general population of entrepreneurs in Germany (41% in 2009, Federal Statistical Office of Germany, 2018). The size of the sample allows us to analyze effect heterogeneity with respect to gender with our data for most outcome variables.

3.2 Measuring self-efficacy

General self-efficacy is usually measured by a ten item scale developed by Jerusalem and Schwarzer (1992). Our data set contains a slightly shortened scale of seven statements in a German version translated by von Collani and Herzberg (2003). Respondents were asked to rate to what degree they agree with each statement on a Likert-scale ranging from "1" (does not agree at all) to "7" (agree completely).[7] A list of the items used, and the means of the observed responses in the full sample and separated by gender is found in column (1) of Table 1. Individuals agree the most with the first item, "If someone opposes me, I can find the means and ways to get what I want" (Mean: 5.71), and the least with the fourth item, "I am confident that I could deal efficiently with unexpected events" (Mean: 4.82). We can state that the responses are quite high, probably due to the fact that self-efficacy is higher for the self-employed than the general population (Rauch & Frese, 2007).

As a first step in constructing our self-efficacy variable, we conduct an exploratory factor analysis in which we investigate the ways in which the seven items load onto latent factors. The factor analysis retracts one factor with an eigenvalue above 1,

[6] Note that administrative data shows that, for this time period, virtually all business founders out of unemployment received the start-up subsidy. Individuals were entitled to access the program if they fulfilled certain preconditions. Thus, we are confident that our sample data does not contain any positive bias among all previously unemployed entrepreneurs.

[7] The question was: "Consider your professional situation in general now. To what extent do you agree with the following statements? Please answer with 1 meaning "do not agree at all" to 7 "agree completely."

Table 1 Self-efficacy items by gender and factor analysis

Self-efficacy items	All	Female	Male	Mean Diff. (2) v. (3)	Factor analysis	
				p-value	Factor 1	Uniqueness
	(1)	(2)	(3)	(4)	(5)	(6)
1. If someone opposes me, I can find the means and ways to get what I want.	5.71 (1.08)	5.66 (1.12)	5.75 (1.05)	0.20	0.65	0.57
2. I can always manage to solve difficult problems if I try hard enough.	5.70 (0.98)	5.70 (1.00)	5.70 (0.97)	0.89	0.66	0.56
3. It is easy for me to stick to my aims and accomplish my goals.	5.19 (1.10)	5.26 (1.12)	5.14 (1.09)	0.03	0.68	0.53
4. I am confident that I could deal efficiently with unexpected events.	4.82 (1.18)	4.78 (1.26)	4.84 (1.13)	0.28	0.65	0.58
5. I can remain calm when facing difficulties because I can rely on my coping abilities.	5.21 (1.14)	5.06 (1.20)	5.31 (1.09)	0.00	0.71	0.50
6. I can usually handle whatever comes my way.	5.49 (1.26)	5.63 (1.25)	5.41 (1.25)	0.00	0.63	0.60
7. When I am confronted with a problem, I can usually find several solutions.	5.33 (1.25)	5.41 (1.21)	5.28 (1.27)	0.05	0.67	0.56
Average over all self-efficacy items	5.35 (0.83)	5.36 (0.85)	5.34 (0.81)	0.73		
Observations	1,405	553	852			

Notes: Items are measured on a 7-point Likert-type scale from 1 "strongly disagree" to 7 "strongly agree." We report means and standard deviation (in parentheses) for the full sample, and for female and male entrepreneurs separately. Column (4) presents the *p*-value for *t*-test equal means between the groups. Additionally, columns (5) and (6) present respectively the loadings and uniqueness for the confirmatory factor analysis of the self-efficacy items

thus confirming the unidimensionality of self-efficacy usually assumed in the literature. The rotated factor loadings and unique variances are shown in Table A.1 in the Appendix. Secondly, we then extract a single factor. This has the advantage of avoiding equal weighting of all items and instead relies on the data to determine how each item is weighted in the overall index. As per Piatek and Pinger (2016), simply averaging the items risks measurement error and attenuation bias. The final weights for each item in the confirmatory factor analysis are found in column (5) of Table 1 along with their uniqueness in column (6). All reported weights are higher than 0.5, which indicates that the factor explains the variance of the items better than the retained factor in the exploratory factor analysis from Table A.1 and that all items have similar relevance in the factor model. In turn, column (6) shows a high commonality between the items, as the percentage of variance of each item that is not explained by the common factor, i.e. the uniqueness, is not higher than 0.6. Additionally, based on Cronbach's alpha of 0.85, we conclude that the items are relevant and reliable in describing the self-efficacy of the entrepreneurs. The resulting factor is increasing in self-efficacy and its distribution is shown in Fig. 1. Additionally, Fig. 1 reports the kernel densities of the self-efficacy factor separately for men and women.

It is shown from both the distribution in Fig. 1 as well as the items in Table 1 that the overall distribution of self-efficacy is quite similar between men and women. Columns (2) and (3) of Table 1 show the respective means of the items for female and male business founders, column (4) presents the *p*-value for a *t*-test on mean equality in both groups. While men are significantly more likely to believe that they "can remain calm when facing difficulties" (item 5: 5.31

Fig. 1 Distribution of self-efficacy. *Notes:* Based on factor analysis, the figure shows the density distributions for the full sample, and for female and male entrepreneurs separately. The dashed vertical line represents the cutoff between entrepreneurs who score high (above median, to the right) and low (to the left) on the self-efficacy factor for the whole sample. Kernel distributions use an Epanechnikov function with a bandwidth of 0.2. Figure also reports p-values for t-test and $ksmirnov$-test of equal means and equal distributions between female and male entrepreneurs, respectively

vs. 5.06) than women, women are significantly more likely to believe that they "stick to aims and accomplish goals" (item 3: 5.26 vs. 5.14), "they can handle any situation they face" (item 6: 5.63 vs. 5.41), and "they find several solutions to problems" (item 7: 5.41 vs. 5.27), compared to men. For the other three items, there are no significant differences between the genders. When taking the average over all items together (self-efficacy index), we also do not find a significant difference (p-value: 0.95) between men (5.34) and women (5.36). Figure 1 and the corresponding Kolmogorov-Smirnov-test on the equality of distributions (p-value: 0.39) show that this is true for the mean and for the distribution. Nevertheless, we account for potential gender differences in our heterogeneity analysis in Section 4.4 by standardizing the self-efficacy factor as well as generating dichotomous indicators separately within both sub-samples.

3.3 Selected descriptives for outcomes and other characteristics

Differences in outcomes We consider four different outcome variables at the end of our observation period after 19 months: survival, income, job creation, and innovation activities.[8] For the last three outcomes, we restrict our sample to founders who are still self-employed. Income is measured as monthly net earned income from self-employment (in euros, inflation-adjusted to 2010 levels following the Federal Statistical Office, 2014). With respect to job creation, we consider the extensive margin, i.e., the share of businesses with at least one employee ("1" if at least one employee, "0" otherwise). For innovation activities, we observe whether founders have filed at least one patent application or applied for trademark protection[9] since start-up ("1" if yes, "0" otherwise).

Table 2 shows that individuals who score high (above median) on the self-efficacy factor have a slightly higher probability to survive (74%) than business founders who score low on the self-efficacy factor (72%). They also have a higher income and are more likely to have employees (34% vs. 32%). However, none of these differences is statistically significant. We do find statistically significant differences for having applied for a patent or for trademark protection (10% vs. 7%).

Differences in individual- and business-characteristics Given that our research aim is to identify the influence of self-efficacy on entrepreneurial performance, other individual- and business-related variables that are known to affect entrepreneurial outcomes (Shane et al., 2003), as mentioned in Hypothesis H_1, must be controlled for. Such variables include not just personal characteristics, e.g., age (Kautonen et al., 2014), gender (Fairlie and Robb, 2009), and human capital of the entrepreneur (Unger et al., 2011), but also

[8] Since we are analyzing the entrepreneurial performance of start-ups, we do not analyze the type of exit from self-employment, i.e., whether it was voluntary or involuntary or whether the exit was a transition into unemployment or due to the fact that an employment opportunity emerged (cf. (Millán et al., 2012; Andersson & Wadensjö, 2007; van Praag, 2003)). As pointed out by Caliendo and Künn (2011) and Caliendo et al. (2016), who analyze an earlier start-up program for unemployed individuals in Germany, a transition into employment might also be seen as a policy success, but this holds only for previously unemployed business founders (see Caliendo et al., 2020b for a more extensive discussion on the assessment of start-up subsidies for the unemployed from a business and active labor market policy perspective). For start-ups out of an employed position, it is not plausible to consider a return to an employed position as a successful outcome.

[9] See also Block et al. (2014), who propose that trademarks may also be used as proxy for innovation activities.

Table 2 Descriptive statistics for outcomes by self-efficacy level

	All	Self-efficacy factor		Mean Diff.
		Low	High	Low v. High
				p-value
	(1)	(2)	(3)	(4)
Survival	0.73	0.72	0.74	0.22
Net working income (Euros/month)	2,201.91	2,142.78	2,261.52	0.24
Employees dummy	0.33	0.32	0.34	0.22
Patents or TM	0.09	0.07	0.10	0.02
Observations	1,405	705	700	

Notes: All reported numbers are shares (unless stated otherwise) for the full sample in column (1) and differentiated by scoring high (above median) and low in the self-efficacy factor in columns (2) and (3). We report *p*-values for *t*-tests of equal means between the groups in column (4)

potential intergenerational transmission, for instance, via parental self-employment (Dunn & Holtz-Eakin, 2000). They further include the labor market history; e.g., the duration of the last dependent employment (Parker, 2018) or the income from last dependent employment (Astebro & Chen, 2014). There are also well-known business-related characteristics, like the industry-specific experience before start-up (Bosma & Van Praag, 2004) and the financial capital invested when the firm was launched (Holtz-Eakin et al., 1994; Blanchflower & Oswald, 1998), which influence later firm development, as well as local macro-economic conditions (Millán et al., 2012; Sedláček & Sterk, 2017).

Our data allow us to include a wide range of these variables as listed in Appendix Table A.2. It shows that business founders who score high on the self-efficacy factor differ in some (but not all) individual- and business-related characteristics from founders who score low on the self-efficacy factor. Founders with high self-efficacy are, on average, older, and more likely to have finished middle secondary school, more likely to have an apprenticeship certificate, but less likely to be German, and less likely to have finished university education. Founders with high self-efficacy are also more likely to have more employment experience before the start-up and are more likely to work in the manufacturing sector. In terms of background and intergenerational transmission, founders with high self-efficacy are more likely to have parents born abroad but less likely to have self-employed parents. On the other hand, we do not see any significant differences for several other variables, such as capital invested at start-up, previous income from dependent employment, and the unemployment experience directly before the start-up.

4 Empirical analysis

4.1 Estimation strategy

To test the influence of self-efficacy on business development 19 months after business formation, we control for an extensive set of individual and business-related characteristics as well as local macroeconomic conditions that are shown to matter for entrepreneurial development (as discussed in Section 3.3). We employ logit estimations for business survival, the employer dummy variable (taking the value "1" if the business has at least one employee and "0" otherwise), as well as the indicator of innovation activities. The following logit regression on survival with the same business is exemplary for all binary outcome variables:

$$\begin{aligned} \mathrm{P}(\mathrm{Survival}_i &= 1|\mathrm{Self\text{-}Efficacy}_i, \mathbf{X_i}) \\ &= F(\alpha + \beta\, \mathrm{Self\text{-}Efficacy}_i + \mathbf{X}'\boldsymbol{\gamma}), \end{aligned} \quad (1)$$

where we operationalize *Self-Efficacy*$_i$ based on the self-efficacy factor defined in Section 3.2. $\mathbf{X_i}$ stands for the vector of control variables. These include personal characteristics A_i (age categories, children categorized, marital status, nationality, living in East Germany), human capital B_i (school achievement, professional education), intergenerational transmission C_i

(parents born abroad, parental self-employment, business takeover from parents, school achievement of father, father of respondent employed at age 15), labor market history D_i (starting out of unemployment or not, duration of last dependent employment right before start-up, monthly net income from last dependent employment categorized, employment experience before start-up), local macroeconomic conditions E_i (vacancies related to stock of unemployed, unemployment rate, real GDP per capita in 2008), as well as business-related characteristics F_i (sector, industry-specific experience before start-up, capital invested at start-up categorized, capital at start-up consisted entirely of own equity). When examining the influence of self-efficacy on income, we use an OLS regression with the same set of covariates.

4.2 Main results

Table 3 presents our main regression results. In panel A, column (1) shows that an increase of one standard deviation (SD = 0.91) in the self-efficacy factor leads to a 3.0 percentage points higher survival probability, after controlling for the full set of covariates.[10] This relates to a relative effect of 4.1%, which is economically relevant and statistically significant. Thus, self-efficacy has explanatory power for survival in month 19, even after controlling for a large set of covariates that are proven to be key determinants, confirming H_1.

Similarly, we observe a significant influence of self-efficacy on all other outcome variables. A one SD increase of the individuals' score on self-efficacy is associated with a higher income from self-employment and a higher probability of employing others in their firm, confirming H_2 and H_3. The economic magnitude is about 7.9% for income and 8.8% for employees (controlling for all other covariates), which becomes even larger for the last outcome variable. In confirmation of H_4, a one SD increase in the self-efficacy factor is associated with an increase in the probability to file a patent or apply for trademark protection by 1.6 percentage points (18.4%).

Non-linearities In order to test for non-linearities in our results, we create a dummy variable based on the self-efficacy factor in panel B of Table 3, taking the value "1" if the factor is above the median and "0" otherwise. The results are as expected as we see stronger relative effects for all outcome variables (even though the result is no longer significant for survival). Especially for the innovation outcome, the effect more than triples to 68.1% when we compare individuals above the median with those below. In order to tease this out even further, we split the self-efficacy factor into terciles in panel C and examine the effects relative to the first tercile. It turns out that the effects are, in fact, driven by those individuals who score in the highest tercile in the self-efficacy factor. Being in this tercile, i.e., having a very high self-efficacy, is associated with a 12.5% higher survival probability, a higher income by 16.3%, and also a higher probability of having employees (21.3%); all these are relative to individuals scoring in the lowest tercile. For innovation activities, we even find relative effects in the magnitude of 101.6%.

Overall, we conclude that self-efficacy has a significantly positive influence on a broad spectrum of entrepreneurial performance measures 19 months after businesses have been ventured and after controlling for a large set of relevant covariates. The effects are driven by those individuals with the highest self-efficacy scores.

4.3 Robustness analysis

We consider the robustness of our results to three issues. First, in order to test the results with respect to the construction of our self-efficacy factor, we re-run the analysis from Table 3 based on a manual index that gives each of the seven self-efficacy items equal weight, i.e., we sum them up and take the average. Table A.3 contains the results. It shows that the results are qualitatively and quantitatively very similar to our main estimation results. This is not just true with respect to the statistical significance but also the relative magnitudes. Hence, results are robust with respect to the construction of the self-efficacy factor.

In a second step, we test the robustness of our results with respect to the inclusion of other personality characteristics, like risk aversion, the Big Five personality traits, and locus of control. Appendix Table A.2 shows that the personality of founders with high self-efficacy significantly differs from founders with low self-efficacy. Since these variables

[10] To put this into perspective and give an example: A one standard deviation increase moves an individual from the 50%-th to the 86%-th percentile of the self-efficacy distribution.

Table 3 Self-efficacy on entrepreneurial outcomes after 19 months

	Survival	Net working income	Employees	Patents or TM
	(1)	(2)	(3)	(4)
	Logit	OLS	Logit	Logit
A. ***Self-efficacy factor index***				
Self-efficacy factor	0.030**	174.868***	0.029**	0.016*
	(0.013)	(51.418)	(0.015)	(0.009)
Mean	0.730	2,201.91	0.329	0.087
Effect in %	4.1	7.9	8.8	18.4
Pseudo R^2 or R^2	0.108	0.298	0.224	0.150
B. ***Above and below median (factor)***				
Above median	0.034	297.348**	0.051*	0.047**
	(0.027)	(133.857)	(0.027)	(0.019)
Mean below median	0.719	2,142.78	0.317	0.069
Effect in %	4.7	13.9	16.1	68.1
Pseudo R^2 or R^2	0.105	0.296	0.223	0.156
C. ***Terciles***				
Tercile 2	0.065**	114.343	0.015	0.047**
	(0.030)	(147.416)	(0.033)	(0.024)
Tercile 3	0.085***	341.304**	0.070**	0.063***
	(0.031)	(153.473)	(0.033)	(0.022)
Mean tercile 1	0.682	2,088.82	0.328	0.062
Effect tercile 2 in %	9.5	5.5	4.6	75.8
Effect tercile 3 in %	12.5	16.3	21.3	101.6
Pseudo R^2 or R^2	0.110	0.296	0.224	0.159
Observations	1,405	974	1,056	1,056
Controls:				
A. Personal characteristics	×	×	×	×
B. Human capital	×	×	×	×
C. Intergenerational transmission	×	×	×	×
D. Labor market history	×	×	×	×
E. Local macroeconomic conditions	×	×	×	×
F. Business-related characteristics	×	×	×	×

Notes: Reported are regression coefficients from OLS regressions for net income from self-employment as well as marginal effects of logit regressions for all other outcomes. All outcomes except self-employed with same business (N=1,405) are conditional on business survival and reported for those who are still in business only (n=1,056). Income (n=974) is based on slightly lower numbers of observations due to item non-responses

Standard errors in parentheses. ***/**/* indicates statistical significance at the 1/5/10% level. Covariates include all variables listed in Table A.2. Detailed results are available upon request

are shown to influence entrepreneurial decision, performance, and persistence (Caliendo et al., 2010; Zhao et al., 2010; Caliendo et al., 2014; Caliendo et al., 2020a; Caliendo et al., 2022), one might be concerned about their relation to self-efficacy and the consequences for the effects. Table A.4 in the Appendix shows that all personality characteristics are correlated, but the correlation between self-

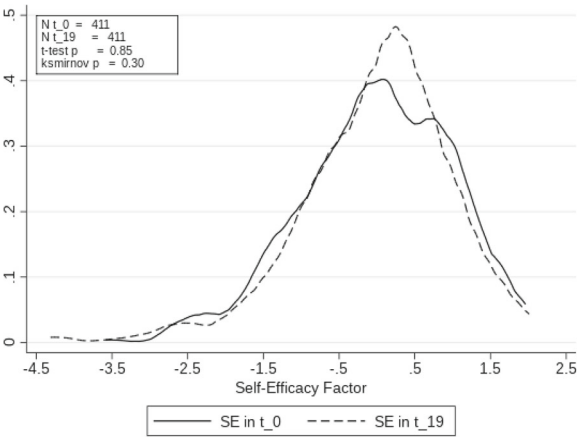

Fig. 2 Self-efficacy distribution at start and after 19 months. *Notes:* Based on factor analysis, the figure shows the density distributions of self-efficacy at the beginning of the start-up ($t = 0$) and 19 months after ($t = 19$). Kernel distributions use an Epanechnikov function with a bandwidth of 0.2. Figure also reports p-values for t-test and $ksmirnov$-test of equal means and equal distributions between the measures at different timing

efficacy and other personality characteristics is not distinctly higher than between the other personality characteristics themselves.[11] In Appendix Table A.5, we re-run our main analysis from Table 3 additionally controlling for a vector G_i of personality characteristics (Big Five, locus of control, readiness to take risk). Unfortunately, we do not observe these for all individuals, such that the sample gets slightly smaller. Nevertheless, the results are remarkably stable, similar both qualitatively and quantitatively. The effects of self-efficacy on survival and income are even a bit stronger once we control for the other personality characteristics, while the effect on patents is slightly smaller. Nearly all effects remain statistically significant and coefficients remain overall very similar.

Finally, we emphasize in Section 2 that we rely on the standard assumption that GSE is — in contrast to ESE — a stable personality characteristic (at least within a few years). Hence, using it measured at the same time as our outcome variables should not be a problem. In order to test this assumption, we make use of the fact, that we observe self-efficacy for a small subset ($N = 411$) of individuals both at the start of their entrepreneurial career (in t_0) and 19 months later. Figure 2 shows that the distribution of self-efficacy is very similar across both measurement points and neither the mean (t-test p-value: 0.85) nor the distribution ($ksmirnov$-test p-value: 0.30) are statistically different from each other. However, since this data is only available for a small subsample and only considers a relatively short time period, we do not want to overemphasize this finding and highlight this issue in our limitations section.

4.4 Heterogeneity analysis

In a next step, we examine potential effect heterogeneity between female and male business founders. Although, as already shown in Section 3.2, self-efficacy is remarkably similarly distributed between women and men, in this section, we analyze whether it unfolds similar or different influences on the outcome variables for the two genders. Tables 4 and 5 replicate our analysis from Table 3 for both groups separately, showing that the direction and magnitude of the marginal effects are rather similar for women and men; these are close to the main results, although there are also interesting differences.

We standardize the self-efficacy factor for each sub-sample and generate the dichotomous variables that are used to analyze non-linearities separately for each group.[12] Table 4 presents the analysis for female entrepreneurs ($N = 553$), who represent about 38% of the total sample; Table 5 does this analogously for male entrepreneurs ($N = 852$).[13] If we start with the continuous self-efficacy factor in panel A of Tables 4 and 5, we see that effects are (partly) slightly stronger for females, but not always significant. An increase of one SD in the self-efficacy factor is associated with an increase of 5.3 percentage points in the probability of business survival for female entrepreneurs, which represents a relative effect of 7.3%, whereas survival rates of male entrepreneurs are not significantly influenced by their self-efficacy level.[14] Likewise, the

[11] For instance, the correlation is 0.34 with locus of control and 0.23 with risk tolerance, two personality characteristics somehow related to self-efficacy.

[12] Given that the distribution of self-efficacy for male and female entrepreneurs are not significantly different (see the discussion in Section 3.2 and Table 1 and Fig. 1), the estimated effect sizes are comparable. The standard deviation for females (males) is 0.88 (0.92).

[13] The number of observations in our estimation for female entrepreneurs decreases due to multicollinearity.

[14] Note that for business survival, the factor differs significantly between females and males.

Table 4 Self-efficacy on entrepreneurial outcomes after 19 months — by gender: female entrepreneurs

	Survival	Net working income	Employees	Patents or TM
	(1)	(2)	(3)	(4)
	Logit	OLS	Logit	Logit
A. ***Self-efficacy factor index - Female entrepreneurs***				
Self-efficacy factor	0.053***	109.832**	0.033	0.010
	(0.020)	(54.579)	(0.026)	(0.028)
Mean	0.719	1,381.746	0.240	0.080
Effect in %	7.3	7.9	13.8	12.5
Pseudo R^2 or R^2	0.160	0.358	0.264	0.537
B. ***Above and below median (factor) - Female entrepreneurs***				
Above median	0.068*	313.520***	0.084*	0.102
	(0.040)	(112.458)	(0.044)	(0.067)
Mean below median	0.695	1,268.817	0.227	0.064
Effect in %	9.8	24.7	37.0	159.4
Pseudo R^2 or R^2	0.152	0.366	0.268	0.568
C. ***Terciles - Female entrepreneurs***				
Tercile 2	0.111**	178.478	0.056	0.006
	(0.045)	(133.978)	(0.053)	(0.077)
Tercile 3	0.113**	136.572	0.124**	0.097
	(0.049)	(136.814)	(0.063)	(0.082)
Mean tercile 1	0.645	1,330.016	0.217	0.070
Effect tercile 2 in %	17.2	13.4	25.8	8.6
Effect tercile 3 in %	17.5	10.3	57.1	138.6
Pseudo R^2 or R^2	0.121	0.231	0.216	0.330
Observations	545	377	404	279
Controls:				
A. Personal characteristics	×	×	×	×
B. Human capital	×	×	×	×
C. Intergenerational transmission	×	×	×	×
D. Labor market history	×	×	×	×
E. Local macroeconomic conditions	×	×	×	×
F. Business-related characteristics	×	×	×	×

Notes: Sample consists of female entrepreneurs only. Reported are regression coefficients from OLS regressions for net income from self-employment as well as marginal effects of logit regressions for all other outcomes. All outcomes except self-employed with same business (N=553) are conditional on business survival and reported for those who are still in business only (n=407). Income (n=377) is based on slightly lower numbers of observations due to item non-responses

Standard errors in parentheses. ***/**/* indicates statistical significance at the 1/5/10% level. Covariates include all variables listed in Table A.2. Detailed results are available upon request

Table 5 Self-efficacy on entrepreneurial outcomes after 19 months — by gender: male entrepreneurs

	Survival	Net working income	Employees	Patents or TM
	(1)	(2)	(3)	(4)
	Logit	OLS	Logit	Logit
A. ***Self-efficacy factor index - Male entrepreneurs***				
Self-efficacy factor	0.010	195.685***	0.037**	0.032***
	(0.016)	(72.785)	(0.018)	(0.012)
Mean	0.735	2,693.69	0.385	0.107
Effect in %	1.4	7.3	9.6	29.9
Pseudo R^2 or R^2	0.134	0.277	0.235	0.196
B. ***Above and below median (factor) - Male entrepreneurs***				
Above median	0.012	335.921*	0.049	0.057**
	(0.034)	(192.377)	(0.036)	(0.027)
Mean below median	0.726	2,636.20	0.369	0.083
Effect in %	1.7	12.7	13.3	68.7
Pseudo R^2 or R^2	0.134	0.275	0.232	0.194
C. ***Terciles - Male entrepreneurs***				
Tercile 2	0.014	208.178	0.023	0.064**
	(0.038)	(214.435)	(0.044)	(0.032)
Tercile 3	0.061	370.931	0.078*	0.091***
	(0.039)	(228.491)	(0.042)	(0.029)
Mean tercile 1	0.705	2,571.066	0.384	0.071
Effect tercile 2 in %	2.0	8.1	6.0	90.1
Effect tercile 3 in %	8.7	12.0	20.3	128.2
Pseudo R^2 or R^2	0.136	0.274	0.234	0.202
Observations	852	597	649	649
Controls:				
A. Personal characteristics	×	×	×	×
B. Human capital	×	×	×	×
C. Intergenerational transmission	×	×	×	×
D. Labor market history	×	×	×	×
E. Local macroeconomic conditions	×	×	×	×
F. Business-related characteristics	×	×	×	×

Notes: Sample consists of male entrepreneurs only. Reported are regression coefficients from OLS regressions for net income from self-employment as well as marginal effects of logit regressions for all other outcomes. All outcomes except self-employed with same business (N=852) are conditional on business survival and reported for those who are still in business only (n=649). Income (n=597) is based on slightly lower numbers of observations due to item non-responses

Standard errors in parentheses. ***/**/* indicates statistical significance at the 1/5/10% level. Covariates include all variables listed in Table A.2. Detailed results are available upon request

relative effect of an increase of one SD in the self-efficacy factor is slightly higher for female than for male entrepreneurs on income (7.9% vs. 7.3%). In turn, male entrepreneurs benefit from self-efficacy with regard to innovation and employees, since an increase of one SD of the self-efficacy factor has a relative effect of 29.9% on the probability of filing for a patent or applying for trademark protection and 9.6% on the probability of having employees (while the effect for females are 12.5% and 13.8%, but not statistically significant).

When considering non-linearities, we use the same analysis as in Section 4.2. As shown in panel C of Table 4, female entrepreneurs in the top tercile of the self-efficacy factor distribution have higher probabilities of business survival (11.3 percentage points) and having employees (12.4 percentage points) compared to women at the bottom of the distribution in the first tercile. These associations have strong economic magnitude as they represent a relative effect of 17.5% (survival) and 57.1% (having employees). The relative effect is even higher for innovation (138.6%), albeit not statistically significant. We must keep in mind that filing a patent or applying for trademark protection is a rare event and that the sample size of female entrepreneurs is rather small, making a precise estimation difficult. As for male entrepreneurs (see Table 5), we observe a significant relationship between being in the top tercile of the self-efficacy factor distribution and the probability of having employees (20.3%) and to file patents or apply for trademark protection (128.2%). Overall, we do not observe non-linearities in the relationship between self-efficacy and any of the outcome variables, rather a positive linear relationship for both female and male entrepreneurs, where the effects are driven by those in the highest percentile.

4.5 Limitations

We should emphasize that our approach is not without limitations. Most crucially, our observation window is restricted to roughly 1.5 years after business formation and we are unable to determine if the positive influence of this specific personality characteristic persists. Thus, future research needs to investigate to what extent similar effects of self-efficacy prevail in the longer run. Secondly, it is generally argued that self-efficacy is a stable personality characteristic and we do not find any contradictory evidence in our data. However, concerns about stability and reverse causality might be more prevalent if the measurement points of self-efficacy and outcomes are further apart than the 19 months observed here. Hence, it would be interesting to specifically examine this in future research. The third limitation that we want to emphasize is the fact that start-ups out of unemployment are over-represented in our sample. However, Table A.2 in the Appendix shows that the share of individuals starting from unemployment is identical in the groups with low and high self-efficacy. As this separation is of main relevance for our analysis, we are confident that, in the present case, the over-representation does not limit the interpretation of the results in a substantial way. But clearly, it might be interesting to examine in future research whether self-efficacy has different effects for start-ups from unemployment and non-unemployment.

5 Discussion and conclusion

Individuals having a high level of self-efficacy are meant to have a strong belief in their own capabilities, inherently viewing tasks as challenges to be accomplished. This personality characteristic is expected to enhance the ability of individuals to accomplish entrepreneurial activities, thus to get an own business up and running, as well as to introduce novel ideas into the business, even when setbacks hinder such introductions. Therefore, this paper investigates how self-efficacy, based on the concept of Bandura (1977, 1991, 1997), relates to entrepreneurial performance. More specifically, we empirically investigate, using a sample of 1,405 business founders, whether this characteristic — extracted from a factor analysis — influences start-up performance 19 months after their businesses were ventured. Importantly, performance is measured by an extensive set of outcome variables that include indicators for firm growth.

Our analysis leads to two main findings. First, in support of hypotheses H_1 to H_4, we observe that the higher entrepreneurs score in generalized self-efficacy, the better is their start-up performance, even after controlling for a large set of covariates, including individual- and business-related characteristics as well as macroeconomic variables. This positive relationship is significant for all performance measures used

in our analysis in nearly all specifications, including survival of the business, entrepreneurial income, and growth-oriented outcomes, like innovation or job creation. Remarkably, the effects for the latter growth-related outcome are particularly strong. We also show that some of these effects are driven by individuals in the top tercile of the distribution, i.e., those who score highest in self-efficacy.

Second, we investigate — for the first time to the best of our knowledge — how female and male entrepreneurs score in this personality characteristic and how it influences start-up performance in both groups. We observe that generalized self-efficacy is remarkably similarly distributed between female and male entrepreneurs, while the literature shows differences in entrepreneurial self-efficacy between the two genders (see inter alia Wilson et al., 2009; Wennberg et al., 2013). The reason for these differences in entrepreneurial self-efficacy might be attributable to less entrepreneurial experience among female entrepreneurs (Newman et al., 2019), but it should not be interpreted in the sense that female entrepreneurs are per se less self-efficacious when they turn to this employment form. Future research should further investigate how self-efficacy as a personality characteristic, also relative to the task-related ESE, influences entrepreneurial development.

We then find for both female and male entrepreneurs that high scores in generalized self-efficacy have particularly strong effects for filing for patents and for hiring employees; thus, for variables signaling an actually growing business in terms of job creation and for potentially growing businesses when their patent is turned into an innovation output. The effect on innovation is, however, not statistically significant for female entrepreneurs as the smaller number of observations makes it difficult to estimate precise effects in this context.

Our findings have implications for future research and policy. Self-efficacy is a central personality characteristic that contributes to the understanding of what drives the successful growth of start-ups. This could be accounted for when designing policy measures, in particular when aiming to identify potentially successful entrepreneurs for programs that focus on supporting start-ups with innovation potential. Second, the influence of self-efficacy for female and male entrepreneurs on firm performance allows to consider some policy advice. For that, we must keep in mind that the concept of generalized self-efficacy analyzed here differs fundamentally from entrepreneurial self-efficacy. As entrepreneurial self-efficacy is a task-related measure, it is less stable and, hence, can be trained directly through appropriate instruments. In much contrast to this, the actual level of generalized self-efficacy among entrepreneurs could be used for a target-oriented development of measures on how to support entrepreneurs effectively in their endeavor toward growth-oriented businesses. This might include appropriate training measures, coaching offers, or business incubators. When training measures are designed, it is important to focus on practically oriented courses toward growing businesses that correspond to the specific levels of self-efficacy observed among the entrepreneurs (Piperopoulos & Dimov, 2015). Even if coaches are not able to change the innate generalized self-efficacy of their coachees in the short run (Bandura, 1997), they can precisely use knowledge about it to adapt their coaching style accordingly. That is, accommodating participants and designing teaching materials such that each coachee can develop skills or learn new techniques that maximize their probability of success given their individual level of self-efficacy. For instance, when running business incubators, a support measure that is often effective for nascent entrepreneurs with growth ambitions, it is possible to create a supportive environment between the participating entrepreneurs. These could gain from observing their peers in such incubators when these peers succeed because of their sustained efforts to grow their businesses. Third, we also observe an influence of generalized self-efficacy on survival, which is, however, only significant among female entrepreneurs. Given that female entrepreneurs have generally lower survival probabilities than their male counterparts (Fairlie & Robb, 2009), we have identified one crucial personality characteristic that needs consideration when designing appropriate support measures with a focus on female entrepreneurs. Last, but not least, in our analysis, we have seen that the influence of self-efficacy on entrepreneurial performance remains stable when adding other personality characteristics. Based on these findings, future research may investigate to what extent there are positive interactions effects between self-efficacy and other related personality characteristics, like risk tolerance or locus of control, which are also important for successfully growing businesses.

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Competing interests The authors declare no competing interests.

Appendix

Table A.1 Results from factor analysis

Self-efficacy items	Factor 1 (1)	Factor 2 (2)	Factor 3 (3)	Uniqueness (4)
1. If someone opposes me, I can find the means and ways to get what I want.	0.57	0.29	0.24	0.53
2. I can always manage to solve difficult problems if I try hard enough.	0.58	0.27	0.27	0.51
3. It is easy for me to stick to my aims and accomplish my goals.	0.52	0.39	0.25	0.52
4. I am confident that I could deal efficiently with unexpected events.	0.35	0.54	0.22	0.54
5. I can remain calm when facing difficulties because I can rely on my coping abilities.	0.30	0.57	0.36	0.45
6. I can usually handle whatever comes my way.	0.24	0.37	0.51	0.54
7. When I am confronted with a problem, I can usually find several solutions.	0.40	0.28	0.50	0.52

Notes: Rotated results for exploratory principal factor analysis conducted on self-efficacy items

Table A.2 Descriptive statistics for all covariates

	All (1)	Self-efficacy factor		Mean Diff. (3) v. (4) *p*-value (4)
		Low (2)	High (3)	
A. *Personal characteristics*				
Age at start-up				
<25	0.04	0.05	0.04	0.31
25–<35	0.24	0.27	0.20	0.02
35–<45	0.32	0.32	0.32	0.55
45–<56	0.28	0.25	0.32	0.03
≥56	0.12	0.11	0.12	0.24
Male	0.62	0.62	0.62	0.96
Children in household				
No children	0.63	0.63	0.63	0.95
Children under 6	0.19	0.20	0.17	0.09
Children from 6 to 14	0.24	0.23	0.26	0.21

Table A.2 (continued)

	All	Self-efficacy factor		Mean Diff. (3) v. (4)
		Low	High	*p*-value
	(1)	(2)	(3)	(4)
Married	0.56	0.55	0.58	0.19
German citizen	0.95	0.96	0.95	0.09
Living in East Germany	0.22	0.20	0.24	0.10
B. ***Human capital***				
Highest schooling certificate				
None or lower secondary school	0.18	0.13	0.23	0.00
Middle secondary school	0.33	0.31	0.36	0.01
Upper secondary school	0.49	0.57	0.41	0.00
Professional education				
Unskilled workers/others	0.05	0.05	0.06	0.88
Skilled workers (apprenticeship)	0.45	0.41	0.50	0.00
Technical college education	0.15	0.14	0.16	0.06
University education	0.34	0.40	0.29	0.00
C. ***Intergenerational transmission***				
Parents born abroad	0.19	0.17	0.20	0.07
Parents are/were self-employed	0.34	0.36	0.32	0.07
Highest schooling certificate of father				
None or lower secondary school	0.56	0.51	0.62	0.00
Middle or upper secondary school	0.44	0.49	0.38	0.00
Father employed when respondent 15 years old	0.90	0.90	0.90	0.82
D. ***Labor market history***				
Start-up from unemployment	0.82	0.81	0.83	0.75
Duration of dependent employment right before start-up				
<1 year	0.05	0.05	0.06	0.93
5 or more years	0.49	0.49	0.48	0.38
Monthly net income from last dep. employment right before start-up				
Non-employed	0.15	0.13	0.18	0.03
€0–€1,000	0.14	0.15	0.13	0.16
> €1,000–€1,500	0.21	0.21	0.22	0.56
> €1,500–€2,500	0.27	0.28	0.26	0.35
> €2,500	0.18	0.19	0.18	0.90
Dependently employed and income not specified	0.04	0.05	0.03	0.88
Unemployment experience before start-up[a]				
0	0.12	0.14	0.10	0.28
>0–≤2	0.30	0.29	0.31	0.84
>2–≤5	0.29	0.30	0.29	0.63
>5–≤15	0.24	0.22	0.25	0.27
>15	0.05	0.04	0.05	0.98
Employment experience before start-up[a]				
≤50	0.20	0.24	0.16	0.00
>50–≤70	0.22	0.23	0.21	0.09

Table A.2 (continued)

	All	Self-efficacy factor		Mean Diff. (3) v. (4) *p*-value
		Low	High	
	(1)	(2)	(3)	(4)
>70–≤90	0.37	0.36	0.37	0.51
>90–≤99	0.16	0.13	0.19	0.00
>99	0.05	0.04	0.06	0.01
E. ***Local macroeconomic conditions***				
Vacancies related to stock of unemployed	15.35	15.77	14.91	0.00
Unemployment rate	8.37	8.16	8.59	0.04
Real GDP per capita in 2008 (in €1000)	34.30	35.58	32.97	0.00
F. ***Business-related characteristics***				
Sectoral distribution of businesses				
Manufacturing, crafts	0.11	0.10	0.13	0.02
Construction	0.05	0.05	0.05	0.29
Retail	0.13	0.12	0.15	0.31
Transport, logistics	0.03	0.03	0.03	0.61
Financial service, insurance industry	0.04	0.03	0.04	0.26
IT	0.07	0.09	0.05	0.00
Other services	0.37	0.38	0.37	0.87
Other sectors	0.19	0.20	0.17	0.03
Industry-specific experience before start-up				
Due to dependent employment	0.70	0.72	0.67	0.11
Due to former self-employment	0.22	0.21	0.24	0.10
Due to secondary employment	0.25	0.25	0.24	0.73
Due to hobby	0.30	0.28	0.33	0.08
Due to honorary office	0.08	0.09	0.07	0.32
None	0.10	0.10	0.10	0.81
Capital invested at start-up				
None or not specified	0.18	0.19	0.17	0.43
< € 1,000	0.07	0.06	0.09	0.09
€ 1,000–< € 5,000	0.27	0.29	0.26	0.35
€ 5,000–< € 10,000	0.14	0.14	0.13	0.58
€ 10,000–< € 50,000	0.27	0.26	0.28	0.36
≥ € 50,000	0.07	0.07	0.07	0.81
Capital at start consisted entirely of own equity	0.54	0.52	0.57	0.10
G. ***Personality traits***[b]				
Big five				
Conscientiousness	6.11	5.92	6.31	0.00
Extraversion	5.78	5.46	6.12	0.00
Agreeableness	6.16	6.00	6.32	0.00
Openness	5.06	4.78	5.35	0.00
Neuroticism	3.97	4.17	3.76	0.00
Locus of control	5.48	5.29	5.68	0.00
Readiness to take risks	6.01	5.62	6.41	0.00

Table A.2 (continued)

	All	Self-efficacy factor		Mean Diff. (3) v. (4)
		Low	High	*p*-value
	(1)	(2)	(3)	(4)
Observations	1,405	705	700	

Notes: All reported numbers are shares (unless stated otherwise) for the full sample in column (1), and differentiated by scoring high (above median) and low in the self-efficacy factor on columns (2) and (3). We also report *p*-values for *t*-tests of equal means between the groups

[a] Reported as the share of working time, standardized by age 15

[b] Reported numbers based on a slightly smaller sample (N = 1,392)

Table A.3 Robustness 1 — self-efficacy (manual index) on entrepreneurial outcomes after 19 months

	Survival	Net working income	Employees	Patents or TM
	(1)	(2)	(3)	(4)
	Logit	OLS	Logit	Logit
A. ***Self-efficacy manual index***				
Self-efficacy manual index	0.029**	176.447***	0.030**	0.017*
	(0.013)	(49.692)	(0.014)	(0.009)
Pseudo R^2 or R^2	0.110	0.298	0.222	0.151
B. ***Above and below median (manual index)***				
Above median	0.045*	305.970**	0.057**	0.055***
	(0.027)	(127.551)	(0.027)	(0.018)
Pseudo R^2 or R^2	0.108	0.296	0.222	0.161
C. ***Terciles (manual index)***				
Tercile 2	0.071**	0.370	0.004	0.046*
	(0.032)	(147.016)	(0.033)	(0.023)
Tercile 3	0.084***	298.178**	0.067**	0.056***
	(0.031)	(148.732)	(0.032)	(0.021)
Pseudo R^2 or R^2	0.113	0.295	0.222	0.157
Observations	1,405	974	1,056	1,056
Controls:				
A. Personal characteristics	×	×	×	×
B. Human capital	×	×	×	×
C. Intergenerational transmission	×	×	×	×
D. Labor market history	×	×	×	×
E. Local macroeconomic conditions	×	×	×	×
F. Business-related characteristics	×	×	×	×

Notes: Reported are regression coefficients from OLS regressions for net income from self-employment as well as marginal effects of logit regressions for all other outcomes. All outcomes except self-employed with same business (N=1,405) are conditional on business survival and reported for those who are still in business only (n=1,056). Income (n=974) is based on slightly lower numbers of observations due to item non-responses

Standard errors in parentheses. ***/**/* indicates statistical significance at the 1/5/10% level. Covariates include all variables listed in Table A.2. Detailed results are available upon request

Table A.4 Self-efficacy and personality traits correlations

	1.	2.	3.	4.	5.	6.	7.	8. .
1. Self-efficacy	1.000							
2. Conscientiousness	0.311***	1.000						
3. Extraversion	0.373***	0.246***	1.000					
4. Agreeableness	0.203***	0.332***	0.290***	1.000				
5. Openness	0.231***	0.112***	0.280***	0.191***	1.000			
6. Neuroticism	−0.185***	0.129***	−0.014	0.080***	0.109***	1.000		
7. Locus of control	0.340***	0.179***	0.178***	0.029	−0.017	−0.298***	1.000	
8. Risk seeking	0.226***	0.004	0.160***	0.006	0.154***	−0.137***	0.136***	1.000

Notes: The table shows the correlation matrix of self-efficacy, the Big 5 personality traits, locus of control, and readiness to take risks. ***/**/* indicates statistical significance at the 1/5/10% level

Table A.5 Robustness 2 — self-efficacy on entrepreneurial outcomes after 19 months — including other personality traits

	Survival	Net working income	Employees	Patents or TM
	(1)	(2)	(3)	(4)
	Logit	OLS	Logit	Logit
A. ***Self-efficacy factor index***				
Self-efficacy factor	0.041***	203.045***	0.023	0.010
	(0.015)	(63.914)	(0.018)	(0.012)
Pseudo R^2 or R^2	0.123	0.310	0.234	0.165
B. ***Above and below median (factor)***				
Above median	0.038	287.857*	0.038	0.040*
	(0.029)	(148.337)	(0.030)	(0.022)
Pseudo R^2 or R^2	0.119	0.308	0.234	0.170
C. ***Terciles***				
Tercile 2	0.079**	92.425	0.005	0.045*
	(0.031)	(154.683)	(0.035)	(0.027)
Tercile 3	0.114***	348.700*	0.060	0.057**
	(0.035)	(188.415)	(0.039)	(0.028)
Pseudo R^2 or R^2	0.126	0.308	0.235	0.173
Observations	1,392	967	1,047	1,047
Controls:				
A. Personal characteristics	×	×	×	×
B. Human capital	×	×	×	×
C. Intergenerational transmission	×	×	×	×
D. Labor market history	×	×	×	×
E. Local macroeconomic conditions	×	×	×	×
F. Business-related characteristics	×	×	×	×
G. Personality traits	×	×	×	×

Notes: Reported are regression coefficients from OLS regressions for net income from self-employment as well as marginal effects of logit regressions for all other outcomes. All outcomes except self-employed with same business (N=1,392) are conditional on business survival and reported for those who are still in business only (n=1,047). Income (n=967) is based on slightly lower numbers of observations due to item non-responses

Standard errors in parentheses. ***/**/* indicates statistical significance at the 1/5/10% level. Covariates include all variables listed in Table A.2. Detailed results are available upon request

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