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COVID-19 vaccination: lower intention and coverage among entrepreneurs compared to employees

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Abstract

Purpose – Lockdowns and the forced closure of certain industries during the COVID-19 pandemic severely impacted workers, particularly entrepreneurs, who were financially and emotionally involved in their businesses. Two studies have shown that entrepreneurs have a lower willingness to get vaccinated against COVID-19 than employees. In this study, the authors try to replicate the vaccination gap between the two groups. Second, the authors study whether the difference persists when controlling for demographics, vaccination attitudes and the COVID-19 context, including the financial impact of the pandemic, its effect on the wellbeing of workers, and government attitudes. Third, the authors study whether there are differences in how the context of the pandemic relates to vaccination willingness for entrepreneurs and employees.

Design/methodology/approach – The authors conduct regression analyses using three large datasets. The authors study vaccination status (February 2022) in a 27-country Eurobarometer sample, vaccination intention (December 2020) in a Dutch sample from the LISS panel and vaccination status (July 2021) in a sample from the Understanding America Study (UAS).

Findings – All datasets confirm that entrepreneurs have lower vaccination intention and coverage than employees. Even when controlling for the variables described in the LISS and UAS datasets, this negative difference remains. The study results also indicate that demographics, especially vaccination attitudes, are much more important than contextual influences in the decision to get vaccinated against COVID-19.

Originality/value – The authors are the first to dive further into the vaccination differences between entrepreneurs and employees. They advise further research into the drivers of this gap, specifically relating to the role of personality and social normative influences.

Keywords Vaccination intention, Vaccination status, Entrepreneurs, Employees, COVID-19 pandemic

Paper type Research paper

1. Introduction

The COVID-19 pandemic has had an unprecedented impact worldwide. It caused a global health crisis of considerable consequences in terms of morbidity and mortality (Ioannidis,

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2020; Islam *et al.*, 2021). Moreover, the pandemic forced governments to impose multiple regulations, such as (semi)-lockdowns and the closure of certain industries, which had far-reaching effects on businesses and the economy. While the economic impact was cushioned by the fiscal support of governments to some extent, the pandemic triggered an economic downturn with a GDP drop of 6.5% in 2020 in Europe and upswings in unemployment and business failure rates (ILO Monitor, 2021; Muggenthaler *et al.*, 2021; Pak *et al.*, 2020). In addition to its impact on physical health and the economy, the pandemic seriously affected mental health and wellbeing, with studies reporting higher levels of depression, anxiety, loneliness and suicidal ideation (O'Connor *et al.*, 2021; Pierce *et al.*, 2020; Wang *et al.*, 2020). Collectively, the pandemic has impacted at least three aspects of individuals' everyday life: physical health, financial security and mental wellbeing.

While the pandemic affected everyone, the extent of its impact across the three aspects varied greatly across groups. Heterogeneous impacts have been noted across gender, socioeconomic status, age, race and countries (Crossley *et al.*, 2021; ILO Monitor, 2021; Karaye and Horney, 2020; Martin *et al.*, 2020; Salari *et al.*, 2020). Additionally, within the working population, the impact varied (Belitski *et al.*, 2022; Kritikos *et al.*, 2020; Patel and Rietveld, 2020). While businesses in some industries could continue to operate normally, other industries had to close abruptly or shift from in-person work to remote work from home. Studies show that entrepreneurs were more directly affected by the pandemic than individuals employed by companies (Belitski *et al.*, 2022; Kritikos *et al.*, 2020). Self-employed individuals and small-business owners were badly impacted due to financial uncertainty and being active in hard-hit sectors (Bartik *et al.*, 2020; Fairlie and Fossen, 2021; ILO Monitor, 2021; Stephan *et al.*, 2021a, b). While governments have made multiple emergency policy decisions related to COVID 19, these measures have not averted all consequences (Ionescu-Somers and Tarnawa, 2020). For example, 93% of US small- to medium-sized enterprises were reportedly disrupted by the pandemic, with an average drop in the annual revenue of 16% (Digitally Driven, 2020). Moreover, in a global survey of entrepreneurs, 61% indicated that their company was at risk (Stephan *et al.*, 2021a, b).

Because entrepreneurs are often emotionally invested in their business and bear the financial responsibility for their employees, pandemic-induced risks and uncertainty are expected to have a more severe impact on entrepreneurs than on employees. While employees were undoubtedly affected by mass layoffs, especially among low-wage workers (Cajner *et al.*, 2020), when entrepreneurs lose a business, it affects them on multiple levels. Not only does losing one's business often mean loss of personal financial investments, but the identity, self-image and wellbeing of entrepreneurs is strongly connected to their business (Stephan, 2018; Torrès *et al.*, 2022). The literature has shown that job loss, unemployment and "shocks", such as industrial and natural disasters, are more harmful and cause more distress for entrepreneurs than for comparable employees (Backhans and Hemmingsson, 2012; Hetschko, 2016; Stephan, 2018). Moreover, identity shifts occur even for those entrepreneurs who voluntarily retire (Byrnes and Taylor, 2015), indicating the level of importance of one's business to the identity and wellbeing of the entrepreneur. Along with this, the pandemic and the financial insecurity that resulted from it were found to have a stronger negative effect on the wellbeing of entrepreneurs in terms of psychological distress than on regular employees (Backman *et al.*, 2021; Patel and Rietveld, 2020). Finally, in addition to the increased burnout levels of entrepreneurs during the pandemic, Torrès *et al.* (2022) showed that the level of burnout was most strongly related to the perceived risks of bankruptcy, followed by the less intense effects of the lockdown and COVID-19 health-related risks.

Our study is inspired by the self-determination theory of Ryan and Deci (2000), which proposes that all humans have three basic motivational needs – autonomy, competence and relatedness – that are important for wellbeing development and growth. Entrepreneurship as an occupation entails autonomy and competence. In the context of the pandemic,

entrepreneurs experienced increased uncertainty (financial) due to an exogenous shock, which reduced their sense of agency and control (autonomy). Lockdowns and physical distancing also affected their social networks (relatedness). In other words, in all aspects, the constraints that surfaced during the pandemic affected entrepreneurs' self-determination, a threat that leads to loss of wellbeing.

Global and widespread vaccinations are recognized as the most promising way to address the pandemic. To be a viable strategy, enough people need to be vaccinated to reach herd immunity. Additionally, with respect to reviving the economy, including labour market recovery and enterprise protection, vaccination strategy has been cited as crucial (ILO Monitor, 2021; Viegelahn, 2021). During the pandemic, higher COVID-19 vaccination rates were associated with less stringent workplace restrictions and increases in working hours globally. Specifically, in the second quarter of 2021, on average, every 14 people who were fully vaccinated were associated with one full-time equivalent job added to the global labour market (ILO Monitor, 2021). Taking together the importance of vaccination for ending the pandemic and the expected impact of business loss on entrepreneurs, one may expect entrepreneurs to be more willing to be vaccinated against COVID-19 to save their business.

To our surprise, two recent studies find the opposite to be true. Valckx *et al.* (2022), using a large Belgian sample, show that self-employed individuals were less willing to get vaccinated against COVID-19 than employees. Moreover, Nguyen *et al.* (2022a, b) find that the self-employed had the lowest vaccination coverage across all working groups in a US sample. These studies do not provide further insights into the underlying causes of this difference. However, there are some arguments that may explain the lower vaccination willingness of entrepreneurs. For example, Nguyen *et al.* (2022a, b) illustrated that a higher proportion of the self-employed reported that they did not trust the government or the vaccine as reasons for not getting vaccinated compared to those in other working categories. As many businesses were negatively impacted by the regulations implemented by the government, this may have negatively affected entrepreneurs' trust in government, creating low willingness to follow governmental advice on vaccinations. This may be the case for those who saw their businesses go bankrupt during the pandemic.

1.1 The current study

1.1.1 Contribution. Our study contributes in the following three ways. First, the findings of Valckx *et al.* (2022) and Nguyen *et al.* (2022a, b), indicating a lower vaccination willingness of entrepreneurs compared to other groups, did not focus on entrepreneurs specifically but merely reported on them as part of a broader range of findings in an overview study. That is, Valckx *et al.* (2022) focus on individual factors associated with vaccination willingness, while Nguyen *et al.* (2022a, b) focus on the entire US workforce and how employment type connects to vaccination willingness. Our study is the first to address whether entrepreneurs report lower vaccination willingness than employees, controlling for a range of factors, while at the same time exploring whether these factors could explain a lower willingness to receive the vaccine.

Second, we are the first to investigate whether the context of the pandemic affects vaccination uptake and whether it influences entrepreneurs and employees differently. As future pandemics may again lead to business closures and may therefore disproportionately affect entrepreneurs, it is important to obtain a better understanding of whether contextual factors have any effect on their vaccination decisions and hence whether the group of entrepreneurs requires further attention regarding vaccinations.

Third, there is a range of literature on the mental and physical health of entrepreneurs, connected to entrepreneurial decisions such as entry, exit and success (Stephan, 2018; Wiklund *et al.*, 2020; Gish *et al.*, 2022; Torrès and Thurik, 2018). However, there is no literature

that focuses on decisions unrelated to the business, such as studies that focus on medical decisions or the vaccination choices of entrepreneurs, as the current study does.

1.1.2 Explanation of vaccination gap: 3 sets of antecedents. There is a vast amount of literature on the antecedents of vaccination behaviour. These antecedents may differ between entrepreneurs and employees and could therefore explain the vaccination gap between the two groups. In this study, we will control for three sets of antecedents: demographics, vaccination attitudes and the COVID-19 context. Below, we describe (the relevance of) these antecedents.

First, studies have shown the relevance of demographic characteristics for COVID-19 vaccination acceptance. These characteristics, being male, age, education level and socioeconomic status, have all been positively linked to willingness to get vaccinated against COVID-19 (Malik *et al.*, 2020; Murphy *et al.*, 2021; Rhodes *et al.*, 2020). These variables have also been linked to the propensity to be an entrepreneur. Although these are not strictly uniform findings, it holds that "[a]s with age, the majority of studies have reported a positive relationship between educational attainment and the probability of being or becoming an entrepreneur" (Parker, 2018, p. 163). In addition, ". . . a higher proportion of men than women engage in entrepreneurship in almost all developed countries" (Parker, 2018, p. 300), and the self-employed (those without employees) earn less than employees (Sorgner *et al.*, 2017). Therefore, we study whether the vaccination gap between the two groups remains when controlling for the variables sex, age, education and income.

Second, the perception of and attitude towards vaccination is obviously of considerable importance in the decision to get vaccinated. A powerful model in explaining vaccination intention is the 5C model, which reflects the five most important psychological antecedents of vaccination acceptance (Betsch *et al.*, 2018). The 5C model consists of confidence (in the vaccine, its producers and the system that delivers it), complacency (the extent to which one feels unthreatened and not at risk from the vaccine-preventable disease), calculation (the extent to which one engages in extensive information searching), constraints (the potential existence of physical and psychological barriers to getting vaccinated) and collective responsibility (the willingness to get vaccinated to protect others by means of herd immunity) (Betsch *et al.*, 2018). Recent studies have shown the relevance of this model for COVID-19 vaccination, underlining the relative importance of the level of confidence and collective responsibility for this vaccine (Kwok *et al.*, 2021; Wismans *et al.*, 2021a, b). It is challenging to formulate *a priori* expectations about differences in vaccination attitudes between entrepreneurs and employees. One may expect higher confidence levels (due to the key role of overconfidence in new venture creation: Kraft *et al.*, 2022) and higher complacency levels (because entrepreneurs are more risk seeking: Caliendo *et al.*, 2014). Regarding collective responsibility, there has been growing literature on social entrepreneurs, that is, those who start a business to serve self-interests and collective interests (Hoogendoorn *et al.*, 2022), which is in contrast to the many studies focusing on self-interest and the pursuit of private economic gains (Dacin *et al.*, 2010; Van de Ven *et al.*, 2007). How entrepreneurs score in this sample in terms of collective responsibility is difficult to predict, partly because this is related to the degree to which entrepreneurs are aimed at serving collective interests. Hence, we study whether the potential vaccination difference between entrepreneurs and employees remains when controlling for vaccination attitudes. We therefore follow the 5C model and include those aspects of the model that are available in our data.

Finally, as mentioned, we include variables related to the COVID-19 context in terms of the financial impact of the pandemic, mental wellbeing and one's trust in the government. The financial impact is captured by an individual's prospects of keeping their job/company (job security) and of their financial situation (financial security). Little research substantiating the link between these financial impact variables and vaccination willingness has been done (an exception is Wang *et al.* (2021), who do not find a relationship between pandemic impact in

terms of work and income on the one hand and vaccination willingness on the other hand). We also include mental wellbeing because studies show a negative link between mental health symptoms and vaccination (Nguyen *et al.*, 2022a, b). Higher government trust has been related to higher vaccination willingness (Sachs *et al.*, 2022). Regarding the differences between entrepreneurs and employees, we note the following for the context variables. Entrepreneurs are less likely to be satisfied with their job in terms of job security than employees (Millán *et al.*, 2011). In addition, those who are self-employed report lower probabilities of keeping their job during COVID-19 and higher chances of running out of money in the next three months (Patel and Rietveld, 2020). Although the literature shows that entrepreneurs have better general health and mental health than employees (Rietveld *et al.*, 2015), the pandemic has taken a higher toll on the wellbeing of entrepreneurs compared to the employed (Patel and Rietveld, 2020). Another paper showed that prepandemic government trust among the self-employed was lower than that of employees and that while government trust increased on average in the first year of the pandemic, this increase was smaller for the self-employed than for wageworkers (Kudrnáč and Klusáček, 2022). Finally, Nguyen *et al.* (2022a, b) showed that a higher proportion of the self-employed mentioned a lack of trust in the government as a reason for not getting vaccinated compared to other working groups. In sum, we study whether pandemic context variables (job and financial security, mental health, government attitude) can explain potential differences between entrepreneurs and employees in the decision to get vaccinated.

In addition to controlling for the COVID-19 context variables in our model specifications to study whether the vaccination gap between entrepreneurs and employees remains, we investigate whether the context variables associate differently with vaccination willingness between entrepreneurs and employees. Therefore, we include interaction terms between the context variables and being an entrepreneur versus an employee.

1.1.3 Study setup. To explore these relationships, we use three open access datasets. We first study the COVID-19 vaccination coverage of entrepreneurs and employees in a large 27-country sample ($N > 13{,}500$) from the Flash Eurobarometer launched by the European Commission in all European Union (EU) member states. This dataset serves as a first step to establish whether there is a general difference in vaccination coverage. Second, we use two other datasets that zoom in on a particular country, i.e. the Netherlands and the United States. These datasets allow us to investigate vaccination differences and their drivers in a much more detailed way. The two datasets contain the three sets of antecedents (demographics, vaccination attitudes, COVID-19 context) that are used to explain a potential difference in vaccination coverage between entrepreneurs and employees. One of these datasets is derived from the Dutch LISS (Longitudinal Internet studies for the Social Sciences) panel administered by CentERdata (Tilburg University, The Netherlands) (Scherpenzeel and Das, 2018) and focuses on COVID-19 vaccination intentions before COVID-19 vaccines became available. The other dataset is derived from the Understanding Coronavirus in America ("Covid") survey from the Understanding America Study (UAS) (Kapteyn *et al.*, 2020) and focuses on COVID-19 vaccination status during a later phase of the pandemic.

2. Methods

2.1 Data sources and setup

For each dataset mentioned above, the setup of the regression models is shown in Table 1. The first dataset (Flash Eurobarometer) is used as a starting point to identify whether there is a general difference in vaccination coverage between entrepreneurs and employees in a large European sample. While we include the demographic variables sex, age and education in our Eurobarometer analysis, we include two additional sets of variables for the other two datasets (LISS and UAS), which are absent in the Flash Eurobarometer dataset: vaccination

Data source	Country and sample size	Dependent variable	Model 1 Demographics	Model 2 Vaccination attitudes	Model 3 COVID-19 context	Model 4–7 Interaction analyses
Eurobarometer	27 EU Member States (N = 13,674)	Vaccination status (0/1) (February 2022)	Entrepreneur (vs employee); Sex; Age; Education; Country	–	–	–
LISS Panel	The Netherlands (N = 1,501)	Vaccination intention [0–100] (December 2020)	Entrepreneur (vs employee); Sex; Age; Education; Income	Variables Model 1; Confidence; Complacency	Variables Model 2; Job/company security; Financial security; Mental wellbeing; Government attitude	Variables Model 3; Interaction between Entrepreneur and Job/Company security (Model 4); Financial security (Model 5); Mental wellbeing (Model 6); Government attitude (Model 7)
Understanding America Study (UAS)	United States (N = 2,420)	Vaccination status (0/1) (June/July 2021)	Entrepreneur (vs employee); Sex; Age; Education; Income	Variables Model 1; Confidence; Complacency; Collective responsibility	Variables Model 2; Job/company security; Financial security; Mental wellbeing	Variables Model 3; Interaction between Entrepreneur and Job/Company security (Model 4); Financial security (Model 5); Mental wellbeing (Model 6)

Source(s): Authors' own work

Table 1. Setup regression models

attitudes and the COVID-19 context. We investigate whether a potential difference in vaccination intention/status between entrepreneurs and employees remains when controlling for these variables. The regression models are defined as uniformly as possible across the databases, although data availability and operationalization are sometimes inconsistent. For example, the LISS and UAS datasets do not cover the complete 5C scale, and we therefore include two (LISS) and three (UAS) Cs in the analyses. Moreover, government attitude was only available in the LISS data but not in the UAS dataset.

Below, we describe the Flash Eurobarometer dataset, the LISS dataset and the UAS dataset.

2.2 Eurobarometer dataset

The Flash Eurobarometer survey on "Attitudes on vaccination against COVID-19" is a cross-sectional survey conducted for the European Commission in 2022. Data were collected online between February 7 and 15, 2022, by Ipsos European Public Affairs among the population aged 15 and above in each member state of the EU (European Commission, 2022). We exclude the unemployed population and those under 18 or above 65 years of age from the sample and arrive at 13,674 observations from 27 countries for our estimation sample.

Table 1 (row 1) lists the variables included in the regression models, and supplementary material 1 provides an overview of how these variables are operationalized. COVID-19 vaccination status (0: No; 1: Yes) is used as the dependent variable.

2.2.1 Descriptive statistics Eurobarometer data. Table 2 presents the percentages, means and standard deviations of the Eurobarometer variables for employees, entrepreneurs and

Table 2.
Descriptive statistics Eurobarometer data by group (employees, entrepreneurs, total sample) – $N = 13{,}674$

	Employees ($N = 11{,}511$)		Entrepreneurs ($N = 2{,}163$)			Total sample ($N = 13{,}674$)	
	Mean/%	*SD*	Mean/%	*SD*	*p*-value[a]	Mean/%	*SD*
Vaccination status	82.69%		77.30%		<0.001	81.83%	
Male	49.27%		55.99%		<0.001	50.33%	
Age	41.93	11.79	43.70	12.74	<0.001	42.21	11.96
Education					0.35		
No full-time education	2.18%		2.31%			2.20%	
Up to 15 years	2.21%		2.73%			2.29%	
16–19 years	33.03%		31.76%			32.83%	
20 years or more	62.58%		63.20%			62.68%	

Note(s): [a] *p*-values correspond to two-tailed *t*-tests (continuous variables) and Chi-square tests (categorical variables) assessing the difference between entrepreneurs and employees
Source(s): Authors' own work

for the combined sample. A total of 77.30% of entrepreneurs versus 82.69% of employees in this sample are vaccinated against COVID-19, indicating significantly lower vaccination coverage among entrepreneurs. Table S2.1 in Supplementary material 2 presents the correlation matrix.

2.2.2 Methodology Eurobarometer data. We performed binary logistic regressions with vaccination status (0/1) as the dependent variable. As the coefficients in logistic regressions do not have a direct interpretation, we also calculated average marginal effects (AME), which can be interpreted as the association between a 1-unit increase in the independent variable and the probability of being vaccinated or the difference in predicted probabilities of being vaccinated between categories in the case of binary or categorical variables. We controlled for country fixed effects and clustered standard errors by country (Abadie *et al.*, 2023).

2.3 LISS dataset

The LISS panel is a longitudinal sample of Dutch households participating in monthly Internet surveys and covers a variety of domains, including health, work and income (Scherpenzeel and Das, 2018). The households are drawn from the population register by Statistics Netherlands. Although the LISS panel itself comprises approximately 7,500 individuals, our estimation sample consists of 1,501 observations of individuals who participated in all relevant surveys (Scherpenzeel and Das, 2018). We exclude observations from individuals under 18 or above 65 years of age.

Because of the nature of the LISS panel data collection, with different topics being assessed at different time points throughout the year, we make use of data collected from different studies with different timing. The dependent variable – vaccination intention – was assessed in December 2020, which is after (or at the same time as) the independent variables were assessed (between April 2020 and December 2020). An overview of the measures, their corresponding LISS studies and timing is found in Supplementary material 3. We use vaccination intention – ranging from 0 (low) to 100 (high) – as our dependent variable. Table 1 (row 2) shows an overview of the variables included in the regression models.

2.3.1 Descriptive statistics LISS data. Table 3 presents descriptive statistics for the LISS data for employees, entrepreneurs and the combined sample. Vaccination intention is on average higher for employees (M = 60.30) than for entrepreneurs (M = 53.91), and this difference is significant at the 10% level. Table S4.1 in supplementary material 4 presents the correlation table.

2.3.2 Methodology LISS data. We performed ordinary least squares (OLS) regressions with vaccination intention as the dependent variable. In Step 1 (Model 1), the demographic

	Employees (N = 1,366)		Entrepreneurs (N = 135)			Total sample (N = 1,501)	
	Mean/%	*SD*	Mean/%	*SD*	*p*-value[a]	Mean/%	*SD*
Vaccination Intention [0–100]	60.30	39.53	53.91	42.50	0.08	59.72	39.83
Male	50.95%		58.52%		0.09	51.63%	
Age	47.02	11.32	50.30	9.97	0.001	47.32	11.24
Education					0.006		
No education to high school	19.25%		24.44%			19.95%	
Intermediate vocational education	29.72%		15.56%			28.10%	
Higher vocational education	32.43%		36.30%			32.72%	
University	18.59%		23.70%			19.23%	
Income (/1,000)	3.92	1.82	4.25	2.37	0.06	3.95	1.87
Confidence – 1 (low) to 5 (high)	3.68	1.08	3.61	1.25	0.53	3.67	1.10
Complacency – 0 (low) to 10 (high)	7.84	1.80	7.97	1.92	0.43	7.85	1.81
Job/Company security – 0 (low) to 10 (high)	8.11	2.59	5.50	3.56	<0.001	7.87	2.79
Financial security – 1 (it will get a lot worse) to 5 (it will get much better)	3.06	0.75	2.94	0.84	0.07	3.05	0.76
Mental wellbeing – 1 (low) to 6 (high)	4.80	0.77	4.79	0.69	0.89	4.80	0.76
Government attitude – 0 (low) to 10 (high)	6.31	2.02	6.09	2.26	0.22	6.29	2.04

Note(s): [a]*p*-values correspond to two-tailed *t*-tests (continuous variables) and Chi-square tests (categorical variables) assessing the difference between entrepreneurs and employees
Source(s): Authors' own work

Table 3. Descriptive statistics LISS data by group (employees, entrepreneurs, total sample) – N = 1,501

variables were included; in step 2 (Model 2), we added the vaccination attitude variables and in step 3 (Model 3), we added the COVID-19 context variables (see also Table 1). Finally, we included interaction terms between the COVID-19 context variables and being an entrepreneur (Model 4–7, see Table 1). Standard errors robust to heteroskedasticity were used, and the variables included in the interaction terms were mean-centred to facilitate interpretation of the interaction coefficients.

To verify the normal distribution of the residuals, we plotted the standardized residuals against their normal scores (Q-Q plot); the resulting graph indicates normality. We performed a robustness check to account for the fractional nature of our vaccination intention measure (values bounded between and including 0 and 100). After dividing our dependent variable by 100, we performed fractional logistic regressions (Papke and Wooldridge, 1996).

2.4 Understanding America Study (UAS) dataset

To study actual vaccination status instead of vaccination intention, we used data from the UAS [1]. The UAS is a nationally representative panel of households containing approximately 9,500 respondents aged 18 years and older. Our estimation sample, including those who answered all relevant measures and were not older than 65 years old, consists of 2,420 observations. Respondents are recruited using address-based sampling and respond to the survey online (Alattar *et al.*, 2018). Since March 10, 2020, the effects of the pandemic on respondents of this panel have been tracked by launching biweekly surveys (for more information see: Kapteyn *et al.*, 2020).

We use vaccination status (0: No; 1: Yes) as the dependent variable. The operationalization of all variables is found in Supplementary material 5. Table 1 (row 3) shows an overview of the variables included in the regression models.

2.4.1 Descriptive statistics UAS data. Table 4 presents descriptive statistics of the UAS variables by group (employees and entrepreneurs) and for the total sample. COVID-19 vaccination coverage is higher among employees (73.7%) than entrepreneurs (63.8%) (p = 0.01).

	Employees (N = 2,185)		Entrepreneurs (N = 235)			Total (N = 2,420)	
	Mean/%	*SD*	Mean/%	*SD*	*p*-value[a]	Mean/%	*SD*
Vaccination status (1: yes)	73.68%		63.83%		0.001	72.73%	
Male	41.60%		43.40%		0.59	41.78%	
Age	45.09	11.25	47.32	11.33	0.004	45.31	11.27
Education					0.26		
No education to high school or GED	14.00%		16.60%			14.26%	
Some college – no degree	18.31%		20.43%			18.51%	
Associate college degree (vocational or academic)	14.42%		11.06%			14.09%	
Bachelors degree	29.57%		32.34%			29.83%	
Masters degree or higher	23.71%		19.57%			23.31%	
Income					0.002		
Less than $34,999	14.78%		23.83%			15.66%	
$35,000 to $59,999	17.67%		17.45%			17.64%	
$60,000 to $74,999	12.31%		6.38%			11.74%	
$75,000 to $99,999	17.39%		15.32%			17.19%	
$100,000 to $149,999	20.00%		17.02%			19.71%	
$150,000 or more	17.85%		20.00%			18.06%	
Confidence – 1 (low) to 4 (high)	2.80	0.72	2.74	0.79	0.25	2.79	0.73
Complacency – 1 (low) to 10 (high)	8.66	1.67	8.77	1.79	0.34	8.67	1.68
Collective responsibility – 1 (low) to 4 (high)	3.26	0.75	3.18	0.83	0.14	3.25	0.76
Job/Company security – 1 (low) to 100 (high)	91.07	15.18	90.33	17.48	0.48	91.00	15.42
Financial security – 1 (low) to 100 (high)	90.33	17.24	88.51	22.52	0.14	90.15	17.83
Mental wellbeing – 0 (low) to 12 (high)	10.44	2.68	10.57	2.55	0.48	10.45	2.67

Note(s): [a] *p*-values correspond to two-sided *t*-tests (continuous variables) and Chi-square tests (categorical variables) assessing the difference between entrepreneurs and employees
Source(s): Authors' own work

Table 4. Descriptive statistics UAS data by group (employees, entrepreneurs, total sample) – N = 2,420

Table S6.1 in Supplementary material 6 presents the correlation table. Importantly, two sets of variables are highly correlated: confidence and collective responsibility (r = 0.76) and job/company security and financial security (r = 0.65). These correlations are not surprising given the content of these variables, although in the results section, we report on variance inflation factors in the context of multicollinearity and include the variables separately as a robustness check.

2.4.2 Methodology UAS data. We used vaccination status as the dependent variable and followed the same steps as in the analyses conducted with the LISS data. Given the binary nature of this dependent variable, we conducted binary logistic regression analyses to calculate AME. Standard errors robust to heteroskedasticity were used, and the variables in our interaction analyses were mean-centred.

3. Results

3.1 Results Eurobarometer data

Table 5 presents the results of a logistic regression analysis using Eurobarometer data with COVID-19 vaccination status as the dependent variable.

There is a significant negative association between being an entrepreneur and vaccination status within this large sample covering 27 countries (B = −0.40, p < 0.001). In this model, being an entrepreneur versus an employee is associated with a decrease of 6% points (AME) in the probability of being vaccinated. The baseline probability of being vaccinated in this sample is 0.82.

	B	*SE*	*p*-value	AME
Intercept	*1.19*	*0.20*	*<0.001*	
Entrepreneur	*−0.40*	*0.08*	*<0.001*	*−0.06*
Male	*0.20*	*0.05*	*<0.001*	*0.03*
Age	*0.02*	*0.003*	*<0.001*	*0.002*
Education				
Up to 15 years[1]	−0.23	0.21	0.28	−0.03
16–19 years	−0.14	0.20	0.47	−0.02
20 years or more	0.23	0.18	0.21	0.03
Country fixed effects	Yes			
N	13,674			
Adjusted McFadden R^2	0.11			
Log Likelihood	−5,774.18			

Note(s): B = estimated coefficient (unstandardized); SE = standard error (clustered by country); AME = Average Marginal Effect. Coefficients that are significant at the 5% level are italic printed. [1]reference category is no full-time education

Source(s): Authors' own work

Table 5. Results binary logistic regression Eurobarometer data – dependent variable: vaccination status (Yes (1) versus No (0))

In the analyses below based on the LISS and UAS data, we investigate whether the negative association between being an entrepreneur and the willingness to get vaccinated against COVID-19 remains when controlling for other factors.

3.2 Results LISS data

Table 6 presents the results of OLS regressions using LISS data with COVID-19 vaccination intention [0–100] as the dependent variable.

Controlling for the demographic variables, Model 1 shows that entrepreneurs' vaccination intention is 10.71 points lower on average than the vaccination intention of employees (B = −10.71, p = 0.003).

Model 2 adds vaccination attitudes, which strongly increase the explained variation in vaccination intention (Adjusted R^2 Model 1 = 8%; Model 2 = 49%). Both vaccination attitudes are significantly related to vaccination intention (confidence: B = 24.42, $p < 0.001$; complacency: B = −1.34, p = 0.001). Controlling for demographics and vaccination attitudes, entrepreneurs' vaccination intention is on average 5.77 points lower than that of employees and significant at the 5% level (B = −5.77, p = 0.03). Hence, the coefficient of the Entrepreneur variable is reduced by 46% in the absolute sense, but a negative difference between the two groups remains after controlling for vaccination attitudes [2].

In Model 3, the COVID-19 context variables are added to the model. In this model, the negative relationship between being an entrepreneur and vaccination intention remains and is significant at the 5% level (B = −5.98, p = 0.04). While job/company security, financial security and mental wellbeing are not significantly related to vaccination intention, we find a significant positive association between government attitude and vaccination intention (B = 1.18, p = 0.01).

3.2.1 Interaction models LISS data. Table 7 presents four models using the LISS data in which interaction terms between the COVID-19 context variables (mean-centred) and the entrepreneur variable are added. In all models (4–7), there are no significant differences between entrepreneurs and employees in how the contextual pandemic variables are associated with vaccination intentions.

3.2.2 Robustness check LISS data – fractional logistic regression. To account for the bounded nature of our dependent variable, the results of fractional logit regressions can be

	Model 1: Demographics			Model 2: Vaccination attitudes			Model 3: COVID-19 context		
	B	*SE*	*p*	B	*SE*	*p*	B	*SE*	*p*
Intercept	10.47	5.28	0.05	*−36.69*	*5.17*	*<0.001*	*−35.47*	*7.15*	*<0.001*
Demographics									
Entrepreneur	*−10.71*	*3.61*	*0.003*	*−5.77*	*2.73*	*0.03*	*−5.98*	*2.86*	*0.04*
Male	0.70	2.00	0.73	*−4.05*	*1.48*	*0.01*	*−3.47*	*1.50*	*0.02*
Age	*0.75*	*0.09*	*<0.001*	*0.36*	*0.07*	*<0.001*	*0.34*	*0.08*	*<0.001*
Education									
Intermediate vocational education[1]	0.12	3.01	0.97	1.23	2.19	0.57	0.85	2.19	0.70
Higher vocational education	*8.52*	*2.92*	*0.004*	4.15	2.12	0.05	3.47	2.14	0.10
University	*15.38*	*3.43*	*<0.001*	2.91	2.67	0.28	2.15	2.69	0.42
Income (/1,000)	*2.19*	*0.55*	*<0.001*	0.15	0.40	0.71	0.11	0.41	0.78
Vaccination attitudes									
Confidence				*24.42*	*0.59*	*<0.001*	*23.60*	*0.71*	*<0.001*
Complacency				*−1.34*	*0.41*	*0.001*	*−1.26*	*0.41*	*0.002*
COVID-19 context									
Job/Company security							−0.11	0.30	0.72
Financial security							−1.57	1.10	0.16
Mental wellbeing							0.18	1.03	0.86
Government attitude							*1.18*	*0.45*	*0.01*
N	1,501			1,501			1,501		
Adjusted R^2	0.08			0.49			0.50		

Note(s): B = estimated coefficient (unstandardized); *SE* = robust standard error. Coefficients that are significant at the 5% level are italic printed. [1]Reference category is "No education to high school"
Source(s): Authors' own work

Table 6.
Linear regression analyses LISS data – dependent variable: vaccination intention [0–100]

found in supplementary material 7 (Tables S7.1 and S7.2). We repeat the exercises as presented in Tables 6 and 7. Overall, the conclusions based on these additional regressions are similar to those based on OLS in Tables 6 and 7. That is, we find a robust negative relationship between being an entrepreneur and vaccination intention across all model formulations. The only exception is that we find a significant interaction between Government attitude and being an entrepreneur in Model 7 in Table S7.2 (B = 0.21, p = 0.03), indicating that government attitude may be more strongly positively related to vaccination intention among entrepreneurs compared to employees. A visual representation of this relationship is presented in Figure S7.1.

3.3 Results UAS data

Table 8 presents the results of binary logistic regressions using the UAS data with vaccination status as the dependent variable [3], [4].

Model 1 includes the demographic variables. In line with the findings based on LISS data on vaccination intention, being an entrepreneur compared to being an employee is negatively related to COVID-19 vaccination status in Model 1 (B = −0.49, p = 0.002). Being an entrepreneur on average decreases the probability of being vaccinated by 9% points compared to being an employee (baseline probability of being vaccinated = 0.73).

Including vaccination attitudes in Model 2 strongly increases the explained variation in vaccination status (Adjusted McFadden R^2 Model 1: 8%; Model 2: 38%).

Table 7. Linear regression analyses LISS data including interaction terms between COVID-19 context and Entrepreneur – dependent variable: vaccination intention [0–100]

	Model 4: Interaction Job/ Company security			Model 5: Interaction Financial security			Model 6: Interaction Mental wellbeing			Model 7: Interaction Government attitude		
	B	*SE*	*p*	B	*SE*	*p*	B	*SE*	*p*	B	*SE*	*p*
Intercept	*−36.37*	*7.32*	*<0.001*	*−40.12*	*6.48*	*<0.001*	*−34.59*	*6.90*	*<0.001*	*−27.94*	*7.23*	*<0.001*
Demographics												
Entrepreneur	*−7.20*	*3.42*	*0.04*	*−5.85*	*2.81*	*0.04*	*−5.96*	*2.84*	*0.04*	*−5.69*	*2.83*	*0.04*
Male	*−3.41*	*1.50*	*0.02*	*−3.46*	*1.5*	*0.02*	*−3.48*	*1.50*	*0.02*	*−3.43*	*1.50*	*0.02*
Age	*0.34*	*0.08*	*<0.001*	*0.34*	*0.08*	*<0.001*	*0.34*	*0.08*	*<0.001*	*0.33*	*0.08*	*<0.001*
Education												
Intermediate vocational education[1]	0.80	2.19	0.71	0.83	2.19	0.71	0.84	2.19	0.70	0.87	2.19	0.69
Higher vocational education	3.40	2.13	0.11	3.47	2.14	0.10	3.48	2.14	0.10	3.58	2.14	0.09
University	2.12	2.68	0.43	2.12	2.70	0.43	2.15	2.69	0.43	2.25	2.69	0.40
Income (/1,000)	0.12	0.41	0.78	0.11	0.41	0.79	0.11	0.41	0.79	0.13	0.40	0.75
Vaccination attitudes												
Confidence	*23.60*	*0.71*	*<0.001*	*23.62*	*0.71*	*<0.001*	*23.60*	*0.71*	*<0.001*	*23.55*	*0.71*	*<0.001*
Complacency	*−1.25*	*0.41*	*0.002*	*−1.26*	*0.41*	*0.002*	*−1.26*	*0.41*	*0.002*	*−1.31*	*0.42*	*0.002*
COVID-19 context												
Job/Company security	−0.01	0.32	0.98	−0.12	0.30	0.69	−0.11	0.30	0.72	−0.12	0.30	0.68
Financial security	−1.52	1.11	0.17	−1.74	1.13	0.12	−1.58	1.10	0.15	−1.58	1.10	0.15
Mental wellbeing	0.15	1.03	0.89	0.18	1.03	0.86	0.08	1.04	0.93	0.31	1.03	0.77
Government attitude	*1.18*	*0.45*	*0.01*	*1.17*	*0.45*	*0.01*	*1.18*	*0.45*	*0.01*	*0.98*	*0.47*	*0.04*
Interaction												
Job/Company security*Entrepreneur	−0.62	0.80	0.44									
Financial security*Entrepreneur				1.66	3.63	0.65						
Mental wellbeing*Entrepreneur							1.39	4.88	0.78			
Government attitude*Entrepreneur										1.79	1.14	0.12
N	1,501			1,501			1,501			1,501		
Adjusted R^2	0.50			0.50			0.50			0.50		

Note(s): B = estimated coefficient (unstandardized); *SE* = robust standard error. Coefficients that are significant at the 5% level are italic printed. [1]Reference category is 'No education to high school'

Source(s): Authors' own work

Table 8.
Logistic regression analyses UAS data – dependent variable: vaccination status (0/1)

	Model 1: Demographics				Model 2: Vaccination attitudes				Model 3: COVID-19 context			
	B	*SE*	*p*	AME	*B*	*SE*	*p*	AME	*B*	*SE*	*p*	AME
Intercept	*−1.32*	*0.24*	*<0.001*		*−7.72*	*0.59*	*<0.001*		*−7.51*	*0.62*	*<0.001*	
Demographics												
Entrepreneur	*−0.49*	*0.15*	*0.002*	*−0.09*	*−0.57*	*0.21*	*0.01*	*−0.06*	*−0.57*	*0.21*	*0.01*	*−0.06*
Male	−0.13	0.10	0.20	−0.02	*−0.38*	*0.13*	*0.003*	*−0.04*	*−0.37*	*0.13*	*0.004*	*−0.04*
Age	*0.02*	*0.004*	*<0.001*	*0.004*	*0.02*	*0.01*	*<0.001*	*0.003*	*0.02*	*0.01*	*<0.001*	*0.003*
Education	*0.33*	*0.04*	*<0.001*	*0.06*	*0.15*	*0.05*	*0.003*	*0.02*	*0.14*	*0.05*	*0.004*	*0.02*
Income												
$35,000 to $59,999[1]	0.28	0.15	0.06	0.06	0.12	0.19	0.53	0.01	0.14	0.20	0.48	0.02
$60,000 to $74,999	0.21	0.17	0.22	0.04	−0.24	0.22	0.28	−0.03	−0.23	0.22	0.31	−0.03
$75,000 to $99,999	*0.66*	*0.17*	*<0.001*	*0.13*	0.40	0.22	0.06	0.05	0.43	0.22	0.05	0.05
$100,000 to $149,999	*0.40*	*0.16*	*0.01*	*0.08*	−0.01	0.21	0.94	−0.002	0.01	0.21	0.96	0.001
$150,000 or more	*1.19*	*0.19*	*<0.001*	*0.21*	*0.64*	*0.24*	*0.01*	*0.07*	*0.66*	*0.25*	*0.01*	*0.07*
Vaccination attitudes												
Confidence					*2.03*	*0.15*	*<0.001*	*0.23*	*2.04*	*0.15*	*<0.001*	*0.23*
Complacency					*−0.09*	*0.04*	*0.01*	*−0.01*	*−0.09*	*0.04*	*0.03*	*−0.01*
Collective responsibility					*0.92*	*0.13*	*<0.001*	*0.10*	*0.91*	*0.13*	*<0.001*	*0.1*
COVID-19 context												
Job/Company security									0.0001	0.01	0.98	0.0001
Financial security									−0.0002	0.005	0.96	−0.0003
Mental wellbeing									−0.03	0.02	0.28	−0.003
N	2,420				2,420				2,420			
Adjusted McFadden R^2	0.08				0.38				0.38			
Log Likelihood	−1,301.83				−860.301				−859.709			

Note(s): B = estimated coefficient (unstandardized); *SE* = robust standard error; AME = Average Marginal Effect. Coefficients that are significant at the 5% level are italic printed. [1]: reference category is "Less than $34,999"
Source(s): Authors' own work

Importantly, after controlling for differences in vaccination attitudes, being an entrepreneur compared to being an employee is significantly negatively related to vaccination status (B = −0.57, p = 0.01, AME = −0.06). The marginal effect decreases by approximately one-third in absolute sense between Model 1 and Model 2 [5]. The three vaccination attitudes are significantly related to vaccination status (confidence: B = 2.03, p < 0.001; complacency: B = −0.09, p = 0.01; collective responsibility: B = 0.92, p < 0.001). We conclude that even when controlling for vaccination attitudes, a negative relationship between entrepreneurship and vaccination status remains.

In Model 3, the COVID-19 context variables are added to the model, which does not lead to an increase in explained variance compared to Model 2. After controlling for the three context variables, being an entrepreneur versus an employee remains negatively related to vaccination status, B = −0.57, p = 0.01. This negative relationship is reflected by a 6-percentage point decrease in the probability of being vaccinated, which is similar to Model 2. In line with the LISS data, job/company security, financial security and mental wellbeing are not significantly related to vaccination status.

Overall, we find a robust negative relationship between being an entrepreneur versus an employee and COVID-19 vaccination status in the UAS data, even when controlling for demographics, vaccination attitudes and the COVID-19 context. This is in line with the association we find between entrepreneurs and COVID-19 vaccination intention in the LISS data.

3.3.1 Interaction models UAS data. Table 9 presents three models using the UAS data in which interaction terms between the COVID-19 context variables (mean-centred) and the entrepreneur variable are added. Note that government attitude is not included in this dataset.

Model 4 and Model 5 show that job/company security and financial security do not have different associations with vaccination status between entrepreneurs and employees. Model 6, including the interaction term between Mental wellbeing and Entrepreneur, shows a positive and significant interaction coefficient (B = 0.14, p = 0.03). Hence, there is some evidence that mental wellbeing relates differently to vaccination status for entrepreneurs and employees. Additional calculations show that the relationship among entrepreneurs is significant at the 10% level (p = 0.09), while we know from Table 9 that it is not significant among employees (B = −0.04, p = 0.13). For ease of interpretation, Figure 1 shows the interaction plot of this relationship, based on Model 6 of Table 9.

3.4 Dominance analysis

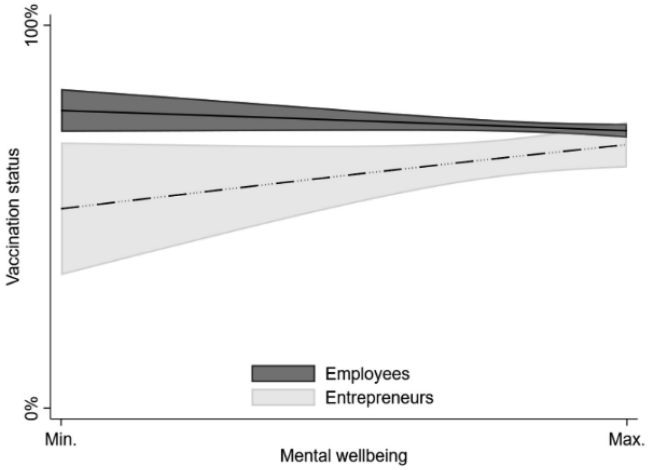
We apply dominance analysis (Azen and Budescu, 2003; Luchman, 2021) to investigate the relative impact of each variable, measured in terms of each variable's contribution to the model's R^2 value. Focusing on the Eurobarometer dataset, the entrepreneur variable is responsible for approximately 3% of the total R^2. This percentage is comparable to the age variable (5%) and the set of education dummies (4%) and higher than the gender variable (1%). The country dummies are, unsurprisingly, responsible for the largest part of explained variation (86% of total R^2).

For the LISS and UAS data, the confidence variable is the dominant variable across the model specifications (responsible for 79% of total R^2 in LISS and 52% of total R^2 in UAS). Government attitude is responsible for approximately 10% of the total R^2 in LISS, while in the UAS analysis collective responsibility is responsible for 35% of the total R^2. All other variables do not exceed 5% in either analysis. The entrepreneur variable is responsible for 5% of the total R^2 in LISS and UAS, but this reduces to approximately 1% when the confidence variable is added to the models. This is a higher percentage than gender (LISS and UAS), complacency (UAS), job security (LISS and UAS), financial security (LISS and UAS)

Table 9.
Logistic regression analyses UAS data including interaction terms between COVID-19 context and Entrepreneur – dependent variable: vaccination status (0/1)

	Model 4: Interaction Job/Company security				Model 5: Interaction Financial security				Model 6: Interaction Mental wellbeing			
	B	*SE*	*p*	AME	*B*	*SE*	*p*	AME	*B*	*SE*	*p*	AME
Intercept	*−7.43*	*0.73*	*<0.001*		*−7.53*	*0.72*	*<0.001*		*−7.80*	*0.62*	*<0.001*	
Demographics												
Entrepreneur	*−0.52*	*0.22*	*0.02*	*−0.07*	*−0.53*	*0.22*	*0.02*	*−0.07*	*−0.58*	*0.21*	*0.01*	*−0.07*
Male	*−0.37*	*0.13*	*0.004*	*−0.04*	*−0.36*	*0.13*	*0.01*	*−0.04*	*−0.37*	*0.13*	*0.004*	*−0.04*
Age	*0.02*	*0.01*	*<0.001*	*0.003*	*0.02*	*0.01*	*<0.001*	*0.003*	*0.02*	*0.01*	*<0.001*	*0.003*
Education	*0.14*	*0.05*	*0.004*	*0.02*	*0.14*	*0.05*	*0.004*	*0.02*	*0.15*	*0.05*	*0.003*	*0.02*
Income												
$35,000 to $59,999[1]	0.14	0.20	0.47	0.02	0.13	0.20	0.50	0.02	0.14	0.20	0.49	0.02
$60,000 to $74,999	−0.22	0.22	0.32	−0.03	−0.23	0.22	0.30	−0.03	−0.23	0.22	0.29	−0.03
$75,000 to $99,999	*0.43*	*0.22*	*0.05*	*0.05*	0.42	0.22	0.05	0.05	0.42	0.22	0.05	0.05
$100,000 to $149,999	0.02	0.21	0.92	0.002	0.01	0.21	0.96	0.001	0.02	0.21	0.94	0.002
$150,000 or more	*0.66*	*0.25*	*0.01*	*0.07*	*0.65*	*0.25*	*0.01*	*0.07*	*0.66*	*0.25*	*0.01*	*0.07*
Vaccination attitudes												
Confidence	*2.04*	*0.15*	*<0.001*	*0.23*	*2.04*	*0.15*	*<0.001*	*0.23*	*2.04*	*0.15*	*<0.001*	*0.23*
Complacency	*−0.09*	*0.04*	*0.03*	*−0.01*	*−0.09*	*0.04*	*0.04*	*−0.01*	*−0.09*	*0.04*	*0.04*	*−0.01*
Collective responsibility	*0.91*	*0.13*	*<0.001*	*0.10*	*0.91*	*0.13*	*<0.001*	*0.10*	*0.91*	*0.13*	*<0.001*	*0.10*
COVID-19 context												
Job/Company security	−0.001	0.01	0.81	0.00004	−0.0001	0.01	0.98	−0.00002	0.0002	0.01	0.96	0.00003
Financial security	−0.001	0.005	0.86	−0.0001	−0.002	0.005	0.74	−0.0001	−0.001	0.005	0.89	−0.0001
Mental wellbeing	−0.02	0.02	0.30	−0.003	−0.03	0.02	0.29	−0.003	−0.04	0.03	0.13	−0.003
Interactions												
Job/Company security*Entrepreneur	0.02	0.01	0.15									
Financial security*Entrepreneur					0.01	0.01	0.26					
Mental wellbeing*Entrepreneur									*0.14*	*0.06*	*0.03*	
N	4,240				4,240				4,240			
Adjusted McFadden R^2	0.38				0.38				0.38			
Log Likelihood	−858.635				−859.027				−858.217			

Note(s): B = estimated coefficient (unstandardized); *SE* = robust standard error; AME = Average Marginal Effect. Coefficients that are significant at the 5% level are italic printed. [1]: reference category is "Less than $34,999"
Source(s): Authors' own work



Source(s): Author's own work

Figure 1. Interaction plot visualizing the relationship between mental wellbeing and vaccination status for entrepreneurs and employees, including 95% confidence intervals, based on Model 6, Table 9

and mental wellbeing (UAS). However, it is less than age, education, income, confidence (LISS and UAS), mental wellbeing (LISS), complacency (LISS), government attitude (LISS) and collective responsibility (UAS).

4. Discussion

The COVID-19 pandemic has had an unprecedented impact on businesses and on business owners, i.e. entrepreneurs. Economies were gradually able to reopen because of the widespread vaccinations against COVID-19. To our initial surprise, two earlier studies showed that COVID-19 vaccination willingness was lower among self-employed individuals than among employees in a Belgian and US sample (Nguyen *et al.*, 2022a, b; Valckx *et al.*, 2022). In the present study, we aimed to study whether there is indeed a robust difference in COVID-19 vaccination intention and status between entrepreneurs and employees and clarify what could explain this difference.

In line with previous findings, we show a robust difference in COVID-19 vaccination status and intention between entrepreneurs and employees, with entrepreneurs consistently reporting lower willingness to receive the vaccine. This difference is found in three large datasets, covering representative samples in the EU, the Netherlands and the United States. We first tried to replicate the difference in vaccination coverage between entrepreneurs and employees using the large Eurobarometer dataset covering 27 EU member countries, consisting of over 13,500 observations from February 2022. Controlling solely for demographic variables, we confirmed that entrepreneurs are less likely to be vaccinated against COVID-19 than employees.

Having confirmed the existence of a vaccination gap, using the two other datasets, we studied whether this difference remained when also controlling for differences in vaccination attitudes and the impact and context of the COVID-19 pandemic. In the Dutch LISS dataset, we analysed vaccination intention assessed prior to the availability of COVID-19 vaccines (December 2020) and again confirmed that entrepreneurs reported lower COVID-19 vaccination intention than employees. While controlling for vaccination attitudes and the COVID-19 context variables, the strength of the relationship between being an entrepreneur and vaccination intention decreased, but a significant and negative association remained.

In general, we find that vaccination attitudes were strongly related to vaccination intention, while the COVID-19 context factors studied play less of a role, except for government trust, which is positively related to vaccination intention.

In the UAS data, we studied actual vaccination status in the USA in June/July 2021 after all adults had the opportunity to get vaccinated against COVID-19. In this sample, we similarly found that entrepreneurs, compared to employees, were less likely to be vaccinated against COVID-19. Even when controlling for demographics, vaccination attitudes and the COVID-19 context, the negative difference in vaccination status between entrepreneurs and employees remained. Additionally, in this dataset, vaccination attitudes were more strongly associated with vaccination status compared to the COVID-19 context variables. Finally, the results of the UAS data hinted at a difference in the relationship between mental wellbeing during the pandemic and vaccination status between entrepreneurs (positive relationship) and employees (nonsignificant negative relationship). However, given that we do not find this association in the LISS dataset, we refrain from further interpretation.

5. Conclusion

In line with the studies of Valckx *et al.* (2022) and Nguyen *et al.* (2022a, b), there is a robust difference in COVID-19 vaccination willingness between entrepreneurs and employees, which has now been confirmed in five datasets. Entrepreneurs consistently report lower COVID-19 vaccination intention and COVID-19 vaccination status than employees. Given the importance of mass vaccinations for ending pandemics, which are expected to occur more frequently in the future (Marani *et al.*, 2021), it is crucial to obtain a better understanding of what causes this vaccination gap. Using three large and representative samples, we show that this difference is not fully explained by differences in demographics, vaccination attitudes or the way the COVID-19 pandemic affected financial and job security and levels of mental wellbeing or government attitude. Our results indicate that among the working population, vaccination attitudes are more important in the decision to get vaccinated and in explaining the vaccination difference between entrepreneurs and employees than the contextual influences during the COVID-19 pandemic, such as the degree to which one was financially affected by the pandemic or mental health. In contrast with the expectation that the lower COVID-19 vaccination willingness of entrepreneurs could be driven by the larger financial and mental impact of the pandemic on entrepreneurs, the present study seems to indicate that this is not the case. Such situational variables are hence less important than expected. There is little research available focusing on the situational impact during a pandemic and how this affects vaccination behaviour, and future research should be aimed at exploring these situational variables further and to see whether pandemic-induced changes in these variables are associated with vaccination willingness.

5.1 Implications

Considering the importance of widespread vaccination, it is concerning that entrepreneurs report lower COVID-19 vaccination intention and status. The observation that a vaccination difference remains in our analysis after controlling for a range of factors is important from a managerial and societal point of view given that business owners could serve as a role model for employees within their companies both regarding work-related and non-work-related behaviours (Blok *et al.*, 2015; Koch and Binnewies, 2015). Lower vaccination rates among certain groups can have multiple social implications, including eroded public perception and trust, increased health disparities and strain on healthcare systems. Furthermore, we observe that vaccination attitudes are more important in explaining entrepreneurs' lower willingness to get vaccinated than contextual factors. Although future research should be aimed at incorporating all 5Cs in the analysis, from a policy point of view, it would be interesting to

explore the origin of different vaccination attitudes among entrepreneurs to determine whether they might be amended. All in all, future research disentangling the underlying reasons for entrepreneurs' lower vaccination willingness is needed such that policy campaigns targeted at entrepreneurs could be more effective. We now provide more detailed directions for further research.

5.2 Future research

To further explain the drivers of the entrepreneur–employee vaccination gap, we suggest exploring other promising alternative explanations and recommend future research in the following areas: social normative influences, personality differences and variability among entrepreneurs. First, social normative influences (including what behaviour is expected, approved and performed by others) are important drivers of human behaviour in general and the decision to get vaccinated (Agranov *et al.*, 2021; Cialdini *et al.*, 1990; Cialdini and Goldstein, 2004; Smith-McLallen and Fishbein, 2008). Future research may therefore investigate the role of social norms in explaining the vaccination gap between entrepreneurs and employees using two pathways. The first pathway relates to entrepreneurs' social environment, which may differ from that of employees, and therefore, different social norms surrounding the COVID-19 vaccinations may exist. For example, the decision to become an entrepreneur has been found to be related to the size and composition of one's social network (Allen, 2000; Falck *et al.*, 2012; Giannetti and Simonov, 2009). Along the same line of reasoning, future research could study and control for regional impact. As entrepreneurs tend to cluster together spatially, this could also modify prevailing social norms in this environment (Andersson and Larsson, 2016; Sorenson, 2017). A second area of investigation might examine whether there are differences in the importance of norms for the decision to get vaccinated. Entrepreneurs have been found to be driven by overconfidence (Koellinger *et al.*, 2007), which is linked to the tendency toward independence as opposed to following the crowd (Bernardo and Welch, 2001). This could mean that, compared to regular employees, entrepreneurs may be less affected by existing social norms surrounding COVID-19 vaccination, resulting in a lower willingness to get vaccinated.

Second, in future research, it would be worthwhile to investigate psychological differences between the two groups, such as personality traits. The literature describes a link between ADHD (attention-deficit hyperactivity disorder) and entrepreneurship, which is mostly driven by higher levels of impulsivity (Antshel, 2018; Lerner *et al.*, 2019). At the same time, recent studies show impulsivity and an ADHD diagnosis to be negatively related to both COVID-19 vaccination intention and adherence to COVID-19 regulations in general (Dvorsky *et al.*, 2022; Merzon *et al.*, 2021; Wismans *et al.*, 2021a, b). Increased impulsivity levels of entrepreneurs could thus negatively affect their vaccination decisions. Furthermore, it would be worthwhile to assess the role that overconfidence and optimism play in vaccination decisions: both traits are found to be higher among entrepreneurs than among employees, and they may be important in vaccination decision-making as well (Bernoster *et al.*, 2018; Koudstaal *et al.*, 2015). Finally, entrepreneurs are known to take more risks than the general population (Caliendo *et al.*, 2014; Zhao *et al.*, 2010). However, the relationship between risk attitude and vaccination behaviour is less clear as people perceive both the risks that are associated with getting vaccinated (side effects) and the risks that are associated with not getting vaccinated (getting infected and possibly ill). Accordingly, studies have shown positive (Trueblood *et al.*, 2021), negative (Massin *et al.*, 2015) and no (Okubo *et al.*, 2021) links between risk attitude and vaccination outcomes. It should be noted that we already capture part of the effects of overconfidence, optimism and risk-taking by including complacency, which reflects the perceived risk of COVID-19. However, future research should study the role of personality differences between entrepreneurs and employees in the decision to get vaccinated against COVID-19.

Third, it is possible that the lower vaccination willingness of entrepreneurs is driven by a particular group or type of entrepreneur. Unfortunately, with the data available, we were not able to further distinguish between the entrepreneurs in our sample. It would be interesting to research whether business size (the number of employees) or sector impacts vaccination decisions. For example, entrepreneurs without employees might feel a lower sense of collective responsibility. Additionally, entrepreneurs working in heavily impacted sectors might be less likely to get vaccinated as well, although one might expect that part of this association is captured by the context variables. At the same time, it is possible that the higher willingness of employees to get vaccinated is driven by those working in the health sector, where vaccination was strongly encouraged although not mandated at the time our data were collected.

Future research should investigate what causes entrepreneurs to be less willing to get vaccinated against COVID-19, among others, focusing on the role of social normative influences and personality.

5.3 Limitations

While the present study makes use of multiple large representative datasets, it is prone to some limitations. First, for most of our context measures, we had to rely on static variables (current mental health, current government attitudes). For future research, it would be worthwhile to use longitudinal data of measures collected pre pandemic and during the pandemic (e.g. change in government trust, mental health and income), acknowledging that these data are hard to find. Relatedly, it is possible that the timing of data collection affected our outcomes. Second, while we aimed to base our selection of vaccination attitudes on the 5C model, not all 5Cs were available in the datasets used. Moreover, we relied on self-selected proxies of the 5Cs. For future research, it would be interesting to study all five factors as measured using the validated 5C scale (Betsch *et al.*, 2018).

Notes

1. We aimed to perform additional analyses on COVID-19 vaccination status with data from the COVID-19 study conducted with the Understanding Society sample part of the UK Household Longitudinal Study. First results were in line with the findings presented here, showing a negative relationship between being an entrepreneur compared to being an employee and COVID-19 vaccination status. However, the group of nonvaccinated entrepreneurs contained only 22 observations. We therefore do not deem these analyses to be reliable and refrain from including this dataset and these outcomes in the paper.
2. Additional indirect effects analyses using bootstrapping (Hayes, 2022) show that the vaccination attitude variables do not significantly mediate the relationship between Entrepreneur and COVID-19 vaccination intention. This is also true for the contextual variables.
3. Given some high correlations between independent variables as shown in Supplementary Table S6.1, we check for multicollinearity by assessing Variance Inflation Factors calculated performing a linear regression like Model 3. The VIFs range from 1.03 to 2.51, indicating no concern for multicollinearity. As Confidence and Collective responsibility are strongly related in this sample ($r = 0.76$), we also performed regressions including the variables separately. Unsurprisingly, effect sizes for Confidence and Collective responsibility increase in these models. In the model excluding Collective responsibility, Mental wellbeing is significantly associated with vaccination status ($B = -0.04$, $SE = 0.02$, $p = 0.049$), other conclusions remain the same. In the model excluding Confidence, conclusions remain the same, except that Male ($B = -0.18$, $SE = 0.12$, $p = 0.13$) and Complacency ($B = -0.06$, $SE = 0.04$, $p = 0.14$) are not significantly associated with vaccination status. Finally, Job/Company security and financial security is also strongly correlated ($r = 0.65$), in models including these variables individually all conclusions remain the same.

4. In all models using the UAS data, we include Education as continuous variable, since likelihood ratio tests showed that there is no improvement in model fit when including education categorically (as dummies) compared to continuously (1–5). We include Income categorically, by including dummy variables, as this significantly improves model fit. We take the lowest income level as the reference category ("Less than $34,999") in all models.
5. Additional indirect effect analyses for logistic regression (Breen *et al.*, 2013) show that the vaccination attitudes do not significantly mediate the relationship between Entrepreneur and COVID-19 vaccination status. The same applies to the contextual variables.

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Supplementary material
The supplementary material for this article can be found online.

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