The First Is Free

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The first is free: do employee stocks incentivize stock market participation?

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ABSTRACT

Relatively few people participate in the stock market. We investigate whether getting employee stocks as part of one's compensation makes people more likely to actively invest in stocks. We find the probability of actively participating in the stock market increases by 15% for those who have been given employee stocks. This lends strong support to cognitive costs in stock market entry. We further find that people predominantly increase direct stock holdings as opposed to indirect holdings via mutual funds. Despite the significant spillover effects from holding employee stocks and an overall larger fraction of individual wealth being invested into stocks, it does not result in well diversified investing.

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1. Introduction

A fundamental puzzle within the studies of household finance is that few people invest in the stock market. This is contrary to economic theory, which is very clear on the benefits of participation, where in a market with a positive equity premium every household should hold at least some stocks (Badarinza, Campbell, and Ramadorai 2016). Making matters worse, even when households do hold stocks, they tend to hold relatively few stocks, small amounts and invest in their own employers' stock; all of which lead to lower welfare gains from stock market participation than would otherwise be possible. It is therefore of interest to policymakers to understand what facilitates stock market participation, as well as what can limit bad investments once households have entered the market. Our analysis is at the nexus of these two concerns. We investigate if receiving employee stocks, which mechanically induces more stock market participation, also leads to diversification and more investment in other stocks, thereby limiting the welfare losses.

Among the explanations offered for limited stock market participation by the literature are monetary and/or cognitive costs to entry (Andersen and Nielsen 2011; Vissing-Jorgensen 2003), non-standard preferences (Barberis, Huang, and Thaler 2006; Garlappi, Uppal, and Wang 2007; Pagel 2018), beliefs (Guiso, Sapienza, and Zingales 2008; Hurd, van Rooij, and Winter 2011), and financial literacy (van Rooij, Lusardi, and Alessie 2011). Existing research also shows that when people do hold stocks, they often hold stocks highly correlated with their endowment risk, such as employee stocks (Benartzi 2001; Mitchell and Utkus 2003; Poterba 2003), leading to welfare losses (Døskeland and Hvide 2011).

Employee stocks are offered to employees by a listed company as part of a compensation package. Holding such a stock is therefore not a consequence of individuals' active investment decisions. However, employee stock holdings have implications for a household's portfolio, and it is the rest of the portfolio that we investigate. We hypothesize that receiving employee stocks could potentially make individuals more aware of equity-based investment opportunities and thus lower fixed costs of participation in other stocks or mutual funds (Christelis,

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Georgarakos, and Haliassos 2011). This implies that employee stocks could increase individuals' investment in the general stock market, which is what we test. On the other hand, as an alternative outcome, households could wish to limit further risky stock investments as their received employee stocks can correlate with their income risk. Additionally, households may potentially not consider their employee stocks at all when making decisions about their other holdings. Under these alternatives the household will not increase their stock holdings further when holding an employee stock. This paper explores these possibilities, comparing the portfolios of households with no employee stocks to the portfolios of those with employee stocks (excluding employee stock portion). We investigate not only participation, but also at how diversified stock participants are, as well as the intensive margin of how much is invested in the stock market.

Our main result support the first possibility, thereby lending support to theories explaining limited stock market participation by cognitive costs to entry. This result, i.e. that employee stocks incentivize further stock market participation, implies that the adverse effects of holding employee stocks are mitigated. Namely, employee stocks tend to both underperform and serve as poor hedges, due to being highly correlated with endowment risk (Døskeland and Hvide 2011). Since getting employee stocks incentivizes active stock market participation it thereby works to alleviate some of these welfare losses.

We apply very comprehensive registry data on the stockholdings of all employees in Denmark to investigate if individuals holding employee stocks are more likely to participate in the stock market directly. The employee stocks we study are stocks given to employees for free or at a significant discount as a part of their compensation structure. The economic incentives to accept these stocks are quite large, so most people do. Thus, more accurately, we study the spillover effects of the decision to continue to hold them. We study this not only by examining direct stocks investment, but also indirect stock holding via mutual funds. Lastly, in addition to studying participation (the extensive margin), we also study whether households with employee stocks hold a larger fraction of financial assets in equities, and a larger number of different stocks (the intensive margin).

As our main result we find that on average the stock market participation rate is around 3.6%-points higher for those who hold employee stocks (excluding the employee stock). This translates into an economically significant 15% increase in active participation rates, namely from 24.4% to 28.0%. We furthermore find that individuals' direct stockholdings alone account for around 60% of this increase in participation rates. The remainder is explained by either mutual fund holdings or a combination of direct stock holdings and mutual fund holdings.

We additionally find that although individuals with employee stocks hold a statistically significantly larger number of individual stocks, the increase in the number of stocks is not economically significant. The implication of this result is that while there are significant spillover effects, it does not lead to diversified investing. This limits some of the potential gains from the increased participation, as people hold more idiosyncratic risk than if their increased participation came through mutual fund holdings.

Finally, we find that people with employee stocks invest a larger fraction of their financial assets in stocks, showing that employee stocks not only spur investors to actively participate in the stock market, but that investors significantly shift their portfolio allocation. Combining this with the above findings, this indicates that individuals invest a fairly large proportion of their financial wealth into mostly underdiversified portfolios.

All in all, we find that employee stock holdings are associated with higher stock market participation rates, and a significant transfer of fraction of financial wealth into equities, but the mode of participation is not very diversified. This implies some (limited) welfare gains to offset the losses from holding a stock so correlated with labor income. Overall, our result that employee stocks spur active stock investment lends support to explaining the limited stock market participation by cognitive costs to entry. In addition, as holding an employee stock makes individuals more likely to invest in individual stocks compared to mutual funds, this further supports an informational interpretation, since getting an employee stock is unlikely to provide direct information about mutual funds, as opposed to stocks.

The paper proceeds by introducing the comprehensive ownership data used in our study. The following section (Section 3) introduces the econometric methods we apply. After presenting our results (Section 4) and potential limitations (Section 5), a final section concludes.

2. Data

The dataset analyzed is detailed employee level registry data from Statistics Denmark. We examine a 2011 cross section (this is the last year for which we have reliable data) of all employees above the age of 18, with a nonzero amount of financial assets, and with data on various control variables of interest. Those control variables are age, marital status, level of education, ethnicity, disposable income, wealth in banks (deposits, bonds, etc.), debt, gender, homeownership status, property value, whether one has kids living at home, region of residence, job category, and squares of all numerical variables.[1] As mentioned, an individual is defined as holding an employee stock, if they hold a stock that was given to them by their employer as part of their compensation. Stocks are identified as such in the Statistics Denmark registries via third-party-reported information originating from banks and brokerage firms of each individual. We want to investigate whether holding this kind of stock is correlated with stock market participation in other stocks or mutual funds. The dependent variable is first a binary variable indicating whether an individual holds equity in addition to any employee stocks an individual might have, and subsequentially a categorical variable indicating what type of equity holdings this is; individual stocks, mutual funds, both, or none. Thereafter we analyze the number of non-employee stocks an individual has, and the fraction of financial wealth held in non-employer equity.

The summary statistics are shown in Table 1. A total of 82,830 individuals hold employee stocks (cf. bottom row of Table 1), which translates into 4.4% of the full population of employees. Table 1 reveals that those with employee stocks have a higher income, are wealthier, have a higher education, hold more knowledge intensive jobs, are more likely to be male and own property. This is not entirely unexpected, considering that stocks are more likely to be a part of compensation in well paid jobs. The subsequent analysis controls for any such dissimilarities. Crucial to this analysis, however, is the sizeable difference in stock participation rates between these two groups, with the rates being 36% for those who hold employee stocks, while 24% for those who do not. Part of this difference is due to the differences in observables, as our results will show, but this nevertheless provides an early indication of a large and economically significant difference.

A limitation of this data is that it is from 2011, and investment behavior might have changed over time, which could lead to our results no longer being applicable. However, while we do not have access to microdata for recent years, Statistics Denmark has published recent reports on general investment behavior in Denmark. These reports pertain to the total population, whereas we look only at the employed population. First, the reports (Neergaard 2023; Statistics Denmark 2021) show that limited participation is still a problem in Denmark, with only 21% of all individuals owning equities in 2019. This is comparable to our number of roughly 25%, where the difference is explained by people under the age of 18 (which we exclude) that have a very low participation rate, and by us focusing on the employed population. Second, like in our sample, ownership of individual stocks is the most common mode of participation in Denmark, with ownership of individual stocks being around 1.7 times more common than mutual fund investments. There are no reports on the average number of individual stocks held, nor how many hold employee stocks or the behavior of those holding them. However, seeing as the two aforementioned features of limited participation and the primary mode of participation being individual stocks are similar in more recent years, it is arguably likely that other features of investment behavior also remain. Therefore, despite not being able to provide firm statements for periods outside our sample, the conclusions we draw from our results are likely to apply more broadly.

3. Econometric methods

The econometric analysis in this paper heavily draws on methods of modeling limited dependent variables, as our outcome variables are by their very nature discrete or bounded. We model stock market participation using a logit regression and the mode of stock market participation using a multinomial logit (discrete). We next model the number of stocks using a Poisson and hurdle Poisson regression (count variable) and the fraction of financial wealth in stocks (bounded between 0 and 1) using a fractional regression.

Firstly, the logit specification is as follows:

$$P(StckMktPart_i = 1|x_i) = \Lambda(\delta HasEmployeeStock_i + x_i\beta) \tag{1}$$

Table 1. Summary statistics.

Categorical variables	Has employee stocks		No employee stocks	
Stock market participation (excl. employee stock)	35.65%		24.37%	
Individual stocks (excl. employer stock)	24.83%		18.33%	
Mutual funds	3.75%		2.49%	
Both mutual funds and individual stocks	7.06%		3.55%	
Male	54.35%		49.89%	
Homeowner	75.17%		60.00%	
Has kids	26.93%		27.39%	
Married	65.43%		55.36%	
Divorced	8.51%		9.37%	
Single	25.03%		34.06%	
Widowed	1.02%		1.21%	
Capital region	43.51%		30.67%	
Central Denmark region	20.02%		21.82%	
Nortern Denmark region	8.22%		10.58%	
Zealand region	16.04%		14.95%	
Southern Denmark region	12.22%		21.98%	
Lower than high school	8.85%		17.42%	
High school	50.19%		45.41%	
Short higher education	11.69%		5.01%	
Bachelor's degree	13.37%		21.31%	
Master's degree or higher	15.90%		10.85%	
Danish	96.07%		93.88%	
Immigrant	3.22%		5.39%	
Descendant of immigrants	0.71%		0.73%	
Management	5.86%		4.87%	
Work requiring knowledge high level	39.65%		29.05%	
Work requiring knowledge medium level	27.06%		13.00%	
Office and customer service	13.78%		8.55%	
Service and sales	3.31%		19.00%	
Agriculture	0.07%		0.61%	
Artisan	3.06%		9.89%	
Operators	5.03%		5.92%	
Other manual labor	2.14%		8.09%	
Military	0.04%		1.03%	
Continuous variables	**Mean**	**Std.**	**Mean**	**Std.**
Disposable income (100,000 DKK)	3.32	1.26	2.60	1.06
Age	43.64	10.19	42.12	11.91
Wealth in stocks (100,000 DKK)	1.16	2.39	0.16	1.10
Non-stock financial assets (100,000 DKK)	1.88	3.61	1.20	2.74
Property value (100,000 DKK)	10.24	10.00	7.06	9.38
Debt (100,000 DKK)	8.94	8.43	6.47	7.53
Nr. of observations	82,830		1,783,230	

This table shows, for those with and without an employee stock, the means and standard deviation (fractions in each category for categorical variables), for the various control variables and the dependent variable. All DKK variables measured in 100,000 DKK and are winsorized at a 0.5% level. Stock market participation is defined as owning a mutual fund or an individual stock, excluding employee stocks.

where $StckMktPart_i$ is a dummy equal to 1 if an individual, i, participates in the stock market (excluding their possible employee stocks), $\Lambda(*)$ is the logistic function, $HasEmployeeStock_i$ is a dummy equal to 1 if an individual holds employee stocks, and x_i is a row vector of control variables. Secondly, the multinomial logit model specification is:

$$P(ParticipMode_i = j|x_i) = \frac{\exp(\delta_j HasEmployeeStock_i + x_i\beta_j)}{1 + \sum_{h\in J}\exp(\delta_h HasEmployeeStock_i + x_i\beta_h)} \tag{2}$$

where $ParticipMode_i$ is individuals' participation mode, which is defined among the set of investment options $J =$ Individual stocks, mutual funds, both individual stocks and mutual funds, with holding no risky assets as the base outcome.

Thirdly, the Poisson regression is specified as follows:

$$\#Stocks_i \sim Poisson(\lambda_i) \ with \ \lambda_i = \exp(\delta HasEmployeeStock_i + x_i\beta) \tag{3}$$

where *#Stocks* is the number of different companies' stocks an individual holds, minus the number of employee stocks. I.e. it takes the value 1 if an individual holds equities in 1 company other than the company they work at, 2 if they hold equities in 2 companies, etc.

Finally, we model the fraction of financial wealth invested in equities as follows:

$$E[ShareEquities_i|x] = \Lambda(\delta HasEmployeeStock_i + x\beta) \tag{4}$$

$ShareEquities_i$ is the share of financial wealth invested in equities by an individual, excluding potential investments in employee stocks. While we assume the reader is familiar with the more standard logit models and Poisson regression, we provide a brief overview of calculation of average partial effects, the hurdle Poisson and the fractional regression.

3.1. Average partial effects

In our analysis we mostly apply nonlinear functions to model household decisions when it comes to investments in stocks. While these models provide a good fit to the limited dependent variables of interest (number of stocks, participation decision etc.), it is often difficult to interpret the estimated coefficients directly. We therefore calculate average partial effects (APE-s) as follows. Let the expected value of some random variable y, conditional on covariates x, be an arbitrary function $G(x)$:

$$E[y|x] = G(x) \tag{5}$$

In our case we are interested in the effect of a binary variable, whether an individual has employee stocks, on the function G. However, unless G is a linear function, this effect will generally depend on the level of the covariates, and thus it is hard to interpret. Instead, in the discrete case, we can calculate the value of $G(x)$ for every individual in our sample, for the two different values of the binary variable, and then average over the difference,

$$N^{-1}\sum_{i=1}^{N}[G(x\beta + \delta HasEmployeeStock) - G(x\beta)] \tag{6}$$

where N is the number of observations, *HasEmployeeStock* is a binary dummy variable, and δ and β are parameters to be estimated. Essentially, we make two predictions for all individuals in our sample using their values of x, i.e. one with the dummy *HasEmployeeStock* set equal to 1 and another when it is set to 0. Then the APE is the average of the difference in the two predictions across all individuals. In other words, the APE is the average effect of having an employee stock compared to having none, for all individuals in our sample.

3.2. Hurdle Poisson regression

In our data we observe that a large fraction of individuals (75%) does not participate in the stock market. This econometric problem, known as excess zeros, can be inconsistent with standard count models, which can lead to inconsistent estimates of partial effects. To deal with the problem of excess zeros we apply a two-part model, where zeros come from a decision to not participate in the stock market, and then, conditional on participation, investors decide how many stocks to purchase (Pohlmeier and Ulrich 1995).

Our modeling presumes a random outcome variable $y \in \mathbb{Z}_{\geq 0}$ (in our case this is number of stocks), and the responses $y = (y_1, \ldots, y_N)$ are independent. In addition, we define $\lambda = \exp(x\beta)$, where x is our set of covariates.

In the two-part (hurdle) model it is assumed that the zeros and the positive counts come from two separate data generating processes (Cameron and Trivedi 2005). Zeros are determined by the density $f_1(*)$, so probability $P(y = 0) = f_1(0)$, and the positive counts by a truncated distribution $f_2(y|y\rangle 0) = \frac{f_2(y)}{1-f_2(y)}$, multiplied by $P(y > 0)$

to ensure that the probabilities sum up to 1. This can be interpreted as individuals having a two-step decision making process. They first decide whether to purchase individual stocks, and if they decide to do so, they then decide how many stocks to purchase. The density is:

$$g(y) = \begin{cases} f_1(0) & if y = 0 \\ \dfrac{1 - f_2(0)}{1 - f_2(y)} f_2(y) & if y \geq 1 \end{cases} \tag{7}$$

In our case we assume $f_1(*)$ is a logit model (namely $f_1(0) = \Lambda(x\gamma)$, where $\Lambda(*)$is the logistic function), and $f_2(*)$ is Poisson(λ) distributed (Cameron and Trivedi 2005). Maximum likelihood estimation is feasible by estimating the two models separately (the non-truncated model and then the truncated model on only those who participate). Then expected number of stocks held by an individual is $E[y|x] = (1 - f_1(0|x)) * E[y|y\rangle 0, x] = (1 - f_1(0|x)) * \frac{\lambda}{1-\exp(-\lambda)}$, which can be used for calculating average partial effects.

Note that the conditional mean is different from λ, so if the data generating processes of these models are true, then that implies that the normal Poisson regression (which normally is quite robust to misspecification) is inconsistent (Cameron and Trivedi 2005).[2] This is one of the reasons why we use the hurdle model; as a robustness check of the Poisson regression conditional mean assumption. The other reason is that the hurdle model provides a clear way of examining the extensive margin (using the logit model) and the intensive margin (using the truncated Poisson model) separately.

3.3. Fractional regression

The fraction of wealth in stocks is a variable that is bounded between 0 and 1. While one could use a linear regression for to predict such a dependent variable, it might predict values outside of these bounds. There are a few alternate ways of modeling fractional response variables defined in the unit interval $[0, 1]$. For example, one can use a two-limit Tobit, but this requires a pileup both at zero and one, and it imposes restrictions on the conditional density of the dependent variable (Wooldridge 2010). Another is to use a regression based on the beta distribution (Kieschnick and McCullough 2003), but it is not applicable with pileups at zero or one, and requires distributional assumptions (Wooldridge 2010). The approach taken in this project is therefore to use the factional regression and specify the conditional mean as the logistic function:

$$E[y|x] = \frac{\exp(x\beta)}{1 + \exp(x\beta)} = \Lambda(x\beta) \tag{8}$$

This can be estimated using quasi-maximum likelihood, which is consistent if the conditional mean is correctly specified (Papke and Wooldridge 1996). Average partial effects can be calculated as one would do in the logit model, only they are interpreted as changes in the fraction of wealth invested in stocks, rather than the change in probabilities.

While this approach can easily deal with a large pileup at either endpoint of the distributional, it might be intuitively appealing to additionally apply a two-part model (Ramalho and da Silva 2009). This is because an individual might first decide whether to participate in the stock market, and then how large a fraction of their financial assets to invest. Again, we can use a logit to model the decision not to participate, $f_1(0)$. Instead of unconditionally specifying $E[y|x] = \Lambda(x\beta)$, we can specify the mean conditional on x and participation as $E[y|x, y\rangle 0] = \Lambda(x\beta)$. In this case, there is no need for truncation methods, as we have explicitly specified the mean of the participating subpopulation (Wooldridge, 2011). The logit and the fractional response regression can then be estimated separately. Then the expected fraction of wealth invested in stocks, can be expressed as $E[y|x] = \mathrm{P}(y > 0) * E[y|x, y\rangle 0] = (1 - f_1(0)) * \Lambda(x\beta)$, and using this expression for making predictions, average partial effects can be easily obtained.

Table 2. Stock market participation.

	Stock market participation			
	LPM		Logit	
	(1)	(2)	(3)	(4)
Has employee stocks	0.113∗	0.047∗	0.542∗	0.213∗
	(0.002)	(0.002)	(0.007)	(0.008)
Avg. partial effect	0.113∗	0.047∗	0.113∗	0.036∗
	(0.002)	(0.002)	(0.002)	(0.002)
Avg. partial effects controls				
Male		0.036∗		0.034∗
		(0.001)		(0.001)
Income		0.026∗		0.022∗
		(0.001)		(0.001)
Deposits		0.046∗		0.035∗
		(0.000)		(0.000)
Has masters' degree		0.069∗		0.070∗
		(0.001)		(0.001)
Age		0.010∗		0.009∗
		(0.000)		(0.000)
Control variables	No	Yes	No	Yes
Nr. of observations	1,866,060	1,866,060	1,866,060	1,866,060
Pseudo R^2	0.00	0.11	0.00	0.11

This table shows the results of a linear probability model (1–2) and a logit (3–4). The dependent variable is a binary variable equaling 1 if an individual participates in the stock market, and 0 otherwise. Standard errors (in parenthesis) are robust. Standard errors for the average partial effects (APE-s) are calculated using the delta method. ∗ Significant at 1% level. The variables deposits and income are measured in 100,000 DKK. Has Masters Degree is a dummy equal to 1 if an individual has a masters' degree or higher education, and is the only one out of 5 education categories displayed: the baseline category is not having completed high school.

4. Results

We first examine if owning employee stocks increases the likelihood of participating in the stock market (owning non-employee stocks). To do this we apply the logit model as shown in equation 1, and the result of this analysis is shown in Table 2. In this table, we also present the average partial effects of particularly interesting control variables: age, gender, education, income, and deposit holdings.

Looking at the average partial effects from the logit model we see that the average increase in the probability of stock market participation, from holding an employee stock is 11.3%-points without controls (this is the unconditional difference in fractions reported in the summary statistics), and 3.6% when controls are added (see columns 3 and 4). This corresponds to an increase the stock market participation rate from 24.4% (cf. summary statistics) up to 28%, corresponding to a 15% increase (i.e. [28%−24.4%] / 24.4% = 15%). These average partial effects line up nicely with the linear probability model (column 2), which estimates the effect of having employee stocks to be 4.7%-points. Thus, even when controlling for all the differences in observables, there still is a large difference in the average probability of participating in the stock market between those who hold employee stocks compared to those who do not.

Turning to the select set of control variables we observe that men and the highly educated are more likely to participate, and the probability of participating in the stock market is increasing in wealth, income, and age. All of this is consistent with stylized facts in the literature.[3] These coefficients also give a sense of the magnitude of the effect of owning employee stocks. Namely, we can see the effect is roughly comparable to the difference between genders, but is smaller than the difference between very highly educated and those with a low degree of education. This is intuitive, as even though getting experience with the stock market through employee stock options might reduce cognitive fixed costs of entering the stock market, this effect is unlikely to be larger than that of a masters' degree.

Given that individuals holding employee stocks are more likely to invest in the stock market, it raises the question of what kind of equity are they most likely to hold? We analyze this using the multinomial logit model

Table 3. Stock market participation mode.

	Stock market participation mode					
	Individual stocks		Mutual funds		Both	
	(1)	(2)	(3)	(4)	(5)	(6)
Has employee stocks	0.465∗	0.181∗	0.571∗	0.281∗	0.849∗	0.392∗
	(0.008)	(0.009)	(0.019)	(0.021)	(0.014)	(0.017)
Avg. partial effect	0.065∗	0.021∗	0.013∗	0.004∗	0.035∗	0.011∗
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Control variables	No	Yes	No	Yes	No	Yes
Nr. of observations	1,866,060	1,866,060	1,866,060	1,866,060	1,866,060	1,866,060
Pseudo R^2	0.00	0.11	0.00	0.11	0.00	0.11

This table shows the results of a multinomial logit model. The dependent variable is a categorical variable for the mode of stock market participation, where the possible categories are to invest in individual stocks, mutual funds, both, or none (which is the baseline). Thus, the odd numbered columns, are the results from the multinomial logit without control variables, and the even numbered columns are the results of the multinomial logit with controls. Standard errors (in parenthesis) are robust. Standard errors for the average partial effects (APE-s) are calculated using the delta method. ∗ Significant at 1% level.

presented in equation (2). Looking at the results in Table 3, we can see that the average partial effect on the probability of investing in a mutual fund is only 0.4%-points (column 4), while it is 2.1%-points for individual stocks (column 2), and 1.1%-points for the probability of investing in both (column 6). This interestingly shows that most $(2.1/(0.4 + 2.1 + 1.1) = 60\%)$ of the difference in stock market participation across the two groups is driven by the tendency of those who hold employee stocks to also hold other individual stocks.[4]

The result that 60% of the larger participation rates among employee stockholders come from individual stock holdings has important implications. As portfolios of households without mutual funds contain a great deal of idiosyncratic risk (Calvet, Campbell, and Sodini 2007), this indicates that the increased stock market participation is not properly diversified. This limits the potential benefits from the increased participation.

To sum up, these results provide two overall takeaways. First, the welfare loss from holding employee stocks is countered by the fact that it is also associated with holding more equity. In other words, people who own one stock that is highly correlated with their endowment are more likely to invest in other equity options. However, on average this benefit appears to be limited by largely underdiversified participation. Second, the increased participation is intuitively likely to be associated with a decrease in the cognitive costs of buying stocks. This can happen because when individuals receive a stock from their employer, they also receive general information about stocks, trading options, etc. In addition, holding an employee stock has the largest effect on the probability of investing in individual stocks, which further backs up this informational interpretation, as getting an employee stock is unlikely to provide direct information about mutual funds, as opposed to stocks.

4.1. Portfolio diversification

The result that people are more likely to invest in stocks, not mutual funds, will generally not lead to a large gain from diversification unless they invest in several different individual companies. To investigate further potential diversification, we estimate the Poisson regression from equation (3) to analyze the effect of holding an employee stock on the number of individual non-employee stocks an individual holds.

The results are displayed in Table 4, column 1. They show that holding employee stocks is positively related to holding a larger number of stocks. The average partial effect shows that on average, the effect of holding employee stocks is associated with an 0.159 increase in the expected number of individual stocks a person holds. While this is small in absolute terms, consider that the average number of stocks in the entire sample (including those with no stocks) is 0.45. Then this suggests that individuals with employee stocks hold 36% (0.16/0.45) more individual stocks. Thus, as people generally hold very few stocks, the relatively small partial effect is still a large relative change in the number of stocks an individual holds.

In Table 5, we assess the fit of the Poisson model by comparing the predicted probabilities of the outcomes 0–9 (holding 0–9 stocks) with the actual frequencies in the data (Cameron and Trivedi 2010). We see that the

Table 4. Number of stocks and fraction of wealth in stocks.

	Number of individual stocks		% Wealth in stocks	
	Poisson	Hurdle Poisson	Fractional logit	Hurdle fractional logit
	(1)	(2)	(3)	(4)
Total effect				
Has employee stocks	0.308∗		0.301∗	
	(0.009)		(0.009)	
Avg. partial effect	0.159∗	0.142∗	0.016∗	0.012∗
	(0.006)	(0.005)	(0.001)	(0.001)
Extensive margin				
Has employee stocks		−0.227∗		−0.235∗
		(0.008)		(0.009)
Avg. partial effect		−0.038∗		−0.039∗
		(0.001)		(0.001)
Intensive margin				
Has employee stocks		0.210∗		0.087∗
		(0.011)		(0.009)
Avg. partial effect		0.300∗		0.015∗
		(0.007)		(0.003)
Control variables	Yes	Yes	Yes	Yes
Nr. of observations	1,866,060	1,866,060	1,866,060	1,866,060

This table shows the results of Poisson and fractional regressions. In columns 1–2 the dependent variable is a count variable, the number of non-employee stocks an individual holds. In columns 3–4 the dependent variable is a fractional variable, the fraction of wealth, that is invested in equity (excluding employee stocks). In columns 2 and 4 I also model the extensive margin separately, i.e. the decision to participate; this is a logit model using the same covariates, where the dependent variable is a binary variable taking on the value 1 if an individual is not participating. Thus, the signs are flipped from Table 1. The combined effect is the effect on the dependent variable resulting from both the intensive and extensive margins. Standard errors (in parenthesis) are robust. Standard errors for the average partial effects (APE-s) are calculated using the delta method. ∗ Significant at 1% level.

model appears to predict zero outcomes (non-participation) relatively poorly. We therefore also apply the hurdle model described in Section 3.2, which accounts for this, as a robustness check. More specifically, if the underlying data generating process indeed follows a two-part process, then the conditional mean assumption of the simple Poisson model is no longer correct, and the estimates are inconsistent (Cameron and Trivedi 2005). In addition, the hurdle model allows us to investigate the extensive and intensive margin separately. The analysis above considered only the total effect on the number of stocks held, by combining the decision to participate in the stock market (thereby getting a count of 1), and the decision to acquire additional stocks. With the hurdle model, we analyze these two decisions separately. A logit with all the same control variables is used to model the decision *not* to hold individual stocks (i.e. the zero counts), as described in Section 3.2. The truncated Poisson regression is used for the positive counts. The results can be seen in Table 4, column 2.

The hurdle model fits the data better (cf. Table 5), particularly (and by construction) the zeros, but are also closer in terms of other predicted probabilities. However, as shown in Table 4, column 2, the total average partial effects are similar to the one from the simple Poisson regression, although slightly smaller at 0.142. This indicates that the conditional mean specification from the simple Poisson regression is not very different from the hurdle model allowing for excess zeros (with better fit), implying that the estimates in column 1 are robust to this kind of misspecification.

The extensive margin is significantly negative (column 2), suggesting that those with employee stocks are less likely to hold zero non-employee stocks. This is not surprising considering the previous analysis. However, there is also a significantly positive effect on the intensive margin, meaning that for those who are participating in the stock market, having employee stocks increases the expected number of individual stocks they buy. The average partial effect on the number of stocks held, given one is already participating in the stock market, is estimated on the whole sample (using the results from the hurdle model) at around 0.30. Thus, the total effect of an increase of 0.142 stocks held comes both from those with employee stocks being more likely to participate,

Table 5. Poisson fit.

Pr(Nr. Stocks = x)	Actual	Poisson	Hurdle Poisson
0	77.68%	67.73%	77.68%
1	15.13%	23.75%	10.25%
2	3.18%	6.08%	6.33%
3	1.31%	1.59%	3.15%
4	0.77%	0.48%	1.43%
5	0.51%	0.18%	0.63%
6	0.35%	0.08%	0.28%
7	0.25%	0.04%	0.13%
8	0.18%	0.02%	0.06%
9	0.14%	0.01%	0.03%
Maximum deviation	0.00%	9.95%	4.88%

This table shows the predicted probabilities of the various Poisson regression for the first 10 count outcomes, compared to the actual fractions in the data.

as well as investing more on average once they participate. Overall, this section shows that while statistically significant, and finding large effects relative to the average number of stocks held, these effects (around 0.142 extra stocks) are not large enough to generate significant diversification benefits. Thus, this supports our previous findings, showing that while stock market participation is higher amongst those with employee stocks, it is not well diversified participation, limiting benefits of participation.

Finally, in Table 4 we analyze the fraction of wealth invested in equity (excluding employee stocks), as the benefits of participation may be limited if individuals only invest a small fraction of their wealth. We specify the conditional mean of this fraction as a logistic function and estimate it using quasi maximum likelihood, as shown in equation (4) and described in more detail in Section 3.3. In Table 4, column 3, we can see that everything else equal, individuals with employee stocks are expected to hold 1.6%-points (which translates into a 30% increase relative to the average value of 5% for those without employee stocks, i.e. 1.6% / 5% $\approx$ 30%) more of their wealth in equities on average. While this effect is statistically significant, it is not necessarily economically significant, as the average amount of financial assets is only around 130,000 DKK ($\approx$ 17,000 USD), implying that this effect represents around 2,000 DKK ($\approx$ 260 USD) more in stocks for the average individual. Like for the Poisson regression, we can also specify a two-part model, assuming that people decide first whether to participate, and then how large a fraction of their wealth to invest. We accordingly specify the conditional mean of the fraction of wealth in stocks, conditional on participating, as a logistic function. We similarly model the decision *not* to participate in the stock market using a logit model. While the average partial effect on the overall conditional mean (i.e. for those participating and those not) is similar to the previous case, we can also see that this effect is not only coming from the extensive margin, but also the intensive margin. The average partial effect for those participating is 1.2%-points, which indicates that on average, among those participating, those with employee stocks hold more of their wealth in equities. This confirms our previous results, showing that those who hold employee stocks do not only participate by holding one or two shares, but invest a significantly larger share of their financial wealth, than those without employee stocks.

5. Limitations

It is plausible, that while an individual's stock market participation does not affect the likelihood of getting an employee stock, it can affect the likelihood of holding one, i.e. not selling it. This complicates the interpretation of the results as it implies that not only may stock market participants be more likely to hold employee stocks, but holding employee stocks (not selling them) can affect stock market participation. This endogeneity could be further explored in extended datasets, e.g. possibly by comparing individuals switching jobs to firms offering employee stocks, to their former coworkers who are not receiving stocks. This would provide more exogenous variation in employee stock holdings, but this goes beyond the richness of our data.

A second issue is that the independence of irrelevant alternatives assumption (IIA) is unlikely to hold. A violation of this assumption could potentially invalidate our multinomial logistic regression results. Approaching it from an additive random utility point of view, the assumption is that the random component of utility an individual gets from investing in mutual funds is uncorrelated (and Gumbel distributed) with the random component of utility she would get from investing in e.g. individual stocks. This is unlikely, and indeed, using Hausman and McFadden's (1984) test of this assumption, we find that it is violated (not reported for brevity), meaning for example that the choice between no risky assets and mutual funds is in fact affected by having individual stocks as an investment option. In principle there exist ways of relaxing this assumption such as assuming the random components have a multivariate normal distribution, allowing for arbitrary correlation, or using a nested logit (Wooldridge 2010). However, as we are bound to having individual-specific covariates, and these models are underidentified without alternative-specific covariates (Keane 1992; Walker 2002), it is not feasible to relax the IIA within our setting.

6. Conclusion

To conclude, we find that individuals holding employee stocks are on average 15% more likely to participate in the stock market and that this increased participation is mostly due to them investing in individual stocks, rather than mutual funds. This indicates that employee stocks have positive spillover effects on stock market participation, which offsets the negative diversification effects of holding the employee stocks correlated with their endowment. This spillover effect is likely to emerge because of a decrease in the fixed cost of investing, as employees gain information on investing in individual stocks when they get their employee stocks (whereas no such information is gained for mutual funds). We also find that the percentage change in the expected number of individual stocks owned is large (36%), but the average absolute change is quite small (0.16 stocks). This indicates that individuals are not fully realizing potential diversification gains that could come through further stock market participation. Finally, we analyze the effect on the fraction of wealth invested in equity and find that those who hold employee stocks invest a larger fraction (on average 1.2%-points) of their wealth in equities. Overall, our results lend support to explaining limited stock market participation by cognitive costs to entry.

The implications for policymakers are two-fold. First, as experience with financial markets relates positively to additional stockholdings this implies that policymakers trying to increase the general participation rates in their country should explore ways of providing individuals with better understanding of financial markets to decrease the cognitive barriers to entry. Second, regulators need to be overly worried about the negative welfare consequences of employees receiving employee stocks highly correlated with their endowment, as on average they hold more stocks in non-employer companies compared to individuals without employee stocks, thus diversifying away some of the losses. Among possible steps to be taken, regulators may encourage more information to be shared on the benefits of being invested in the stock market, including encouraging companies to provide additional information when they distribute company stocks to their employees, as well as inform them about the general benefits of diversification.

Notes

1. Job category is defined using the first digit of the DISCO08 code. Results are robust to using the 2 first digits.
2. A more flexible distribution such as the negative binomial might be more beneficial in that case, but to keep it simple, we use the Poisson distribution.
3. The control variables are also in line with earlier research in the remaining regressions, and we prefer to keep the focus on the main variable of interest, namely whether individuals hold employee stocks. As Tables 3 and 4 are already quite complex, we therefore do not report effects of control variables in subsequent tables.
4. While these raw effects are the most relevant, it is also of interest to relate it to popularity of each participation mode (cf. summary statistics). This gives a more complete interpretation of our estimated effects. Namely, we can see that the average effect on the probability of investing in a mutual fund corresponds to a 16% increase in mutual fund investment (0.4%/2.49%), while it is just 11% for individual stocks (2.1%/18.33%), and 31% for the probability of investing in both (1.1%/3.55%). Thus, the relative increase in probability due to holding employee stocks, is higher for the mutual fund based options. Thus, even though the partial effects for mutual funds are relatively small, there is a large relative effect on the probability of participating

through mutual funds. In other words, despite the absolute increase in stock market participation via mutual funds is relatively small, the proportional change is large. But again, the largest absolute effect still comes from increased individual stockholding.

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No potential conflict of interest was reported by the author(s).

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Data availability statement

The data underlying this article cannot be shared publicly due to data-restriction policies of Statistics Denmark, who hosts the data used in the article.

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