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GIOVANI, DONNE E LAVORO

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LIFELONG LEARNING AND ADAPTIVE CAPACITY AMONG SELF-EMPLOYED WORKERS UNDER THE TWIN TRANSITION

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THEORETICAL FRAMEWORK

- The digital and green transitions are reshaping production systems, labour markets and skill requirements (European Commission, 2022; OECD, 2023).
- Digitalisation increases demand for advanced skills while accelerating the obsolescence of routine competences (Autor et al., 2003; Acemoglu & Autor, 2011; Cirillo et al., 2021).
- Lifelong learning is becoming essential not only for productivity, but also for adaptation, resilience and continued market access (Becker, 1964; Beck, 1992; Selenko et al., 2025).
- Self-employed workers directly bear both the returns and costs of training, but often face income volatility, weak social protection and limited institutional support (OECD, 2021; ILO, 2022)…

…This creates a paradox: self-employed workers are highly exposed to technological and regulatory change, yet participate less in formal training than employees (Eurofound, 2024)

The paper combines human capital and political economy perspectives to examine unequal adaptive capacities within heterogeneous forms of self-employment

THEORETICAL FRAMEWORK

Human capital incentives

Self-employed workers directly capture the returns to training but also bear its full costs. They invest when expected productivity and income gains exceed financial and opportunity costs (Becker, 1964; ILO, 2021).

Twin-transition pressures

Digitalisation creates immediate and market-driven pressures for continuous skill upgrading (Autor et al., 2003; Acemoglu & Autor, 2011).The green transition produces more gradual and institutionally mediated changes in skills and tasks (Bowen et al., 2018; Vona, 2021).

Unequal adaptive capacity

Economic insecurity, time constraints and limited institutional support may prevent workers from investing in training—even when expected returns are high (Sen, 1999; Bonvin et al., 2018; OECD, 2021).

*Training participation depends on both the **incentive to adapt** and the **capacity to invest**.*

FROM THEORETICAL MECHANISMS TO RESEARCH QUESTIONS

EXPOSURE

Are self-employed workers exposed to higher levels of digital and green transformation more likely to invest in lifelong learning activities?

From transition pressure to training investment

DIFFERENT PRESSURES

Do the digital and green transitions exert different effects on lifelong learning participation among self-employed workers?

Immediate, market-driven pressures versus gradual, institutionally mediated change

CAPACITY TO RESPOND

Does economic vulnerability limit self-employed workers' capacity to invest in lifelong learning despite digital and green transition pressures?

From incentives to unequal adaptive capacity

Exposure → Type of transition → Capacity to respond

DATA, SAMPLES AND VARIABLES

European Working Conditions Survey (EWCS) 2024 conducted by Eurofound: harmonised microdata on working conditions, occupations, skills, training, income and technological characteristics across European countries. Sample restricted to self-employed workers with complete information.

Dependent variable

Self-paid training: Dummy variable= 1 if the respondent participated in personally financed training.Proxy for autonomous human-capital investment.

Main explanatory variables

- Digital exposure: dummy identifying occupations with high exposure to digital technologies, automation, AI-related tasks and ICT-intensive processes.
- Green exposure: dummy variable obtained by matching EWCS occupational data with the OECD task-based classification of green occupations (Vona et al., 2018; Scholl, Turban & Gal, 2023), aggregated from ISCO-08 four-digit to two-digit codes. It equals 1 for workers in green-exposed occupations and 0 otherwise.
- Economic vulnerability: perceived ability to make ends meet, classified as low, medium or high vulnerability.
- High education: dummy = 1 for tertiary education, corresponding to ISCED levels 6–8.

Controls: Age, Gender, Monthly income, Sector controls, Country fixed effects

DATA, SAMPLES AND VARIABLES

Descriptive analysis

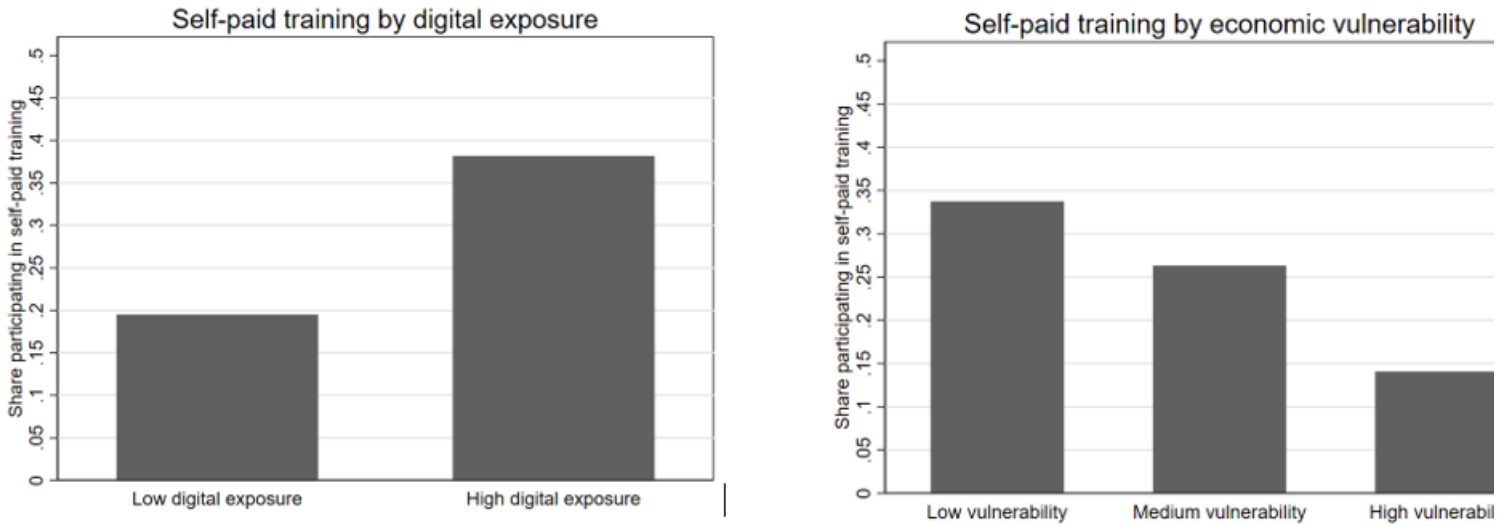

Figure 1a 1b Self-paid training by digital exposure and Self-paid training by economic vulnerability, own elaboration on EWCS 2024 data

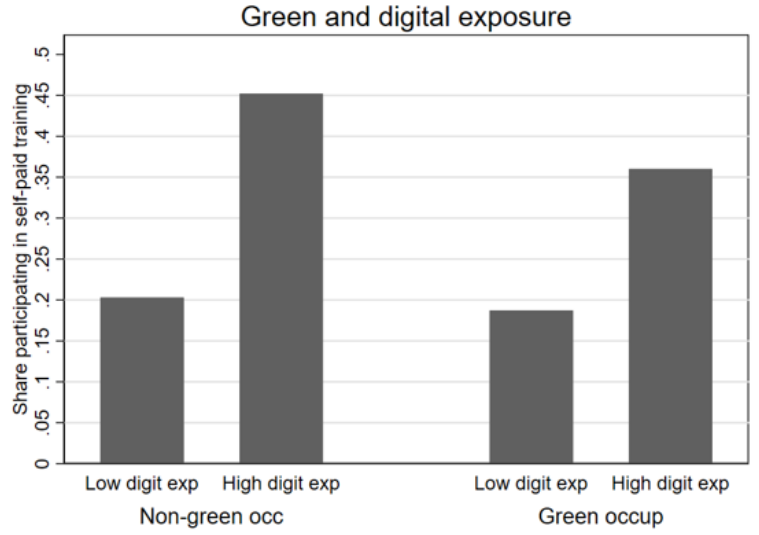

Figure 2 Green and digital exposure by self-paved training, own elaboration from EWCS 2024 data

- Digital exposure is associated with substantially higher participation in self-paid training.
- Economic vulnerability progressively reduces the capacity to invest in lifelong learning.
- Digital exposure matters across both green and non-green occupations, while green exposure shows a weaker association with training

EMPIRICAL STRATEGY

Binary logistics regression

The probability of participating in self-paid training is modelled as:

$$P(Self\text{-}paid\ training_i = 1) = f\left(Digital_i, Green_i, Vulnerability_i, Education_i, X_i, Sector_j, Country_k\right)$$

- **Model 1:** baseline effects of digital and green exposure.
- **Model 2:** adds economic vulnerability and income.
- **Model 3:** introduces interaction terms to capture heterogeneous adaptive capacity.

Estimation: sector controls and country fixed effects · robust standard errors · logit coefficients and average marginal effects (Wooldridge, 2016).

RESULTS

Table. 2 Coefficient estimated logit models

	1	2	3
	Self-paid training	Self-paid training	Self-paid training
Green occupation	0.0875	0.0857	0.108
	(0.135)	(0.137)	(0.133)
High digital exposure	0.477***	0.475***	0.510***
	(0.135)	(0.135)	(0.0957)
Green occupation # High digital exposure	0.00478	-0.0289	-.1987227
	(0.161)	(0.162)	(.1657151)
Age	-0.0250***	-0.0251***	-0.0250***
	(0.00264)	(0.00268)	(0.00268)
Female	-0.0459	-0.0306	-0.0295
	(0.0810)	(0.0824)	(0.0823)
High education	0.532***	0.492***	0.707***
	(0.0877)	(0.0890)	(0.180)
Medium vulnerability		-0.0904	-0.0893
		(0.0769)	(0.0769)
High vulnerability		-0.754***	-0.753***
		(0.149)	(0.150)
Monthly income		0.0000202	0.0000209
		(0.0000242)	(0.0000242)
High digital exposure # High education			-0.199
			(0.166)
Green occupation # High education			-0.114
			(0.188)
Observations	5849	5742	5742

Standard error in parenthesis p<0.10, ** p<0.05, *** p<0.01

Table 3. Estimated average marginal effect

	1	2	3
Green occupation	0.0140	0.0110	0.0108
	(0.0175)	(0.0178)	(0.0178)
High digital exposure	0.0773***	0.0733***	0.0718***
	(0.0135)	(0.0135)	(0.0136)
Age	-0.00392***	-0.00394***	-0.00392***
	(0.000405)	(0.000411)	(0.000410)
Female	-0.00719	-0.00479	-0.00462
	(0.0127)	(0.0129)	(0.0129)
High education	0.0887***	0.0816***	0.0898***
	(0.0154)	(0.0154)	(0.0164)
Medium vulnerability		-0.0146	-0.0145
		(0.0125)	(0.0125)
High vulnerability		-0.109***	-0.109***
		(0.0197)	(0.0197)
Monthly income		0.00000317	0.00000327
		(0.00000380)	(0.00000379)
Observations	5849	5742	5742

Standard error in parenthesis p<0.10, ** p<0.05, *** p<0.01

RESULTS

- **Digital exposure is positively associated with training participation**. Highly digitally exposed workers show a 7.2–7.7 percentage-point higher probability of self-paid training across all models

- **Higher education is associated with greater participation**. Tertiary-educated workers have an 8.2–9.0 percentage-point higher probability of self-paid training

- Severe economic vulnerability is negatively associated with training. **Highly vulnerable workers show a 10.9 percentage-point lower probability of participation in Models 2 and 3** Medium vulnerability is not statistically significant.

- Green occupational exposure is not statistically significant. The estimated marginal association is small, approximately +1.1 percentage points, and does not differ statistically from zero.

- **Training participation decreases with age.** Each additional year is associated with an approximately 0.39 percentage-point lower probability of self-paid training

- Additional results: Gender and monthly income are not statistically significant. Neither the Green × Digital interactions in Models 1–2 nor the exposure–education interactions in Model 3 are significant.

CONCLUSIONS AND DISCUSSION

- **Digital exposure is positively associated with self-paid training**, suggesting that technological change generates immediate pressures for skill adaptation.
- **Green occupational exposure shows no statistically significant association**, possibly reflecting more gradual and institutionally mediated adjustment processes.
- **Severe economic vulnerability is associated with substantially lower training participation**, limiting workers' capacity to respond to structural change.
- Lifelong learning is therefore not only a human-capital investment, but also a **capability-dependent mechanism of economic resilience**.

The need to adapt is increasing, but the capacity to respond remains unequally distributed

CONCLUSIONS AND DISCUSSION

- **Reduce training costs** through targeted subsidies and vouchers for vulnerable self-employed workers
- **Address time and income constraints** with flexible programmes and compensation for foregone earnings
- **Expand accessible training infrastructures** beyond employer-sponsored learning
- **Anticipate digital and green skill needs** through sector-specific and task-based programmes.

An inclusive twin transition requires both incentives to learn and the capacity to act.

Limitations and future research

Cross-sectional evidence does not establish strong causality. Future research should use longitudinal data and more detailed task-based measures of green exposure.

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THANK YOU FOR ATTENTION!

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