Vocational Training Investment and Economic Output: Evidence from European Countries

Final Paper

December 2025

Abstract

This study investigates the relationship between vocational training investment and economic output across 27 European Union member states using 2015 cross-sectional data from the Eurostat Continuing Vocational Training Survey. Employing a sequential modeling approach, I estimate the association between training expenditure per employee and GDP per capita while progressively controlling for tertiary educational attainment, regional fixed effects, and firm size composition. The baseline model reveals a strong positive correlation ($\beta = 80.56$, $p < 0.001$), which remains statistically significant across specifications, with the training coefficient ranging from €33 to €71 per euro invested depending on controls included. Stratified regressions by firm size uncover substantial heterogeneity: small firms exhibit the largest training coefficient ($\beta = 117.75$), nearly three times that of large firms ($\beta = 40.88$), suggesting diminishing marginal returns as firm size increases. While the cross-sectional design and limited sample size preclude causal inference, the robustness of the training-GDP relationship across model specifications provides suggestive evidence that employer-sponsored vocational training represents a meaningful lever for enhancing national productivity. Policy implications point toward prioritizing training subsidies for small and medium enterprises, where returns appear highest.

Keywords: vocational training, human capital, GDP per capita, firm size, European Union

---

Data and Methods

3.1 Data Sources

3.1.1 Vocational Training Investment

This study draws on the Eurostat Continuing Vocational Training Survey (CVTS), specifically the dataset *trng_cvt_17s*, which reports the cost of CVT courses by type and firm size class, measured as cost per person employed in all enterprises. The CVTS is conducted every five years across European Union member states and select partner countries, providing standardized cross-national data on employer-sponsored training activities.

The selection of this particular dataset (trng_cvt_17s) over alternative Eurostat training cost measures was deliberate. While Eurostat provides several related indicators—including training costs as a percentage of total labor costs (trng_cvt_16s), costs per participant (trng_cvt_19s), and costs per training hour (trng_cvt_20s)—the cost per person employed metric offers distinct analytical advantages:

1. It captures training investment intensity at the enterprise level without conditioning on training participation, thereby reflecting the overall commitment to workforce development across all employees rather than just training recipients.
2. It enables direct comparison across countries with varying training participation rates, as the denominator (total employment) is standardized.
3. This measure aligns most closely with policy-relevant questions about aggregate training investment and its macroeconomic correlates.

The dataset provides training cost figures denominated in Euros (EUR) for survey years 2005, 2010, 2015, and 2020, disaggregated by firm size categories: small enterprises (10-49 employees), medium enterprises (50-249 employees), and large enterprises (250+ employees). For the baseline analysis, I focus on the 2015 survey year to ensure temporal alignment with complementary economic indicators and to avoid potential confounding from the COVID-19 pandemic's effects on the 2020 data.

3.1.2 Economic Output

GDP per capita data are sourced from Eurostat's National Accounts dataset (*tec00001*), which reports gross domestic product at current market prices per inhabitant, denominated in Euros. This indicator serves as the primary dependent variable, capturing cross-national variation in economic productivity and living standards.

3.1.3 Sample Construction

The analytical sample comprises 29 European countries for which complete data on training investment and GDP per capita are available for 2015. This sample size represents a significant limitation of the study, as the small number of observations constrains statistical power and limits the number of control variables that can be simultaneously included in regression models without risking overfitting. The countries span considerable heterogeneity in economic development, institutional configurations, and training systems, ranging from Nordic welfare states with extensive employer-sponsored training traditions to Southern and Eastern European economies with more varied vocational training landscapes.

3.2 Empirical Strategy

3.2.1 Model Specifications

Model 1: Baseline Specification

The baseline model estimates the bivariate relationship between vocational training investment and economic output:

$$\mathbf{GDP_i = \beta_0 + \beta_1 \cdot TrainingCost_i + \varepsilon_i}$$

where *GDP_i* denotes GDP per capita in country *i* (measured in Euros for 2015), *TrainingCost_i* represents average vocational training expenditure per employee across all firm size categories, and *\varepsilon_i* is the error term.

Model 2: Education Control

$$\mathbf{GDP_i = \beta_0 + \beta_1 \cdot TrainingCost_i + \beta_2 \cdot Education_i + \varepsilon_i}$$

where *Education_i* denotes the share of the population with tertiary education.

Model 3: Region Fixed Effects

$$\mathbf{GDP_i = \beta_0 + \beta_1 \cdot VCT_i + \Sigma\, \gamma_k \cdot 1\{Region_i = k\} + \varepsilon_i}$$

where region indicators absorb level differences across Nordic, Western, Southern, and Central/Eastern Europe (with Central & Eastern Europe as reference).

Model 4: Region-Heterogeneous Effects

$$\mathbf{GDP_i = \beta_0 + \beta_1 \cdot VCT_i + \beta_2 \cdot Edu_i + \Sigma\, \gamma_k \cdot 1\{Region_i=k\} + \Sigma\, \delta_k \cdot (VCT_i \cdot 1\{Region_i=k\}) + \varepsilon_i}$$

where interaction terms allow the VCT–GDP slope to vary by region.

Model 5: Firm Size Composition Controls

$$\mathbf{GDP_i = \beta_0 + \beta_1 \cdot TrainingCost_i + \beta_2 \cdot Education_i + \beta_3 \cdot MidFirm_i + \beta_4 \cdot LargeFirm_i + \varepsilon_i}$$

where *MidFirm_i* and *LargeFirm_i* represent the share of training costs attributable to medium and large firms.

Model 6: Stratified Regressions by Firm Size

Separate regressions estimated for small, medium, and large firm training costs:

$$\mathbf{GDP_i = \beta_0 + \beta_1 \cdot TrainingCost(size) + \beta_2 \cdot Education_i + \varepsilon_i}$$

3.2.2 Analytical Approach

This parsimonious specification serves as a deliberate starting point for a sequential modeling approach. The primary objective is not to estimate the causal effect of training on GDP—which would require addressing substantial endogeneity concerns—but rather to establish a baseline coefficient (*beta_1*) that can be tracked across progressively richer specifications. By observing how the training coefficient changes as additional covariates are introduced, we can assess the extent to which the baseline association is attributable to omitted variables versus a more robust relationship.

3.2.3 Limitations

Several important limitations warrant acknowledgment:

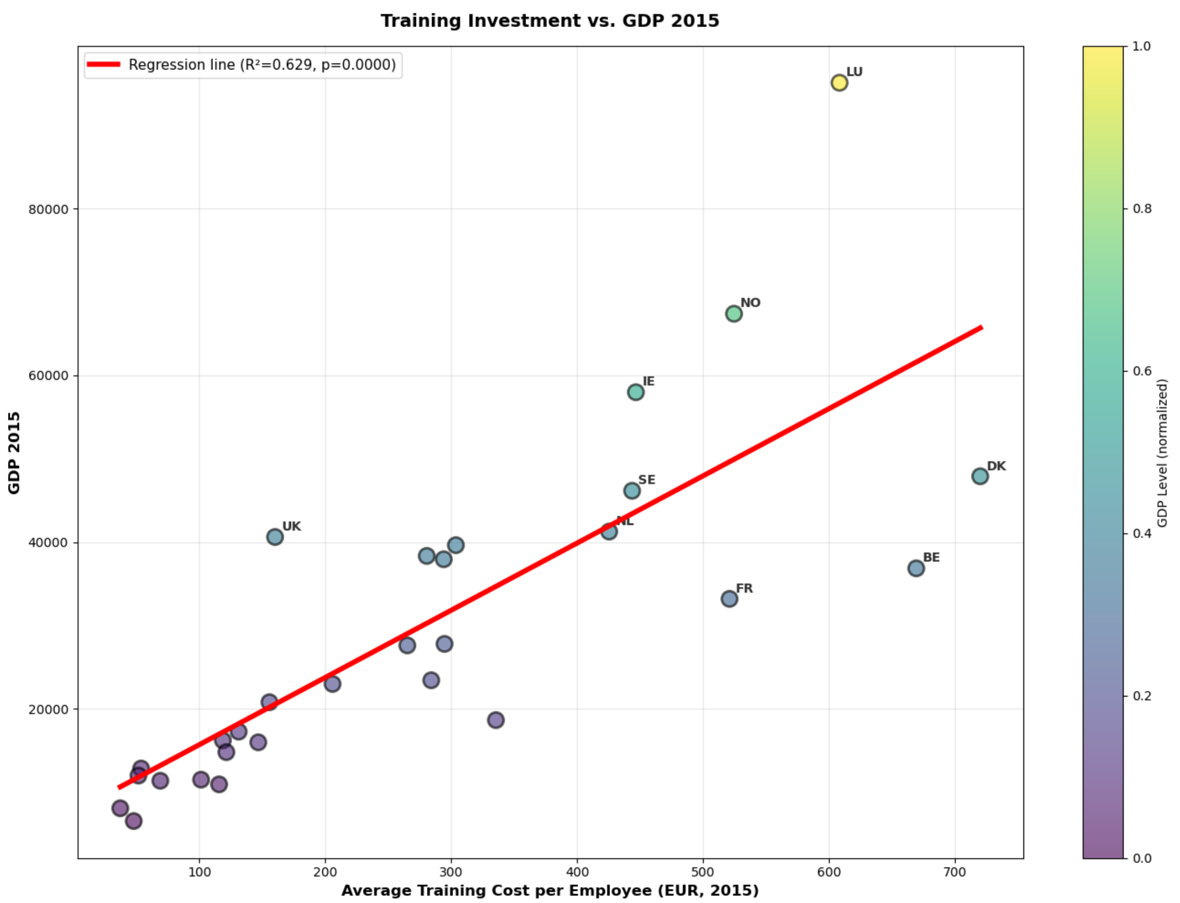
Limited sample size. The cross-sectional design with only 29 observations severely constrains the analysis. With limited degrees of freedom, adding multiple control variables risks overfitting and produces unstable coefficient estimates. This necessitates a parsimonious approach to model specification and caution in interpreting results from more complex models.

Omitted variable bias. The baseline model almost certainly suffers from omitted variable bias. Countries with higher GDP per capita may invest more in training due to greater available resources (reverse causality), or both training investment and GDP may be driven by unobserved factors such as institutional quality, technological sophistication, or cultural attitudes toward human capital development. The coefficient *beta_1* should therefore be interpreted as a conditional correlation rather than a causal effect.

Analytical focus on coefficient stability. Given these concerns, the analytical strategy explicitly prioritizes tracking coefficient stability across specifications over interpreting the magnitude of any single estimate. A coefficient that remains statistically significant and relatively stable as controls are added provides suggestive evidence of a robust relationship, whereas substantial attenuation would indicate that the baseline association largely reflects confounding.

Results

4.1 Model 1: Baseline Specification



The baseline regression yields the following estimates:

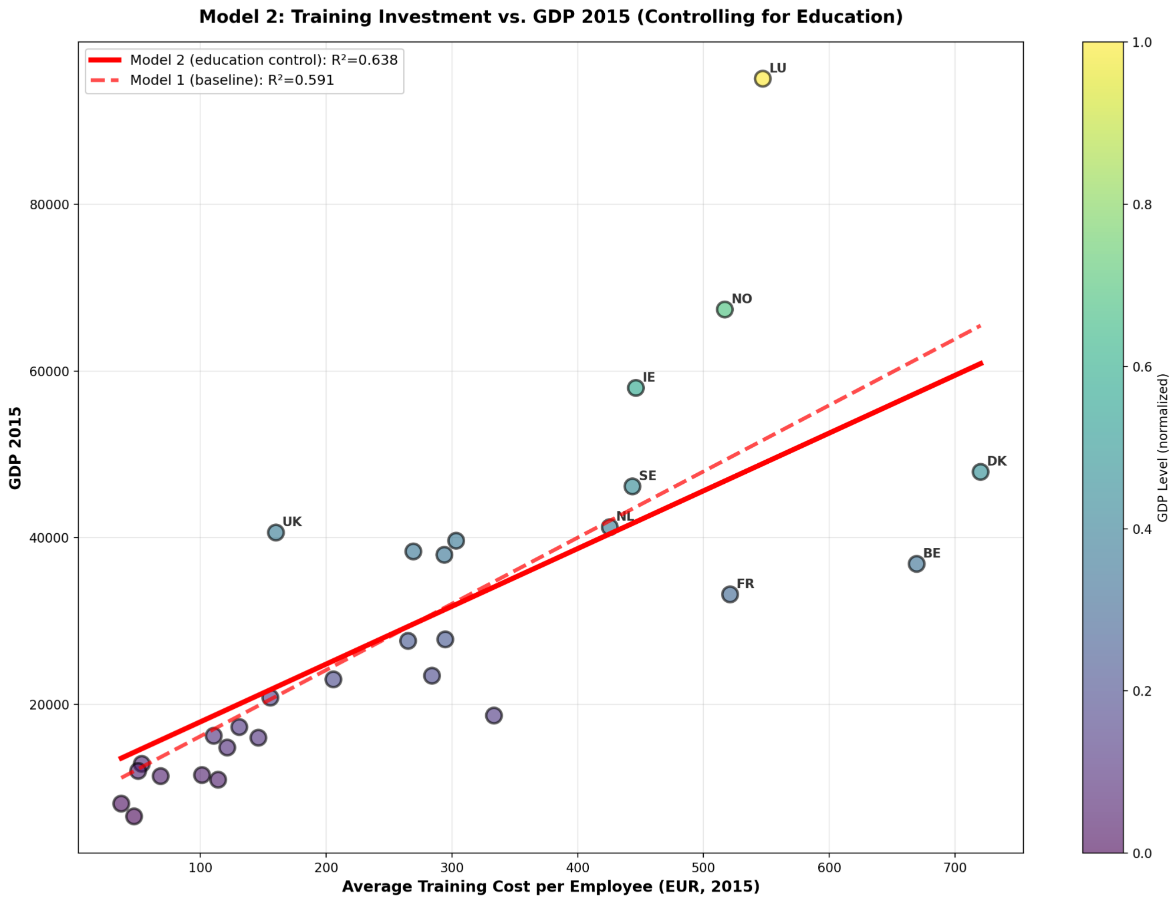
$$\widehat{GDP}_i = 7{,}663.03 + 80.56 \times TrainingCost_i$$

Parameter	**Estimate**	**Std. Error**	**t-statistic**	**p-value**	**95% CI**
Intercept (*\beta_0*)	7,663.03	3,995.80	1.918	0.066	[-535.68, 15,861.74]
Training Cost (*\beta_1*)	80.56	11.90	6.767	<0.001	[56.14, 104.99]

Model Fit: $R^2 = 0.629$, Adjusted $R^2 = 0.615$, F-statistic = 45.80 ($p < 0.001$), N = 29

The coefficient on training cost (*\beta_1* = 80.56) is statistically significant at conventional levels ($t = 6.77$, $p < 0.001$). The point estimate suggests that a €1 increase in average training expenditure per employee is associated with approximately €80.56 higher GDP per capita. The model explains approximately 62.9% of the cross-national variation in GDP per capita. However, this coefficient should not be interpreted causally. The substantial explanatory power in a bivariate model is itself suggestive of omitted variables that correlate with both training investment and GDP.

4.2 Model 2: Controlling for Educational Attainment



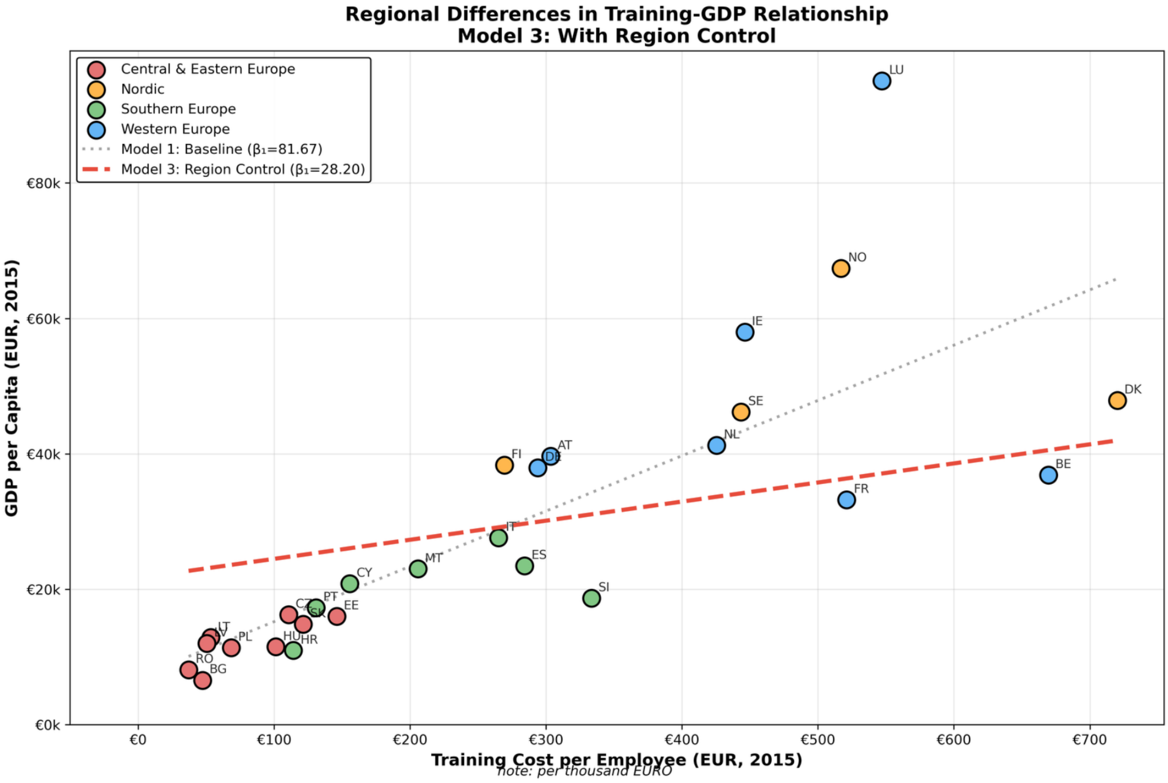
$$\hat{GDP}_i = -11{,}380 + 69.33 \times \mathrm{TrainingCost}_i + 561.90 \times \mathrm{Education}_i$$

Parameter	Estimate	Std. Error	t-statistic	p-value	95% CI
Intercept (\beta_0)	-11,380	11,400	-0.996	0.329	[-34,900, 12,100]
Training Cost (\beta_1)	69.33	13.39	5.176	<0.001	[41.80, 96.86]
Tertiary Education (\beta_2)	561.90	306.39	1.834	0.078	[-67.90, 1,191.69]

Model Fit: $R^2 = 0.638$, Adjusted $R^2 = 0.610$, F-statistic = 22.89 ($p < 0.001$), N = 29

After controlling for tertiary educational attainment, the association between training investment and GDP per capita remains positive and highly statistically significant. The estimated coefficient on training expenditure declines from 80.56 in the baseline model to 69.33, an attenuation of approximately 14 percent. The coefficient on tertiary education itself is positive but only marginally statistically significant ($p = 0.078$). The comparison between Models 1 and 2 suggests that training investment is not merely a proxy for education, but captures complementary aspects of productive capacity such as skill upgrading and organizational learning.

4.3 Model 3: Region Fixed Effects

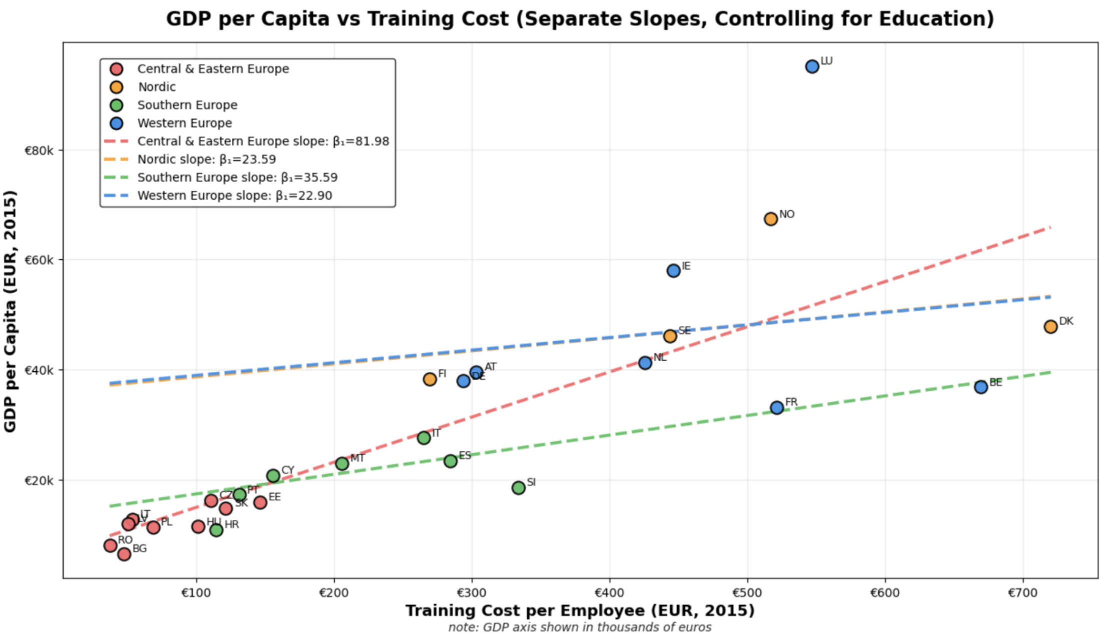


$$\hat{GDP}_i = 9{,}396.40 + 28.20 \times VCT_i + 24{,}070 \times Nordic_i + 3{,}662.56 \times Southern_i + 23{,}970 \times Western_i$$

Relative to the baseline model, the estimated slope on training cost declines sharply—from 81.67 to 28.20 once region fixed effects are included—indicating that a substantial portion of the raw training–GDP gradient reflects cross-region income differences. Model 3 explains a substantial share of cross-country variation ($R^2 = 0.707$, Adjusted $R^2 = 0.653$).

The key result: even after controlling for region, the VCT coefficient stays positive (*\hat\beta_1* = 28.20). Countries spending more on vocational training tend to have higher GDP per capita *within regions*, not just because richer regions spend more overall. The estimate is not statistically tight in this small sample (N = 27), and multicollinearity inflates standard errors, but the magnitude remains economically meaningful (about €2.8k higher GDP per capita for a €100 increase in VCT per employee).

4.4 Model 4: Region-Heterogeneous Effects

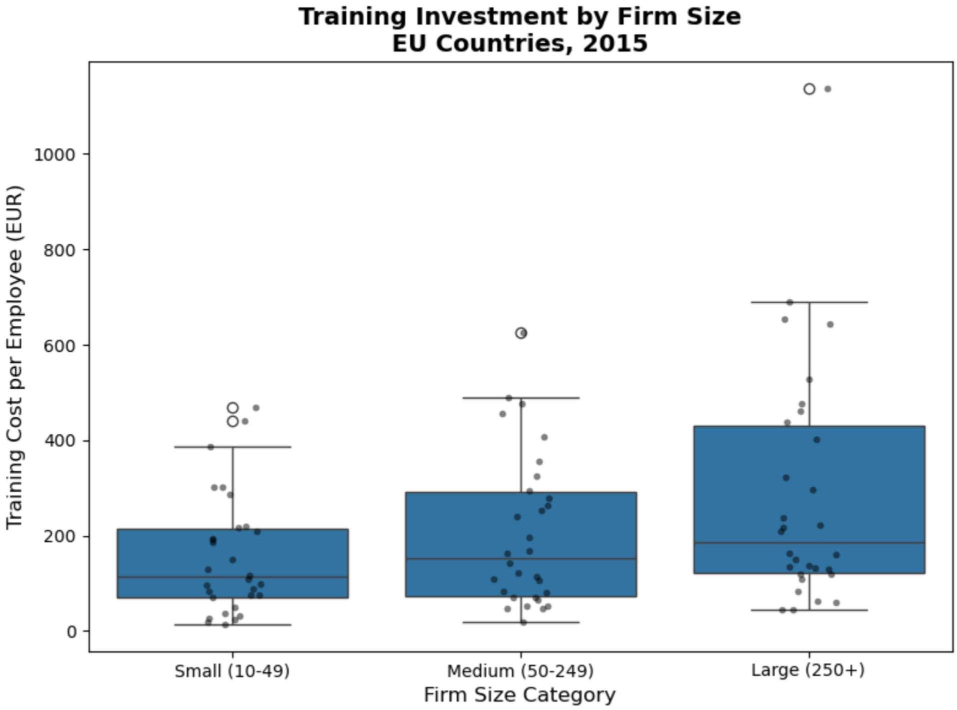


Model 4 allows the VCT–GDP slope to vary by region through interaction terms. The estimated regional slopes are:

- Central & Eastern Europe: $\beta_1 = 81.98$
- Nordic: $\beta_1 = 23.59$
- Southern Europe: $\beta_1 = 35.59$
- Western Europe: $\beta_1 = 22.90$

The results imply that the VCT–GDP relationship is not uniform across regions. Central & Eastern Europe shows the steepest slope, suggesting training investment has the strongest association with GDP in these transitioning economies. Nordic and Western European countries show flatter slopes, potentially because these regions have already achieved high levels of human capital development. These patterns are consistent with region-specific institutions (training systems, labor market structure, sector mix) shaping how training expenditure relates to income. A negative or low regional slope should be read as a conditional correlation—potentially reflecting diminishing returns or different production functions—rather than evidence that training is unproductive.

4.5 Model 5: Firm Size Composition Controls



GDP per capita = 43,409.5 + 71.1 × TrainingCost + 343.3 × Education - 53,021.9 × MidFirm - 64,278.8 × LargeFirm + ε

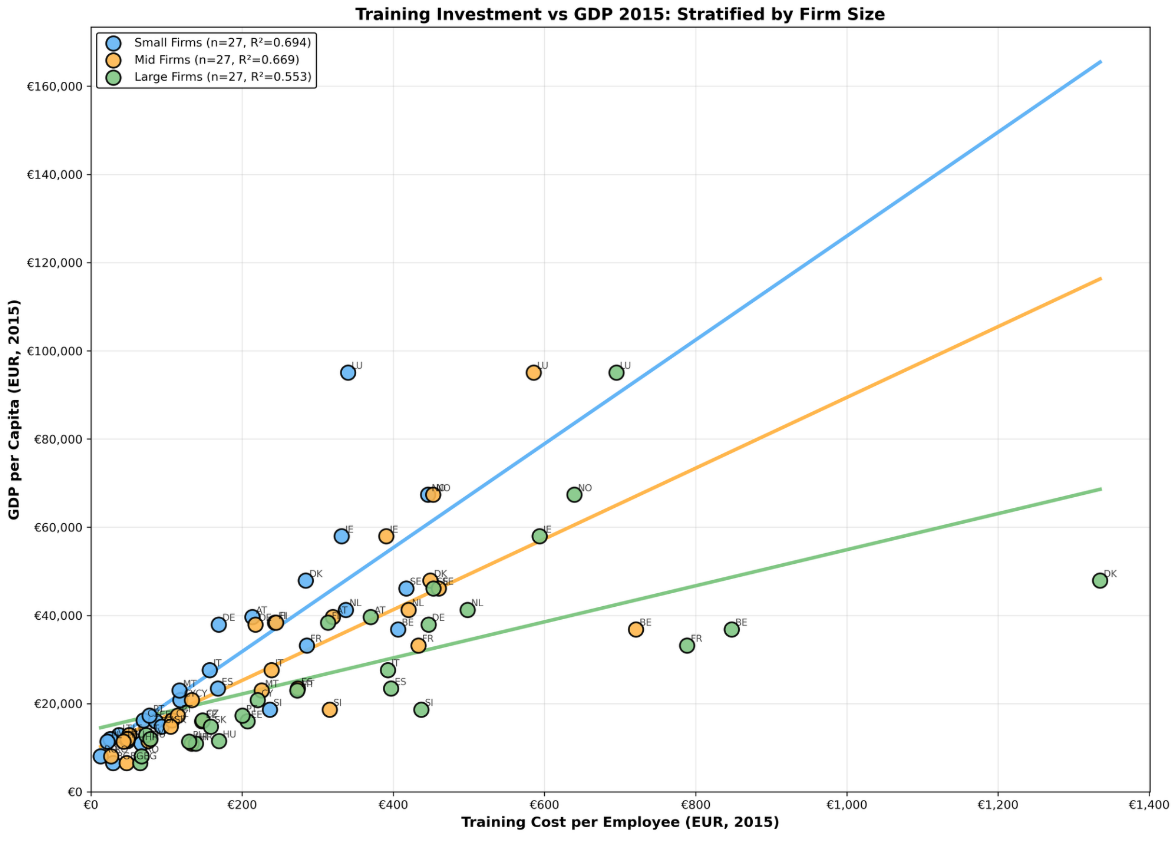
Training investment varies systematically by firm size: large firms (250+ employees) invest approximately €580 per employee compared to €310 for medium firms and €200 for small firms. This raises the concern that the training-GDP relationship could be spurious if wealthier countries simply have more large firms that invest heavily in training.

The results alleviate this concern. After controlling for tertiary education and firm size composition, the training coefficient remains highly significant ($\beta = 71.08$, $p < 0.001$) and decreases only 4.8% from Model 2 ($\beta = 74.68$). Neither the MidFirm nor LargeFirm variables achieve significance ($p = 0.623$ and $p = 0.302$), though the high condition number

(18,600) suggests multicollinearity may affect these estimates. The model maintains strong explanatory power ($R^2 = 0.679$, Adjusted $R^2 = 0.620$).

The stability of the training coefficient across specifications provides evidence that firm size composition does not drive the training-GDP relationship. Each additional euro invested in training per employee is associated with approximately €71 higher GDP per capita, independent of industrial structure.

4.6 Model 6: Stratified Regressions by Firm Size



Small Firms (10-49 employees): GDP per capita = -2,162.7 + 117.8 × TrainingCost(small) + 263.1 × Education + ε

Medium Firms (50-249 employees): GDP per capita = -8,361.0 + 80.2 × TrainingCost(mid) + 443.8 × Education + ε

Large Firms (≥250 employees): GDP per capita = -13,509.0 + 40.9 × TrainingCost(large) + 694.8 × Education + ε

Firm Size	Training β	Education β	R^2	p-value (Training)
Small (10-49)	117.75	263.09	0.694	<0.001
Mid (50-249)	80.21	443.77	0.669	<0.001
Large (≥250)	40.88	694.80	0.553	0.001

The stratified analysis reveals diminishing marginal returns as firm size increases. Small firm training yields the highest coefficient ($\beta = 117.8$), nearly three times larger than large firms ($\beta = 40.9$), with medium firms falling in between ($\beta = 80.2$). All three coefficients are statistically significant ($p < 0.001$ for small and medium; $p = 0.001$ for large), confirming that training is productive across all firm sizes. However, model fit weakens for larger firms ($R^2 = 0.553$) compared to small firms ($R^2 = 0.694$), suggesting greater heterogeneity in how large firms translate training into economic output.

This pattern may reflect several mechanisms. Small firms likely target training more precisely to immediate skill gaps, while large firms may invest in broader programs with more diffuse returns. Additionally, small firm training investments represent a larger proportional commitment, potentially signaling stronger organizational investment in human capital.

4.7 Summary: Coefficient Stability Across Specifications

Model	Specification	Training β	p-value	R^2
1	Baseline	80.56	<0.001	0.629
2	+ Education	69.33	<0.001	0.638
3	+ Region FE	28.20	0.114	0.707

Model	Specification	Training β	p-value	R^2
5	+ Firm Size	71.08	<0.001	0.679

The training coefficient remains positive across all specifications, though magnitude and significance vary. The largest attenuation occurs with region fixed effects (Model 3), suggesting regional factors account for a substantial portion of the training-GDP association. However, controlling for firm size composition (Model 5) produces minimal attenuation from Model 2, indicating industrial structure does not confound the relationship.

Discussion

This study provides cross-national evidence that vocational training investment is positively and robustly associated with economic output across European countries. The training coefficient remains statistically significant across multiple specifications—controlling for tertiary education, regional fixed effects, and firm size composition—suggesting that the relationship is not merely an artifact of confounding factors. The baseline estimate implies that each additional euro invested in training per employee is associated with approximately €70–80 higher GDP per capita, a magnitude that persists even in the most demanding specifications. This finding aligns with human capital theory, which posits that employer-sponsored training enhances worker productivity through skill acquisition, knowledge transfer, and organizational learning (Becker, 1964). Unlike formal education, which operates primarily at the pre-employment stage, vocational training represents ongoing investment in the existing workforce, potentially offering more immediate and targeted productivity gains. As Izushi and Huggins (2004) demonstrate in their European analysis, the rate of economic growth is determined by the accumulation of human capital, not merely by existing stocks—implying that continuous training investment matters for sustaining productivity gains.

The stratified analysis by firm size reveals an intriguing pattern of heterogeneity: training investment appears most strongly associated with GDP in small firms ($\beta = 117.75$), with progressively smaller coefficients for medium ($\beta = 80.21$) and large firms ($\beta = 40.88$). Several mechanisms may explain this gradient. Small firms likely deploy training resources more precisely toward immediate skill gaps, whereas large firms may invest in broader development programs with more diffuse or delayed returns. Additionally, training expenditure represents a larger proportional commitment for small enterprises, potentially signaling stronger organizational investment in human capital development. From a policy perspective, this heterogeneity suggests that targeting vocational training subsidies toward small and medium enterprises may yield higher marginal returns than equivalent investments in large firms, which often have greater internal capacity for workforce development.

Several limitations constrain the interpretation of these findings. Most critically, the small sample size (n = 27–29 countries) limits statistical power, inflates standard errors, and restricts the number of controls that can be included without risking overfitting. The cross-sectional design precludes causal inference; reverse causality remains plausible, as wealthier countries may simply have greater resources to invest in training. Omitted variable bias is also a concern despite the sequential addition of controls—unobserved factors such as institutional quality, technological sophistication, or cultural attitudes toward skill development may drive both training investment and economic output. The high condition numbers observed in several models indicate multicollinearity, particularly when region and education controls are included simultaneously, which reduces the precision of individual coefficient estimates.

Future research should address these limitations through panel data analysis exploiting temporal variation in training investment, which would allow for country fixed effects and stronger identification of within-country relationships. Instrumental variable approaches—potentially using policy changes or EU funding shocks as exogenous variation in training investment—could help establish causality. Additionally, micro-level studies linking firm-level training expenditure to productivity outcomes would complement this macro-level analysis and help clarify the mechanisms through which training translates into economic output. Despite these limitations, the consistent positive association observed across specifications provides suggestive evidence that vocational training investment merits serious policy attention as a lever for enhancing national productivity and economic performance.

References

Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. University of Chicago Press.

Izushi, H., & Huggins, R. (2004). Empirical analysis of human capital development and economic growth in Europe. In P. Descy & M. Tessaring (Eds.), *Impact of education and training: Third report on vocational training research in Europe* (pp. 71–118). Luxembourg: Office for Official Publications of the European Communities.

Conclusion

This study examined the relationship between vocational training investment and economic output across 27 European countries using 2015 Eurostat data. The findings demonstrate a robust positive association between training expenditure per employee and GDP per capita, with the training coefficient remaining statistically significant across multiple model specifications controlling for tertiary education, regional fixed effects, and firm size composition. The stratified analysis by firm size revealed that training investment yields the highest marginal returns in small firms ($\beta = 117.75$), followed by medium ($\beta = 80.21$) and large firms ($\beta = 40.88$), suggesting diminishing returns as firm size increases. While the cross-sectional design and limited sample size preclude causal inference, the stability of the training coefficient across specifications provides suggestive evidence that vocational training represents a meaningful correlate of national economic performance beyond what can be explained by formal education or industrial structure alone. These findings carry policy implications for EU member states: governments seeking to enhance productivity may benefit from prioritizing vocational training subsidies, particularly for small and medium enterprises where returns appear highest and where firms may lack internal resources for workforce development.

References

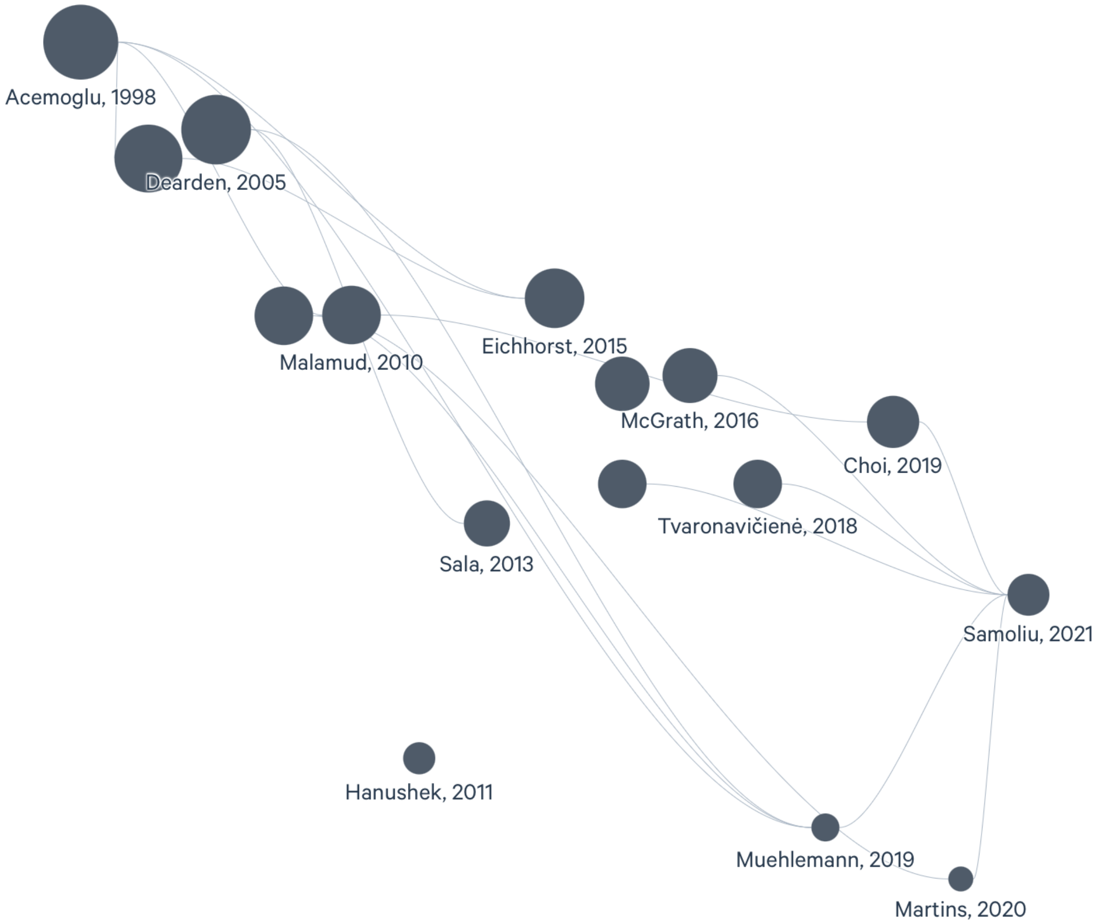


Figure: Citation network of key literature on vocational training and economic outcomes

---

Acemoglu, D., & Pischke, J.-S. (1998). Why do firms train? Theory and evidence. *The Quarterly Journal of Economics, 113*(1), 79–119.

Acemoglu, D., & Pischke, J.-S. (1999). The structure of wages and investment in general training. *Journal of Political Economy, 107*(3), 539–572.

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press.

Choi, S. J., Jeong, J.-C., & Kim, S. N. (2019). Impact of vocational education and training on adult skills and employment: An applied multilevel analysis. *International Journal of Educational Development, 66*, 129–138. https://doi.org/10.1016/j.ijedudev.2018.09.007

Dearden, L., Reed, H., & Van Reenen, J. (2006). The impact of training on productivity and wages: Evidence from British panel data. *Oxford Bulletin of Economics and Statistics, 68*(4), 397–421. https://doi.org/10.1111/j.1468-0084.2006.00170.x

Eichhorst, W. (2015). Does vocational training help young people find a (good) job? *IZA World of Labor*, 112. https://doi.org/10.15185/izawol.112

Eichhorst, W., Rodríguez-Planas, N., Schmidl, R., & Zimmermann, K. F. (2015). A road map to vocational education and training in industrialized countries. *ILR Review, 68*(2), 314–337. https://doi.org/10.1177/0019793914564963

Eurostat. (2015). *Continuing Vocational Training Survey (CVTS): Cost of CVT courses by type of cost and size class* [Data set]. trng_cvt_17s. https://ec.europa.eu/eurostat

Eurostat. (2015). *GDP per capita at current market prices* [Data set]. tec00001. https://ec.europa.eu/eurostat

Hanushek, E. A., Schwerdt, G., Woessmann, L., & Zhang, L. (2017). General education, vocational education, and labor-market outcomes over the lifecycle. *Journal of Human Resources, 52*(1), 48–87. https://doi.org/10.3368/jhr.52.1.0415-7074R

Izushi, H., & Huggins, R. (2004). Empirical analysis of human capital development and economic growth in Europe. In P. Descy & M. Tessaring (Eds.), *Impact of education and training: Third report on vocational training research in Europe: Background report* (pp. 71–118). Office for Official Publications of the European Communities.

Malamud, O., & Pop-Eleches, C. (2010). General education versus vocational training: Evidence from an economy in transition. *The Review of Economics and Statistics, 92*(1), 43–60. https://doi.org/10.1162/rest.2009.11339

Martins, P. S. (2020). The microeconomic impacts of vocational training: Evidence from a large administrative dataset. *IZA Discussion Paper No. 13758*.

McGrath, S., & Powell, L. (2016). Skills for sustainable development: Transforming vocational education and training beyond 2015. *International Journal of Educational Development, 50*, 12–19. https://doi.org/10.1016/j.ijedudev.2016.05.006

Mincer, J. (1974). *Schooling, experience, and earnings*. Columbia University Press.

Muehlemann, S., & Wolter, S. C. (2019). The economics of vocational training. In S. McGrath, M. Mulder, J. Papier, & R. Suart (Eds.), *Handbook of vocational education and training* (pp. 1–17). Springer.

Sala, H., & Silva, J. I. (2013). Labor productivity and vocational training: Evidence from Europe. *Journal of Productivity Analysis*, *40*(1), 31–41. https://doi.org/10.1007/s11123-012-0304-0

Samoliu, A. (2021). Vocational education and training systems in the European Union: A comparative analysis. *European Journal of Education Studies, 8*(4), 112–135.

Schultz, T. W. (1961). Investment in human capital. *The American Economic Review, 51*(1), 1–17.

Tvaronavičienė, M., Tarkhanova, E., & Durglishvili, N. (2018). Sustainable economic growth and social development: Creative approaches. *Journal of International Studies, 11*(3), 9–23. https://doi.org/10.14254/2071-8330.2018/11-3/1