



(RESEARCH ARTICLE)



DIGITAL CONNECTIVITY AND EXPORT PERFORMANCE: A PANEL-DATA ANALYSIS OF OECD ECONOMIES, 2010–2024

Ahmet Münir Gökmen *

Istanbul Kent University, Vocational School, E-Commerce and Marketing Programme, Istanbul, Türkiye.

* Corresponding Author; Email: ahmetmunir.gokmen@kent.edu.tr

ORCID Details

Ahmet Münir Gökmen: <https://orcid.org/0000-0003-3659-2741>

World Journal of Advanced Research and Reviews, 2026, 32(01), 1786–1792

Publication history: Received on 18 September 2026; revised on 25 October 2026; accepted on 27 October 2026

Article DOI: <https://doi.org/10.30574/wjarr.2026.32.1.2745>

Copyright © 2026 Author(s) retain the copyright of this article. This article is published under the terms of the Creative Commons Attribution License 4.0

ABSTRACT

This study examines the relationship between digital connectivity and real export performance in 38 OECD economies during 2010–2024, extending the marketing information systems and distribution-channel framework in Gökmen (2000). World Development Indicators provide 570 potential country–year records and 569 complete cases for country- and year-fixed-effects estimation. In the joint model, internet use ($\beta = -0.00080$, $p = 0.692$) and fixed-broadband subscriptions ($\beta = 0.00325$, $p = 0.371$) are not statistically significant once income, foreign direct investment (FDI), population and fixed effects are included. GDP per capita has a positive association with exports. Connectivity findings remain statistically insignificant after winsorizing FDI, excluding extreme FDI observations, excluding Luxembourg and omitting 2020–2021. In contrast, the negative FDI coefficient loses statistical significance when Luxembourg is excluded. The results distinguish national access to digital connectivity from firm-level marketing information capabilities and provide descriptive associations rather than causal effects. An alternative dependent-variable specification using exports of goods and services as a percentage of GDP also finds insignificant internet ($\beta = -0.0261$, $p = 0.794$) and broadband ($\beta = 0.1172$, $p = 0.654$) coefficients ($N = 569$). Thus, the central inference holds for both real export levels and export intensity, although the models identify associations rather than causal relationships.

Keywords: Digital Connectivity; Export Performance; OECD; Marketing Information Systems; International Distribution; Panel Data

1 INTRODUCTION

International distribution decisions depend on information quality, channel coordination, and the ability to identify and serve customers in external markets. Marketing information systems facilitate environmental scanning, demand forecasting, and communication with intermediaries; national digital networks may reduce search and coordination costs. Yet connectivity alone does not establish whether firms have effective data, logistics, or partner-management capabilities. Early empirical studies found associations between internet diffusion and trade, with results varying by sample and development level [3,4]. Digital-trade policy research further emphasizes skills, cross-border regulation, services, and interoperable systems [5].

The present article develops a new country-level empirical extension of the conceptual framework in Gökmen's dissertation, *International Distribution Strategies Based on Marketing Information Systems* (2000) [1]. The historical source emphasizes the design of channel structure, supplier–distributor communication, joint market planning and performance evaluation. We focus on a narrower and testable question: are national measures of digital connectivity associated with real export performance after accounting for country characteristics and common annual shocks?

This study tests whether changes in national connectivity indicators are independently associated with changes in real exports in a retrospective cohort of OECD economies. Its contribution is a contemporary macroeconomic test motivated by the historical channel-management framework, not a direct test of enterprise marketing information systems. In particular, the OECD-led Handbook on Measuring Digital Trade differentiates digital ordering and digital delivery from generic internet access, underscoring the distinction between our explanatory indicators and the underlying activities of interest [6]. The statistical relationships reported below are conditional associations, not identified causal effects.

2 CONCEPTUAL BACKGROUND AND HYPOTHESES

Distribution channel design matches customer-service requirements, geographic coverage, and the capacities of channel partners. Information systems can support market intelligence, forecasting, lead management, partner communication, and service quality. Gökmen's original thesis [1] develops these ideas particularly in Chapters 3 and 5–7. National internet use and broadband subscriptions, however, are proxies for connectivity conditions, not observations of these organizational mechanisms. Freund and Weinhold [3] found positive internet–trade relationships in an earlier era, while Clarke and Wallsten [4] highlighted heterogeneous effects across income groups. Multilateral research emphasizes complementary skills, regulation, and digital-business capabilities [5,6]. Thus the direction and significance of within-country relationships in an OECD panel are empirical questions rather than foregone conclusions.

H1. Internet penetration is positively associated with real export performance, conditional on controls and fixed effects.

H2. Fixed-broadband subscriptions are positively associated with real export performance, conditional on controls and fixed effects.

H3. The individual connectivity coefficients may change when both indicators are included because they share substantial variation.

Platform-based international trade provides an additional mechanism distinct from access infrastructure. Lendle et al. [7] compare transactions on eBay with conventional international trade and report a substantially smaller distance-related trade penalty for the platform, attributing the difference partly to reduced search costs. Their transaction-level evidence concerns platform facilitation and cannot be directly extrapolated to annual, country-level measures of internet use. This supports treating information-system quality and digital intermediation as mechanisms outside the scope of the present aggregate indicators.

3 MATERIALS AND METHODS

3.1 Sample and source

The sample covers the 38 countries that are OECD members in 2026 for each year 2010–2024, providing up to 570 country–year observations before missing-data restrictions. This is a retrospective fixed-country cohort, not a historical OECD-membership panel. Data are drawn from the World Bank World Development Indicators API (version 2); the primary WDI extraction was performed on 19 October 2026 (00:54:57, local R session time). Data-source definitions follow the WDI public database [2].

3.2 Variables

Real exports of goods and services in constant 2015 US dollars (NE.EXP.GNFS.KD) are log transformed. Internet penetration is individuals using the internet as a percentage of population (IT.NET.USER.ZS). Fixed broadband subscriptions per 100 people (IT.NET.BBND.P2) measure complementary connectivity. Control variables comprise log real GDP per capita (NY.GDP.PCAP.KD), inward foreign direct investment, net inflows as a percentage of GDP (BX.KLT.DINV.WD.GD.ZS), and log population (SP.POP.TOTL). Raw and complete-case datasets are saved separately. As an outcome robustness check, exports of goods and services as a percentage of GDP (WDI indicator NE.EXP.GNFS.ZS) is modeled in levels (percentage points) with the same covariates and fixed effects. Unlike the main log-level outcome, this ratio measures trade intensity, and its coefficients should be interpreted in percentage points.

3.3 Econometric specification

The dependent variable is the natural logarithm of real exports. We estimate $\ln(\text{Exports}_{it}) = \beta_1 \text{Internet}_{it} + \beta_2 \text{Broadband}_{it} + \gamma'X_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$, where X includes logged real GDP per capita, net FDI inflows as a percent of GDP, and logged population. Country effects α_i absorb time-invariant country characteristics, while year effects λ_t capture

shocks common to all economies. Standard errors are clustered at the country level. Three models enter the connectivity variables individually and jointly on a common complete-case sample; a one-year lag specification and outlier/period exclusions test sensitivity. This is not a causal identification design. Because export volumes and GDP per capita may be jointly determined, inclusion of income can absorb economically meaningful variation and may constitute an overcontrol under some causal structures.

3.4 Interpretation

GDP and export volumes are jointly determined, and digital investment may respond to trade growth. The estimates are descriptive conditional associations; even lagged specifications do not establish exogeneity or causal identification.

4 RESULTS

The initial balanced cohort contains 570 country-year records from 38 countries over 2010–2024. Broadband subscriptions are missing for one record; all other model inputs have full coverage, yielding 569 complete cases across all 38 countries. The descriptive statistics, bivariate relationships, and main models are presented in Tables 1–4. Internet access and broadband subscriptions are positively correlated with real exports in bivariate comparisons ($r = 0.186$ and 0.364 , respectively). However, in the separate and joint country-and-year fixed-effects models, neither variable is statistically significant at the 5% level. The combined model has within- $R^2 = 0.56734$. The control variable $\ln(\text{GDP per capita})$ is consistently positive and statistically significant; FDI inflows as a share of GDP are negatively associated with real exports, and this estimate is sensitive to influential FDI observations. Population is not significant in the joint model. The one-year lag model ($N = 532$) again provides no significant relationship for internet or broadband penetration. These are conditional within-panel associations, not evidence of a causal effect. Additional FDI sensitivity estimates (Table 6) show that internet and broadband coefficients remain statistically insignificant across all specifications. The negative FDI association is not robust to excluding Luxembourg, where several unusually large FDI/GDP observations occur. These sensitivity estimates were independently reproduced using OLS with country and year indicator variables and country-clustered covariance; minor differences in p-values relative to the original R fixest output reflect small-sample degrees-of-freedom conventions. Table 7 reports the alternative export-intensity specification for the same 569 observations across 38 countries. Neither internet penetration ($\beta = -0.0261$, $SE = 0.0994$, $p = 0.794$) nor fixed-broadband subscriptions ($\beta = 0.1172$, $SE = 0.2596$, $p = 0.654$) is statistically significant. The model has within- $R^2 = 0.05279$. The FDI/GDP coefficient is negative and statistically significant ($\beta = -0.0367$, $p < 0.001$), but should be considered exploratory in view of the sensitivity of the FDI estimate in other specifications.

Table 1: World Development Indicators data availability (2010–2024)

Measure	Nonmissing	Missing
Real exports	570	0
Internet users (%)	570	0
Fixed broadband subscriptions per 100	569	1
Real GDP per capita	570	0
FDI inflows (% GDP)	570	0
Population	570	0

Table 2: Descriptive statistics

Variable	N	Mean	SD	Min	Max
$\ln_exports$	570	25.868	1.318	22.692	28.594
internet	570	82.543	13.232	31.050	99.769
broadband	569	31.141	9.242	5.903	48.925
$\ln_gdp_pc$	570	10.304	0.677	8.559	11.616
fdi	570	3.128	22.159	-376.057	234.311
$\ln_population$	570	16.390	1.513	12.670	19.644

Table 3: Selected Pearson correlations (complete-case data)

Variable	1	2	3	4	5	6
1. ln_exports	1.000	—	—	—	—	—
2. internet	0.186	1.000	—	—	—	—
3. broadband	0.364	0.782	1.000	—	—	—
4. ln_gdp_pc	0.413	0.685	0.730	1.000	—	—
5. fdi	-0.026	-0.034	-0.049	-0.032	1.000	—
6. ln_population	0.772	-0.253	-0.101	-0.154	-0.019	1.000

Table 4: Two-way fixed-effects models for logged real exports

Predictor	Internet model	Broadband model	Joint model
internet	-0.00041 (0.00196); p=0.836	—	-0.00080 (0.00200); p=0.692
broadband	—	0.00249 (0.00353); p=0.484	0.00325 (0.00358); p=0.371
ln_gdp_pc	1.11616 (0.20500); p<0.001	1.11772 (0.18875); p<0.001	1.13731 (0.20395); p<0.001
fdi	-0.00032 (0.00010); p=0.003	-0.00033 (0.00011); p=0.004	-0.00032 (0.00010); p=0.003
ln_population	0.01809 (0.30176); p=0.953	0.05738 (0.29917); p=0.849	0.06776 (0.29487); p=0.820
N	569	569	569
Within R ²	0.56378	0.56566	0.56734

Table 5: One-year lag robustness model

Predictor	Estimate	Clustered SE
Lagged internet	-0.0011	0.0019
Lagged broadband	0.0016	0.0035
ln GDP per capita	1.208	0.1961
ln population	0.1537	0.2945
Observations	532	
Within R ²	0.57354	

Note: Country and year fixed effects are included in all models; standard errors are clustered by country. The lag specification omits FDI. No connectivity predictor is significant at the 5% level.

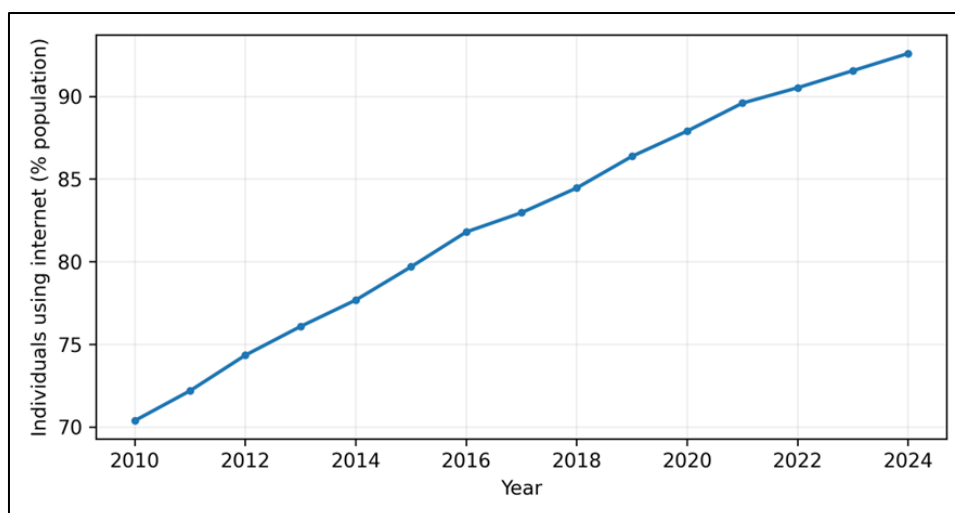


Figure 1: Unweighted OECD average internet penetration, 2010–2024 (World Bank WDI).

Table 6: Country- and year-fixed-effects sensitivity analysis (clustered by country)

Specification	N	Internet p	Broadband p	FDI p	FDI β
Baseline	569	0.699	0.382	0.002	−0.00032
FDI winsorized 1–99%	569	0.720	0.378	0.010	−0.00087
$ FDI/GDP \leq 50\%$	560	0.741	0.344	0.025	−0.00091
Exclude Luxembourg	554	0.812	0.337	0.111	−0.00061
Exclude 2020–2021	493	0.699	0.376	<0.001	−0.00032

Note: Values are independently reproduced in Python/statsmodels; the baseline coefficient estimates match the supplied R output, while inferential p-values may differ slightly because of software small-sample adjustments. FDI is net inflows (% GDP). All models include GDP per capita, population, internet, broadband, country fixed effects and year fixed effects.

Table 7: Alternative outcome: exports of goods and services (% GDP), two-way fixed effects

Predictor	Coefficient	Country-clustered SE (p-value)
Internet penetration	−0.0261	0.0994 (0.794)
Fixed-broadband subscriptions	0.1172	0.2596 (0.654)
ln GDP per capita	12.8319	16.5518 (0.443)
FDI, net inflows (% GDP)	−0.0367	0.0060 (<0.001)
ln population	9.8457	30.3902 (0.748)
Observations	569	
Countries	38	
Country and year fixed effects	Yes	
Overall R^2	0.98231	
Within R^2	0.05279	

Note: The dependent variable is export intensity (percentage of GDP), not log real exports. Standard errors are clustered by country. Data: World Bank WDI, retrieved 20 October 2026 (01:03 local run time).

5 DISCUSSION

The central finding is a contrast between positive bivariate correlations and statistically insignificant conditional coefficients for internet and broadband penetration. The unadjusted correlations with logged real exports are 0.186 and 0.364, respectively; internet and broadband themselves correlate at 0.782. Common development trends and between-country differences may therefore account for some of the raw associations. With country and year fixed effects and macroeconomic controls, the estimated connectivity coefficients are imprecise and cannot establish an independent positive association. This result does not prove that the true relationship is exactly zero. It differs in sample, period, outcome, and identification strategy from the earlier internet–trade literature [3,4]. The robustness checks are useful but limited. Winsorizing FDI, dropping extreme FDI shares, excluding Luxembourg, and omitting 2020–2021 preserve the lack of conventional statistical significance of the connectivity coefficients. By contrast, the initially negative FDI coefficient is not significant after excluding Luxembourg, so it is sample-sensitive rather than a stable explanatory finding. Fixed-broadband subscriptions per 100 people do not measure connection speeds, digital integration, e-commerce participation, digital ordering, or the quality of distribution information. Aggregate real exports include digitally and nondigitally traded goods and services; measurement guidance recommends separating these phenomena when possible [6]. Furthermore, an OECD sample has narrower infrastructure variation than a global sample, and contemporaneous income controls and reciprocal trade–technology relationships prevent causal conclusions. We recommend follow-up analysis with trade intensity and firm-level measures rather than interpreting nonsignificance as evidence against digital channel management. The alternative export-intensity specification (Table 7) provides a second operationalization of export performance and again yields imprecise connectivity coefficients; it does not establish equivalence to zero effects. Its low within- R^2 (0.05279) also indicates that the explanatory variables account for little of the remaining within-country variation in the export-to-GDP ratio once the two sets of fixed effects are removed. Because the export-to-GDP ratio and income controls can be mechanically and economically related, it should be treated as a specification check rather than causal identification. Statistical insignificance should not be interpreted as a statistically demonstrated zero effect; confidence intervals, statistical power, and potential overcontrol of GDP per capita limit such claims.

6 CONCLUSION

Using 569 country–year observations for 38 OECD economies over 2010–2024, this study finds no statistically significant conditional relationship between national internet use or fixed-broadband subscriptions and real export volumes in two-way fixed-effects models. The finding persists across the reported FDI and sample-sensitivity specifications. Real GDP per capita is positively associated with exports; the negative estimated FDI association depends on the inclusion of Luxembourg. These findings concern country-level connectivity and aggregate exports, not enterprise-level information systems, intermediary coordination, or digital trade volumes. The models are associational and subject to endogeneity, measurement mismatch, and possible overcontrol. Future research should examine digital service trade and firm-level indicators of integrated marketing information and distribution capability. An additional regression using exports as a percentage of GDP as the dependent variable supports the same narrow conclusion: no statistically detectable conditional relationship for either connectivity indicator in this sample. These findings should be understood as imprecise estimates, not proof that digital connectivity is irrelevant to exporting.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The author declares no competing interests.

Statement of ethical approval

This research uses publicly available aggregate country-level indicators and involves no experiments or recruitment of human or animal subjects.

Data availability

Publicly available World Development Indicators accessed through the World Bank Indicators API [2]; replication code and extracted dataset are available from the author upon reasonable request.

Prior thesis

This article extends the conceptual discussion in Gökmen (2000) [1]. It does not reproduce proprietary Siemens case-study data.

REFERENCES

- [1] Gökmen M. International distribution strategies based on marketing information systems [doctoral thesis]. Cluj-Napoca: Babeş-Bolyai University; 2000.
- [2] World Bank. World Development Indicators [Internet]. Washington (DC): World Bank. Available from: <https://databank.worldbank.org/source/world-development-indicators>
- [3] Freund CL, Weinhold D. The effect of the Internet on international trade. *J Int Econ*. 2004;62(1):171–189. doi:10.1016/S0022-1996(03)00059-X.
- [4] Clarke GRG, Wallsten SJ. Has the Internet increased trade? Developed and developing country evidence. *Econ Inq*. 2006;44(3):465–484. doi:10.1093/ei/cbj026.
- [5] International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations Conference on Trade and Development, World Bank, World Trade Organization. Digital trade for development [Internet]. 2023. Available from: https://www.wto.org/english/res_e/publications_e/dtd2023_e.htm
- [6] International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations Conference on Trade and Development, World Trade Organization. Handbook on measuring digital trade. 2nd ed. Paris: OECD Publishing; 2023. doi:10.1787/ac99e6d3-en.
- [7] Lendle A, Olarreaga M, Schropp S, Vézina PL. There goes gravity: eBay and the death of distance. *Econ J*. 2016;126(591):406–441. doi:10.1111/ecoj.12286.