CRISIS AND CONNECTIVITY: TECHNOLOGICAL STRUGGLES IN EASTERN EUROPE AND CENTRAL ASIA DURING THE 2008-2009 CRISIS

HALIL D. KAYA
PROFESSOR OF FINANCE, NORTHEASTERN STATE UNIVERSITY,
e-mail: kaya@nsuok.edu

Abstract

This paper investigates whether the 2008–2009 global financial crisis influenced the trend in technology adoption among manufacturing and service sector firms in Eastern Europe and Central Asia. The analysis focuses on three key indicators of technology use: email for communication, company websites for product promotion, and access to high-speed internet. Drawing on data from the World Bank's BEEPS surveys, the study first finds that manufacturing firms consistently demonstrate higher levels of technology adoption than service firms. Despite the economic shock of the global crisis, the upward trend in technology use continued across both sectors. For instance, the share of service firms using email rose from 70.89% pre-crisis to 79% post-crisis, while for manufacturing firms it increased from 80.04% to 89.19%. Similarly, website usage grew from 45.61% to 51.74% among service firms and from 58.83% to 67.42% among manufacturers. Data on high-speed internet access—available only for service sector firms—indicates an increase from 61.00% before the crisis to 78.25% after the crisis. Additionally, perceptions of telecom as a business obstacle improved: while firms initially viewed it as a "minor" to "moderate" issue, post-crisis, it was generally considered a "no" to "minor" obstacle. Overall, the findings indicate that the global financial crisis did not disrupt the positive trajectory of technology adoption in the region.

Keywords: *crisis, service sector, manufacturing, technology, BEEPS, email, website, internet, EECA, Eastern Europe, Central Asia*

Clasificare JEL : *O33, G01, L86, P27, D22*

1. Introduction and context of the study

The 2008–2009 global financial crisis represents a watershed moment in contemporary economic history, profoundly affecting firms' operational strategies, investment decisions, and technological trajectories worldwide. For firms in Eastern Europe and Central Asia (EECA), a region characterized by diverse economic structures and varying institutional capacities, the crisis posed unique challenges and opportunities for technology adoption, particularly within the manufacturing and service sectors. Understanding how the crisis influenced these firms' use of key digital technologies—such as email communication, company websites, and access to high-speed internet—is critical for assessing the resilience and adaptability of EECA economies amid global disruptions.

Previous research has revealed a complex and sometimes contradictory impact of economic recessions on technological change. On one hand, studies of the Great Recession demonstrate that downturns can accelerate the adoption of skill-intensive and routine-biased technologies, prompting firms to restructure operations and invest in digital capabilities despite adverse economic conditions (Hershbein & Kahn, 2016; Kopytov, Roussanov, & Taschereau-Dumouchel, 2018). On the other hand, evidence from firm-level analyses indicates substantial cuts in innovation investments during recessions, highlighting demand shocks as key inhibitors of technology development and diffusion (Elfsbacka Schmöller, Goldfayn-Frank, & Schmidt, 2024; Anzoategui et al., 2019). Furthermore, cross-border technology flows and R&D-intensive foreign direct investment (FDI) tend to contract in recessionary periods, constraining access to advanced technologies, especially critical for emerging economies (Sun & Zheng, 2024).

The macroeconomic and institutional context of EECA countries adds further complexity. Variability in government transparency, financial market development, human capital, and policy support influences firms' ability to innovate and adopt new technologies (Dirir, 2023; Wang et al.,

2020). Studies focused on developing and emerging markets suggest that sustained investments in R&D and complementary human capital are necessary for translating technological innovation into economic growth (Mohamed, Liu, & Nie, 2022; Salam et al., 2019). However, weak institutional frameworks often undermine these processes, impeding the capacity of firms to leverage technological advances during and after crises (Jammeh, 2022; Fayyaz & Bartha, 2025).

In the specific context of telecom and IT sectors, which are pivotal to the digital transformation of EECA economies, evidence from analogous emerging markets shows mixed resilience to recessions. While telecom firms tend to adopt cost-efficiency strategies under crisis pressure, IT firms may capitalize on strong human capital and synergies to accelerate digital development (Sharma & Sharma, 2011). This dynamic aligns with broader conceptualizations of crises as simultaneous opportunities for digital innovation, sources of operational disruption, and mechanisms that expose digital inequalities (Gkeredakis, Lifshitz-Assaf, & Barrett, 2021).

Drawing on comprehensive firm-level data from the World Bank's Business Environment and Enterprise Performance Surveys (BEEPS), this paper investigates whether the 2008–2009 global financial crisis altered the trajectory of technology adoption among manufacturing and service sector firms in EECA. Focusing on three key indicators—email usage, website presence, and high-speed internet access, the study examines sectoral differences and evolving perceptions of telecom infrastructure as a business constraint. In doing so, it contributes to a nuanced understanding of how economic shocks interact with digital adoption patterns in transitional economies, with policy implications aimed at fostering resilience and sustainable technological growth in the region.

2. Literature Review

The 2008–2009 global financial crisis had a profound and multifaceted impact on firms' technological adoption and telecom use, with important implications for economic growth, innovation, and business resilience.

Several studies highlight recessions as both disruptive shocks and opportunities for technological change. Hershbein and Kahn (2016) provide evidence from the Great Recession that firms accelerate routine-biased technological change (RBTC) during downturns, restructuring production to require higher-skilled workers and adopting new technologies despite weak labor markets. Their findings suggest that recessions can act as catalysts for skill-intensive technology adoption, contributing to long-term labor market polarization. Similarly, Kopytov, Roussanov, and Taschereau-Dumouchel (2018) argue that recessions encourage firms and workers to adopt and develop new skill-intensive technologies, which, although painful in the short term, foster accelerated technological progress post-recession.

Conversely, Elfsbacka Schmöller, Goldfayn-Frank, and Schmidt (2024) document a substantial contraction in firms' innovation investments during recessions, with German firms cutting R&D and technology diffusion spending by over 60%. Their firm-level analysis underscores how demand shocks during crises translate into reduced technology investments, thereby slowing medium-term productivity growth. This perspective is supported by Anzoategui et al. (2019), who model endogenous technology adoption and show that the post-Great Recession productivity slowdown was driven partly by demand-induced reductions in technology development and adoption.

Sun and Zheng (2024) extend this discussion to cross-border technology investments, finding that R&D-intensive foreign direct investment (FDI) declines when destination countries enter recession, especially in advanced economies. This suggests that global recessions constrain not only domestic innovation but also international technology flows, critical for EECA firms that rely on cross-border investments and partnerships.

Macroeconomic stability and policy environments also play a crucial role in shaping firms' technology use and innovation. Studies such as Dirir (2023) and Wang et al. (2020) emphasize the importance of government transparency, financial development, human capital, and globalization in promoting technological innovation. In the EECA context, where institutional quality varies widely,

these findings indicate that recessions may exacerbate existing vulnerabilities in innovation ecosystems.

Research from emerging and developing countries provides further nuance. Mohamed, Liu, and Nie (2022), Kaur and Singh (2016), and Tung and Hoang (2024) document positive long-run relationships between R&D investments and economic growth, highlighting the importance of sustained innovation efforts. Yet, Jammeh (2022) and Fayyaz and Bartha (2025) caution that weak institutions and poor governance can undermine the effectiveness of technological innovation, a concern pertinent to many EECA countries. Salam et al. (2019) reinforce the need for complementary investments in human capital and technology adoption to translate innovation into growth.

The telecom and IT sectors, critical for EECA's digital transformation, show mixed resilience during recessions. Sharma and Sharma (2011) examine the Indian telecom and IT industries during the global downturn, noting that while telecom firms sought cost efficiencies and operational restructuring, the IT sector leveraged strong human capital and sectoral synergies to sustain growth. This suggests that telecom firms in EECA may similarly face pressures to optimize operations, while IT firms could use the crisis to accelerate digital capabilities.

Gkeredakis, Lifshitz-Assaf, and Barrett (2021) offer a framework framing crises as simultaneous opportunities, disruptions, and exposures for digital technology use. They argue that crises can accelerate digital innovation and remote work adoption, but also expose inequalities and coordination challenges, dynamics highly relevant to EECA firms navigating uneven digital infrastructure and skills.

Furthermore, Qenaat et al. (2025) highlight the increasing role of advanced digital technologies such as AI, ICT, and green tech in shaping economic development, emphasizing the importance of policy support, legal frameworks, and infrastructure investments. Hanif, Bakar, and Nawaz (2022) similarly underline the positive impact of ICT on sustainable development in advanced economies, signaling a potential growth pathway for EECA telecom and technology sectors post-crisis.

There are many policy implications. Hausman and Johnston (2014) argue that insufficient innovation before the crisis exacerbated economic collapse and prolonged recovery, emphasizing the need for policies that foster innovation as a key to resilience. Bayar (2015), Ildırar, Özmen, and İşcan (2016), and Akcali and Sismanoglu (2015) similarly stress the positive effects of R&D investment on economic growth, advocating tailored R&D policies to support sustainable technological advancement.

Collectively, these studies imply that for EECA firms, the 2008–2009 crisis likely had a dual impact: short-term cuts in technology investments and innovation spending, paired with longer-term acceleration in digital adoption and restructuring towards more skill-intensive technology use. The crisis revealed vulnerabilities in firms' capacity to sustain innovation during downturns, while also offering an impetus to adopt new digital tools and business models. Effective macroeconomic policies, institutional reforms, and investments in human capital and digital infrastructure appear crucial to enabling EECA firms to convert crisis-driven disruptions into sustainable technological and economic growth.

3. Data and methodology

This study utilizes firm-level data from the World Bank's Business Environment and Enterprise Performance Surveys (BEEPS) IV and V, covering service sector and manufacturing firms across 32 countries in Eastern Europe and Central Asia. BEEPS IV, conducted during 2008–2009, represents the "crisis period," while BEEPS V, carried out between 2011 and 2016, corresponds to the "post-crisis period." The analysis compares these two timeframes using both Chi-squared tests and Mann-Whitney-Wilcoxon tests to assess differences in technology adoption and perceived infrastructure obstacles.

The study focuses on three primary indicators of technology use: email communication, website presence, and access to high-speed internet. First, the proportion of service sector firms using

email for communication is compared across the two periods, followed by a similar comparison for manufacturing firms. Next, the analysis examines the share of service firms with a website for product promotion, and subsequently, the same comparison is made for manufacturers. Access to high-speed internet is then evaluated, although data are available only for service sector firms. Finally, the study investigates changes in firms' perceptions of telecommunications as a business obstacle. Specifically, it assesses whether service firms categorized telecom infrastructure during and after the crisis as a "no obstacle," "minor obstacle," "moderate obstacle," "major obstacle," or "very severe obstacle." Did the perceived severity of telecom infrastructure as a business obstacle decrease over time?

The next section presents the empirical results.

4. EMPIRICAL RESULTS

Table 1 shows the results of the Chi-Square tests comparing the percentage of firms that were using email to communicate with clients or suppliers during the Crisis and Post-Crisis periods. The results for service sector firms are shown on Panel A, while the results for manufacturers are shown on Panel B.

Panel A shows that 70.89% of service sector firms used email to communicate with clients or suppliers during the Crisis period, while the corresponding percentage is 79.00% during the post-Crisis period. The difference is statistically significant ($p<0.0001$). Therefore, significantly more service sector firms used email to communicate with clients or suppliers, post-Crisis.

Table 1. Does the Firm use Email to Communicate with Clients or Suppliers?

Panel A. Service Firm

	Crisis		Post-Crisis	
	N	**%**	**N**	**%**
Yes	2,718	70.89	3,115	79.00
No	1,116	29.11	828	21.00
Total	3,834	100	3,943	100
Statistic	**df**	**Value**	**Prob**	
Chi-Square	1	68.1726	<0.0001	

Panel B. Manufacturing Firm

	Crisis		Post-Crisis	
	N	**%**	**N**	**%**
Yes	4,018	80.04	5,776	89.19
No	1,002	19.96	700	10.81
Total	5,020	100	6,476	100
Statistic	**df**	**Value**	**Prob**	
Chi-Square	1	187.7485	<0.0001	

Panel B shows that 80.04% of manufacturers used email to communicate with clients or suppliers during the Crisis period, while the corresponding percentage is 89.19% during the post-Crisis period. Similar to the service sector, significantly more manufacturers used email to communicate with clients or suppliers, post-Crisis ($p<0.0001$).

These findings are consistent with expectations, as email communication became increasingly common over time, and the global crisis was not anticipated to significantly disrupt this trend. The table indicates a substantial increase in the proportion of firms using email in the years following the end of the crisis.

Table 2 shows the results of the chi-squared tests comparing the percentage of firms that were using their own website during the Crisis and Post-Crisis periods.

Panel A shows that 45.61% of service sector firms used their own website during the Crisis period, while the corresponding percentage is 51.74% during the post-Crisis period. The difference is statistically significant (p<0.0001). Therefore, significantly more service sector firms used their own website post-crisis.

Panel B shows that 58.83% of manufacturers used their own website during the Crisis period, while the corresponding percentage is 67.42% during the post-Crisis period. The difference is statistically significant (p<0.0001). Therefore, significantly more manufacturers used their own website post-crisis.

These findings align with expectations, as the use of websites by firms became increasingly common over time, and the global crisis was not expected to significantly disrupt this trend. The table shows a substantial increase in the proportion of firms with their own websites in the years following the crisis.

Table 2. Does the Firm use its own Website?

Panel A. Service Firm

	Crisis		Post-Crisis	
	N	**%**	**N**	**%**
Yes	1,745	45.61	2,039	51.74
No	2,081	54.39	1,902	48.26
Total	3,826	100	3,941	100
Statistic	**df**	**Value**	**Prob**	
Chi-Square	1	29.1906	<0.0001	

Panel B. Manufacturing Firm

	Crisis		Post-Crisis	
	N	**%**	**N**	**%**
Yes	2,938	58.83	4,363	67.42
No	2,056	41.17	2,108	32.58
Total	4,994	100	6,471	100
Statistic	**df**	**Value**	**Prob**	
Chi-Square	1	89.9954	<0.0001	

Table 3 shows the results of the chi-squared tests comparing the percentage of firms that had a high-speed internet connection on premises during the Crisis and Post-Crisis periods. Since there was no data on manufacturers, here we only examined service sector firms.

Table 3. Service Firm Have a High-Speed Internet Connection on Premises?

	Crisis		Post-Crisis	
	N	**%**	**N**	**%**
Yes	2,307	61.00	3,080	78.25
No	1,475	39.00	856	21.75
Total	3,782	100	3,936	100
Statistic	**df**	**Value**	**Prob**	
Chi-Square	1	272.3324	<0.0001	

The table shows that 61.00% of service sector firms had a high-speed internet connection on premises during the Crisis period, while the corresponding percentage is 78.25% during the post-

Crisis period. The difference is statistically significant ($p<0.0001$). Therefore, significantly more service sector firms had a high-speed internet connection on premises post-crisis.

These findings are consistent with expectations, as high-speed internet connections became increasingly common over time, and the global crisis was not anticipated to significantly disrupt this trend. The table indicates a substantial increase in the proportion of firms that had a high-speed internet connection in the years following the end of the crisis.

Table 4 shows the results of the Mann-Whitney-Wilcoxon test comparing the "degree of obstacle" that telecommunications posed to service sector firms during the Crisis and Post-Crisis periods. "No obstacle" was coded as 0, "Minor obstacle" was coded as 1, "Moderate obstacle" was coded as 2, "Major obstacle" was coded as 3, and "Very severe obstacle" was coded as 4. Since there were no data on manufacturers, we only examined service sector firms.

Table 4. Is Telecommunication an Obstacle to the Operations of the Service Firm?

	Crisis			Post-Crisis			Mann-W.
Variables	**N**	**Mean**	**Std**	**N**	**Mean**	**Std**	**p-value**
Telecommunication as an obstacle	3763	1.2610	1.4306	3918	0.7187	1.2023	<0.0001

Note: No obstacle=0, Minor obs=1, Moderate obs=2, Major obs=3, Very severe obs=4.

The table shows that the mean value is 1.2610 during the Crisis Period and 0.7187 during the Post-Crisis Period. The difference is statistically significant ($p<0.0001$). The Crisis Period value of 1.2610 falls somewhere between 1 ("Minor obstacle") and 2 ("Moderate obstacle"), while the post-Crisis value of 0.7187 falls between 0 ("No obstacle") and 1 ("Minor obstacle"). This finding indicates that service sector firms in the region suffered more due to telecommunication issues during the Crisis Period, when compared to the post-Crisis period.

These findings are consistent with our expectations of more severe issues for firms in transitioning economies during the global crisis. The global crisis likely caused slower infrastructure development, delayed investments, or budget-related service constraints in these developing nations.

5. Conclusion

This study examines whether the 2008–2009 global financial crisis affected the trajectory of technology adoption among firms in Eastern Europe and Central Asia, focusing on the use of email communication, company websites, and high-speed internet access. Drawing on data from the BEEPS IV and BEEPS V surveys, the analysis reveals that technology use continued to rise across both service and manufacturing sectors despite the economic shock of the crisis.

Specifically, the proportion of firms using email and websites increased significantly in the post-crisis period. Service sector firms saw email usage rise from 70.89% to 79%, and website usage from 45.61% to 51.74%. Manufacturing firms showed even higher adoption rates, with email usage increasing from 80.04% to 89.19% and website use from 58.83% to 67.42%. In the case of high-speed internet—data available only for service firms, access expanded from 61.00% pre-crisis to 78.25% post-crisis. Furthermore, the perceived severity of telecom infrastructure as a business obstacle decreased over time. In the earlier period, firms rated telecom as a "minor" to "moderate" obstacle. However, post-crisis, they rated telecom as a "no" to "minor" obstacle.

Overall, the results suggest that the global financial crisis did not hinder the upward trend in technology adoption. On the contrary, firms in the region continued to integrate digital tools into their operations, with manufacturing firms maintaining a consistently higher rate of adoption than

service firms. These findings underscore the resilience of technological progress even in the face of significant economic disruptions.

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