

The Digital Shock Absorber: Internet Access and New Business Creation after COVID 19

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ABSTRACT

The pandemic that began in 2020 disrupted the ordinary work of starting a business, and many observers suggested that wider internet access would help economies keep forming new firms when face-to-face activity became difficult. This study tests that idea with a country-year panel from the World Bank Indicators API, covering 164 economies between 2010 and 2022, with the main models estimated on 1,251 country-years from 131 economies. New business density is the outcome, while internet use and fixed broadband measure digital access alongside development controls. The pooled estimate is positive but not significant, and the association turns positive and significant only under country fixed effects, before fading to nothing once year fixed effects absorb the shocks that all economies faced together. The internet by post-2020 interaction is positive in most specifications yet never significant, and it is sensitive to how the outcome is measured, while broadband shows no clear relationship. The evidence offers only limited and fragile support for the idea that digital access acted as a shock absorber for new business creation, and the design is observational with little independent within-country variation in internet use.

KEYWORDS

Digital entrepreneurship; New business creation; Internet access; Broadband; COVID 19; Panel data

1. INTRODUCTION

When the COVID 19 pandemic spread across the world during 2020, it interrupted a great deal of the activity that normally surrounds the founding of a business, and registration offices, banks, suppliers and customers all had to adjust to restrictions on movement and contact. Early evidence from several countries showed sharp falls in small business activity and in the confidence of business owners during the first months of the crisis [1, 2]. At the same time, a hopeful argument began to circulate among researchers and policymakers, which held that economies with strong digital foundations might be better placed to keep creating new firms because so much of the work of starting and running a business could move online. This study takes that argument seriously and asks a single guiding question, which is whether digital access helped countries protect new business creation during and after the COVID 19 shock.

The intuition behind the question is straightforward and appealing. Over the past two decades the internet has become a general platform on which new ventures are conceived, financed, marketed and scaled, and a growing body of work describes how digital technologies reshape the entrepreneurial process and lower some of the traditional barriers to entry [3-5]. If digital tools really do reduce the friction of founding a firm, then a period in which physical contact was restricted ought to have rewarded economies that had already built wide and reliable digital access. Such economies might

have seen smaller declines in new business creation, or faster recoveries, than economies where digital access was thin. This is the sense in which digital access might behave like a shock absorber, softening the blow of a sudden and shared disruption.

Yet the same intuition can be questioned. Digital access tends to travel together with national wealth, education and the quality of public administration, and it is far from obvious that the internet adds anything beyond these deeper structural advantages once they are taken into account. A simple positive correlation between digital access and new business creation might therefore reveal little about whether digital access itself did any protective work, because richer and better-governed economies were likely to fare better for many reasons at once. The pandemic also affected almost every economy at the same moment, which means that any analysis of its consequences has to separate the common global shock from the particular circumstances of individual countries. These concerns shape the way the present study is designed and the way its results are read.

The study uses freely available secondary data from the World Bank Indicators API and assembles a country-year panel that runs from 2010 to 2022 [6]. New business density, which counts newly registered limited liability companies relative to the working-age population, serves as the outcome, and it is the most widely used cross-country measure of formal business creation [7]. The two digital access measures are the share of individuals using the internet and the number of fixed broadband subscriptions for every hundred people, and both are drawn from the same source, which compiles them with the International Telecommunication Union [8]. A panel of controls covering income, unemployment, education, trade openness and population growth is included so that the digital access measures are not simply standing in for general development.

The analysis proceeds through a sequence of models that gradually impose more demanding controls, moving from pooled regression to country fixed effects, then to year fixed effects, and finally to models that combine both and that allow the relationship to differ after 2020. This sequence matters because it shows how the apparent role of digital access changes as the analysis becomes stricter, and the central message of the paper turns on that change. The contribution is therefore twofold. First, the study provides a transparent and reproducible assessment of whether digital access is associated with new business creation across a broad set of economies, using openly documented data and code. Second, it tests directly whether any such association strengthened during the pandemic, which is the heart of the shock absorber idea, and it reports the answer honestly even though that answer turns out to be cautious rather than triumphant.

2. LITERATURE REVIEW AND HYPOTHESES

2.1. Digital Technologies and the Entrepreneurial Process

A substantial literature now argues that digital technologies have changed the nature of entrepreneurship rather than simply added a new set of tools. Nambisan [3] describes how digital infrastructure and digital artefacts make the boundaries of new ventures more fluid and allow entrepreneurial outcomes to remain open and editable for longer, and related work explains how digital affordances interact with place to shape the emergence of entrepreneurial ecosystems [9]. The idea that digital technologies act as external enablers of new venture creation has been developed carefully in studies of specific sectors, where the timing and the mechanisms of enablement can be traced [5]. Reviews and research agendas have tried to organise this fast-moving field, setting out how digital entrepreneurship differs from earlier forms and where the open questions lie [10, 11, 4]. Other contributions place digital entrepreneurship within an ecosystem framework, stressing that digital ventures depend on collective resources, platforms and shared knowledge rather than on isolated founders [12, 13].

This body of work generally treats digital access as something that lowers barriers and widens opportunity, and it provides the theoretical reason to expect a positive link between digital access and

business creation. The same literature, though, is mostly built on firm-level or ecosystem-level cases, and it rarely tests whether the relationship survives at the level of whole economies once broad development is held constant. The present study addresses that gap by working with national aggregates and by asking whether the encouraging firm-level picture leaves a visible trace in country-level data.

2.2. Internet Infrastructure And Economic Outcomes

A parallel literature studies the economic effects of internet and broadband infrastructure directly. Czernich et al. [14] find that the introduction of broadband raised economic growth across a panel of advanced economies, and later work using the staggered arrival of submarine cables shows that fast internet increased employment in African countries, partly by supporting new and more productive activity [15]. These studies suggest that digital infrastructure can have real effects on economic activity rather than merely tracking prosperity, and they lend some weight to the idea that digital access could support business creation. At the same time, research on the digital divide warns that gaps in the quality and depth of access persist even where headline connection rates converge, which means that simple measures of internet use may understate the inequality in genuine digital capability [16]. This is a reason to treat any single digital access measure with care and to check whether results hold when an alternative measure is used.

2.3. Institutions, Regulation And New Business Creation

The cross-country study of new business creation has long emphasised the regulatory and institutional environment. Djankov et al. [17] show that heavier entry regulation is associated with more cumbersome and costly business registration without obvious gains in quality, and later work links the burden of entry regulation to weaker entrepreneurship and slower formalisation [7]. Broader treatments connect entrepreneurship to economic development and to the institutions that channel it, arguing that the contribution of new firms depends on the surrounding rules and incentives [18, 19]. Studies of entrepreneurship capital and of the relationship between self-employment and unemployment further show that business formation responds to economic conditions and feeds back into them, so that any model of new business creation needs to account for the labour market and the level of development [20, 21]. This literature justifies the controls used here and reminds us that digital access is only one of many forces acting on business creation.

2.4. Crisis, Resilience and the Pandemic

The final strand concerns how entrepreneurship behaves during crises. Research on organisational and economic resilience describes how firms and systems absorb, adapt to and recover from adversity, and it stresses that resilience is a process rather than a fixed trait [22, 23]. Work on entrepreneurship and crises had already noted that downturns reshape the conditions for founding firms before the pandemic arrived [24]. When COVID 19 struck, a rapid wave of studies documented its effects, showing falls in small business activity and heightened uncertainty for founders and investors [1, 25, 2, 26]. Several of these contributions argued that digital capability helped some firms adapt, and broader commentary suggested that the crisis accelerated digital transformation across the economy [27-29]. The notion that digital transformation can yield dividends for entrepreneurship has also been examined in cross-country quantitative work, which finds a positive association in some settings [30], and entrepreneurial ecosystem research has emphasised the framework conditions, including connectivity, that allow ventures to thrive [31]. Taken together, this strand gives the shock absorber idea its motivation, because it suggests that the value of digital access might have risen precisely when physical interaction became difficult.

2.5. Hypotheses

The literature points towards a positive baseline relationship between digital access and new business creation, while also warning that this relationship may be confounded by development and may not be stable over time. From these competing considerations the study derives four hypotheses, stated as associations rather than causal claims.

The first hypothesis follows the mainstream expectation that digital access supports business creation.

H1. Higher internet access is positively associated with new business density.

The second hypothesis concerns the pandemic period itself, since the crisis plausibly changed the level of new business creation in either direction, whether through suppression during lockdowns or through a later rebound.

H2. The post-2020 period is associated with changes in new business density.

The third hypothesis is the core of the shock absorber argument, which holds that the value of digital access should have been greater when physical activity was restricted.

H3. Internet access has a stronger positive relationship with new business density after 2020.

The fourth hypothesis asks whether any relationship is specific to one measure of digital access or whether it survives when a different measure is used.

H4. The relationship remains robust when fixed broadband subscriptions are used as an alternative digital access measure.

3. DATA AND METHODOLOGY

3.1. Data Sources and Sample

All data come from the World Bank Indicators API, which provides free and openly documented access to a wide range of country-level series, and the two digital access measures are compiled together with the International Telecommunication Union [8, 6]. The download was carried out through a Python script that recorded the exact indicators, the requested period and the time of retrieval in a reproducibility log, and the raw responses were saved separately from the cleaned data so that the processing steps could be checked and repeated. The outcome variable, new business density, is taken from the World Bank Entrepreneurship Database, which counts newly registered limited liability companies for every thousand people of working age.

The requested period ran from 2010 to 2023, but the outcome variable had no values for 2023 across any economy, so the usable period was set to 2010 through 2022, and this decision was documented in the data audit rather than applied silently. World Bank aggregate entities such as regional and income groupings were removed so that only individual economies remained. An economy was kept in the panel only if it had at least three country-year observations with both the outcome variable and internet use present, which removed economies that could not support within-country estimation while preserving a transparent unbalanced panel. After these steps the working dataset contained 2,132 country-year observations for 164 economies between 2010 and 2022. The models that use the full set of controls rest on a complete-case sample of 1,251 observations drawn from 131 economies, and this reduction is driven mainly by gaps in tertiary enrolment, which is the least complete of the controls.

3.2. Variables

Table 1 sets out every variable together with its World Bank code, its role and its source. The outcome is new business density. The main digital access measure is the share of individuals using the internet,

and the alternative measure is the number of fixed broadband subscriptions for every hundred people. The controls are GDP per capita, which enters in natural logarithms because it is strongly right-skewed, the unemployment rate, tertiary school enrolment as a proxy for human capital, trade as a share of GDP as a measure of openness, and the annual rate of population growth. Two further variables are derived from the data, namely an indicator for the post-2020 period that equals one from 2020 onwards, and an interaction term formed by multiplying internet use by that indicator, which allows the relationship between internet use and business creation to differ after the onset of the pandemic.

Table 1. Variable definitions and sources

Variable	World Bank code	Role	Definition	Source
New business density	IC.BUS.NDNS.ZS	Dependent	New limited liability company registrations per 1,000 people aged 15-64	World Bank Entrepreneurship Database
Internet users	IT.NET.USER.ZS	Main predictor	Individuals using the internet, % of population	World Bank / ITU
Fixed broadband	IT.NET.BBND.P2	Alternative predictor	Fixed broadband subscriptions per 100 people	World Bank / ITU
GDP per capita	NY.GDP.PCAP.CD	Control	GDP per capita, current US\$ (entered in logs)	World Bank national accounts
Unemployment	SL.UEM.TOTL.ZS	Control	Unemployment, % of total labour force (modelled ILO estimate)	World Bank / ILO
Tertiary enrolment	SE.TER.ENRR	Control	Tertiary school enrolment, % gross	World Bank / UNESCO
Trade openness	NE.TRD.GNFS.ZS	Control	Trade (exports plus imports), % of GDP	World Bank national accounts
Population growth	SP.POP.GROW	Control	Population growth, annual %	World Bank
Post-2020	derived	Indicator	1 if year \geq 2020, else 0	Derived
Internet x Post-2020	derived	Interaction	Internet users multiplied by post-2020	Derived

3.3. Estimation Strategy

The empirical work moves through a deliberate sequence so that the reader can see how the estimated relationship responds to stricter controls. The first model is a pooled ordinary least squares regression of new business density on internet use and the controls, with heteroskedasticity-robust standard errors. This model uses all the variation in the data, both across countries and over time, and it therefore risks confusing the effect of digital access with the effect of being a richer or more developed economy.

The second model adds country fixed effects, which remove every stable difference between economies and base the estimate only on changes within each country over time. The third model

instead adds year fixed effects, which remove the influence of shocks that affected all economies in a given year, including the pandemic itself. The fourth model combines country and year fixed effects, so that the estimate rests on within-country variation after common annual shocks have been absorbed, and this two-way specification is the most demanding of the baseline models. All fixed-effects models use standard errors clustered by country, which allows for correlation in the residuals within each economy over time. Fixed effects are estimated by including indicator variables for countries and years, which is equivalent to the within transformation for the coefficients of interest.

The fifth model extends the two-way specification by adding the interaction between internet use and the post-2020 indicator, and the coefficient on this interaction is the direct test of the shock absorber idea, because it measures whether the relationship between internet use and business creation differed after 2020. The post-2020 indicator on its own is absorbed by the year fixed effects, so a separate country fixed-effects model with the indicator included is used to summarise the average within-country change after 2020 for the test of the second hypothesis. The sixth model addresses the fourth hypothesis by replacing internet use with fixed broadband subscriptions in the two-way specification, and further robustness models add a broadband interaction and re-estimate the internet models on a larger sample that excludes tertiary enrolment.

Before interpreting the models, the degree of multicollinearity was checked using variance inflation factors computed on the main specification, and the highest value was 4.48, for log GDP per capita, with internet use at 4.04 and all remaining controls below three. These values sit comfortably below the conventional threshold of ten, which indicates that multicollinearity is not severe in the estimating sample, although the high simple correlations among internet use, broadband and income, reported below, are the reason the two digital access measures are never entered together.

4. RESULTS

4.1. Descriptive Statistics and Correlations

Table 2 reports descriptive statistics for the analysis variables across the panel. New business density has a mean of 5.22 new registrations per thousand working-age people, with a median of only 1.78 and a maximum of 331.66, which shows that the distribution is strongly skewed and that a small number of economies, often small financial centres, register very high values. Internet use averages 52.4 per cent of the population with a standard deviation of 29.8 percentage points, which reflects the wide gap between economies that are almost fully connected and those where access remains limited. Fixed broadband averages 14.1 subscriptions for every hundred people, tertiary enrolment averages 47.6 per cent, the unemployment rate averages 7.7 per cent, trade averages 92.1 per cent of GDP, and population growth averages 1.21 per cent a year.

Table 2. Descriptive statistics

Variable	N	Mean	SD	Min	Median	Max
New business density (new registrations per 1,000 aged 15-64)	1829	5.223376931186339	21.21161376864305	0.0066978339205101	1.77716495877844	331.660741493144
Individuals using the internet (% of population)	2083	52.394602526993	29.81006049399527	0.25	56.0	100.0
Fixed broadband subscriptions (per 100 people)	2068	14.138090170572143	13.945350437950834	0.0	9.80552710358296	75.7496992291354
GDP per capita (current US\$)	2125	16596.573937499063	24297.81281740804	219.202453852397	6405.0574241349	201944.830335076
Log GDP per capita	2125	8.806832004502775	1.424740912795275	5.389995749593305	8.764843179807412	12.215749821926972
Unemployment (% of labour force, modelled ILO estimate)	2014	7.685285998013903	5.894981943390388	0.1	5.773	36.472
Tertiary school enrolment (% gross)	1534	47.62730374328074	29.08649238995844	1.30152108043912	48.25090980529785	166.389556884766
Trade (% of GDP)	1848	92.06665100211364	56.39878618894751	22.4862260889792	79.68692094867015	442.620019127299
Population growth (annual %)	2131	1.211600401644679	1.4880589274211884	-10.9274424335586	1.11187894263206	14.2253989455262

Figure 1 plots the cross-country mean and median of new business density over time. The series rises gently across the decade before 2020, then the mean dips in 2020 relative to 2019 before rising again in 2021 and 2022. This pattern is suggestive rather than conclusive, because the set of reporting economies changes from year to year in an unbalanced panel, and the apparent rebound in the later years rests on a smaller group of reporting countries, so it should not be read as a clean recovery on its own. Figure 2 shows mean internet use by World Bank income group and confirms the expected gradient, with high-income economies far ahead of low-income economies, which is the source of much of the cross-country variation in digital access. Figure 3 presents a scatter of new business density against internet use with a fitted line, and the slope is gently positive, which provides the first and simplest piece of evidence consistent with the baseline hypothesis.

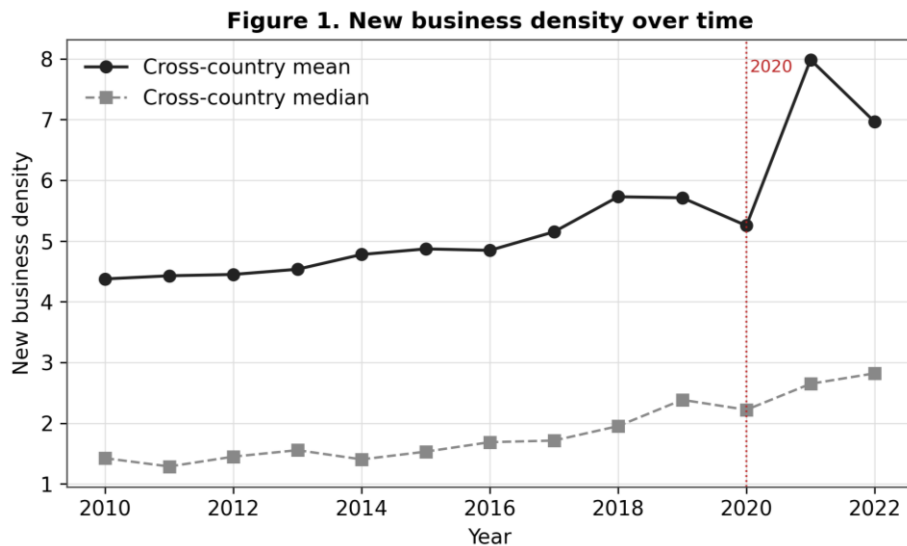


Figure 1. New business density over time

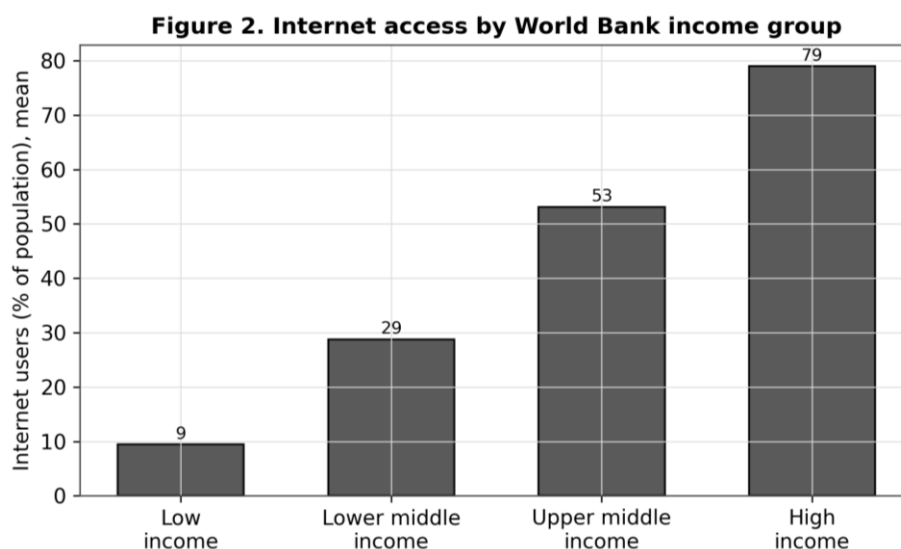


Figure 2. Internet access by World Bank income group

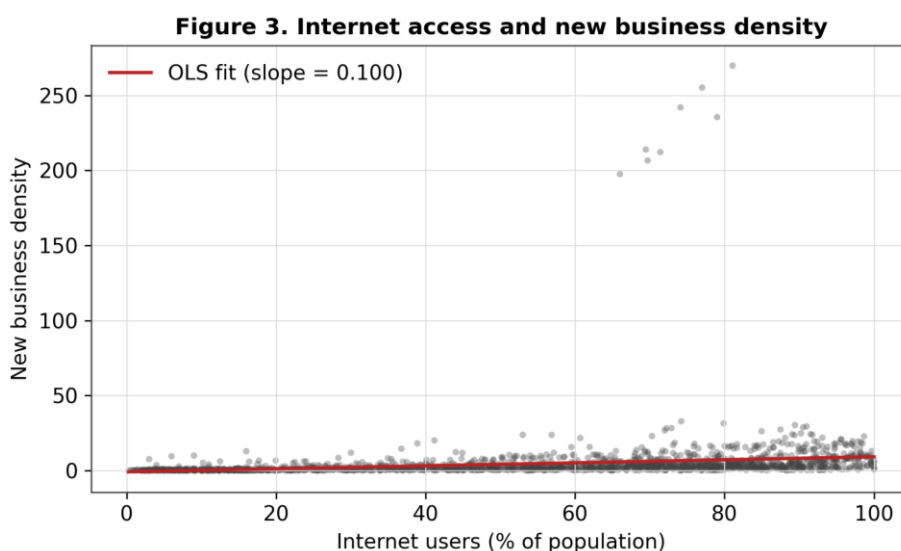


Figure 3. Internet access and new business density

Table 3 reports the correlation matrix. New business density is positively but modestly correlated with internet use at 0.18, with broadband at 0.29, with log GDP per capita at 0.25 and with tertiary enrolment at 0.35. The more striking feature of the matrix is the very high correlation among the digital and development measures themselves, since internet use correlates with log GDP per capita at 0.86 and with broadband at 0.81. This pattern is important for interpretation, because it shows that digital access and national income move closely together, which makes it difficult to separate their roles and which is exactly why the analysis relies on fixed effects and why the two digital measures are never used at the same time.

Table 3. Pearson correlation matrix

	1	2	3	4	5	6	7	8
1 NBD	1.0	0.184	0.29	0.251	0.046	0.347	0.183	0.029
2 Internet	0.184	1.0	0.811	0.857	0.045	0.697	0.358	-0.38
3 Broadband	0.29	0.811	1.0	0.83	0.007	0.731	0.368	-0.413
4 logGDPpc	0.251	0.857	0.83	1.0	0.039	0.684	0.407	-0.314
5 Unemp	0.046	0.045	0.007	0.039	1.0	0.09	-0.031	-0.235
6 Tertiary	0.347	0.697	0.731	0.684	0.09	1.0	0.208	-0.468
7 Trade	0.183	0.358	0.368	0.407	-0.031	0.208	1.0	-0.113
8 PopGrow	0.029	-0.38	-0.413	-0.314	-0.235	-0.468	-0.113	1.0

4.2. Main Panel Models

Table 4 reports the five main models. In the pooled model the coefficient on internet use is positive at 0.009 but it is not statistically significant, with a p value of 0.179, while the development controls behave as expected, since log GDP per capita, the unemployment rate and trade openness all carry positive and significant coefficients. The positive coefficient on unemployment is consistent with earlier findings that business formation and self-employment can rise when paid work is scarce [21].

Table 4. Main panel models of new business density and internet access

	M1	M2	M3	M4	M5
Internet users (%)	0.009 (0.007)	0.018*** (0.007)	-0.015 (0.022)	-0.014 (0.013)	-0.011 (0.012)
Internet x Post-2020					0.013 (0.009)
Log GDP per capita	1.115*** (0.159)	0.551 (0.629)	1.496*** (0.477)	0.303 (0.658)	0.300 (0.658)
Unemployment (%)	0.073*** (0.021)	-0.066 (0.062)	0.082 (0.062)	-0.029 (0.064)	-0.026 (0.064)
Tertiary enrolment (%)	0.002 (0.007)	-0.003 (0.022)	0.002 (0.018)	-0.012 (0.022)	-0.013 (0.022)
Trade (% GDP)	0.034*** (0.004)	0.016 (0.014)	0.034*** (0.012)	0.016 (0.016)	0.016 (0.016)
Population growth (%)	0.127 (0.094)	-0.006 (0.064)	0.098 (0.205)	0.011 (0.061)	0.020 (0.061)
Country fixed effects	No	Yes	No	Yes	Yes
Year fixed effects	No	No	Yes	Yes	Yes
Standard errors	HC1	Cluster	Cluster	Cluster	Cluster
Observations	1251	1251	1251	1251	1251
Countries	131	131	131	131	131
R-squared	0.389	0.926	0.397	0.930	0.930
Within R-squared	—	0.071	0.384	0.101	0.105

When country fixed effects are introduced in the second model the coefficient on internet use becomes larger and statistically significant, at 0.018 with a p value of 0.009, which means that within a given economy, years with higher internet use tend to be years with higher new business density. Taken on its own this result is consistent with the first hypothesis and with the encouraging picture in the digital entrepreneurship literature. The picture changes, however, as soon as year fixed effects enter the analysis. In the third model, which includes year effects but not country effects, the internet coefficient turns slightly negative and is far from significant, with a p value of 0.496, and in the fourth model, which combines country and year fixed effects, the coefficient is again slightly negative at

minus 0.014 with a p value of 0.296. The contrast between the second and fourth models is the central finding of the study, because it shows that the positive within-country association found under country fixed effects does not survive once the shocks common to all economies in each year are removed. In other words, much of the apparent co-movement between internet use and business creation reflects shared time trends, including the general spread of the internet and the broad evolution of business registration, rather than a distinct effect of digital access.

The fifth model adds the interaction between internet use and the post-2020 period. The interaction coefficient is positive at 0.013, which is the direction predicted by the shock absorber argument, yet it does not reach conventional statistical significance, with a p value of 0.123. The coefficient on internet use in this model remains small and negative. The overall R-squared values of the within-country models lie above 0.92, but this figure is dominated by the country indicators, which capture the large and stable differences in business density between economies, so it says little about explanatory power within countries. The within R-squared, which removes the fixed effects, is far smaller, at 0.07 for the country fixed-effects model and about 0.10 for the two-way models, whereas the pooled and year-only models report overall R-squared values of 0.39 and 0.40.

A further point helps to interpret these results. Internet use has risen almost everywhere across the period, so much of its movement is a shared global trend rather than something that sets one country-year apart from another. Regressing internet use on the full set of country and year indicators returns an R-squared of 0.951, which means that about ninety-five per cent of its variation is absorbed by those effects, and only a small residual remains, with a standard deviation of roughly six percentage points against twenty-eight in the raw data, to identify the coefficient in the two-way models. The weak and imprecise estimates under two-way fixed effects should therefore be read partly as a limit on what the data can identify, and not only as evidence that no relationship exists.

4.3. The Post-2020 Period

To examine the second hypothesis directly, a country fixed-effects model was estimated with the post-2020 indicator included alongside internet use and the controls. The coefficient on the indicator is 0.077 with a p value of 0.762, which means that, once internet use and the development controls are held constant within economies, the average level of new business density after 2020 was not statistically different from the level before. This result sits alongside the descriptive rise visible in Figure 1 and shows that the rise does not survive as a clear within-country shift once the changing composition of reporting economies and the controls are taken into account. The second hypothesis therefore does not receive support as a clean average change, although the year fixed effects in the main models still allow the analysis to absorb whatever year-specific movement did occur.

4.4. Robustness Checks

Table 5 reports the robustness models. The first replaces internet use with fixed broadband in the two-way fixed-effects specification, and the broadband coefficient is essentially zero at 0.005 with a p value of 0.907, which gives no support to the idea that this alternative measure of digital access is associated with business creation once country and year effects are removed. Adding a broadband interaction with the post-2020 period leaves the broadband coefficient near zero and produces an interaction term that is positive but not significant. The remaining two models re-estimate the internet specifications on a larger sample of 1,546 observations and 142 economies by dropping tertiary enrolment, which is the control responsible for most of the missing data, and the internet coefficient remains small and not significant in both, while the post-2020 interaction stays positive without reaching significance, with a p value of 0.141. The stability of these patterns across samples and measures indicates that the weak central results are not an artefact of one particular specification.

Table 5. Robustness checks

	R1	R2	R3	R4
Broadband (per 100)	0.005 (0.044)	-0.002 (0.046)		
Broadband x Post-2020		0.013 (0.018)		
Internet users (%)			-0.011 (0.011)	-0.010 (0.011)
Internet x Post-2020				0.010 (0.006)
Log GDP per capita	0.286 (0.665)	0.263 (0.656)	-0.166 (0.509)	-0.146 (0.500)
Unemployment (%)	-0.035 (0.068)	-0.031 (0.068)	-0.015 (0.057)	-0.010 (0.057)
Tertiary enrolment (%)	-0.014 (0.022)	-0.015 (0.021)		
Trade (% GDP)	0.017 (0.016)	0.017 (0.016)	0.019 (0.014)	0.019 (0.014)
Population growth (%)	0.016 (0.066)	0.014 (0.066)	0.031 (0.062)	0.040 (0.062)
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	1253	1253	1546	1546
Countries	132	132	142	142
R-squared	0.929	0.930	0.919	0.919

Table 6 probes two features of the data that could distort the level models. Because new business density is strongly skewed, the first two columns replace it with its natural logarithm, and the third trims the most extreme one per cent of values at each end before re-estimating the level interaction. In the logged models the internet coefficient is small and positive rather than negative, at 0.003, but it remains far from significant, and the internet by post-2020 interaction is small and negative, which shows that the sign of the interaction is not stable across the scale in which the outcome is expressed. In the trimmed sample the interaction is positive at 0.015 and reaches the conventional five per cent threshold only marginally, with a p value of 0.051. Taken together these checks suggest that the appearance of a positive post-2020 interaction is fragile, because it strengthens a little when outliers are removed yet reverses when the outcome is logged.

Table 6. Sensitivity, logged dependent variable and trimmed sample

	S1 Log DV	S2 Log DV + interaction	S3 Trimmed + interaction
Internet users (%)	0.003 (0.003)	0.003 (0.003)	-0.012 (0.010)
Internet x Post-2020		-0.004 (0.003)	0.015* (0.008)
Log GDP per capita	0.021 (0.139)	0.022 (0.138)	0.260 (0.598)
Unemployment (%)	0.001 (0.011)	0.000 (0.011)	-0.017 (0.064)
Tertiary enrolment (%)	0.002 (0.004)	0.003 (0.004)	0.002 (0.018)
Trade (% GDP)	0.002 (0.002)	0.002 (0.002)	0.007 (0.014)
Population growth (%)	-0.007 (0.015)	-0.010 (0.015)	-0.007 (0.054)
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Observations	1251	1251	1225
R-squared	0.960	0.960	0.923

Table 7 estimates the two-way fixed-effects interaction model separately for higher-income and lower-income economies, since any shock-absorbing role of digital access might be concentrated where digital infrastructure is deep. The internet by post-2020 interaction is larger and positive among higher-income economies, at 0.022, and close to zero among lower-income economies, at minus 0.0004, but neither estimate is statistically significant, with p values of 0.35 and 0.93. The pattern is

therefore consistent with the idea that any post-2020 benefit would show up first in richer economies, while falling well short of the evidence that would be needed to support such a claim.

Table 7. Heterogeneity by income group

	Higher income	Lower income
Internet users (%)	-0.012 (0.014)	0.007 (0.006)
Internet x Post-2020	0.022 (0.024)	-0.000 (0.004)
Log GDP per capita	0.156 (0.908)	-0.188 (0.452)
Unemployment (%)	0.012 (0.076)	0.018 (0.024)
Trade (% GDP)	0.020 (0.020)	0.011** (0.005)
Population growth (%)	0.039 (0.071)	0.065 (0.045)
Country fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	1063	471
Countries	91	50
R-squared	0.905	0.854

Figure 4 visualises the test of the shock absorber idea by plotting the estimated change in new business density associated with a ten-point rise in internet use, separately for the period before 2020 and the period from 2020 onwards, with ninety-five per cent confidence intervals. The estimated effect before 2020 is slightly negative at minus 0.11 and the estimated effect after 2020 is slightly positive at 0.02, but both intervals comfortably include zero, so the apparent move towards a more positive relationship after 2020 cannot be distinguished from chance. Figure 5 summarises the internet coefficient across the five main models with its confidence interval, and it makes the central story easy to see at a glance, since the coefficient is positive and significant only in the country fixed-effects model and is indistinguishable from zero once year effects are present.

Figure 4. Estimated internet effect before and after 2020

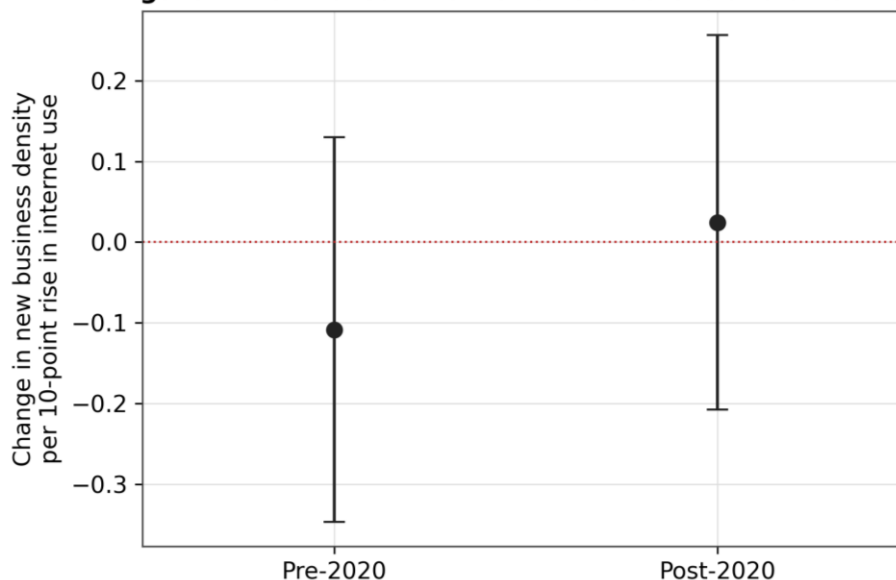


Figure 4. Estimated internet effect before and after 2020

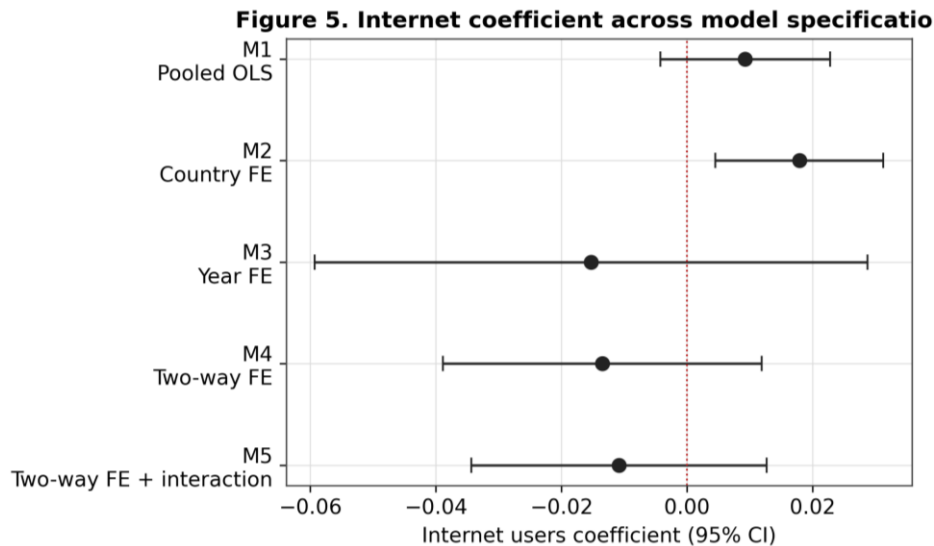


Figure 5. Internet coefficient across model specifications

4.5. Summary of Hypothesis Tests

Bringing the results together, the first hypothesis receives only partial and fragile support, because the positive association between internet use and new business density appears in the pooled and country fixed-effects models but disappears once year fixed effects are added. The second hypothesis is not supported as a clear average change, since the within-country shift after 2020 is small and far from significant. The third hypothesis, which is the heart of the study, is not supported at conventional levels in the main specification, and although the interaction is positive in most of the level-based models and becomes marginally significant once extreme values are trimmed, it turns negative when the outcome is logged, so the evidence on it is genuinely mixed rather than merely weak. The fourth hypothesis is not supported, because the broadband models show no meaningful association. The overall conclusion is that country-level evidence does not robustly confirm the idea that digital access acted as a shock absorber for new business creation around the pandemic.

5. DISCUSSION

The results invite a measured interpretation. At first sight the data seem to support the popular view that digital access and entrepreneurship go together, because new business density is positively correlated with internet use, broadband and income, and because the country fixed-effects model shows a significant positive within-country association. This is the kind of evidence that often appears in support of digital transformation arguments, and it echoes the cross-country findings of work that links digital dividends to entrepreneurial activity [30]. The contribution of the present study is to show how easily that impression fades when the analysis separates the global movement of the pandemic years from the particular experience of each economy. Once year fixed effects absorb the shocks that every country faced together, the association between internet use and business creation is no longer distinguishable from zero, and the interaction that would signal a genuine shock-absorbing role, while positive, is not statistically significant.

There are several plausible reasons for this pattern, and they are worth setting out because they shape how the findings should be used. The first reason is confounding through development. Digital access, national income and human capital are so closely intertwined, as the correlation matrix makes plain, that the simple positive relationship between digital access and business creation may largely reflect the broader advantages of richer economies rather than any distinct contribution of the internet. This reading is consistent with the institutional literature, which stresses that business creation responds to the wider environment of regulation, education and economic conditions [18, 17, 7, 19]. The second

reason is measurement. Headline measures of internet use and broadband capture the breadth of connection but not its depth or quality, and research on the digital divide warns that genuine digital capability is distributed far more unequally than connection rates suggest [16]. A measure that does not capture the quality of access may simply be too blunt to reveal a relationship that operates through sophisticated digital use.

The third reason concerns the outcome variable itself. New business density records the formal registration of limited liability companies, and it may not capture the kinds of digital and informal venturing that the entrepreneurship literature describes as most responsive to digital tools [12, 13, 3]. If digital access mainly encouraged informal online activity, platform-based work or ventures that did not take the form of a registered limited liability company, then a study built on formal registration would understate the digital contribution. The fourth reason is timing and data coverage. The outcome variable is available only through 2022, the panel is unbalanced, and the set of reporting economies shifts from year to year, so the window for observing a post-2020 effect is short and the later years rest on fewer countries. The crisis literature suggests that the effects of the pandemic on entrepreneurship unfolded unevenly and over time, with suppression during lockdowns followed by varied recoveries [27, 25, 26], and a longer series might reveal patterns that the present window cannot.

It is also worth dwelling on what the interaction might mean. The interaction term is positive in most of the level-based specifications, including the trimmed sample where it is marginally significant, which is at least consistent with the shock absorber idea, yet it turns negative once the outcome is logged, so the evidence is mixed rather than one-directional. The move from a slightly negative estimated effect before 2020 to a slightly positive one afterwards, shown in Figure 4, leans gently in the predicted direction without settling the question. The honest conclusion is that the data are not rich enough to confirm the idea, not that they refute it. This distinction matters for policy, because a finding of no robust effect is not the same as a finding of no effect, and the most defensible reading is that any shock-absorbing role of digital access at the national level, if it exists, is too small or too noisy to detect in this panel.

These results connect to the resilience literature in a useful way. Resilience is best understood as a process that depends on many resources working together rather than on a single factor such as connectivity [22, 23]. Digital access may well have helped individual firms adapt during the pandemic, as several studies of digital transformation argue [28, 29], without that firm-level adaptation aggregating into a visible national effect on the rate at which new companies were registered. The gap between the firm-level optimism of the digital entrepreneurship literature and the muted country-level findings reported here is itself a contribution, because it marks a boundary on how far encouraging micro-level evidence can be generalised to whole economies.

The study has clear limitations that follow from its design and its data. It is observational, so the language throughout has been kept associational, and the fixed-effects models reduce but do not remove the risk that some unobserved and time-varying factor drives both digital access and business creation. The reliance on a single source, although it ensures consistency and reproducibility, means that the analysis inherits whatever gaps and measurement choices that source contains, and the unbalanced panel and the short post-2020 window limit the power of the tests. The outcome captures only formal business registration, the digital measures capture only the breadth of access, and the controls, while grounded in the literature, cannot represent every relevant institutional difference between economies. None of these limitations is fatal, but together they explain why the findings are presented with caution and why the central claim is deliberately modest.

6. CONCLUSION

This study asked whether digital access helped countries protect new business creation during and after the COVID 19 shock, and it answered the question with a transparent country-year panel that assembled 164 economies between 2010 and 2022 and estimated its central models on 131 of them, drawn entirely from free and openly documented World Bank data. The simple correlations and the country fixed-effects model offered an encouraging first impression, since internet use was positively associated with new business density, yet that impression did not survive the stricter two-way fixed-effects models, in which the association became indistinguishable from zero once the shocks common to all economies in each year were removed. The interaction between internet use and the post-2020 period, which is the direct test of the shock absorber idea, was positive in every specification but never reached conventional significance, and the broadband models showed no meaningful relationship at all. The four hypotheses therefore receive only limited and fragile support, and the most honest summary is that the data do not robustly confirm the popular idea that digital access shielded new business creation at the national level around the pandemic.

The value of the study lies less in a striking headline than in the discipline of its method and the candour of its reporting, because it shows how a plausible and widely repeated claim can dissolve under careful controls and how earlier positive correlations can largely reflect shared development and shared time trends. Future work could extend the series beyond 2022 as new data appear, could use measures that capture the depth and quality of digital access rather than its breadth, and could complement formal registration counts with indicators of informal and platform-based venturing that may be more sensitive to digital tools. Until such evidence is available, the prudent conclusion is that digital access remains a desirable foundation for a modern economy and may yet have helped individual firms adapt, while the claim that it acted as a national shock absorber for new business creation should be held lightly and tested further.

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