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APPENDIXES

Entrepreneurship as a Driver of Innovation in the Digital Age: Analysis of Data from 17 ADB Regional Members

Erkko Autio and Donghyun Park

ADB Economics Working Paper No. 721 April 2024

Appendix 1: Informal Entrepreneurship: Effects on Firm-Level Innovativeness and Growth

We next consider the potential effect of informal entry density and institutional conditions on firm-level productivity potential. We consider three economy-level influences: the possible negative externality created by high informal entry density, property protection, and entry regulations. We use the same economy-level data as previously mentioned, with the difference that while the previous analysis aggregated individual-level data for estimates of economy-level entry density, this section presents a cross-level analysis that combines economy-level data with individual-level data.

We approximate firm-level productivity potential with data describing firm-level innovativeness and growth aspirations. As proxies for innovativeness, we use product innovation, the use of new technologies, and export activity. These proxies were taken from the GEM dataset and are explained in section 3 of this paper. As a measure of growth aspiration, we use the firm's expected number of employees in 5 years' time. We measure the effects separately for baby businesses (entrepreneurial businesses less than 42 months old, indicated as 'babybuso') and established businesses (older than 42 months, indicated as 'estbbuso').

A1.1 Expected effects

A high density of informal entries may operate as a negative externality that inhibits the productivity potential of formal and informal entries alike. At high levels of informal entrepreneurship, its consequences become part of the institutional environment in an economy, which can shape individual behaviors such an entrepreneurs' innovative activities and growth aspirations. This can happen because informal ventures can avoid

paying tax and social security expenses, as well as laws specifying minimum salary levels (Webb et al. 2009), in addition to avoiding costs of compliance (e.g., hiring a lawyer, accountant, or allocating the entrepreneur's time to compliance activities). Because they can avoid taxes and compliance costs, informal entrepreneurs may gain unfair advantage in competition against registered businesses in the sectors where they operate (Estrin and Mickiewicz 2012). It is harder for formal ventures to "fly under the radar" (Levie and Autio 2011; Godfrey 2011). Therefore, as the prevalence of informal entrepreneurship in an economy grows, both formal and informal entrepreneurs alike may be less likely to invest in innovation and growth (Bu and Cuervo-Cazurra 2019). We therefore expect:

- H4 Economy-level entry density of informal entrepreneurs will be negatively associated with individual entrepreneurs' product innovation, use of new technologies, and export activities.
- H5 Economy-level entry density of informal entrepreneurs will be negatively associated with individual entrepreneurs' growth aspirations.

Similar to this reasoning, we also expect that entry regulations will exercise a negative influence on firm-level innovativeness:

- H6a The number of procedures required for starting a business, the cost of registering a new business, and the size of required paid-in minimum capital will be negatively associated with individual entrepreneurs' product innovation, use of new technologies, and export activities.
- H6b The number of procedures required for starting a business, the cost of registering a new business, and the size of required paid-in minimum capital

will be negatively associated with individual entrepreneurs' growth aspirations.

Finally, as laid out above, we expect an economy's property right protection regime to influence the productivity potential of new entrepreneurial businesses:

- H7a The strength of an economy's property protection regime will be positively associated with individual entrepreneurs' product innovation, use of new technologies, and export activities.
- H7b The strength of an economy's property protection regime will be positively associated with individual entrepreneurs' growth aspirations.

A1.2 Data and Analysis

We used the same predictor variables as in the previous analysis. Given that we are conducting a multi-level analysis, the control variables needed to be amended to cover individual-level demographics commonly associated with entrepreneurs' innovative and growth orientation. We controlled for the respondent's gender with a dummy (male = 1, female = 2). We also controlled the respondent's age (years) and household income level relative to economy average (three tiers: lower, middle, and upper 33% tier, with lower tier as the baseline). Given that human capital is associated with entrepreneurs' innovativeness, we controlled for entrepreneurs' education level (five levels: primary, some secondary, secondary, post-secondary, graduate experience, with primary as the base level). We also controlled the entrepreneurs' risk-taking with a dummy (yes = 1 to the question: "Would fear of failure prevent you from starting your own business?").

As economy-level controls we used population size and growth and the economy's GDP per capita at PPP (five quintiles, the lowest quintile as base).

To estimate the impact of informal entrepreneurship in an economy on entrepreneurs' growth aspirations, we adopted multilevel regression technique to predict the growth aspirations of individuals. We first verified that there existed a sufficient amount of variance in the level of entrepreneurial growth aspiration between economies by calculating the intraclass correlation coefficient (ICC). We then specified and tested a set of two-level models with random intercepts and slopes, which allowed both the individual-level factors (level-1) and economy-level factors (level-2) to affect innovative activity and growth aspirations of individual entrepreneurs, accounting for variation in growth patterns across economies. We used maximum likelihood algorithms for fitting the model.

A1.3 Findings

The results of this analysis are shown in Appendix Table A1. First, looking at control variables we observed that gender was associated with baby business owners' growth use of new technologies (higher for women) and negatively associated with established business owners' export activities (higher for men). We also observed that the individual's age was negatively associated with product innovation and new technology use, and increases in household income were positively associated with new product innovation and export activity but negatively associated with new technology use. Education level was positively associated with innovation variables, and the highest level of education was also positively associated with growth orientation. Regarding economy-level controls,

population size was positively associated with new product innovation and technology use in baby businesses. Development stage was—surprisingly—negatively associated with product innovation among established entrepreneurs, generally positively associated with technology use among both baby businesses and established businesses, and generally negatively associated with export activity. Development stage was also positively associated with baby business growth orientation. Finally, GDP growth was negatively associated with product innovation and technology use.

We then have a look at the findings. First, we observe that informal entry density is negatively associated with new product development among both baby businesses and established businesses. Informal entry density also suppresses new technology use among established businesses, export activity among baby businesses, and growth aspirations among established entrepreneurial businesses. The patterns are negative throughout, although not all associations are statistically significant, possibly due to sample limitations.

For regulations of entry, we find number of procedures required to start a business to exhibit a positive association with new product innovation among established businesses, a negative association with new technology use among established businesses (borderline significant for baby businesses), and a negative association with export activity among baby businesses. The cost of registering a new business exhibits a negative association with product innovation and export activity among established businesses. Minimum paid-in capital requirement exhibits a negative association with new product innovation and export activity for both baby businesses and established businesses. Property right protection exhibits a positive association with both new product innovation and new technology use for both baby and established businesses but a negative association with growth aspirations among baby businesses.

We can thus conclude that:

- (i) Informal entry density appears to have a broadly general negative association with both innovative activity and growth orientation among new entrepreneurial firms.
- (ii) Entry regulations broadly exhibit negative associations with innovativeness but not with growth orientation; however, the number of required entry procedures deviates from this pattern.
- (iii) Property rights protection exhibits positive associations with new product innovation and new technology use but a surprising negative association with baby business growth expectations.

A1.4 Discussion

The findings of our cross-level analysis broadly confirm that an economy's institutional conditions regulate the productivity potential of new entrepreneurial firms, and that the economy's entry density of informal entrepreneurs constitutes a broad negative externality that dampens both innovative activity and growth orientation. Our analysis provides one of the first direct evidence of cross-level effects of this density at the firm level. While the broad associations confirm the importance of institutional conditions in shaping the productivity potential of new entrepreneurial ventures, the patterns revealed are not entirely consistent and point to the need for a more fine-grained analysis, with larger sample sizes and better firm-level control over registration status. The key policy message is that both institutional conditions and entry regulations matter and should be carefully addressed by governments wanting to enhance their economy-level

entrepreneurial dynamic and enhance the productivity potential of their populations of entrepreneurial new firms.

| | rr | | | | - | | | |
|--|-------------------|-----------|-------------------|-----------|-------------------|-----------|-------------------|-----------|
| | babybuso estbbuso | | babybuso estbbuso | | babybuso estbbuso | | babybuso estbbuso | |
| | New P | roduct | New | / tech | Exp | oort | Gro | wth |
| Informal entrepreneurship | -0.137** | -0.158*** | -0.015 | -0.336*** | -0.200* | -0.000 | -0.027 | -0.032* |
| (entry density per 1000 adults 16-64 yrs) Entry regulations | (0.045) | (0.035) | (0.064) | (0.079) | (0.084) | (0.070) | (0.021) | (0.015) |
| Starting a business: number of procedures | 0 162+ | 0.184* | -0 219+ | -0.461*** | 0.268* | 0 144 | -0.024 | -0.050+ |
| | (0.098) | (0.079) | (0.129) | (0.105) | (0.116) | (0.088) | (0.043) | (0.027) |
| Starting a business: registration cost | -0.045 | -0.467*** | 0.059 | 0.072 | -0.107 | -0.410*** | 0.022 | 0.019 |
| (% per capita income) | (0.046) | (0.078) | (0.059) | (0.045) | (0.068) | (0.118) | (0.021) | (0.022) |
| Starting a business: paid-in minimum capital | -0.182*** | -0.118** | -0.036 | 0.036 | -0.241*** | -0.161*** | 0.033+ | -0.023 |
| (% per capita income) | (0.038) | (0.041) | (0.046) | (0.051) | (0.045) | (0.042) | (0.018) | (0.015) |
| Country institutions | () | () | () | (, | () | () | () | () |
| Property right protection | 0.110+ | 0.339*** | 0.305*** | 0.645*** | 0.010 | -0.074 | -0.112*** | -0.017 |
| | (0.060) | (0.052) | (0.074) | (0.091) | (0.101) | (0.082) | (0.027) | (0.020) |
| Individual-level controls | () | () | (, | (, | () | () | () | () |
| Gender (Male=1, Female=2) | 0.028 | 0.049 | 0.149** | 0.050 | -0.047 | -0.150* | -0.013 | -0.025 |
| | (0.047) | (0.040) | (0.057) | (0.049) | (0.067) | (0.059) | (0.022) | (0.018) |
| Age | -0.065** | -0.027 | -0.143*** | -0.155*** | -0.016 | -0.024 | 0.005 | -0.013 |
| | (0.024) | (0.021) | (0.028) | (0.025) | (0.033) | (0.030) | (0.011) | (0.009) |
| Income1 (Middle 33% tier) | -0.062 | 0.101* | -0.020 | -0.026 | -0.012 | 0.017 | -0.021 | 0.009 |
| | (0.059) | (0.051) | (0.073) | (0.061) | (0.088) | (0.075) | (0.028) | (0.022) |
| Income2 (Upper 33% tier) | 0.076 | 0 184*** | -0 197** | -0.024 | 0 377*** | 0 215** | 0.035 | 0.023 |
| | (0.063) | (0.054) | (0.076) | (0.065) | (0.087) | (0.076) | (0.030) | (0.024) |
| Education1 (some secondary) | 0.014 | 0.078 | -0 131 | -0.095 | 0.190 | -0.012 | 0.047 | 0.0024) |
| | (0.093) | (0.068) | (0 112) | (0.081) | (0.148) | (0.106) | (0.043) | (0.029) |
| Education? (secondary) | 0 214* | 0 247*** | 0 111 | 0 144+ | 0 444** | 0.316** | 0.046 | 0.002 |
| | (0.085) | (0.063) | (0.103) | (0.076) | (0.138) | (0 100) | (0.039) | (0.027) |
| Education3 (post-secondary) | 0 386*** | 0 423*** | -0.019 | 0.198* | 0.625*** | 0.421*** | 0.080+ | 0.017 |
| | (0.090) | (0.069) | (0.105) | (0.084) | (0.140) | (0 104) | (0.042) | (0.030) |
| Education (graduate experience) | 0.622*** | 0.551*** | (0.103) | (0.084) | 0.140) | 0.104) | 0.156* | (0.030) |
| Education (graduate experience) | (0.139) | (0 117) | (0.157) | (0.150) | (0 193) | (0.151) | (0.065) | (0.051) |
| Fear of Failure (ves-1) | 0.17** | -0.002 | 0.028 | -0.047 | 0.039 | -0.027 | 0.003 | -0.017 |
| | (0.047) | (0.040) | (0.057) | (0.049) | (0.067) | (0.057) | (0.022) | (0.018) |
| Country-level controls | (0.047) | (0.040) | (0.057) | (0.045) | (0.007) | (0.037) | (0.022) | (0.010) |
| Population size | 0 422* | 1 200 | 1 /15** | 0 767 | 0.402 | 1 202+ | 0.012 | 0.017 |
| | (0.170) | (0.951) | (0.462) | (0.507) | (0.402 | -1.303+ | -0.013 | (0.017 |
| Population growth (%) | 0.115 | 0.218* | -0.102 | 0.238* | -0.011 | 0.358*** | 0.082* | 0.1/1*** |
| ropulation growth (76) | (0.076) | (0.104) | -0.102 | (0 112) | (0.106) | (0 109) | (0.032) | (0.027) |
| Development stage | -0.187 | -1 888*** | 0.800*** | 0.113) | -0.367+ | -3 39/*** | 0.270*** | 0.110 |
| (second quintile of GDP per cap at ppp) | (0.159) | (0 311) | (0,203) | (0.208) | (0.216) | (0.576) | (0.074) | (0.110) |
| Development stage | 0 191 | -1 883*** | 1 633*** | 1 217*** | -1 859*** | -3 195*** | 0.289*** | 0 1 1 9 |
| (third quintile of GDP per cap at ppp) | (0.191 | (0.321) | (0.310) | (0 212) | (0.318) | (0.614) | (0.085) | (0.111) |
| Development stage | -0.098 | -2 /05*** | 1 196*** | 0.688** | -0 799* | -3 017*** | 0 179+ | 0.108 |
| (fourth quintile of GDP per cap at ppp) | (0.222) | (0 334) | (0.337) | (0 223) | (0.397) | (0.643) | (0.098) | (0.116) |
| Development stage | -0 291 | -2 603*** | 1 867*** | 0.699* | -0 573 | -2 701*** | 0.283* | 0.165 |
| (fifth quintile of GDP per cap ppp) | (0.302) | (0.403) | (0.411) | (0.296) | (0.469) | (0.716) | (0.126) | (0 137) |
| GDP growth (%) | -0.084** | -0 222*** | -0.042 | -0 112*** | -0.047 | -0.045 | 0.023 | 0.012 |
| | (0.032) | (0.027) | (0.035) | (0.033) | (0.041) | (0.034) | (0.015) | (0.012) |
| Constant | -0.685** | -0.184 | -1 319* | -2 583*** | -0.946+ | 0 103 | -0 176+ | -0.081 |
| constant | (0.237) | (0.579) | (0.531) | (0.619) | (0.503) | (0.717) | (0.097) | (0.092) |
| | (0.237) | (0.575) | (0.551) | (0.015) | (0.303) | (0.717) | (0.057) | (0.052) |
| Observations | 8,514 | 12,808 | 8,116 | 12,365 | 8,500 | 12,759 | 8,794 | 14,062 |
| Number of groups | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Observations per group: min | 100 | 140 | 92 | 146 | 97 | 145 | 102 | 178 |
| Observations per group: avg | 709.5 | 1067.3 | 676.3 | 1030.4 | 708.3 | 1063.3 | 732.8 | 171.8 |
| Observations per group: max | 2567 | 4689 | 2469 | 4618 | 2626 | 4711 | 2671 | 4822 |
| Wald Chi ² | 223.11*** | 385.28*** | 220.12*** | 435.22*** | 207.11*** | 238.37*** | 49.83*** | 56.23*** |
| Degree of freedom | 21 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |
| Log pseudolikelihood | -5563.57 | -7898.70 | -4046.32 | -5820.35 | -3222.42 | -4555.47 | -12433.48 | -19882.22 |
| Random-effects parameters | | | | | | | | |
| Variance (cons) | 0.294+ | 3,446 | 2.694* | 4.194* | 2.022+ | 4.670+ | 0.038 | 0.018 |
| Variance (residual) | 3 29 | 3 29 | 3 2 9 | 3 29 | 3 29 | 3 29 | 0.986 | 0 988 |

Table A1: Cross-Level Effects on Entrepreneurs' aInnovativeness and Growth Aspirations

Standard errors in parentheses *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

babybuso = baby business, estbbuso = established business, GDP = gross domestic product, PPP = purchasing power parity.

Source: Authors' calculations.

Appendix 2. Entrepreneurial Ecosystem Quality and Business Model Innovation As highlighted previously, economies' national systems of entrepreneurship comprise two levels: national and regional (Autio, Nambisan, et al. 2018; Acs, Autio, and Szerb 2014). While the national dimension predominantly sets economy-level "rules of the game" through regulations and national institutional structures, thereby shaping new firms' productivity potential entrepreneurs' entry decisions and post-entry strategic choices, the key dynamics impacting new entrepreneurial firms' realization of this potential mainly operate at the regional level. Economy-level institutional conditions tend to shape social and economic trade-offs concerning who becomes an entrepreneur in the first place (individuals with greater human capital tending to create new businesses with a greater productivity potential as seen in the analysis above) and what strategic goals they decide to pursue through their ventures. However, the ability of entrepreneurs to reach those goals is very much affected by the resource and learning dynamic that operates in regional entrepreneurial communities, which recently have been taken to be labelled as "entrepreneurial ecosystems" (Feld 2012). These are regional-level communities of entrepreneurs, resource providers, new venture accelerators, advisors, service providers, and other stakeholders of the regional entrepreneurial dynamic.

A2.1 Regional Entrepreneurial Ecosystems: The Concept

The regional dynamic supplies new entrepreneurial businesses with three types of capital to boost their productivity potential: financial capital, human capital, and knowledge capital. The knowledge capital component in particular has been fundamentally transformed by digitalization, as has the process of entrepreneurial opportunity pursuit and growth itself (Autio, Nambisan, et al. 2018). Combined, these effects are so

transformative that the world has witnessed the emergence of a novel type of regional cluster since mid-2000s onwards: the entrepreneurial ecosystem. We first elaborate on this novel phenomenon before providing an empirical illustration of their knowledge dynamics.

As such, the regional dimension of economic activity has been studied for well over a century, through conceptual lenses such as industrial districts, clusters, innovative milieus, regional and national innovation systems, and knowledge clusters (Crevoisier 2004; Delgado, Porter, and Stern 2010; Marshall 1920; Piore and Sabel 1984; Maskell 2001). Common to these all is the notion that spatial proximity accords businesses with resource and learning benefits as firms can observe and learn from one another and communicate more easily and frequently. Thanks to such interactions, virtually all clusters and agglomerations documented to date feature some kind of shared knowledge base: a cumulative set of insights, experiences, and lessons shared by most participants of the regional community and shared through direct interactions among these. In virtually all clusters documented in the literature, this knowledge is technical in nature—e.g., there might be a furniture cluster specializing in designing and manufacturing furniture and sharing associated techniques. Or there might be a biotechnology cluster that would share insights and advances regarding this generic technology.

In entrepreneurial ecosystems, this knowledge dynamic is different, as entrepreneurial ecosystems do not so much facilitate a shared knowledge base regarding industrial techniques and designs or generic technologies as they do regarding insights into "what works" in harnessing advances in the Internet and associated digital technologies for business model innovation. A business model defines how a given business organizes its productive upstream activities (or "value creation activities"), its customer-facing downstream activities (or "value delivery activities") and its cost and revenue models. A business model defines how an entrepreneurial business creates, delivers, and captures value (Amit and Zott 2012). This form of innovation differs significantly from the more conventional forms of innovation, such as technology-push innovation (i.e., commercialization of advances in R&D), product innovation, or process innovation.

Business model innovation is central for entrepreneurial ecosystems because of rapid advances in digitalization. Harnessing advances in the Internet and associated digital technologies, entrepreneurial new firms are able to rethink how they organize their value creation, delivery, and capture activities. As an example, the Grab taxi harnesses the Internet to re-think how taxi cab and food delivery services could be organized, thereby re-inventing these businesses. Airbnb and similar sites have done the same for the hotel and accommodation business. These business models would not have been invented by established incumbents (e.g., hotel chains), since they are already invested in hotel buildings. For these reasons, entrepreneurs are at the forefront of business model innovation, and entrepreneurial ecosystems are a special form of cluster that has emerged to support this dynamic.

Before we move to testing these insights empirically, we should note that digitally enhanced business model innovation is not limited to "digital businesses" alone: this is a much more encompassing phenomenon, which affects all kinds of new businesses in virtually all industry sectors. Furthermore, digital business model innovation is not limited to rich economies alone. As a pointed example, the first modern-type new venture accelerator, Y-Combinator, started its operations in the United States' Silicon Valley in 2005. Only some 10 years later, there were over 10 such incubators in the city of Bangalore, India alone (Goswami, Mitchell, and Bhagavatula 2018). Digital transformation is a global phenomenon, and therefore it is important for policymakers to address the entrepreneurial ecosystem phenomenon seriously, also in the ADB region.

A2.2 Entrepreneurial Ecosystem Knowledge Dynamic: A Case Study

To illustrate the knowledge dynamic in operation in regional entrepreneurial ecosystems, we cite an example of a comparative study of Bangkok and Chiang Mai entrepreneurial ecosystems in Thailand (Autio et al. 2019; Autio, Cao, et al. 2018). To assess the maturity of the entrepreneurial ecosystems in each region, we developed an easy-to-use policy tool designed to support regional policymakers to monitor the health and development stage of regional entrepreneurial ecosystems. This policy tool, labelled as the Entrepreneurial Ecosystem Maturity Framework, measured four relevant dimensions of regional entrepreneurial ecosystems: general framework conditions, ecosystem community structure and richness, ecosystem resource dynamic, and ecosystem knowledge dynamic. In total, the policy tool was composed of over 40 items. The tool was designed not only to support the assessment and monitoring of the regional ecosystem health, but also, to highlight bottlenecks so as to support better targeted policy interventions. As expected, the tool suggested that the Bangkok entrepreneurial ecosystem was clearly more developed than the Chiang Mai regional ecosystem, yet it had much catching up to do to reach the level of, e.g., Singapore's entrepreneurial ecosystem.

We then developed and tested our theoretical model. Given that insights into "what works" in terms of harnessing digital advances for business model innovation is an experimentation-driven process, our model emphasized the importance of ecosystemspecific interactions and associated knowledge spillovers among these. The more entrepreneurs residing in a given entrepreneurial ecosystem interact with one another, the more likely they are to share their insights, thereby enabling all ecosystem participants to become more effective business model innovators. To test our hypotheses, we conducted a series of regression analyses, using firm-level business model digital innovativeness as the dependent variable, the intensity of interactions with other ecosystem stakeholders and other entrepreneurs as the independent variables, and knowledge spillovers as the mediator. Descriptions of how the variables were operationalized are in the following section.

A2.3 Variables

Business model digital innovativeness was measured using interview surveys of start-up founders in the two ecosystems. Our operationalization measured the degree to which the start-ups harnessed digital technologies in their: internal operations, marketing and sales, interaction with customer involvement, employees, and international sales (12 items in total). A first-order factor analysis with the 12 items showed that the majority of items loaded on one single factor (eigenvalue 3.16, 74.9% of the total variance); this factor was retained. The intensity of interactions with other ecosystem stakeholders was measured as the intensity of interactions with other ecosystem stakeholders with a five-step scale ranging from 1 (none at all) to 5 (very intense). The overall intensity of

interactions was then measured as the average of stakeholder-specific interactions. The intensity of interactions with other entrepreneurs was measured as specific to other entrepreneurs using the same approach.

Knowledge spillovers from other entrepreneurs was measured as entrepreneurs' perceived learning from other entrepreneurs in the ecosystem across 10 learning categories (e.g., technical know-how to develop new products and services, understanding a given market, identifying new clients, learning how to design a winning business model, etc). The level of knowledge spillovers from other entrepreneurs for each participant was measured as the average response across the ten categories.

As control variables, we used firm age (years), firm size (employees), mentorships, entrepreneurs' work experience, serial entrepreneur status, returnee entrepreneurship status, education level, family experience in entrepreneurship, ICT competencies, and the degree of the venture's internationalization.

A2.4 Data and Analysis

Our database consisted of a list of start-ups in Bangkok and Chiang Mai participating in the 2017 Startup Thailand exhibition (244) and in the Stock Exchange of Thailand's New Economic Warriors database (181), as well as the list of IT companies in Chiang Mai (90). In total, we identified 515 start-up companies in Bangkok and Chiang Mai as our target population. Most of the population were approached for a face-to-face interview. The interviews were conducted in the Thai language. Data collection resulted in a sample of 180 start-up companies, of which 155 companies were from Bangkok (86 %), and the rest from Chiang Mai (14 %).

Ordinary least squares (OLS) regression was used to the relationships. These are shown in Appendix Table A2. Overall, we found full support for our theoretical conjectures. First, we found that the intensity of interactions with other ecosystem stakeholders was positively related to the firm-level business model digital innovativeness $(\beta = .57, p < .01; model 1)$. We also expected that knowledge spillovers would mediate the relationship between interaction intensity with other entrepreneurs and business model digital innovativeness (Baron and Kenny 1986). As shown in model 2, the interaction intensity with other entrepreneurs was significantly related to business model digital innovativeness (β =.14, p<.10). Model 3 shows a significant positive association between interaction intensity with other entrepreneurs and the level of knowledge spillovers (β =.29, p<.01). Finally, as shown in model 4, we found that the previously significant relationship between the interaction intensity with other entrepreneurs and the level of business model digital innovativeness was no longer significant and the effect shrank (β =.08) when the knowledge spill-over variable was added to the equation. However, knowledge spillovers remained significantly related to the level of business model digital innovativeness (β =.20, p<.01). This demonstrated that the effect of interactions on business model innovation was fully mediated by the resulting knowledge spillovers. This inference was confirmed in Sobel test (p<.05) (Sobel 1982). The squared association index – Eta-squared (n^2) – showed that the intensity of interactions with other ecosystem stakeholders explained about 9% of the variance unexplained by other items (Ferguson 2009).

| | Model 1: Business Model Digital | | Model 2: Business Model Digital | | Model 3: Knowledge | | Model 4: Business Model Digital | | Sobel |
|--|---------------------------------------|----------------------------|---------------------------------------|---------------------------|-----------------------|-------------------------------------|---------------------------------------|---------------------------|-------|
| Variables | Innova | | Innova | tiveness T | Spil | lovers | Innova | | Test |
| Interaction intensity with other ecosystem stakeholders | <u>p</u> .57 | 4.23** | <u> </u> | | <u>р</u> | Ľ | <u> </u> | l | |
| Firm age Firm size | 02 .00 | -1.02 1.74 [†] | 01 .00 | -0.37 1.42 | .03 .00 | 0.86 -0.06 | 01 .00 | -0.66 1.50 | |
| Mentorship Work experiences | .06 .02 | 0.45 1.73 [†] | .27 .01 | 2.01 [*] 1.49 | .58 01 | 2.88** -0.84 | .15 .02 | 1.17 1.82 [*] | |
| Serial entrepreneurs Education Family entrepreneurship history | .12 12 06 | 0.89 -1.02 -0.45 | .10 14 03 | 0.71 -1.21 -0.24 | 52 15 17 | 2.53 [*] -0.84 -0.82 | .20 11 .00 | 1.51 -1.00 0.01 | |
| ICT education | .15 | 0.73 | .22 | 1.07 | .58 | 1.83 [†] | 11 | 0.54 | |
| Internationalization | .00 | 1.32 | .00 | 1.03 | .01 | 1.31 [†] | .00 | 0.67 | |
| Interaction intensity with other entrepreneurs | | | .14 | 1.84* | .29 | 2.63** | .08 | 1.07 | 2.24* |
| Knowledge spillovers | | | | | | | .20 | 4.32** | |
| Adjusted <i>R</i> ² F | .11 3.40** | | .04 1.84 [*] | | .11 3.56** | | .12 3.52** | | |

Table A2: Drivers of Business Model Innovation in Entrepreneurial Ecosystems

ICT = information and communication technology.

^b n=180. The sample consists of 155 Bangkok start-ups (86.1%) and 25 Chiang Mai companies (13.9%).

[†] p < .10

* p < .05 ** p < .01

Source: Authors' calculations.

To minimize common method bias, we employed commonly used approaches in designing the survey (Podsakoff et al. 2003). We also performed Harman's one-factor test, which did not flag concerns for the common method bias (Podsakoff and Organ 1986).

A2.5 Discussion

Our analysis highlights both the importance of digitalization for entrepreneurial ecosystems, as well as the pertinent ecosystem interactions that drive new entrepreneurial firms' business model innovativeness. Given that business model innovation has emerged as a key determinant of new entrepreneurial firms' productivity potential in the digital age, facilitating related knowledge interactions has rapidly emerged as a key challenge for entrepreneurship policy. We next summarize our conclusions and discuss challenges for digital-era entrepreneurship policy in ADB regional members.

References

- Acs, Zoltan J., Erkko Autio, and Laszlo Szerb. 2014. "National Systems of Entrepreneurship: Measurement Issues and Policy Implications." *Research Policy* 43 (1): 476-94. 10.2139/ssrn.2008160.
- Amit, Raphael and Christoph Zott. 2012. "Creating Value through Business Model Innovation." *Sloan Management Review* 53: 41–49.
- Autio, Erkko, Selina Cao, Surat Chumjit, Panida Kaensup, and Wanna Temsiripoj. 2019. "Entrepreneurial Ecosystem Advantage: Ecosystem Interactions and Business Model Innovation." Academy of Management Conference, Boston, August 5-9.
- Autio, Erkko, Selina Cao, Wanna Temsiripoj, Pensri Guntasopatr, Panida Kaensup, and Surat Chumjit. 2018. Enhancing Thailand's Ecosystems for Entrepreneurship. Bangkok: King Mongkut University of Technology.
- Autio, Erkko, Satish Nambisan, Llewellyn D. W. Thomas, and Mike Wright. 2018. "Digital Affordances, Spatial Affordances, and the Genesis of Entrepreneurial Ecosystems." *Strategic Entrepreneurship Journal* 12 (1): 72-95. 10.1002/sej.1266.
- Baron, Reuben M and David A Kenny. 1986. "The Moderator–Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations." *Journal of personality and social psychology* 51 (6): 1173.
- Bu, Juan and Alvaro Cuervo-Cazurra. 2019. "How Does Informal Entrepreneurship Affect Innovation?" Academy of Management Proceedings.
- Crevoisier, Olivier. 2004. "The Innovative Milieus Approach: Toward a Territorialized Understanding of the Economy?" *Economic Geography* 80 (4): 367-79.
- Delgado, M., M. E. Porter, and S. Stern. 2010. "Clusters and Entrepreneurship." *Journal* of Economic Geography 10 (4): 495-518. 10.1093/jeg/lbq010.
- Estrin, Saul and Tomasz Mickiewicz. 2012. "Shadow Economy and Entrepreneurial Entry." *Review of Development Economics* 16 (4): 559-78.
- Feld, Brad. 2012. *Startup Communities: Building an Entrepreneurial Ecosystem in Your City*. Hoboken, NJ: Wiley.
- Ferguson, Christopher J. 2009. "An Effect Size Primer: A Guide for Clinicians and Researchers." *Professional Psychology: Research and Practice* 40 (5): 532.
- Godfrey, Paul C. . 2011. "Toward a Theory of the Informal Economy." *The Academy of Management Annals* 5 (1): 231-77.

- Goswami, Ketan, J Robert Mitchell, and Suresh Bhagavatula. 2018. "Accelerator Expertise: Understanding the Intermediary Role of Accelerators in the Development of the Bangalore Entrepreneurial Ecosystem." *Strategic Entrepreneurship Journal* 12 (1): 117-50.
- Levie, J. and E. Autio. 2011. "Regulatory Burden, Rule of Law, and Entry of Strategic Entrepreneurs: An International Panel Study." *Journal of Management Studies* 48 (6): 1392-419.
- Marshall, Alfred. 1920. Principles of Economics. London: MacMillan.
- Maskell, Peter. 2001. "Towards a Knowledge-Based Theory of the Geographical Cluster." *Industrial and corporate change* 10 (4): 921-43.
- Piore, Michael and Charles Sabel. 1984. *The Second Industrial Divide: Possibilities for Prosperity*: Basic books.
- Podsakoff, Philip M, Scott B MacKenzie, Jeong-Yeon Lee, and Nathan P Podsakoff. 2003. "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies." *Journal of Applied Psychology* 88 (5): 879-903.
- Podsakoff, Philip M and Dennis W Organ. 1986. "Self-Reports in Organizational Research: Problems and Prospects." *Journal of management* 12 (4): 531-44.
- Sobel, Michael E. 1982. "Asymptotic Confidence Intervals for Indirect Effects in Structural Equation Models." *Sociological Methodology* 13: 290-312. 10.2307/270723.
- Webb, Justin W., Laszlo Tihanyi, R. Duane Ireland, and David G. Sirmon. 2009. "You Say Illegal, I Say Legitimate: Entrepreneurship in the Informal Economy." *Academy of Management Review* 34 (3): 492-510.