

## 9. Explaining the performance of immigrant entrepreneurship in market economies: empirical evidence of technology signaling

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### INTRODUCTION

Public policy in developed countries is increasingly focused on ambitious, high-growth, high-impact, high-quality and high-performance entrepreneurship (Acs 2010; Brown et al. 2017; Estrin et al. 2013; Giotopoulos et al. 2017; Henrekson and Sanandaji 2020; Hermans et al. 2015). Despite their alternative meanings, these complementary concepts of high-performance entrepreneurship commonly refer to the portion of entrepreneurial activities responsible for the largest share of economic benefits in terms of jobs, innovation, productivity, or output (Autio and Ranniko 2016).

Given the higher rates of entrepreneurship by foreign-born individuals (or immigrants) compared to native-born individuals in several developed nations (Bolivar-Cruz et al. 2014; Fairlie and Lofstrom 2015; Green et al. 2016; Hunt 2011; Kerr and Kerr 2017; Levie and Hart 2013; Li et al. 2018; Portes and Yiu 2013), recent studies have increasingly focused on the antecedents and outcomes of immigrant entrepreneurship (Aliaga-Isla and Rialp 2013; Dheer 2018). While some early empirical research suggests that many immigrant entrepreneurs were “pushed” into lower-performing self-employment or necessity entrepreneurship (Borjas 1986; Clark and Drinkwater 2000), more recent empirical research often finds that immigrant entrepreneurs perform on average equally, if not better, than native-born entrepreneurs on a variety of metrics such as business financing, sales, exports, profits, or patents (Duhamel et al. 2017; Hart and Acs 2011; Hart and Mickiewicz 2016; Hunt 2011; Neville et al. 2014; Ostrovsky and Picot 2018; Ostrovsky et al. 2017; Saxenian 2002; Shami and Mickiewicz 2017).

From a human capital theory perspective (Marvel et al. 2016), the mounting empirical evidence of the over-representation and superior performance of

immigrant entrepreneurship activities raises a number of research questions that go beyond those limited to Schumpeterian economic growth (Acs 2010; Brown et al. 2017; Giotopoulos et al. 2017; Henrekson and Sanandaji 2020). First, it raises the question as to why the relative performance of immigrants in entrepreneurial activities appears more favorable than in labor markets (Clark and Drinkwater 2000; Green et al. 2016; Hartog et al. 2010). And, second, the evidence also begs for an explanation for why immigrants may be able to overcome barriers to entrepreneurship relatively more easily than they are able to in labor markets (Blanchard et al. 2008; Blanchflower et al. 2003; Carter et al. 2015; Ishaq et al. 2010; Lang and Lehman 2012; Lofstrom et al. 2014; Teixeira et al. 2007).

The mixed-embeddedness theory of (immigrant) entrepreneurship outlined by Kloosterman et al. (1999), Kloosterman and Rath (2001), and Kloosterman (2010) is a comprehensive analytical framework that interacts with the micro-level resources that early-stage entrepreneurs can mobilize (e.g. human, social and financial capital), and the meso-level local market opportunity structures (e.g. product demand, market competition and rivalry) with the macro-level institutional environment (e.g. laws, regulations, government grants and other monetary and fiscal incentives) offered by capitalist market economies. An understanding of these questions can be gained through the seminal *mixed-embeddedness theory*.

In this framework, Kloosterman (2010, p. 28) argues that “*markets, [...], are the crucial components of the opportunity structure*” (emphasis added) for immigrant entrepreneurs in developed market economies. But while he recognizes that meso-level market entry barriers (e.g. minimum efficient scale, small ethnic market size) and macro-level institutional barriers (e.g. permits, occupational licensing regulations) can impede immigrant entrepreneurship, he neglects to consider fully the potentially deleterious effects of many meso-level *information barriers and failures* such as *statistical discrimination* (Blanchard et al. 2008; Blanchflower et al. 2003; Cavalluzzo et al. 2002; Fairlie et al. 2016; Teixeira et al. 2007), *adverse selection* (Backes-Gellner and Werner 2007; Connelly et al. 2011; Giones and Miralles 2015; Hellmann and Stiglitz, 2000), or both (Dahlby, 1983).

Two important strands of the economics literature emphasize the potential importance of such information failures for immigrant entrepreneurs. First, Phelps (1972) and Arrow (1973) show that a lack of reliable and unbiased prior information about an immigrant entrepreneur’s human or social capital resources can lead to *statistical discrimination*, i.e. when observable characteristics of an immigrant entrepreneur (e.g. ethnicity, language, accent, nationality, race) are used as a proxy for unobservable outcome-relevant characteristics such as business quality, reliability, productivity or profitability in the market (Fang and Moro 2011).

Indeed, statistical discrimination can hinder an immigrant entrepreneur's market opportunities. A relative lack of information about an immigrant entrepreneur's human, social or financial capital resources compared to that of a native-born entrepreneur can limit their access to financing, hinder their ability to hire skilled employees, and jeopardize their access to critical suppliers and their ability to develop business opportunities with landmark customers. Further, it can also limit their capacity to obtain support from local business networks, security enforcement authorities, or key local decision-makers (Canello 2016; Ishaq et al. 2010; Ram et al. 2013; Ram et al. 2017).

And second, since Akerlof's (1970) seminal "lemons problem" idea, it has been established in many market settings that adverse selection reduces gains from trade when sellers possess private information about market opportunities that buyers can't credibly verify (Amit and Muller 1995; Hellmann and Stiglitz 2000; Myers and Majluf 1984; Plehn-Dujowich 2009). Hence, the presence of some untalented necessity entrepreneurs may also depress the market opportunities to immigrant entrepreneurship (Amit et al. 1990; Bruder et al. 2011; Ghatak et al. 2007).

Hence, in a mixed-embeddedness theory of immigrant entrepreneurship that considers the information market barriers and failures, early-stage immigrant entrepreneurs may face additional information market barriers relative to native-born early-stage entrepreneurs (Lofstrom et al. 2014). Thus, following the lead of the extensive literature on competitive signaling following Spence (1973) and others (Backes-Gellner and Werner 2007; Giones and Miralles 2015; Haagsma 1991; Riley 2001), our main empirical hypothesis is that many early-stage immigrant entrepreneurs may have an incentive to invest in a credible signal of the quality of their business, novel technologies, to overcome any meso-level informational market barriers because of imperfect or incomplete information about their micro-level resources.

We test this hypothesis using data from the 2012 and 2013 Adult Population Survey of the Global Entrepreneurship Monitor (GEM). Our estimations of a sample of 7,178 early-stage entrepreneurs in 28 developed countries show that necessity early-stage immigrant entrepreneurs, those we argue that are most likely to face information barriers about their micro-level resources, use more novel technologies than native-born entrepreneurs. Since more novel technologies are generally more advanced, expensive, and productive, we argue that our empirical result contributes a novel explanation for the relative performance of immigrant entrepreneurs compared to their native-born peers.

This result, consistent with the theory and empirical evidence of competitive signaling and statistical discrimination in labor markets (e.g. Spence 1973; Weiss 1995; Lang and Manove 2011), contributes to the growing body of empirical research on the market barriers to immigrant entrepreneurship (e.g.

Aliaga-Isla and Rialp 2013; Backes-Gellner and Werner 2006; Dheer, 2018; Giones and Miralles 2015; Godley 2013).

The rest of the chapter is organized as follows. The next section briefly outlines the related literature that frames our testable hypothesis of competitive signaling by early-stage immigrant entrepreneurs. Then, the following section describes the data from the GEM and the empirical model used to test our hypothesis on a sample of 7,178 early-stage entrepreneurs in 28 developed countries. Subsequently, we present our main empirical results and briefly discuss ancillary estimations that suggest their robustness. Finally, we summarize our findings and provide concluding comments.

## RELATED LITERATURE

There is a vast literature showing that the propensity for self-employment, business ownership, and entrepreneurship is higher amongst foreign-born immigrants relative to native-born individuals in many developed countries (for example, see Carter et al. 2015 and Mickiewicz et al. 2019 for the UK; Green et al., 2016 for Canada; Jensen et al. 2003 for the Netherlands; Kerr and Kerr 2017 for the USA). The evidence also shows that the share of immigrant entrepreneurs is positively related to a country's total entrepreneurial activity (Li et al. 2018), and also growing more diverse in countries such as the UK (Ram et al. 2013; Ram et al. 2017).

While scholarly research on the determinants and outcomes of immigrant entrepreneurship has grown over the past three decades (Aliaga-Isla and Rialp 2013; Dabić et al. 2020; Dheer, 2018; Rath and Kloosterman 2000), over that time the theoretical understanding of immigrant entrepreneurship has evolved. Initially focused on the social capital perspective (Portes and Sensenbrenner, 1993), the cultural and structuralist (Mavratsas, 1997), and the interactive (Waldinger et al. 1990) theories of ethnic and migrant entrepreneurship, support for the *mixed-embeddedness* theoretical framework of (migrant) entrepreneurship of Kloosterman et al. (1999) has grown in recent years (Ram et al. 2017).

This theory outlines that immigrant entrepreneurship is “not just determined by the resources this aspiring entrepreneur can mobilize but are also decided by the time-and-place specific opportunity structure” (Kloosterman 2010, p. 26) that is linked to market and institutional opportunities, and therefore also includes *market barriers* and *market failures*. This is a comprehensive theory of immigrant entrepreneurship that interacts with the micro-level resources that immigrant entrepreneurs mobilize (e.g. human, social, and financial capital) in the context of meso-level local market opportunity structures (e.g. product market size and rivalry) that are embedded within the macro-level

institutional environment of capitalist developed economies (e.g. laws, regulations, government grants and contributions, macroeconomic conditions).

At the micro-level, the human capital of the entrepreneur, often measured by education, experience, language proficiency, and cultural or religious proximity, provides by far the most robust explanation for immigrant entrepreneurs' selection and performance in entrepreneurial activities (Clark and Drinkwater 2000; Fairlie and Lofstrom 2015; Kloosterman 2010; Lofstrom et al. 2014; Marvel et al. 2016; Millán et al. 2014). But for the human capital to tilt the balance towards a "pulled-in" or "opportunity-driven" explanation for immigrants' greater propensity and superior performance in entrepreneurial activities, any theory of entrepreneurship would also have to explain why immigrants display persistent lower returns on human capital in the labor market (Borjas 1986; Clark and Drinkwater 2000; Ghatak et al. 2007; Hartog et al. 2010).

In this research, we investigate the potential incentive effects of meso-level *information* market barriers and failures about micro-level resources of early-stage immigrant entrepreneurs. In particular, we focus on the potential effects of *statistical discrimination* (Blanchard et al. 2008; Blanchflower et al. 2003; Cavalluzzo et al. 2002; Fairlie et al. 2016; Teixeira et al. 2007) and *adverse selection* (Amit et al. 1990; Backes-Gellner and Werner 2007; Giones and Miralles 2015; Hellmann and Stiglitz, 2000), and possibly both (Dahlby 1983).

Because meso-level market information about the micro-level resources of immigrant entrepreneurs may not be as detailed or reliable as that of native-born entrepreneurs (e.g. education credentials, credit records, or a verifiable history of past entrepreneurial activities), competitive signaling theory suggests that immigrants could have an incentive to overcome the market barriers of statistical discrimination and the market failure of adverse selection using a credible technology signal (Giones and Miralles 2015; Haagsma 1991). We, therefore, posit that many early-stage immigrant entrepreneurs use novel technologies to signal the quality, productivity, and profitability of their new business and overcome these information market barriers and market failures. Because Ostrovsky et al. (2019) find empirical evidence that suggests that the relative gap in meso-level information between immigrant and native-born entrepreneurs and business-owners dissipates over a relatively long period of time (approximately 20 years), we focus on early-stage entrepreneurs to test our hypothesis.

Contrary to the animus-based (or taste-based) economic theories of discrimination (Ishaq et al. 2010), statistical discrimination occurs when rational decision-makers use aggregate group characteristics to infer an individual's non-observable outcome-related characteristic such as job performance (Glover et al. 2017), job attachment (Tanaka 2015), car driving skills (Dahlby

1983), or criminal activity and police brutality (Fryer 2016). Although statistical discrimination in the labor market (Fang and Moro 2011; Lang and Lehmann 2012) is often mentioned as a reason for the higher propensity of immigrants for self-employment and entrepreneurship (Clark and Drinkwater 2000; Fairlie and Lofstrom 2015; Valdez 2011), to our knowledge there have been few empirical studies that have focused on the competitive signaling incentives from statistical discrimination by early-stage immigrant entrepreneurs.

With the exception of empirical studies that consider the problem of adverse selection for the financing of ethnic or minority entrepreneurs in the US and UK credit markets (Blanchard et al. 2008; Blanchflower et al. 2003; Cavalluzzo et al. 2002; Fairlie et al. 2016), where asymmetric information about the quality of an entrepreneur yields tighter credit constraints, in this research we focus on an alternative impact of competitive signaling. To signal the quality of their micro-level resources unobservable at the market meso-level, early-stage immigrant entrepreneurs could invest proportionally more in novel and more productive technologies (e.g. Backes-Gellner and Werner 2006; Godley 2013). From a competitive signaling perspective such investments in novel, more expensive, and productive technologies could result in the superior performance of immigrant entrepreneurship (e.g. de Meza and Webb 1987; Michael 2009), especially for early-stage immigrant entrepreneurs who may have experienced discrimination in the labor market and have been “pushed” into necessity entrepreneurship (e.g. Amit and Muller 1995; Fairlie and Fossen 2018; Hessels et al. 2008; Larsson and Thulin 2019; Poschke 2013).

Hence, within the confines of the mixed-embeddedness theory of immigrant entrepreneurship, we test the theoretical hypothesis of competitive signaling to explain the superior performance of early-stage immigrant entrepreneurship.

## EMPIRICAL APPROACH

To test our hypothesis about early-stage entrepreneurs competitive signaling through novel technologies, we assemble two years of the Adult Population Survey (APS) from the GEM (e.g. Álvarez et al. 2014; Reynolds et al. 2005), years in which individuals were asked if they “were born in the country” (Special Topic 1, Question 7, Global Entrepreneurship Monitor Consortium 2012, 2013). Our database initially includes 311,260 observations on individuals who responded to be either foreign- or native-born in 2012 and 2013 across 80 countries. Our sample precludes the analysis of other related issues such as ethnic, refugee, or economic migrant entrepreneurship in those countries.

Our estimation sample focuses on early-stage entrepreneurs in developed market economies, i.e. individuals who are either early-stage entrepreneurs or owner-managers of new businesses with no more than 42 months of paid

Table 9.1 Sample descriptive statistics

	Observations	Mean	Standard-deviation	Minimum	Maximum
Technology novelty	7178	1.406381	.6730948	1	3
Export intensity	7178	.7943717	.8999321	0	3
Immigrant	7178	.1049039	.3064509	0	1
Necessity	7178	.2050711	.4037817	0	1
Age	7178	40.241	11.71019	16	87
Female	7178	.3572026	.4792086	0	1
Education	7178	1177.333	440.7362	0	1720
Income	7178	31135.07	32864.08	33	68100
Technology sector	7178	.1401505	.4905415	0	2

*Notes:* The sample includes all individuals with non-missing observations on selected variables from the following 28 developed countries (or innovation-driven countries according to GEM classification): USA (reference), Canada, Porto Rico, UK, France, Germany, Italy, Spain, Portugal, Greece, Netherlands, Belgium, Luxembourg, Switzerland, Austria, Ireland, Denmark, Sweden, Finland, Norway, Slovenia, Slovakia, Czech Republic, Israel, Taiwan, Singapore, Japan, and South Korea.

*Source:* Adult Population Survey (APS), Global Entrepreneurship Monitor (GEM), 2012–2013.

salaries to employees. As explained in the previous section, micro-level information about immigrant entrepreneurs is more likely to be imperfect or incomplete relative to native-born entrepreneurs in the early-stages of entrepreneurial activities. The resulting estimation sample includes 7,178 native- and foreign-born (i.e. immigrant) early-stage entrepreneurs with non-missing observations on the dependent and independent variables listed in Table 9.1 from the following 28 developed market economies: USA (reference), Canada, Porto Rico, UK, France, Germany, Italy, Spain, Portugal, Greece, Netherlands, Belgium, Luxembourg, Switzerland, Austria, Ireland, Denmark, Sweden, Finland, Norway, Slovenia, Slovakia, Czech Republic (now called Czechia), Israel, Taiwan, Singapore, Japan, and South Korea.

Since our focus is on testing the competitive signaling using novel (more recent) technologies by early-stage entrepreneurs in the context of imperfect information market barriers (statistical discrimination) or incomplete information market failures (adverse selection), and possibly both, our *dependent variable* is an ordered latent variable measuring the novelty of the technology used by early-stage entrepreneurs. This dependent variable is increasing in novelty: Old – i.e. longer than five years old (0); Recent – i.e. between one to five years old (1); and, Latest – i.e. less than a year old (2). Implicit in this latent empirical construct is that the micro-level resources required to acquire any technology increase according to its novelty, i.e. where the most novel technology is more expensive than the recent technology, and the recent tech-



nology is also more expensive than the old technology. Similar to patents, we assume that the novelty of a technology is observable to market stakeholders.

According to the mixed-embeddedness theoretical framework, the novelty of a technology used by entrepreneurs is influenced by the interaction of three broad groups of independent variables: micro-level (individual) variables, meso-level (market) variables, and macro-level (institutional) variables.

At the micro-level, we include the demographic characteristics of *age* and gender (*female*). We also include the variables *education* (a harmonized cardinal categorical variable across countries) and household *income* (a harmonized cardinal categorical variable across countries). Those independent variables are commonly associated with the relevant characteristics of human, social, and financial capital of early-stage entrepreneurs (e.g. Arenius and Minniti 2005; Backes-Gellner and Werner 2007; Lévesque and Minniti 2006).

In addition, given our main hypothesis, we include the micro-level *independent variables* that determine whether the entrepreneur is foreign-born (*immigrant*) and whether he (or she) is necessity-driven exclusively (*necessity*). Given the extant literature on necessity entrepreneurship (e.g. Fairlie and Fossen 2018; Hessels et al. 2008; Larsson and Thulin 2019; Poschke 2013), we expect the coefficient of necessity-driven entrepreneurs to be negative and reduce the probability of using a technology from a more recent vintage. On the other hand, given the recent empirical evidence that suggests the superior performance of early-stage immigrant entrepreneurs, we expect the coefficient of *immigrant* to increase the probability of using a more recent vintage of the technology (Duhamel et al. 2017; Hart and Acs 2011; Hart and Mickiewicz 2016; Hunt 2011; Neville et al. 2014; Ostrovsky and Picot 2018; Ostrovsky et al. 2017; Saxenian 2002; Shami and Mickiewicz 2017).

But most important in our empirical model, it is the interaction term *immigrant*  $\times$  *necessity* that will measure any moderating effect associated with the competitive signaling by a necessity early-stage immigrant entrepreneur. The central point of our hypothesis is that a necessity-driven early-stage immigrant entrepreneur is significantly more likely to adopt a more novel technology, compared to a native-born necessity-driven early-stage entrepreneur if he (or she) is attempting to signal higher product quality and future profitability to market stakeholders such as employees, customers, and suppliers. If our hypothesis is correct, the parameter on the interaction term *immigrant*  $\times$  *necessity* should be positive and statistically significant whatever is the baseline technology used by native-born early-stage entrepreneurs.

Finally, to take into account other meso-level market opportunity factors we also add a *technology sector* independent variable (an omitted sector is the low tech sector) of the entrepreneur. And for the macro-level factors, we also include country and year fixed effects (omitted categories are the USA



and 2012) to take into account the influence of any year- and country-specific variations in institutional and macroeconomic conditions.

Given this specification of our empirical model, we estimate an ordered probit model (e.g. Greene 2011). Such an approach has been used in other settings where the latent dependent variable crosses progressively higher thresholds (e.g. van der Zwan et al. 2010).

## ESTIMATION RESULTS

Table 9.2 reports our main estimation results from ordered probit regressions where the dependent variable is an ordered nominal (latent) variable of the novelty of the technology. The estimated parameters of the linear index function are reported along with their clustered (by country) robust standard-error in parenthesis immediately below. The average marginal effect of the variable *immigrant* of Model 4 is reported in Figure 9.1.

Our analysis of the results proceeds hierarchically. Model 1 provides the estimated parameters of *immigrant* and *necessity* on the probability of using a more novel technology along with estimated cutoffs between Old and Recent ( $k_1$ ) and Recent and Latest ( $k_2$ ). Estimated parameters on *immigrant* and *necessity* are both statistically significant at conventional levels and have the expected effects on the probability of choosing a more novel technology. Estimates of Model 2 and Model 3 show the effects of sequentially adding micro-level variables (female, age, education, income) and the meso-level market tech sector variable in Model 2, and the addition of macro-level year and country fixed effects variables in Model 3. The estimated coefficient on *immigrant* remains relatively larger (in absolute value) than the coefficient on *necessity*. Adding the individual controls in Model 2 raises the estimated coefficient on *immigrant* relative to the one on *necessity* compared to Model 1, while the addition of country and year variables in Model 3 dampens the relative effect (in absolute value) of *immigrant* compared to *necessity*.

Model 4 adds the interaction term *immigrant*  $\times$  *necessity* to complete the specification of our empirical model. The estimated coefficient on *immigrant* becomes not statistically significant while the coefficient on the interaction term of interest is positive and significant at the 1% level. While Model 4 marginally improves the overall performance of Model 3, the statistical significance of the interaction term combined with the inability to reject the null hypothesis of a direct effect of *immigrant* on the probability of choosing a more recent vintage shows that we cannot reject the hypothesis of competitive technology signaling by necessity-driven early-stage immigrant entrepreneurs.

The estimated average marginal effect of *immigrant* on the probabilities of selecting each vintage of a technology of Model 4 is displayed in Figure 9.1. All else being equal, our main result shows that an early-stage immigrant

Table 9.2 Maximum-likelihood ordered probit estimations – vintage of technology

	Model 1	Model 2	Model 3	Model 4
<i>Dependent variable</i>	<i>Ordered vintage of technology (Old, Recent, Latest)</i>			
Immigrant	.1627432* (.0673258)	.1713216** (.0654038)	.1283889* (.0574317)	.0350876 (.0804578)
Necessity	-.1114714** (.0421033)	-.0885427* (.0414736)	-.1122104** (.03843)	-.1646361** (.0440152)
Immigrant × Necessity				.4258273** (.1311587)
Female		-.0838423** (.0318302)	-.0871917** (.0330876)	-.0877293** (.0332621)
Age		-.0033043** (.0012485)	-.0026707* (.0010929)	-.0025795* (.0011055)
Education		.0000374 (.0000384)	.0000753 (.0000467)	.0000762 (.0000464)
Income		2.94e-08 (4.06e-07)	1.03e-07 (4.27e-07)	1.27e-07 (4.18e-07)
Medium-tech sector		.2678324** (.0724894)	.2379589** (.0652615)	.2362441** (.0657242)
High-tech sector		.3973848** (.0532107)	.4235288** (.0498539)	.4239063** (.0499833)
Country fixed effects	No	No	Yes	Yes
Year fixed effects	No	No	Yes	Yes
k <sub>1</sub>	.518488** (.0390141)	.4398693** (.066758)	.5871187** (.0649531)	.5802346** (.0657739)
k <sub>2</sub>	1.245753** (.046295)	1.172416** (.0630044)	1.332937** (.0554795)	1.327228** (.0565149)
Obs	7178	7178	7178	7178
Log-likelihood	-5777.4	-5741.3	-5662.0	-5655.3
Pseudo-R <sup>2</sup>	0.002	0.008	0.022	0.023

*Notes:* The reference (omitted) categories for included categorical variables are : native-born (immigrant), not necessity driven (necessity), male (female), low tech sector (medium- and high-tech sectors), and the USA and 2012 for country and year fixed effects, respectively. Clustered (by country) robust standard-errors are reported in parenthesis below the maximum-likelihood estimator of the parameter. \*, \*\* indicates the parameter is significant at the 5 percent and 1 percent level, respectively.

*Source:* Adult Population Survey (APS), Global Entrepreneurship Monitor (GEM), 2012–2013.

entrepreneur is more likely, *on average*, to adopt a more novel technology than

a native-born early-stage entrepreneur. Since the estimated average marginal effect of immigrant is derived exclusively from the statistically significant interaction with necessity entrepreneurs, who arguably have very little to gain compared to other early-stage native-born necessity entrepreneurs, we cannot reject the hypothesis of competitive signaling by necessity-driven early-stage immigrant entrepreneurs.

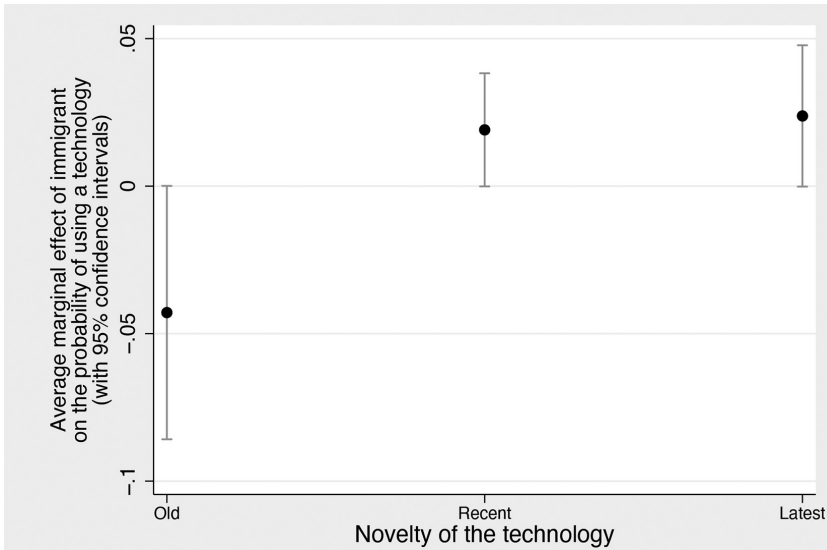


Figure 9.1 Average marginal effect of immigrant on the novelty of technology

Table 9.3 provides an additional regression analysis that suggests alternative signals may not convey as much credible information about the quality of the business to market stakeholders. In particular, the interaction term of *immigrant* with *necessity* does not significantly influence the probability of observing a similarly ordered international orientation. Thus, the novelty of a technology appears associated with a more credible signal than the thresholds of international orientation.

This specification of the linear index function of our ordered probit model and the control variables have been subjected to a number of tests for known and unknown specification errors that are not reported here given the limited space allowed (available from the authors upon request). These tests did not alter substantially the relative scale of the estimated parameters nor the significance or the interpretation of the estimates of the independent variables of interest. In addition, we also estimated a similar model with

**Table 9.3** *Maximum-likelihood ordered probit estimation – international orientation*

Dependent variable	<i>Ordered international orientation as the share of foreign customers in output (None, 1%–25%, 26%–75%, and 76%–100%)</i>
Immigrant	.2704911** (.0483486)
Necessity	–.2013855** (.0384514)
Immigrant × Necessity	.122164 (.1163313)
Female	–.1649449** (.0289431)
Age	–.000466 (.0016315)
Education	.0000584 (.0000396)
Income	1.51e–06** (5.75e–07)
Medium-tech sector	.2623892** (.1011583)
High-tech sector	.3586859** (.0413858)
Country fixed effects	YES
Year fixed effects	YES
$k_1$	–.317956* (.145928)
$k_2$	.8111928** (.0876741)
$k_3$	1.363671** (.0938733)
Obs	7178
Log-likelihood	–7771.9
Pseudo-R <sup>2</sup>	0.061

*Notes:* The reference (omitted) categories for included categorical variables are: native-born (immigrant), not necessity driven (necessity), male (female), low tech sector (medium- and high-tech sectors), and the USA and 2012 for country and year fixed effects, respectively. Clustered (by country) robust standard-errors are reported in parenthesis below the

maximum-likelihood estimator of the parameter. \*, \*\* indicates the parameter is significant at the 5 percent and 1 percent level, respectively.

Source: Adult Population Survey (APS), Global Entrepreneurship Monitor (GEM), 2012–2013.

opportunity-driven early-stage immigrant entrepreneurs. In this case, we found no statistically significant negative effect of the interaction term difference between immigrant and opportunity. This suggests that opportunity-driven immigrant entrepreneurs have no additional incentive to signal the quality of their business to market stakeholders beyond those that are expected from native-born early-stage entrepreneurs.

In our view, our results suggest that the superior performance of early-stage immigrant entrepreneurs compared to their native-born peers can be explained not only by the potentially superior entrepreneurial acumen of opportunity-driven immigrant entrepreneurs (Hunt 2011; Saxenian 2002; Vandor and Franke 2016), but also by the superior technologies adopted by necessity-driven immigrant entrepreneurs who may try to overcome information barriers and market failures. Our evidence suggests that the latter may play a bigger role than had been acknowledged previously in the literature.

## SUMMARY AND CONCLUDING COMMENTS

Human capital provides by far the most important explanation for the greater propensity and superior performance of immigrants in entrepreneurial activities relative to native-born. For the human capital to tilt the balance towards a “pulled-in” explanation of the performance of immigrant entrepreneurship, any theory would also have to explain why immigrants also display persistently lower returns on human capital in the labor market. In other words, if low skilled immigrants in the labor market are “pushed” into entrepreneurship by better earnings prospects, should not their businesses underperform, *on average*, compared to native-born?

In this research, we test a novel hypothesis that early-stage immigrant entrepreneurs may have an additional incentive to invest in a credible and reliable signal of the quality of their business that can boost their performance relative to native-born entrepreneurs. The hypothesis of competitive signaling arises because many early-stage immigrant entrepreneurs may not have as detailed, reliable, and credible information about their education credentials, their credit records, or a verifiable history of past entrepreneurial success compared to their native-born peers. Our hypothesis is that immigrants could have an additional incentive to overcome the market barriers of statistical discrimination and the market failure of adverse selection using a credible technology signal that can boost their performance relative to native-born entrepreneurs.

We test this hypothesis with data from the 2012 and 2013 APS from the GEM. Our estimations of a sample of 7,178 early-stage entrepreneurs across 28

developed countries show that necessity early-stage immigrant entrepreneurs, those we argue that are most likely to face information market barriers and market failures, use more novel technologies than native-born entrepreneurs. If more novel technologies are more productive and also boost the performance of their businesses, our results contribute a novel explanation for the relative performance of immigrant entrepreneurs compared to their native-born peers. Not only can early-stage immigrant entrepreneurship outpace the performance of native-born entrepreneurs because of their superior opportunity-driven entrepreneurial acumen (e.g. Hunt 2011; Saxenian 2002; Vandor and Franke 2016), but also because “pushed-in” necessity-driven immigrant entrepreneurs who try to overcome information barriers and market failures also use more novel technologies. Our evidence suggests that the latter competitive signaling effect may play a bigger role in explaining the superior performance of immigrant entrepreneurship than has been acknowledged in the literature.

So far, most of the public discourse in developed countries has been overwhelmingly focused on the economic benefits of immigrant entrepreneurship in light of their higher propensity and superior performance at entrepreneurial activities. This research shows that some of the economic benefits associated with immigrant entrepreneurship may not fully capture the costs associated with market barriers and failures. Economic inefficiencies can spill over from the labor market into the entrepreneurial business market when immigrants have to incur additional (sunk) costs when they are pushed into entrepreneurial activities. Following Naudé et al (2017), we suggest that public policy should not only look at immigrant entrepreneurs as a cure to economic development but also as a potential symptom of unresolved discrimination of immigrants in the labor market.

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