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BUSINESS MODEL ADAPTATION: ARE NEW TECHNOLOGY-BASED FIRMS DIFFERENT?

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Abstract: The business model is an important construct for practitioners, but only recently researchers have begun to study it. Empirical research on adaptation in particular is almost non-existent. It mostly comprises of case studies of large established firms. We contribute to the gap by creating an economy-wide longitudinal dataset of new ventures. This allows us to describe adaptation in elements of the business model in a manner that has not been possible thus far. We are also able to conduct methodologically sound tests of theory-based models. We consider adaptation to elements of the business model as a form of organisational learning and apply human capital and social capital theory to understand their role in facilitating adaptation. We split our sample in two and deploy the same analyses to firms where proprietary products and processes are relevant and to those where they are not. To test the hypotheses we conduct moderated hierarchical regression analyses on the two groups of firms. We find that social capital and generic education are significant for mainstream firms, but not firms where proprietary products and processes are relevant. The opposite is true for specific education and for generic and specific experience. We also find that the interaction between human and social capital has a different effect in the two groups of firms.

Keywords: Business model adaptation; technology-based firms; human capital; social capital.

I. INTRODUCTION

The business model is an important driver of economic performance (Malone, Weill, Lai, D'Urso, Herman, Apel and Woerner 2006; Zott and Amit 2007; Zott and Amit 2008) and is the transforming mechnism that creates market value from technology and innovation value (Chesbrough and Rosenbloom 2002; Björkdahl 2009). Understanding what factors facilitate or impede business model adaptation therefore becomes very important.

Research on the business model has moved beyond its initial focus on e-business (Mahadevan 2000; Afuah and Tucci ; Amit and Zott 2001; Weill and Vitale 2001) to other sectors such as biotechnology (Bigliardi, Nosella and Verbano 2005; Pisano 2006; Rothman and Kraft 2006; Willemstein, van der Valk and Meeus 2007). Individual studies do, however, remain narrowly focussed, as highlighted by Patzelt et al (2008: 217):

> ... we would also like to encourage business model researchers to extend their attention beyond the e-business and internet industries, on which most studies have focused so far

At the same time, academic researchers have only conducted "embryonic work focusing on a dynamic perspective" of the business model at the firm level (Sosna, Trevinyo-Rodriguez and Velamuri 2010: 402.) Past research has consisted of case studies of large, established firms. These studies have often stated or hypothesised the distinctiveness of early stage ventures in this respect (Chesbrough and Rosenbloom 2002; Sosna et al. 2010), but there is little research on such firms. Entrepreneurship literature shows there are differences and that early stage firms merit separate study (Nicholls-Nixon, Cooper and Woo 2000 ; West and Noel 2009).

Of the few quantitative, regression-based studies on the business model (Malone et al. 2006; Andries and Debackere 2007; Zott and Amit 2007; Patzelt et al. 2008; Zott and Amit 2008; Bock, Opsahl, George and Gann 2012), two make use of adaptation/innovation.

First, Andries and Debackere (2007) used business model adaptation as predictor of survival of new technology businesses in the United States. Their database (the annual CorpTech directory) contained two elements of the business model: product and target market. As a result, the adaptation variable was based on researchers noting changes in

product/market descriptions. Any other forms of adaptation were therefore not observed.

Second, Bock et al (2012) use adaptation as a moderator between structural reconfiguration and structural flexibility. The latter study included one equation with "business model innovation" as dependent variable, finding that leadership involvement was a significant driver. It is, however, based on the 2006 IBM Global CEO Survey, with only 33% of the sample having 0-5,000 employees (Bock et al. 2012: 286).

Other quantitative studies have generally been sectorally based, aimed at describing typologies of business models (Mangematin, Lemarié, Boissin, Catherine, Corolleur, Coronini and Trommetter 2003; Bigliardi et al. 2005; Willemstein et al. 2007). Because of their biotechnology focus, these studies mostly consisted of young firms, but not exclusively so. Further, the phenomenon of adaptation was not the focus of research.

To fill that gap, this paper reports on a panel study of young and nascent firms discovered through a large scale random survey of households (Davidsson, Steffens, Gordon and Reynolds 2008). Because of the broad nature of the study, we can make comparisons between the mainstream and firms for which proprietary processes and products are relevant (hereafter we use the shorthand: IP-relevant firms.)

A further contribution stems from our methodologically sound longitudinal observations, which allows us to make causal inferences (Scandura and Williams 2000; Martinez 2011). In this paper we therefore take an organisational learning perspective. That is, we take business model adaptation to be a reflection of the new firm's learning. We then apply the theory of human and social capital to ask the question: what is the role of human capital and social capital in business model adaptation for mainstream new ventures and for IP-relevant firms.

The paper proceeds as follows. First, we review relevant literature to explicate why we might expect to see differences between the two groups and why human and social capital should impact on business model adaptation. Then, we outline our method and present results. This is followed by a Discussion of implications for theory, practice and further research.

II. THEORY AND HYPOTHESES

A. Distinctiveness of high technology markets

When the business model acts as the transformation mechanism between the science/technology domain and the market domain, then it is subject to uncertainty and dynamism from both domains (Chesbrough and Rosenbloom 2002.) The cognitive difficulties are exacerbated in science-intensive ventures by the fact that the technological uncertainty remains higher for a longer portion of the product development process (Malerba and Orsenigo 2002; Pisano 2006.)

In a similar context, Eisenhardt and Martin (2000) cursorily referred to business models in their analysis of the distinctions between moderately dynamic and high-velocity markets. In the former environments, firms are reliant on existing knowledge and orderly procedures, could more readily identify market participants, and displayed clearer business models. In the latter environments, they state that market boundaries, market participants and business models are more fluid and unpredictable. Here, Eisenhardt and Martin (2000) find that dynamic capabilities need to be based on few rules, mostly in order to set limits or priorities for knowledge search and creation, because existing knowledge is likely to be counterproductive in the rapidly shifting conditions (McKelvie and Davidsson 2009).

While it seems clear that one could have placed business model adaptation within the dynamic capabilities framework given existing definitions, more recent contributions to the field (Teece 2007; Augier and Teece 2008) make the connections explicit, from a logical, theoretical perspective, as evidenced by this passage:

> "The capacity an enterprise has to create, adjust, hone, and, if necessary, replace business models is foundational to dynamic capabilities." (Teece 2007: 1330)

In highly dynamic technology-based environments, market participants learn from each others' experiments, as well as from their own. They take small continuous steps in the business model adaptation process (McGrath 2010). These assertions about business model adaptation in high technology markets are typically hypothesised, but not tested systematically. This study reports data that allow us to test the hypotheses that

H1 IP-relevant firms engage in more business model adaptation than the mainstream

B. Organisational learning, social capital and human capital

The developmental approach of the organisational learning literature sees organisations taking a pro-active learning attitude, as in the dynamic capabilities literature. It theorises that learning changes in manner and content, based on age and size (Sinkula 1994), as well as history of the organisation (Cohen and Levinthal 1990; Shane and Venkataraman 2000). New ventures must rely more on "congenital knowledge" which is then developed through trial and error in the marketplace (Sinkula 1994: 38).

Human capital is both an important driver and recipient of organisational learning. It comprises the accumulated stock of knowledge from certified and experiential learning (Arrow 1962; Brown and Duguid 1991). Generic human capital can be applied across domains with low switching costs and loss of returns (Becker 1964; Reed and De Fillippi 1990). Specific human capital is less easily transferred, precisely because its value is more specific to particular settings.

Previous studies have found that prior stock of knowledge allows learning to occur from new information and the uneven distribution of such stock across the economy impacts on how the information is processed and on entrepreneurial outcomes (Shane 2000; Davidsson and Honig 2003). These higher cognitive abilities should also facilitate business model adaptation.

H2 Greater generic human capital in the form of education and experience will lead to greater business model adaptation in new ventures

H3 Owners' greater specific human capital in the form of education and experience will lead to greater business model adaptation in new ventures

Social capital can enhance organisational advantage through its effect on learning (Brown and Duguid 1991; Nahapiet and Ghoshal 1998) especially for managers "with few peers" within the firm (Burt 1997: 345). This is the situation often found in new ventures struggling with the liability of newness (Stinchcombe 1965). We distinguish between bonding and bridging ties.

Bonding ties occur when there are high levels of camaraderie and trust, such as in families, or among friends (Becker and Murphy 1992; Cope 2011). Information flows rapidly, and there is strong positive reinforcement of behaviour (Sobel 2002), which can lead to excessive reliance on internal communication hence impede adaptation (Kautonen, Zolin, Kuckertz and Viljamaa 2010). Bridging ties connect individuals to networks with which one has fewer interactions, where the sense of common purpose is more diffused. Information flows tend to be slower, but can reach out more broadly making them a more useful means of collecting and disseminating novel ideas and practices (Rogers 1962). Useful bridging ties can accelerate learning especially when markets or technologies are uncertain (Teece 1996), or the young firm has limited accumulated human capital (West and Noel 2009). Hence:

H4 With greater component of family and friends in the new venture founding team, business model adaptation will decrease

H5 Greater use of network connections of the bridging type will lead to greater business model adaptation, with diminishing returns

We can therefore see the important impact of prior human capital embodied in the firm, typically mostly in the owner-founders. This can them be augmented and reshaped through social capital activities that draw in new data and information to interact with existing resources. Past research hypothesises complementarities between human and social capital (Nahapiet and Ghoshal 1998; Ployhart and Moliterno 2011). It follows that their interaction should also have an impact on business model adaptation. Therefore, we hypothesise

H6 There is a stronger positive relationship between bridging social capital and business model adaptation for those with high levels of human capital than for those with low levels of human capital

H7 There is a weaker negative relationship between bonding social capital and business model adaptation for those with high levels of human capital than for those with low levels of human capital

We do not hypothesise relative importance of social and human capital between the two groups of firms (IP-relevant and mainstream), expecting to infer any differences from the empirical results. This is because, while we might expect higher levels of human capital in IP-relevant firms, distinctions within the groups might be important drivers of variance for mainstream firms (Unger, Rauch, Frese and Rosenbusch 2011).

III. METHODS

A. Source of data

Data are drawn from the Comprehensive Australian Study of Entrepreneurial Emergence (CAUSEE) which adopts a methodology developed by the Panel Study of Entrepreneurial Dynamics (PSED) (Gartner et al. 2004; Reynolds 2007). Telephone contact of a random sample of 30,105 households in Australia, generated 1,186 new ventures in its first wave (Davidsson et al. 2008). Interviews were conducted repeatedly over four years. In wave four, 382 respondents were asked questions about their firm's business model.

This design deals with two important sources of selection bias: sampling from an incomplete population (Martinez 2011); sampling on the dependent variable (Denrell and Kovács 2008). It allows temporal separation of dependent and independent variables (Scandura and Williams 2000) and varied question type in a long interview (Podsakoff, MacKenzie, Lee and Podsakoff 2003), in a theory-based model. Thus, our design aids inferences of causality.

B. Measures

In order to distinguish the firms for which technology or innovation are relevant, we asked two questions about intellectual assets. We asked if any applications to protect intellectual property had already been submitted, would be submitted, or was not relevant to the business. We also asked if the business had developed proprietary technology, processes, or procedures that no other company can use, if it would do so in future, or if it was not relevant for the business. The latter question was important, because there are innovations for which formal protection is of little value, or could even be detrimental. Innovative processes and software are typically not protected through patents. In dynamic environments, the cost and time required for formal protection might not be a useful investment compared to rapid creation and exploitation of innovations or discoveries.

From these two questions, we created a dichotomous variable for firms that considered technology and innovation relevant/irrelevant to their business. In this study we use the variable created from answers in wave 1.

1) Dependent variable

Our interviews covered four elements of the business model: product, customers, method of promotion, method of production. In waves 2-4 we also asked about adaptation of those elements:

> For each of the following statements I would like to know whether there has been any *important change during the last 12 months* and, if so, roughly how many changes there have been of that kind. [emphasis in original]

Possible answers ranged from No/0 to Yes/5+. To generate an overall picture of business model adaptation, we aggregated the number of changes for each element of the business model.

For our descriptive analysis, we dichotomised the aggregated responses into a Yes/No variable. If they had made changes, respondents were then given a list of potential reasons and asked how many changes were due to the specific potential antecedent. The reasons are listed in Table 3. For our regression analysis, we drew our dependent variable from the answers to wave four. The raw data were then augmented by 1 and a log-normal transformation taken.

1) Independent variables

Human and social capital were operationalised using variables for each theoretical category (ie generic/specific, bridging/bonding.) Some are formative measures (Leonard-Barton 1992) combining several items in the database, as a count index of the relevant components (McKelvie and Davidsson 2009). Others are single item measures. Observations were mostly taken in wave one, with some from wave two.

We asked questions about the ownership team's collective generic experience: years of general management experience; whether anybody had worked in management in a large corporation for more than a year (dummy variable); number of countries in which all owners had either worked or studied as an adult for a period greater than three months. Our measure of *generic education* is the percent of owners with postsecondary qualification.

Questions relating to the ownership team's collective specific experience asked about: number of years in the same industry as the current new venture; number of prior start-ups created. We constructed an index to capture how the firm's prior work experience was useful to the new venture. In wave 2, we also asked whether employees or other paid helpers had made important contributions in the same areas, during the previous year. Similar variables have been labelled Business Skills Index (Haber and Reichel 2007) or comprehensiveness of

knowledge (Sullivan and Marvel 2011) but generally denote a larger stock of human capital, the higher the index count. To measure specific education, we asked whether any of the owners could help the business in certain areas, based on their education and training.

We adopted one measure of bonding ties and two of bridging ties. Bonding ties typically relate to family and close, long standing connections (Davidsson and Honig 2003; Cope, Jack and Rose 2007). We asked respondents if any owners were related by marriage or blood, were friends from work or social environments, or were strangers.

Important forms of bridging ties consist of connections in networks that are explicitly business related (Davidsson and Honig 2003). We have adopted this method and created a global social capital index counting membership of face-to-face and online business networks, industry groups/associations, as well as aspects of international activities. We sought information about possible sources of information and advice that had been "not used at all; a minor source; or a major source" [emphasis in original]. To compile this external advice index, we listed fourteen potential sources, ranging from employers or colleagues to customers and business media.

As controls we used: age of the youngest and oldest partners; proportion of female partners in the ownership team; a product/service dummy.

C. Statistical procedure

We applied a non-parametric test to the data about whether the firms had made any changes to their business model. Otherwise, we report absolute levels and percentages for the descriptive data on changes of individual elements of the business model and on reasons for changes.

We conducted the analysis in seven models. This was to obviate multicollinearity problems (Chandler, McKelvie and Davidsson 2009). Before testing for interaction effects, we centered the variables on their mean (Jaccard, Wan and Turrisi 1990). We then entered into the moderation step of the regression a cross-product of the hypothesised predictors and moderators (Frazier, Tix and Barron 2004). In the equations testing for moderation effects, all variables are centered on their mean.

In order to test hypotheses 2-7, we ran hierarchical multiple regression analysis. Controls, human capital, social capital, and interaction terms were entered as separate steps in the models.

IV. RESULTS

A. Descriptive data

Table 1 displays the number and percentage of firms that implemented any adaptation to their business model in each wave. On each occasion, the firms that in wave 1had considered IP to be relevant were more likely to have adapted their business model. The χ^2 statistics show that the split between change/no-change in the two groups was significant in each wave: H1 is supported.

	W1		W2		W3		W4	
	N	%	N	%	N	%	N	%
Intellectual property relevant								
No change	141	25.7	103	32.0	87	38.2	72	42.4
Some change	408	74.3	219	68.0	141	61.8	98	57.6
Total	549		322		228		170	
Intellectual property not relevant								
No change	250	39.4	191	48.8	136	48.6	112	52.8
Some change	384	60.6	200	51.2	144	51.4	100	47.2
Total	634		391		280		212	
Crosstab χ^2	25.14***		20.72***		5.53*		4.15*	
† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$								

Table 1: *Change/No-change distribution, Waves 1-4*

When we examine the various elements of the business model (see Table 2) we find two consistent patterns. First, the ranking is the same across waves. Products are the element most likely to be adapted, followed by customers, promotion or selling methods and finally production or sourcing methods. Second, the IP-relevant firms were more likely to have made changes to each element, in each wave.

A tabulation of reasons given for the business model adaptation is in Table 3. We present only data for the IP relevant firms, to save space. In each wave, the top two most frequent reasons driving adaptation were success with customers and internal drivers for innovation. The internal driver was most popular in wave 1 and customers in waves 2-4.

	Number				% of respondents			
	W1	W2	W3	W4	W1	W2	W3	W4
Intellectual property relevant								
Products or services that you sell or intend to sell	284	147	81	66	43.3	45.7	35.5	38.8
What customers you sell to or intend to sell to	206	115	80	55	37.9	35.7	35.1	32.4
The method for promoting or selling	206	108	67	51	37.7	35.5	29.4	30.0
The method for producing or sourcing	180	78	60	33	32.9	24.4	26.3	19.4
Intellectual property not relevant								
Products or services that you sell or intend to sell	227	123	75	50	35.9	31.5	26.8	23.6
What customers you sell to or intend to sell to	188	111	67	51	29.7	28.4	23.9	24.1
The method for promoting or selling	180	91	55	47	28.4	23.3	19.6	22.2
The method for producing or sourcing	142	57	47	35	22.4	14.7	16.8	16.5

Table 2: *Type of change, Waves 1-4*

Intellectual property relevant	Number			% of respondents		
	W1	W2	W3	W1	W2	W3
Customers requested change	194	91	54	35.7	28.3	23.7
Market research suggested change	224	103	55	41.1	32.0	24.1
Suppliers suggested the changes	132	43	34	24.1	13.4	14.9
Funding opportunities or investors suggested it	114	45	20	20.9	14.0	8.8
Had to make changes because of lack of funds	135	56	35	24.8	17.4	15.4
Changes to the management team triggered changes	89	36	27	16.2	11.2	11.8
Success with a customer refocused your effort	247	139	86	45.1	43.3	37.7
Failure with a customer refocused your effort	128	70	46	23.4	21.7	20.2
A partnership with another business encouraged changes	109	53	35	19.9	16.5	15.4
Internal interest in a new innovation led to changes	248	119	73	45.3	37.1	32.0

Table 3: *Reasons for change, Waves 1-3*

Intellectual property relevant vs Intellectual property not relevant	χ^2, significance		
	W1	W2	W3
Customers requested change	15.5***	ns	ns
Market research suggested change	31.8***	10.5***	3.8*
Suppliers suggested the changes	ns	ns	ns
Funding opportunities or investors suggested it	7.0**	5.5*	ns
Had to make changes because of lack of funds	5.0*	ns	ns
Changes to the management team triggered changes	3.8*	ns	5.3*
Success with a customer refocused your effort	ns	3.1†	ns
Failure with a customer refocused your effort	ns	ns	ns
A partnership with another business encouraged changes	11.5***	14.2***	ns
Internal interest in a new innovation led to changes	34.5***	15.8***	8.4**
† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$			

Table 4: Reasons for change, Waves 1-3, Crosstab χ^2 and significance

Table 4 presents results of non-parametric tests, in which we crosstabulated reasons for business model adaptation against the two groups in our analysis. Whenever the Pearson chi-squared statistic was significant, the IP-relevant firms displayed a higher percentage of the particular reason being reported. Success with a customer was the most highly reported driver for both groups, but the incidence between groups was only marginally significant in wave 2. Changes to management was generally at the bottom of the rankings for both group of firms, but its impact on business model adaptation was significantly different between the groups in waves 1 and 3. Similarly, business partnerships were relatively lowly ranked by both groups, but their impact was significantly different in waves 1-2.

B. Hierarchical moderated regression analyses

Phase two of the study involved running hierarchical moderated regression, which is the appropriate statistical tool to test interaction terms. We present the regression results in Table 5. Due to space constraints, we do not show coefficients for each variable. Rather, we report the change in R^2 for each step of the hierarchical regression and its statistical significance.

Intellectual property relevant							
	Social Capital	GenEducn; GenExp	SpecEducn SpecExp	GenEducn * SC	SpecEducn * SC	GenExp*SC	SpecExp*SC
Controls	ns	.06†	ns	.06†	ns	ns	ns
Social Capital	ns			ns	ns	ns	ns
GenEducn		ns		ns			
BusEducn			.06**		.05**		
GenExp		.06*				.06*	
Spec Exp			.07**				.10***
GenEducn*SC				ns			
BusEducn*SC					ns		
GenExp * SC						ns	
SpecExp * SC							.10†
Model R^2/ AdjR^2	.09/.04	.12/.07	.18/.13	.12/.04	.13/.05	.24/.11	.30/.18
Total Model *F*	1.73†	2.38*	3.77***	1.44	1.64†	1.86*	2.49***
N	167	165	166	166	167	166	166
Intellectual property not relevant							
Controls	ns	ns	ns	ns	ns	ns	ns
Social Capital	.12***			.12***	.12***	.12***	.12***
GenEducn		.02*		.ns			
BusEducn			ns		ns		
GenExp		ns				ns	
Spec Exp			ns				ns
GenEducn* SC				ns			
BusEducn* SC					ns		
GenExp * SC						ns	
Spec Exp * SC							ns
Model R^2/ AdjR^2	.16/.12	.08/.04	.05/.00	.18/.12	.17/.11	.20/.11	.24/.14
Total Model *F*	4.09***	2.01*	1.08	3.06***	2.82***	1.96**	2.39***
N	211	209	211	211	211	209	210
† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$							

Table 5: *Moderated hierarchical regression analysis*

In the first three columns, we report the direct effects of: social capital; generic education and experience; specific education and experience. Moderation hypotheses are tested in the following columns. The controls were not significant, but the product/service dummy was significant, with negative sign (ß= -.24, $p \leq .05$) indicating that product firms made more changes than service-based firms. Social capital was insignificant for IP-relevant firms. It was highly significant for the mainstream ($p \leq .001$): global social capital (ß = .16, $p \leq .001$); external advice (ß = .03, $p \leq .01$). H4 is not supported, but H5 is partially supported.

The second model tested the significance of generic human capital. For IP-relevant firms, generic education was not significant, but the step consisting of generic experience variables was significant. The opposite was true in mainstream firms. For IP-relevant firms, general management experience was marginally significant with negative sign (ß = -.01, $p \leq .10$), whereas the other variables were both significant and positive: experience in large corporations (ß = .31, $p \leq .05$); work or srudy abroad (ß = .04, $p \leq .05$). Although the step was not significant for mainstream firms, experience in large corporations was, with positive sign (ß = .24, $p \leq .05$). General education had a positive impact (ß = .003 $p \leq .05$). H2 received partial support.

Specific human capital was tested in the third model. Both the education and esperience steps were significant for IP-relevant firms, but neither was significant for mainstream firms. For IP-relevant firms, same industry experience was significant and negative (ß = .-.01, $p \leq .05$), firm work experience was significant and positive (ß = .06, $p \leq .01$). H3 is supported for IP-relevant firms.

None of the steps containing interaction steps were significant for mainstream firms, but for IP-relevant firms the interaction between specific experience and social capital was marginally significant. Looking more closely into those steps, we find significant interaction effects for mainstream firms between: large corporate exerience and external advice (ß = .06, $p \leq .05$); firm work experience and external advice (ß = -.01, $p \leq .05$); same industry experience and external advice (ß = .06, $p \leq .05$). We also find two significant interaction variables for IP-relevant firms: same industry experience and bonding ties (ß = -.39, $p \leq .01$); firm work experience and collaboration (ß = -.13, $p \leq .01$). There was partial support for H6 and H7 in the mainstream. For IP-relevant firms, the significant interaction terms had the opposite sign to what was hypothesised.

In order to understand better the nature of the moderation in these variables, we ran simple slope plots with high and low levels of the items within the interaction terms. We took high and low to be ± one standard deviation from the mean. First, we present the plots for IP-relevant firms.

Figure 1 shows the plot of business collaboration on business model adaptation for different levels of firm work experience in IP-relevant firms. As the experience variable is a dummy, we took readings at 0 and 1. In IP-rich environments, the relationship between business collaboration and business model adaptation is positive when the focal firm has low levels of prior relevant work experience. The relationship, however, turns negative when the firm embodies higher levels of prior relevant work experience.

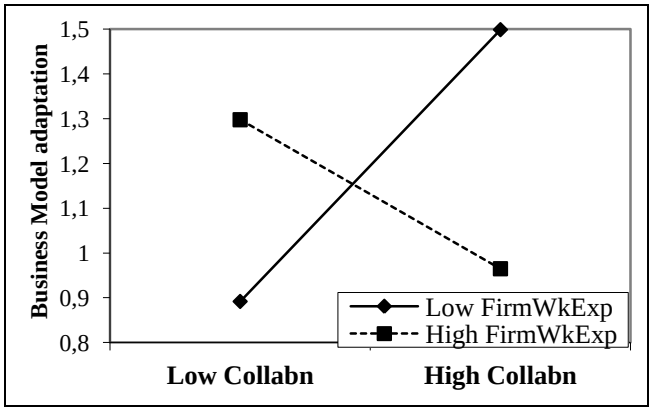

Fig. 1: *Plot of business collaboration on business model adaptation for different levels of firm work experience in IP-relevant firms*

In Figure 2 we plot of bonding ties on business model adaptation for different levels of same industry experience in IP-relevant firms. Again, the relationship switches from positive to negative as this specific human capital increases.

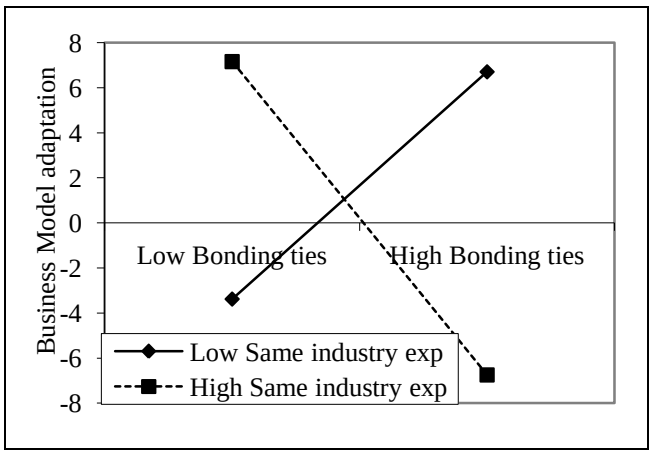

Fig. 2: *Plot of bonding ties on business model adaptation for different levels of same industry experience in IP-relevant firms*

Next, we present simple slope plots for mainstream firms.

Figure 3 shows the plot of external advice on business model adaptation for different levels of same industry experience in mainstream firms. It indicates that the relationship between external advice and business model adaptation is negative when the firm embodies a low level of same industry experience, but turns positive at higher levels of same industry experience.

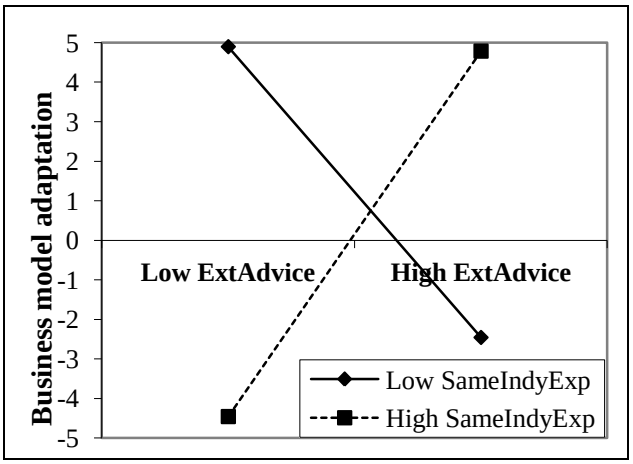

Fig. 3: *Plot of external advice on business model adaptation for different levels of same industry experience in mainstream firms*

Figure 4 displays the plot of external advice on business model adaptation for different levels of firm work experience in mainstream firms. It indicates that the positive relationship between external advice and business model adaptation is stronger at lower levels of firm work experience.

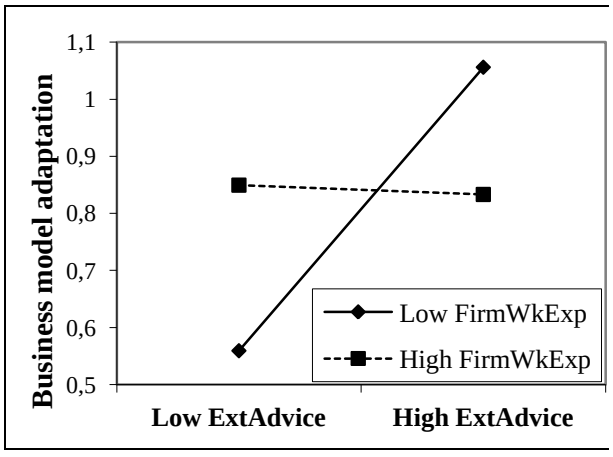

Fig. 4: *Plot of external advice on business model adaptation for different levels of firm work experience in mainstream firms*

In Figure 5 we show the plot of external advice on business model adaptation for different levels of experience in large corporations. As the experience variable is a dummy, we took readings at 0 (no experience) and 1 (experience.) The plot shows that, as the firms seek more external advice, those with experience in large corporations increase their adaptation more than those.

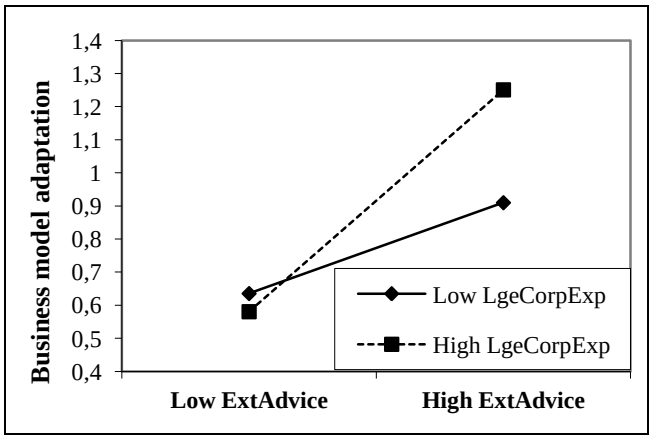

Fig. 5: *Plot of external advice on business model adaptation for different levels of large corporate experience in mainstream firms*

V. DISCUSSION

Both the descriptive and inferential statistics suggest there is a difference between technology-based new firms and the mainstream. Firms for which intellectual property is considered relevant in business terms are more likely to adapt their business model and to do so continuously.

The descriptive data show that for all firms customer interaction is an important driver of business model adaptation. Success with a customer – a form of organisational learning - was consistently the most highly ranked driver of adaptation. It does not, however, relate differently across the two groups of firms. Consistent differences across waves were found in the importance of market research and on internal interest in innovation. Overall, this suggests that the quantity and quality of internal resources has a relatively greater impact in IP-relevant firms.

The results of our inferential tests are consistent with this. Whenever a step was significant in one set of firms, it was not in the other. Thus, social capital was significant for mainstream firms, but not for IP-relevant firms. On the other hand, most of the human capital steps in our regressions were significant for technology based firms, but not for the mainstream. This does not mean that mainstream firms engaged more in networking. Our IP-relevant firms displayed higher mean levels on each measure of social capital and the differences were statistically significant (p = .000 for all of the bridging ties.) Within each category of firms, however, the different

level of networking was differentially associated with business model adaptation.

Average levels of human capital were higher for our IP-relevant firms, and the difference statistically significant ($p \leq .002$) on each measure except for years of management experience and for same industry experience. Experience-based human capital appears to be useful for business model adaptation in IP-relevant firms. Business-specific education also seems to be useful. That is possibly as a complement to the technical education that would often be embodied in firms that are strong in technology or innovation.

For mainstream firms, having a greater presence of general education is associated with greater business model adaptation. This might reflect a greater openness to new ideas or an ability to make connections across disciplines of areas of activity.

It should be noted that the confidence intervals for individual variables do overlap to some degree between the two groups of firms.

In very broad terms, the interaction of human and social capital does not add much to the adjusted R^2 for mainstream firms but it does for IP-relevant firms. When we delve more deeply it appears that external advice is moderated by different forms of human capital, but not uniformly so.

An important implication for both theory and practice is that different sources of learning have a comparative advantage in different contexts. Thus, we need to achieve greater granularity in our theorising and empirical investigations of both social and human capital (Dimov and Shepherd 2005; Stam, Arzlanian and Elfring 2013). Similarly, practitioners (ie entrepreneurs, advisers, technology transfer offices, policy makers) should approach business model adaptation differently depending on the circumstances of the focal firm: mostly networking for mainstream firms; mostly developing human capital for firms in technology- and innovation-rich markets.

VI. Conclusions and Recommendations

New technology-based firms are different.

They engage in more and broader business model adaptation than the mainstream. This is driven more from their human capital than their networking, although the social capital is enhanced by interacting with the human capital.

The design of our study affords high population validity for new ventures in Australia and allows causal inferences, which is rare in business model research. Generalisation to other economies, however, would require replication of the approach taken here. The Global Entrepreneurship Monitor or similar initiatives would be valid.

Our findings suggest there are useful research topics in understanding how networking occurs, the role of boundary spanners and the reasons for different interactions between human and social capital. Contingency theory, configurational perspectives, or related frameworks (Ginsberg and N. 1985; Venkatraman and Ramanujam 1986; Johns 2006; Dimov 2007; Unger et al. 2011; Stam et al. 2013) hold scope for valuable insights into the research task of understand the business model and business model adaptation. They in turn will benefit from the contributions emanating from business model research.

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