The patenting performance of second-generation immigrant inventors in Sweden: differentiated by parents' region of origin

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Outline

1. Introduction
2. Hypotheses
3. Data and discriptive statistics
4. Methodology
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6. Discussion

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1 Introduction (1/4)

(1) Gap:

- Increasing interest in the study of invention and innovation contribution of immigrants.

- No previous study has examined the differences that can exist between those native-born individuals with a different parental background

  Driving forces, implication for integration

(2) Purpose of study:

To explore whether differences in innovation performance exist between

children of immigrants and children of native-born parents by comparing their patenting performance.

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1 Introduction (2/4)

Reason

- The native-born can be different in ethnicity (may relate to discrimination), ethnic identity (degree of acculturation identity), culture and other country-specific human capital—driven by their parent's country of origin.
- Can influence an individual's development and outcome (Fuligni 1997; Ermisch and Francesconi 2001)

The native-born (88.4% of patents in EPO): biological parents' region of origin

(a) native Swedes—two native-born parents;

(b) mixed second-generation immigrants—one native-born and one foreign-born parent;

(c) second-generation immigrants with two foreign-born (FB) parents

Second-generation immigrants

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1 Introduction (3/4)

Research questions

(1) Native Swedes vs. second-generation immigrants

- The upbringing environment and experience: more complicated and challenging
- Importance: second-generation immigrants, more likely to stay, more reliable backbone force

(2) Native Swedes vs. mixed second-generation and second-generation with two FB parents

- Mixed second-generation: advantage in host-country specific human capital with one native-born parent

(3) Native Swedes vs. different groups of second-generation divided by parents' region of origin

- Parents' country of origin captures differences in geographical, language, cognitive, cultural and institutional proximities to Sweden and Swedish culture to some extent .
- These proximities may impact on their children's interactive learning and innovative performance

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1 Introduction (4/4)

(3) Why Sweden is interesting?

- Sweden has seen a rise in immigration since the Second World War.
- Knowledge about their innovation contribution is lacking
- Broaden the understanding of intergeneration incorporation & long-term effect of migration and migration policy

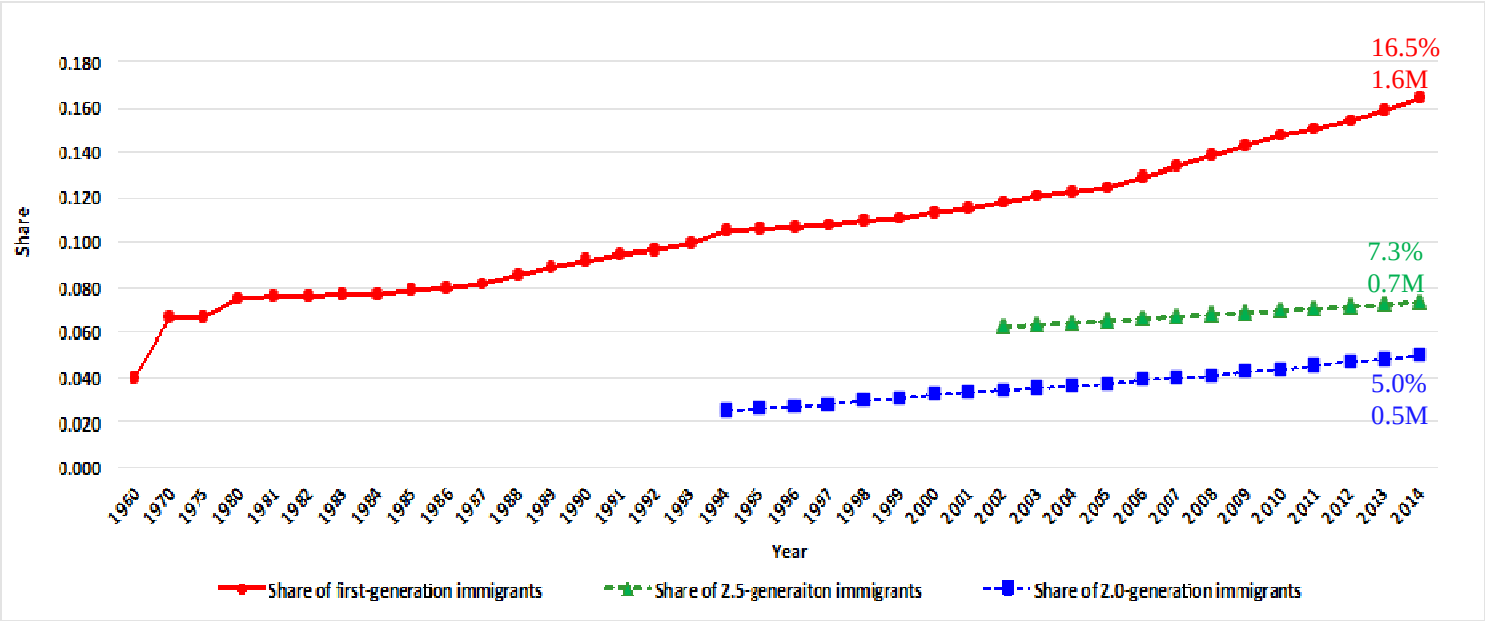

Fig. 1 Share of immigrants of first-generation, mixed second-generation and second-generation with two FB parents in the entire **Swedish** population at all ages, for each year 1960–2014

Sources: Statistics Sweden (2015)

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2 Hypotheses (1/6)

2.1 Positive and negative forces of second-generation immigrants and their impact on invention

(a) Negative effect

- The distinct appearance, language, distinct culture, values and norms may hamper their innovative performance
- Foreign-born parents' effect on fully obtainment of host-country specific human capital, e.g. language, native social network

(b) Positive effect

- Motivation to push them to become more ambitious
- More likly to be open and flexiable to different culture and social network
- Experience of mixed culture, values and norms stimulate their creative capability

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2 Hypotheses (2/6)

If the positive forces dominate over negative forces, then

Hypothesis 1. The patenting performance of second-generation immigrant inventors is similar to or even better than that of native Swedes.

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2 Hypotheses (3/6)

2.2 Differences between mixed second-generation and second-generation immigrants with two FB parents compared with native Swedes

Advantages of mixed second-generation immigrants

- host-country specific human capital: native social network, language

- Their foreign-born parents tend to have higher education level (Ramakrishnan 2004)—positive effect on their children's outcome (Lundborg et al. 2014), e.g. education attainment and non-cognitive skills (Riphahn 2003)

- Benefit more from the mixed culture and mixed ethnicity from family.

Certain distance in proximity positively impact on knowledge creation (Boschma 2005). Mixed ethnicity broaden their social network

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2 Hypotheses (4/6)

Hypothesis 2a. Mixed second-generation immigrant inventors are expected to have a patenting performance similar to or better than native Swedes.

Hypothesis 2b. Second-generation immigrant inventors with two FB parents are expected to have a patenting performance similar to or worse than native Swedes.

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2 Hypotheses (5/6)

2.3 Differences between second-generation immigrants with parents from different regions of origin

- Impact of parent's ethnic background: ethnic differences in skills can be transmitted across generation (Borjas 1992).
- Individual's ethnic background, classified by country of origin
- Individuals from countries with closer geographical distance, share more common knowledge and habits—reduce communication cost, uncertainty, facilitate interactive learning, promote their innovative performance.
- The more the proximity the sending and receiving countries are, the easier it can be for their children to acculturate to the host society (Nekby and Rödin, 2010).
- Discrimination to second-generation immigrants with parents from different regions of origin can also be different

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2 Hypotheses (6/6)

According to the geographical, language, cognitive, cultural and institutional proximity to Sweden, divide second-generation immigrant inventors into 6 groups:

Mixed second-generation immigrant inventors whose non-Swedish parent is from
(a) another Nordic country;
(b) the EU-15 (excluding Sweden, Denmark and Finland);
(c) the rest of Europe (including the former Soviet Union); and
(d) a non-European country.

Second-generation immigrant inventors with two FB parents, of whom
(e) at least one is from another Nordic country (82% of these inventors have both parents from other Nordic countries); and
(f) both are from other European countries.

Hypothesis 3. The closer the proximity of the parents' region of origin to Sweden, the better the patenting performance of their children. According to my categorization, mixed second-generations immigrant inventors whose non-Swedish parent is from another Nordic country are expected to perform best in patenting, while second-generation immigrant inventors with both parents from other European countries are expected to perform worst.

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3 Data and discriptive statistics (1/4)

(1) **Database**: A Swedish inventor database which matches the patent applications filed with the EPO by Swedish residents with their demographic and parental information from 1985 to 2007 (Zheng and Ejermo 2015)

Table 1 Number and share (%) of different groups of identified inventors in Sweden aged 25–64 and patent applications that they contributed to, 1985–2007

Different groups of Swedish residents	Native Swedes	First-generation immigrants	Mixed second-generation immigrants	Second-generation with two FB parents	Total
No. of identified inventors	16,169	2,176	1,251	419	20,015
Share of all identified inventors	80.78%	10.87%	6.25%	2.09%	100%
No. of population	5,546,209	1,274,029	347,990	131,001	7,299,229
Share of inventors in the population	0.29%	0.17%	0.36%	0.32%	0.27%
No. of identified applications (fractional count)	22,513	3,254	1,797	542	28,106
Share of all identified applications	80.10%	11.58%	6.39%	1.93%	100%
Average no. of patents attributed to	1.39	1.49	1.44	1.29	1.40

Sources: Statistics Sweden and CIRCLE data on inventors.

3 Data and discriptive statistics (2/4)

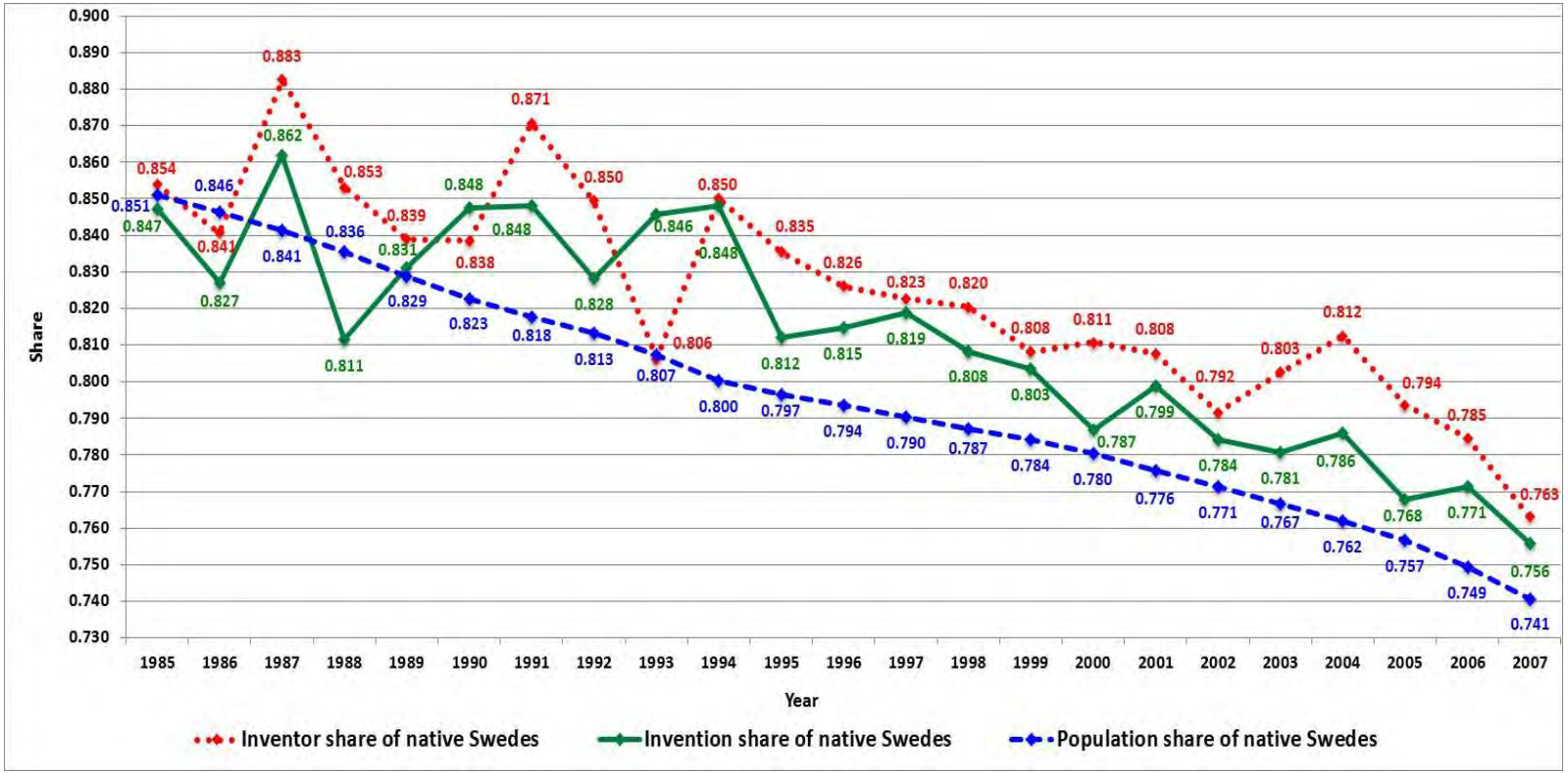

Fig. 2 Share of native inventors in the entire inventors in Sweden, their contribution of inventions (fractional count) and their population share in the entire Swedish population aged 25–64, for each year 1985–2007
Sources: Statistics Sweden and CIRCLE data on inventors

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3 Data and discriptive statistics (3/4)

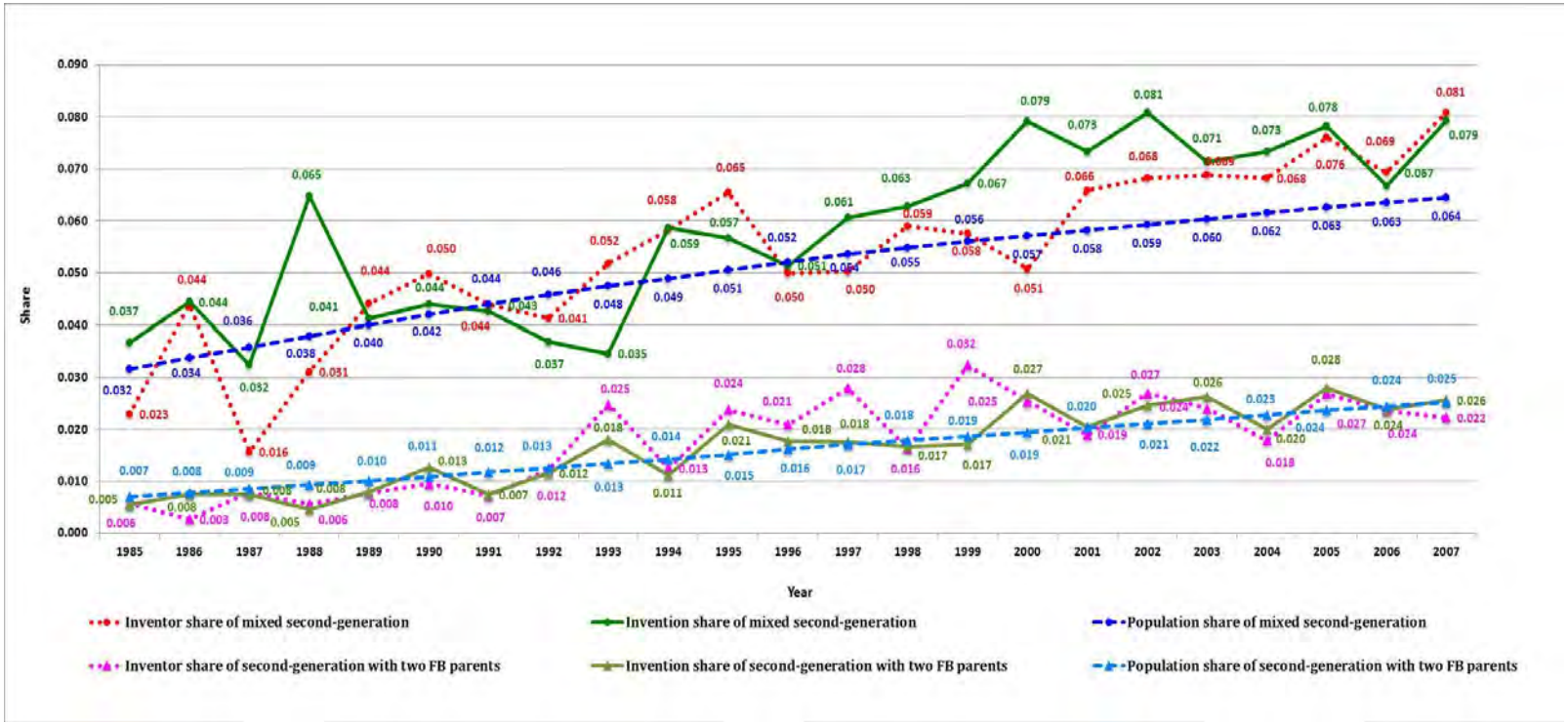

Fig. 5 Share of mixed second-generation and second-generation with two FB parents in the entire inventors in Sweden, their contribution of inventions (fractional count) and their population in the entire Swedish population aged 25–64, for each year 1985–2007

Sources: Statistics Sweden and CIRCLE data on inventors

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3 Data and discriptive statistics (4/4)

Table A1 Descriptive statistics parent's average years of schooling of different groups of native-born inventors, their secondary high school GPAs and shares in the entire inventors who graduated between 1973 and 1996, 1985–2007

Different groups of inventors in Sweden	Average years of schooling[a]		High school GPA for inventors	Share in the entire inventors
	Mother	Father		
All native Swedes	11.7	12.5	376	88.4%
All second-generation	11.5	12.6	371	11.6%
Mixed second-generation	11.8	13.0	372	8.9%
−1 parent from other Nordic country	11.3	12.2	367	4.3%
−1 parent from EU-15	12.2	13.3	374	2.7%
−1 parent from rest of Europe	12.0	13.9	374	1.2%
−1 parent from non-European country	13.2	15.1	393	0.7%
Second-generation with two FB parents	10.5	11.6	369	2.7%
−≥1 parent(s) from other Nordic countries	10.3	11.4	366	1.6%
−2 parents from other European countries	10.7	11.9	373	1.1%
Total share				100%
Total no. of observations				7,742

Sources: Statistics Sweden and CIRCLE data on inventors.

[a] The result of average years of schooling for parents is similar for all number of observations (10,464) used in regressions of Table 4.

4 Methodology (1/2)

(1) Dependent variables and estimation methods

Dependent variable	Rationale of dependent variable	Estimation method[a]	Rationale of estimation method
Total number of patents attributed to each inventor	We use it to examine differences in patent productivity between different types of native-born inventors who attributed with at least one patent application during 1985 and 2007.	Negative binomial models with robust standard errors.	1. Count data 2.Widely overdispersed: more than half (51.5%) of the inventors have only one patent application, and the standard deviation (4.4) of the dependent variable is larger than its mean value (2.9).
NFC received by each patent	1. Studies have demonstrated that it has a significant and positive correlation with the value of a patent (e.g. Harhoff et al. 2003; Hall et al. 2005; Gambardella et al. 2008). 2. Used as the most common indicator and even considered the strongest predictor of patent value compared with other indicators (Lanjouw and Schankerman 1999). 3. Considered a proxy for effective use or importance of a patent to new inventions (Sapsalis et al. 2006).	Negative binomial models with clustered robust standard errors.	1. Count data. It is calculated within a five-year interval after filing the original patent or one of its family members. 2. Highly overdispersed (zero citations: 49.3%, standard deviation: 3.0, mean: 1.5). 3. As 48.5% of inventors have filed more than one patent, we control for intra-inventor correlation by clustered robust standard errors[b].

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4 Methodology (2/2)

(2) Models

Different groups of second-generation immigrant inventors	1		2		3	
	1.1	1.2	2.1	2.2	3.1	3.2
	1g_sim	1g_con	1g_sim	2g_con	6g_sim	6g_con
All second-generation	Yes	Yes				
Mixed second-generation			Yes	Yes		
Second-generation with two FB parents			Yes	Yes		
Mixed second-generation						
−1 parent from other Nordic country					Yes	Yes
−1 parent from EU−15					Yes	Yes
−1 parent from rest of Europe					Yes	Yes
−1 parent from non−European country					Yes	Yes
Second−generation with two FB parents						
−≥1 parent(s) from other Nordic countries					Yes	Yes
−2 parents from other European countries					Yes	Yes
Control variables	No	Yes	No	Yes	No	Yes

***Control variables**: highest education level* at the time of the examined year, *field of study*, *age* and *age2*, *gender*, *firm size*, *sector of work*, *region of work*, *years of schooling for mother/father*, *number of children for mother/father* and *technology classes*. We also control *application year and number of inventors, and number of co-inventors who are native Swedes/mixed second-generation/second-generation with two FB parents/first-generation inventors in a patent* for NFC

Secondary high school GPA, a proxy for unobserved ability, 1973-1996. The results do not change much compared with leaving it out, although it has positively significant effect

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5 Empirical Results (1/5)

Table 4 Negative binomial regressions on total number of patents per inventor aged 25–64, 1985–2007

	1		2		3	
Different groups of second-generation immigrant inventors	1.1 1g_sim	1.2 1g_con	2.1 2g_sim	2.2 2g_con	3.1 6g_sim	3.2 6g_con
All second-generation	0.006 (0.048)	0.025 (0.043)				
Mixed second-generation			0.031 (0.056)	0.044 (0.051)		
Second-generation with two FB parents			−0.080 (0.079)	−0.037 (0.070)		
Mixed second-generation						
−1 parent from other Nordic country					0.038 (0.079)	0.072 (0.073)
−1 parent from EU-15					−0.055 (0.110)	−0.021 (0.097)
−1 parent from rest of Europe					0.131 (0.129)	0.076 (0.115)
−1 parent from non-European country					0.085 (0.169)	0.028 (0.159)
Second-generation with two FB parents						
−≥1 parent(s) from other Nordic countries					−0.122 (0.104)	−0.033 (0.095)
−2 parents from other European countries					−0.030 (0.118)	−0.041 (0.103)
Control variables	No	Yes	No	Yes	No	Yes
Constant	0.399*** (0.021)	0.868** (0.368)	0.399*** (0.021)	0.863** (0.367)	0.399*** (0.021)	0.875** (0.367)
No. of individuals	10,464	10,464	10,464	10,464	10,464	10,464
Wald χ^2	0	1,301	1	1,301	3	1,310
Log pseudolikelihood	−23,050	−22,048	−23,049	−22,047	−23,042	−22,046
Pseudo R^2	0.000	0.043	0.000	0.044	0.000	0.044

Robust standard errors in parentheses. ***p<0.01; **p<0.05; *p<0.1

Sources: Statistics Sweden and CIRCLE data on inventors.

5 Empirical Results (2/5)

Table 5 Negative binomial regressions on number of forward citations for second-generation immigrant inventors aged 25–64, 1985–2007

	1		2		3	
Different groups of second-generation immigrant inventors	1.1 1g_sim	1.2 1g_con	2.1 2g_sim	2.2 2g_con	3.1 6g_sim	3.2 6g_con
All second-generation	0.118** (0.055)	0.098** (0.046)				
Mixed second-generation			0.146** (0.062)	0.120** (0.051)		
Second-generation with two FB parents			0.010 (0.093)	0.014 (0.095)		
Mixed second-generation						
—1 parent from other Nordic country					0.081 (0.100)	0.099 (0.075)
—1 parent from EU-15					0.243** (0.099)	0.165* (0.088)
—1 parent from rest of Europe					0.322*** (0.117)	0.192** (0.093)
—1 parent from non-European country					−0.159 (0.144)	−0.053 (0.214)
Second-generation with two FB parents						
—≥1 parent(s) from other Nordic countries					−0.085 (0.106)	−0.067 (0.104)
—2 parents from other European countries					0.107 (0.142)	0.097 (0.153)
Control variables	No	Yes	No	Yes	No	Yes
Constant	0.399*** (0.021)	0.897** (0.364)	0.399*** (0.021)	0.893** (0.364)	0.399*** (0.021)	0.906** (0.364)
No. of observations	31,002	31,002	31,002	31,002	31,002	31,002
No. of individuals	10,576	10,576	10,576	10,576	10,576	10,576
Wald χ^2	5	2,672	6	2,677	16	2,709
Log pseudolikelihood	−50,829	−48,517	−50,828	−48,516	−50,818	−48,512
Pseudo R^2	0.000	0.046	0.000	0.046	0.000	0.046

Robust standard errors in parentheses. ***p<0.01; **p<0.05; *p<0.1

Sources: Statistics Sweden and CIRCLE data on inventors.

Notes: Coefficient results are reported.

Robustness check

Table A3 Negative binomial regressions on total number of patents per inventor for those who worked in high-tech sectors aged 25–64, 1985–2007

	1		2		3	
Different groups of second-generation immigrant inventors	1.1 1g_sim	1.2 1g_con	2.1 1g_sim	2.2 2g_con	3.1 6g_sim	3.2 6g_con
All second-generation	−0.006 (0.061)	0.005 (0.055)				
Mixed second-generation			0.029 (0.072)	0.034 (0.064)		
Second-generation with two FB parents			−0.118 (0.102)	−0.088 (0.091)		
Mixed second-generation						
−1 parent from other Nordic country					0.054 (0.099)	0.079 (0.088)
−1 parent from EU-15					−0.112 (0.154)	−0.086 (0.142)
−1 parent from rest of Europe					0.104 (0.157)	0.046 (0.127)
−1 parent from non-European country					0.147 (0.211)	0.105 (0.210)
Second-generation with two FB parents						
−≥1 parent(s) from other Nordic countries					−0.166 (0.129)	−0.119 (0.116)
−2 parents from other European countries					−0.060 (0.158)	−0.049 (0.139)
Control variables	No	Yes	No	Yes	No	Yes
Constant	1.154*** (0.020)	−1.297*** (0.337)	1.154*** (0.020)	−1.294*** (0.337)	1.154*** (0.020)	−1.301*** (0.337)
No. of observations	6,777	6,777	6,777	6,777	6,777	6,777
Wald χ^2	0	878	2	878	4	885
Log pseudolikelihood	−15,416	−14,759	−15,414	−14,758	−15,412	−14,757
Pseudo R^2	0.000	0.043	0.000	0.043	0.000	0.043

Robust standard errors in parentheses. ***p<0.01; **p<0.05; *p<0.1

Sources: Statistics Sweden and CIRCLE data on inventors.

Notes: Coefficient results are reported.

Robustness check

Table A4 Negative binomial regressions on number of forward citations for second-generation immigrant inventors who worked in high-tech sectors aged 25–64, 1985–2007

	1		2		3	
Different groups of second-generation immigrant inventors	1.1 1g_sim	1.2 1g_con	2.1 1g_sim	2.2 2g_con	3.1 6g_sim	3.2 6g_con
All second-generation	0.117* (0.069)	0.103* (0.058)				
Mixed second-generation			0.160** (0.077)	0.129** (0.064)		
Second-generation with two FB parents			−0.054 (0.126)	−0.001 (0.134)		
Mixed second-generation						
−1 parent from other Nordic country					0.072 (0.130)	0.076 (0.095)
−1 parent from EU−15					0.301** (0.128)	0.198* (0.112)
−1 parent from rest of Europe					0.323*** (0.120)	0.210** (0.103)
−1 parent from non−European country					−0.180 (0.181)	0.029 (0.280)
Second−generation with two FB parents						
−≥1 parent(s) from other Nordic countries					−0.238* (0.144)	−0.222 (0.145)
−2 parents from other European countries					0.125 (0.181)	0.216 (0.196)
Control variables	No	Yes	No	Yes	No	Yes
Constant	0.469*** (0.026)	0.896** (0.438)	0.469*** (0.026)	0.835* (0.442)	0.469*** (0.026)	0.907** (0.436)
No. of observations	21,875	21,875	21,875	21,875	21,875	21,875
No. of individuals	7,230	7,230	7,230	7,230	7,230	7,230
Wald χ^2	3	2,010	5	2,012	17	2,071
Log likelihood	−36,750	−34,974	−36,747	−34,973	−36,737	−34,967
Pseudo R^2	0.000	0.048	0.000	0.048	0.000	0.048

Robust standard errors in parentheses. ***p<0.01; **p<0.05; *p<0.1
Sources: Statistics Sweden and CIRCLE data on inventors.
Notes: Coefficient results are reported.

5 Empirical Results (5/5)

Results:

- The total number of patents attributed to each inventor: similar
  Immigrant background: no impact on patent productivity

- NFC: native-born immigrant →mixed second-generation immigrants→ EU-15 & the rest of Europe

  - Why not those with one parent from the other Nordic country?

    Too much proximity generates problem of lock-in
    Less well educated parents: less positive selection

  - Non-European country

    Too little proximity between actors generate problems of communication, even highest high school GPA: helps

    Implies disadvantaged in some unobserved human capital: e.g. social networks, too little proximity

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6 Discussion (1/2)

(1) Policy implication

- Should see the impact of immigrants in the host country in long term.
- Ethnic diversity could help promote an individual or even a country's innovative performance in the long run
- Immigrants may leave some positively innovative legacy that may be shown in future (e.g. outstanding offspring)
- Positive selection of immigrants is important. Not only impact their own inventive performance, but their offspring as well

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6 Discussion (2/2)

(2) Contribution

- Provides an initial impression of the patenting contribution of different groups of native born and the impact of their parents' region of origin.
- Broaden the understanding of the importance of parent composition & the long-term effect of migration and migration policy on a host country's innovative development.

(3) Limitations

- Descriptive study, no causal explanation
- Data on country of origin for immigrants is not available, ethnic effects.
- Unable to track the growing environment for individuals
- Collaboration patterns
- Cannot determine who cited the patents
- Cohort effect
- Sectors difference

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Thanks for your attentions!

Comments & Suggestions?

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