Wider effects of immigration; International migration and globalization.

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Study Materials and Reading List

- Slides of the lectures
- All materials provided on: http://home.cerge-ei.cz/pytlikova/LaborSpring16/

Compulsory Readings:

- Kato, T. and Ch. Sparber (2013): The Effect of H-1B Visa Restrictions on the Pool of Prospective Undergraduate Students from Abroad," *Review of Economics and Statistics.*
- Bansak, Simpson, Zavodny: The Economics of Immigration, Part IV Other Effects of Immigration

Other Relevant Literature:

- Nathan, M. (2014): The wider economic impacts of high-skilled migrants: a survey of literature for receivivng countries. *IZA Journal of Migration* 2014, 3:4.
- Card (2010): Immigration and Inequality. *American Economic Review*.
- Javorcik, B. S., Ç. Özden, et al. (2011). "Migrant networks and foreign direct investment." *Journal of Development Economics* 94(2): 231-241.
- Hunt, J. and M. Gauthier-Loiselle (2010). "How Much Does Immigration Boost Innovation?" A*merican Economic Journal: Macroeconomics* 2(2): 31-56.
- Kerr, S. P. and W. Kerr (2011). "Economic Impacts of Immigration: A Survey" *NBER Working Paper 16736*. Cambridge, MA, NBER**.**
- Peri, Giovanni, Kevin Shih, and Chad Sparber (2014), "Foreign STEM Workers and Native Wages and Employment in U.S. Cities", NBER Working Papers 20093
- Parrotta, P., Pozzoli, D. and M Pytlikova (2014): Does Labour Diversity affect Firm Productivity? *European Economic Review*, Vol. 66, February 2014, Pages 144–179.
- *Parrotta, P., Pozzoli, D. and M. Pytlikova (2014): "The Nexus between Labor Diversity and Firm's Innovation." *Journal of Population Economics*. Vol. 27, Issue 2, April 2014, pp 303-364.

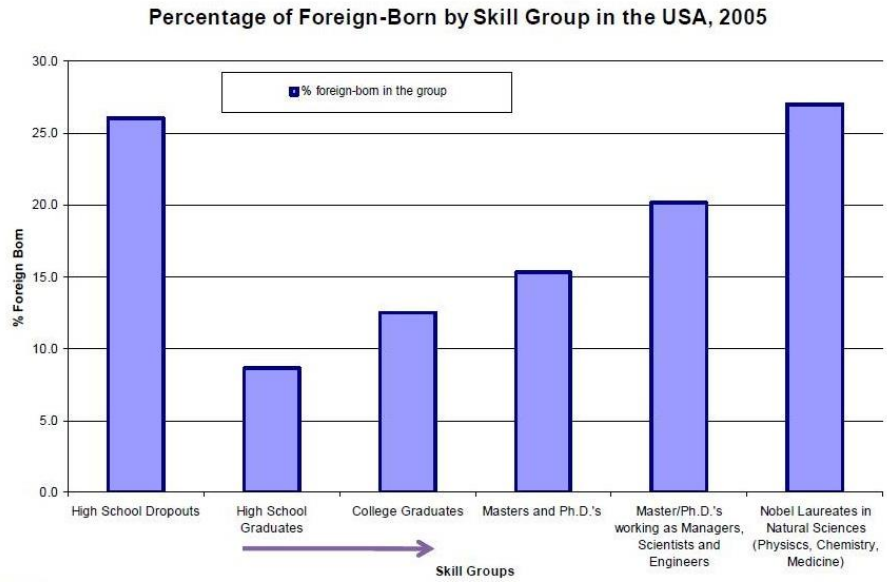
WIDER EFFECT OF MIGRATION

Impacts of Immigration and Ethnic Diversity:

- **Technology and innovation**
- **Productivity**
- Housing
- Prices of goods and services
- Product diversity
- Financial markets
- Entreprenuership
- FDI (impact on sending too)
- Trade (impact on sending too)
- Remittances (impact on sending too)

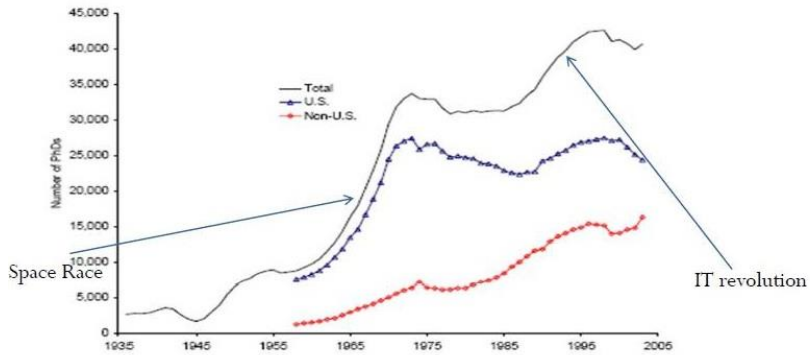
IMPACT OF IMMIGRATION on innovation

- The immigration has a very high concentration of less educated doing manual jobs and also a very high concentration of very highly scientists and engineers
- Is the international mobility of brains an important input in the creation and diffusion of technological knowledge?
- Some countries (Canada, Australia, Denmark, Germany…) are adopting ever more skill-biased immigration policies, most countries make exceptions for highly skilled.
- Immigration policies, plus wages are very important in attracting talents (Grogger and Hanson 2008). As we know from the theory (HC) and evidence, highly educated are much more mobile than less educated.



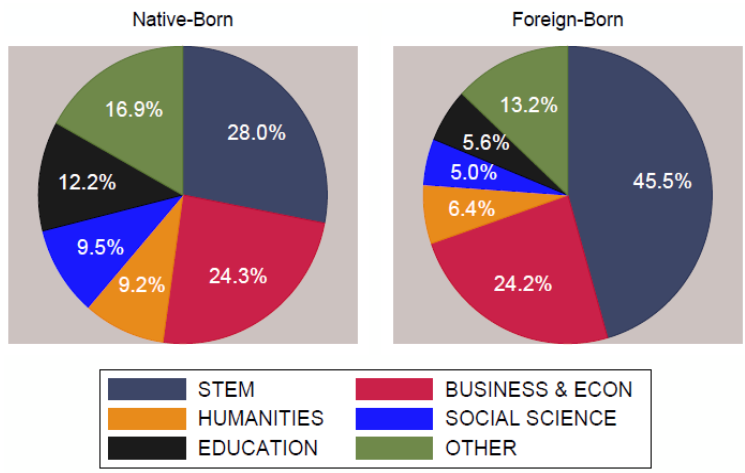
Native and Foreign PhD's in the US

Figure 1. PhD Degrees Awarded by US Universities and National Origin, 1958-2003



Source: NSF, *Survey of Earned Doctorates* microdata and, before 1958, National Academy of Sciences (1958). National origin is defined by the country in which an individual went to high school.

Primary degree share by nativity – workers with a bachelor's degree or more education, 2009–2012



Source: American Community Survey.

STEM - Science, Technology, Engineering, or Mathematics

IMPACT OF IMMIGRATION – on innovation

- Recent research shows that such talented skilled immigrants contribute significantly to the domestic economy by creating jobs as innovators and entrepreneurs
- E.g. Takao Kato's research shows that the USA's decision in 2003 to reduce the number of work visas for skilled immigrants had a drastic effect in terms of scaring away the best students => effect on research, innovation and the entire economy (Kato and Sparber RESTAT 2013)
- Peri, Shih, Sparber (2014), use cross-city panel regressions to estimate wage and employment responses to foreign STEM; a rise in foreign STEM by 1% increases real wages of college-educated natives by 7–8 % and those of non-college-educated natives by 3-4 %. No native employment effects.
- Borjas and Doran QJE2012 - use data on publications, citations, and affiliations of mathematicians to examine the impact of a large, post-1992 influx of Soviet mathematicians on the productivity of their U.S. counterparts. They find a negative productivity effect on those mathematicians whose research overlapped with that of the Soviets. They also document an increased mobility rate (to lower quality institutions and out of active publishing). They argue that the total product of the preexisting American mathematicians shrank and that the Soviet contribution to American mathematics filled in the gap.

IMPACT OF IMMIGRATION: Ethnic diversity and firm outcomes - theory

- ***Ethnic diversity:***
  - **different cultural backgrounds => diverse perspectives** and **ideas, problem-solving abilities,** and also **knowledge about global markets and customers tastes**, which in turn can facilitate the achievement of optimal **creative solutions** and therefore **stimulate innovations and affect firm performance positively**
  - BUT **communication barriers, reduced workforce cohesion,** which **prevent cooperative participation in research activities, bringing high costs of "cross-cultural dealing"**

=> empirically it is still unclear whether more ethnically heterogeneous firms would outperform the relatively more homogeneous ones with respect to innovation.

IMPACT OF IMMIGRATION: Ethnic diversity and firm outcomes - empirics

- ***Case studies:*** diversity in skills and knowledge has a positive effect on worker performance, whether diversity in age and race lowers firm performance (Hamilton et al.2003 and 2004; Kurtulus, 2009).
- ***Studies using regional data:*** a positive effect of ethnic diversity on performance (e.g. Ottaviano and Peri, (2005), Alesina and La Ferrara, (2005), Sparber (2009) and Suedekum et al.(2009)).
- ***Studies using the comprehensive register based data:*** a **positive** significant **effect of ethnic diversity on innovation** as measured by a number of patents and different techological areas of patents (Parrotta, Pozzoli and Pytlikova, JOPECON 2014) **BUT negative** or no significant **effect of ethnic diversity on firm productivity** (Parrotta, Pozzoli and Pytlikova, EER 2014) => **diversity management policies necessary to turn the diversity effects into firms' competitive advantage.**

- ***=> more on the empirical example later***

IMPACT OF IMMIGRANTS AND ETHNIC DIVERSITY

Does Labour Diversity Affect Firm Performance?

Pierpaolo Parrotta, Dario Pozzoli and Mariola Pytliková

EER and JOPECON 2015

Motivation

Many developed countries experienced **changes** in the **composition of the labor force resulting** among others from the following major factors:

i) policy measures that counteract population aging;

ii) anti-discrimination measures,

iii) the growth in immigration from diverse countries,

iv) the worldwide globalization process and SBTCH

Increase in the **female** labor participation, **more seniors and foreigners**, **skill upgrading** of the labor force

=> increasing labor diversity in terms of age, gender, ethnicity and skills.

Motivation

We observe increasing diversity across many workplaces and often **hear about the importance of further internationalization and demographic diversification** for firms.

- The **promotion of diversity** is perceived by firms as a structural change that **improves** the firm **learning and knowledge management** capabilities and **facilitates** firm **productivity**.
- Workforce diversity believed to be a **source of innovation**.
- In many countries, firms' hiring decisions are affected by **governmental affirmative action policies**.
- Firms are under **social pressure** to increase diversity.

Examle of press

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Press

Tuesday 7 December 2010, Financial Times

Japanese companies throw doors open to foreign staff

By Michiyo Nakamoto

When Toshiba held a welcome ceremony for 35 recruits recently, the incoming employees listened to speeches and sang the company song.

There is a sense of crisis that unless we employ a diverse range of people we will not grow.

Thursday 9 October 2010, POLITIKEN

Jo større kulturel spredning i ledelsen, des bedre er innovationen
Chefkonsulent Vagn Riis

Monday 10 August 2010, Berilinske

Danskere ledere hæmmer virksomhederne

Ni ud af ti nye erhvervsledere er danske. Strategien hører til på Arbejdermuseet, siger eksperter.

Research questions:

Do firms benefit from the labor diversity and does it generate competitive advantage?

What is the relationship between workplace labor diversity and firm performance measured as:

- ***innovation***
- ***productivity***
- *exporting (Parrota, Pozoli and Sala)*

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Literature Background

Economic theory suggests that labor diversity may affect firm performance differently and through various channels:

1. Skill and educational diversity:

- According to Lazear (1999), diversity in skills, education and tenure may generate knowledge spillovers and skill complementarities among the employees within a firm => a positive effect on firm performance.
- Yet, there may be certain activities for which having workers with **similar skills and education is preferable**, as in the case of Kremer's (1993) O-ring production function, where profit-maximizing firms should match workers of similar skills/education together.

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Literature Background

Economic theory suggests that workforce diversity may affect firm performance differently and through various channels:

2. Demographic diversity:

- Diversity in age can be beneficial to firms because the human capital of younger and older workers can complement each other (Lazear, 1998).
- Communication frictions if workers are prejudiced, and thus result in some performance costs (Becker 1957 co-worker discrimination model).

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Literature Background

Economic theory suggests that workforce diversity may affect firm performance differently and through various channels:

3. Ethnic and cultural diversity -– *different theoretical predictions:*

Positive

- Improving **decision making and problem solving** (Hong and Page, 2001 and 2004).
- **diverse perspectives, valuable ideas** facilitate **creativity** and knowledge transfer (Berliant & Fujita, 2008) and therefore foster innovation (Alesina & La Ferrara, 2005).
- It may provide information to a firm about the global **product's markets and customers tastes**, which can **enhance the firm's ability to compete in global markets** (Osborne, 2000; Rauch and Casella, 2003).

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Literature Background

Economic theory suggests that workforce diversity may affect firm performance differently and through various channels:

3. Ethnic and cultural diversity -– *different theoretical predictions:*

Negative

- It may (i) hinder potential knowledge transfers due to **linguistic and cultural barriers**, (ii) reduce peer pressure by **weakening social ties and trust**, and (iii) create non-pecuniary disutility of joining or remaining in a ethnically diverse firm (Lazear,1999).
- people often **distrust** members of other ethnic groups and tend to prefer interacting in culturally relatively homogeneous communities (Glaseser et. al., 2000; and Alesina and La Ferrara, 2002).
- It may induce **misunderstanding**, **conflicts and uncooperative behaviors** within workplaces and in this way hinder innovation (Basset-Jones, 2005).

=> may bring high costs of "cross-cultural dealing"

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Empirical evidence

Innovation:

- The **empirical literature** mainly consists of **business case studies** (Horwitz et al., 2007; Harrison and Klein, 2007; Pitcher and Smith, 2001);
- Some scant **evidence using comprehensive data** (Østergaard et al., 2011; Ozgen et al., 2011b)

Productivity

- **Case studies**: Hamilton et al., 2003 and 2004; Kurtulus, 2011; Leonard and Levine, 2006.
- **Aggregate regional& country data**: Ottaviano and Peri, 2006 and 2011; Alesina and La Ferrara, 2005; Sparber, 2009; Suedekum et al., 2009; Alesina et al., 2013.
- **Studies using the LEED**: Iranzo et al.,2008; Navon, 2009; Barrington and Troske, 2001; Grund and Westergaard-Nielsen, 2008a, 2008b; Garnero and Rycx, 2013.

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Aim I

Labor Diversity and Firm Innovation

- we analyze the nexus between firm labor diversity and innovation using data on patent applications at the European Patent Office and a LEED from Denmark.
- We look at three measures of firm innovation:
  - *the propensity to innovate,*
  - *the intensive margins of innovation (number of patents)*
  - *the extensive margins of innovation (probability to apply in different technological areas)*
- We implement 2 instrumental variable strategies to estimate the contribution of workers' diversity in cultural background, education and demographic characteristics to firm's innovation activity.

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Aim II

Labor Diversity and Firm Productivity

- **describe** the empirical associations between firm productivity and labor diversity.
- given that firms may endogenously leverage diversity to improve their performance, we properly address endogeneity (two alternative strategies):
  - we employ **an instrumental variable** (IV) approach (Card, 2001).
  - we follow a recent **structural estimation** technique suggested by Ackerberg, Caves and Frazen (2006)

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Aim III

Labor Diversity and Firm Exporting Behaviour

- Use the EU enlargement and the recent and sudden rise of a right wing party in Denmark to construct the IV strategy.

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Data sources

- Integrated Database for Labor Market Research IDA (1980-2006);
- Firms' business accounts REGNSKAB, FIRE and FIDA (1995-2005);
- CEBR database: patent applications and grants ascribed to Danish firms at the EPO (1978-2003); 2244 firms-applicants.
- Foreign Trade Statistics Register - Intra- and Extra-stat.
- We drop firms <10 and firms with imputed accounting numbers

⇒ *28.000 firms from 1995-2005 for diversity and productivity project*

⇒ *20.000 firms from 1995-2003 for diversity and innovation project*

Variables:

- age, gender, education, work experience, country of origin, firms' workforce, dummies for counties, industries, years and firm sizes;
- valued added, materials, capital stock;
- firms' patent applications per year, pre-sample information indices

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Diversity Index

- We use the **Herfindahl** index to indicate the degree of diversity at the firm level:

$$Index\_h_{it} = \sum_{w=1}^{W} \frac{N_w}{N_i} \left(1 - \sum_{s=1}^{S} p_{wst}^2\right),$$

where $Index\_h_{it}$ is the diversity index of firm i at time t for the dimension h, W is the total number of workplaces (w refers to a given workplace) constituting the firm, and therefore N_w and N_i denote the total number of workers at the workplace and firm levels, respectively. Thus, the ratio between the last two variables corresponds to the weighting function, while p_{wst} is the proportion of the workplace's employees falling into each category s at time t

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Dimensions of diversity: aggregate specification

- **Cultural** diversity is represented by the **employee nationality** and it is based on the following categories: North America and Oceania, Central and South America, Africa, West and South Europe, Formerly Communist Countries, Asia, East Asia and Muslim Countries.
- **Skill** diversity is based on the **highest educational level**: primary, secondary and tertiary education. Tertiary education is split into: social sciences, humanities, engineering and natural sciences.
- **Demographic** diversity is build on the intersection of **gender and age quartiles**.

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Dimensions of diversity: detailed specification

- **Cultural** diversity is represented by the language spoken based on the **linguistic classification** of Ethnologue (Adsera and Pytlikova, 2012): 3rd linguistic tree level, 43 categories, e.g. Germanic West vs. Germanic Nord.
- **Skill** diversity is based on the highest educational level. As before, but we make a distinction also at the secondary level.
- **Demographic** diversity is build on the intersection of gender and age quintiles.

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Descriptive statistics of diversity

	Manufacturing	Construction	Wholesale and retail trade	Transport	Financial and business services	Others
Index Ethnic Aggr	0.175	0.193	0.035	0.067	0.083	0.156
Index Edu Aggr	0.406	0.413	0.293	0.341	0.441	0.455
Index Demo Aggr	0.774	0.735	0.719	0.760	0.734	0.766
N	39039	4291	18470	25906	6274	10711
	Small size	**Middle size**	**Big size**	**1995**	**1999**	**2005**
Index Ethnic Aggr	0.037	0.093	0.282	0.093	0.108	0.128
Index Edu Aggr	0.348	0.377	0.424	0.382	0.379	0.381
Index Demo Aggr	0.729	0.760	0.791	0.743	0.758	0.735
N	39207	40660	24824	6014	10924	12083

Descriptive statistics of diversity

	Non-patenting firms			Patenting firms		
Variables	Median	Mean	Sd	Median	Mean	Sd
IDA Variables:						
males	0.786	0.706	0.247	0.174	0.674	0.199
foreigners	0	0.042	0.078	0.038	0.055	0.061
age1	0.304	0.325	0.173	0.263	0.280	0.127
age2	0.250	0.257	0.121	0.296	0.300	0.090
age3	0.200	0.204	0.110	0.222	0.219	0.079
age4	0.252	0.178	0.15	0.232	0.162	0.067
skill1	0.164	0.272	0.128	0.201	0.238	0.123
skill2	0.714	0.690	0.189	0.658	0.662	0.147
skill3	0	0.038	0.097	0.043	0.100	0.137
tenure	4.466	4.616	1.871	5.038	5.025	1.596
manager	0.016	0.045	0.064	0.037	0.052	0.059
middle manager	0.842	0.764	0.240	0.658	0.599	0.240
blue collars	0.140	0.234	0.348	0	0.384	0.486
size1	1	0.825	0.379	0	0.154	0.316
size2	0	0.093	0.291	0	0.416	0.498
size3	0	0.080	0.272	0	0.056	0.324
Index_ethnic	0	0.087	0.194	0.340	0.299	0.278
Index_skill	0.402	0.367	0.148	0.472	0.437	0.131
Index_demo	0.760	0.746	0.081	0.804	0.795	0.055
Accounting Variables:						
Patent applications	0	0	0	0	0.829	3.142
capital	10864	57015.39	781429.8	77714.73	541278.6	2071364
foreign-ownership	0	0.005	0.066	0	0.004	0.061
multi	0	0.093	0.291	0	0.298	0.457
exp	0	0.488	0.499	1	0.874	0.331
geo_spillover	1090.384	1030.382	345.2853	1130.534	1063.769	362.0997
tech_spillover	40.19252	228.2731	228.2731	50.08433	182.6429	340.2594
N		103224			4312	

Diversity and Firm Innovation - analyses

Empirical models of innovation

- Both the **propensity to innovate** and the **extensive margins** of innovation are estimated using standard binomial regression technique while the **intensive margins** are modelled using count models.
- In every empirical specification, we control for both **observed and unobserved** firm-specific heterogeneity.
- We also account for **possible state dependence** in patenting activity in the count models.

Observable heterogeneity

- Our model specification **controls** for a number of observed variables commonly found to be **important** in the patenting literature.
- Measures of **firm size** (total employment and capital stock), firm specific **characteristics of employees** (shares of managers, middle managers, males, highly skilled workers, technicians, differently aged workers belonging to the employees' age distribution quartiles), **export** dummy, **multi-establishments** dummy and partial/total **foreign ownership**.
- We also take account of the role of **external sources** of knowledge
  - 2 knowledge spillovers: A)index is based on the geographical distance between firms, and B) Jaffe's technological proximity index

Unobserved heterogeneity

- To correct for **unobserved permanent differences** in patent productivity we utilize the fact that we have very long "pre-sample" histories at our disposal.
- Since a prominent feature of our data is an **overall increase** in the level of patenting during the pre-sample period, we **normalize** a firm's number of patents in a pre-sample year by the total number of patents applied for during that year as in Kaiser et al. (2008):

$$\eta_i = \frac{1}{17} \sum_{t=1978}^{1994} \frac{y_{it}}{Y_t}$$

- We also include a **dummy variable** equal to one if the firm had ever innovated prior to 1995.

State dependence

- The standard treatment of **state dependence** in patent production relies on a measure of a firm's previous success in patenting (Blundell, Griffith and Van Reenen, 1995).
- The discounted patent stock of firm *i* in period *t-1* is:

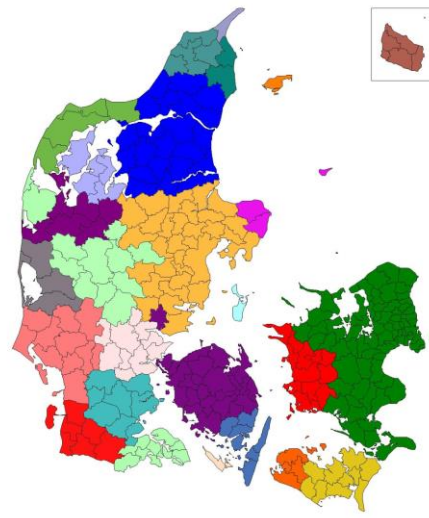
$$disc\_stock_{it-1} = y_{it-1} + (1 - r)disc - stock_{it-2}$$

Instrumental variable approach

- Problem – more diverse workers might be attracted to successful innovative firms
- To cope with the potential simultaneity and endogeneity issues, we decide to follow also 2 **instrumental variable approaches:**

  1. a supply driven instrument alá Card (2001) - we predict the current labor supply at the commuting area by using its historical composition (from 1990) and the current population stocks.

  - **pre-existing labor diversity** (5-13years earlier) measured at commuting areas level is **unlikely correlated with a current firm's innovation**
  - Reinforced by the role of networks in employment process (Montgomery, 1991; Munshi, 2003)
  - low residential mobility rates in Denmark, Filges and Deding, 2009



Danish Commuting Areas in 1995. Source: Andersen (2000)

Instrumental variable approach

2. Alternative instrument based on prediction from push/pull model of determinants of migration: ethnic diversity levels at commuting areas are computed on the basis of shares of foreign population predicted by an empirical model of determinants of migration:

$$m_{clt} = \alpha + \theta_t + (\gamma_l * \theta_t) + (\sigma_c * \theta_t) + \lambda_{cl} + \epsilon$$

We believe that the determinants of migration are likely orthogonal with respect to workplace innovation outcomes.

The effects of labor diversity on firm probability to innovate.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
	Probit	Probit	Probit	Probit (IV)	Probit (IV)	Probit (IV)	Probit (IV)	Probit	Probit	Probit (IV)
index ethnic	0.0052***	0.0009**	0.0008**	0.0016**	0.0027***			0.0002***	0.0002***	0.0011**
	(0.0005)	(0.0004)	(0.0003)	(0.0004)	(0.0002)			(0.000)	(0.000)	(0.0004)
index edu	0.0020***	0.0001**	0.0001**	0.0001		0.0001		0.0001	0.0001	0.0005
	(0.0005)	(0.0000)	(0.0000)	(0.0001)		(0.0001)		(0.000)	(0.000)	(0.0004)
index demo	0.0033***	0.0001	0.0001	0.0001			0.0001	0.0001	0.0001	0.0002
	(0.0004)	(0.0003)	(0.004)	(0.0001)			(0.0001)	(0.000)	(0.000)	(0.0003)
index occ			0.0003						0.0002	
			(0.0002)						(0.000)	
logIK)		0.0012***	0.0011***	0.0012***	0.0012***	0.0012***	0.0012***	0.0012***	0.0012***	0.0012***
		(0.0001)	(0.000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
log(L)		0.0009**	0.0009**	0.0009**	0.0009**	0.0009**	0.0009**	0.0009**	0.0009**	0.0009**
		(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
age1		0.0001	0.0006	0.0007	0.0007	0.0007	0.0007	0.0006	-0.0001	0.0006
		(0.0013)	(0.0004)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0004)	(0.0001)	(0.0007)
age2		0.0022**	0.0022**	0.0022**	0.0022**	0.0022**	0.0022**	0.0006	0.0007*	0.0007*
		(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0004)	(0.0004)	(0.0004)
age3		0.0014*	0.0014**	0.0014**	0.0016**	0.0014**	0.0014**	0.0014**	0.0013	0.0013
		(0.0007)	(0.0006)	(0.0006)	(0.0007)	(0.0006)	(0.0006)	(0.0006)	(0.0009)	(0.0009)
males		-0.0006*	0.0001	-0.0006	-0.0006*	-0.0006*	-0.0007	-0.0006*	-0.0006*	0.0003
		(0.0003)	(0.0001)	(0.0004)	(0.0003)	(0.0003)	(0.0005)	(0.0003)	(0.0003)	(0.0002)
exp		0.0010***	0.0010***	0.0010***	0.0010***	0.0010***	0.0010***	0.0010***	0.0010***	0.0010***
		(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
skill1		0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0011**	0.0011**	0.0011**
		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
skill2		0.0015*	0.0015*	0.0026**	0.0015*	0.0015*	0.0015*	0.0032***	0.0032***	0.0032***
		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0012)	(0.0012)	(0.0012)
tenure		-0.0008**	-0.0008**	-0.0008**	-0.0008**	-0.0008**	-0.0008**	-0.0001	-0.0001	-0.0004*
		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0001)	(0.0001)	(0.0002)
multi		-0.0007	0.0007	0.0007	0.0001	0.0001*	0.0001	-0.0001	-0.0001	0.0006*
		(0.0004)	(0.0004)	(0.0004)	(0.0002)	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0003)
geo_spillover		0.0001	0.0001*	0.0001*	0.0001	0.0001	0.0001	0.0001	0.0001	-0.0001
		(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)
tech_spillover		0.0001*	0.0001*	0.0001*	0.0001*	0.0001	0.0001	0.0001*	0.0001*	0.0008**
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0004)
hypothesis tests (chi2, p-value)										
index ethnic=index edu	25.78; 0.000	17.65; 0.000	16.78; 0.000	36.76; 0.000				19.48; 0.000	19.48; 0.000	19.53; 0.000
index ethnic=index demo	11.24; 0.000	19.57; 0.000	23.12; 0.000	32.786; 0.000				18.87; 0.000	18.87; 0.000	25.126; 0.000
index demo=index edu	3.24; 0.0720	1.13; 0.281	2.02; 0.151	2.75; 0.141				1.67; 0.267	1.67; 0.267	3.75; 0.111
size/industry/year/industry*year dummies	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
shares of foreigners by group of countries	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
shares of employees by occupation	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	96,636	96,636	96,636	96,636	96,636	96,636	96,636	96,636	96,636	96,636
pseudo R-sq	0.136	0.370	0.374	0.372	0.372	0.370	0.371	0.383	0.383	0.386

The effects of labor diversity on firm probability to innovate.

	Probit	Probit	Probit (IV)
Diversity based on aggregate specification			
Index Ethnic	**0.005*** **	**0.0009*** **	**0.002***
	(0.0005)	(0.000)	(0.000)
Index Skill	**0.002*** **	**0.0001*** **	**0.0001**
	(0.0005)	(0.000)	(0.0001)
Index Demo	**0.0033*** **	**0.0001**	**0.0001**
	(0.005)	(0.0003)	(0.0001)
Industry/size/year dummies	no	yes	yes
Observable & unobservable char	no	yes	yes
N	96636	96636	96636
pseudo R2	0.136	0.370	0.372
Diversity based on detailed specification			
Index Ethnic	**0.008*** **	**0.0002*** **	**0.0011** **
	(0.001)	(0.000)	(0.000)
Index Skill	**0.025*** **	**0.0001**	**0.0005**
	(0.002)	(0.000)	(0.0001)
Index Demo	**0.028*** **	**0.0001**	**0.0002**
	(0.003)	(0.000)	(0.0001)
Industry/size/year dummies	no	yes	yes
Observable & unobservable char	no	yes	yes
N	96636	96636	96636
pseudo R2	0.187	0.383	0.386

The effects of labor diversity on firm patent applications

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
	Poisson	Poisson	Poisson	Poisson (IV)	Poisson (IV)	Poisson (IV)	Poisson (IV)	Poisson	Poisson	Poisson (IV)
index ethnic	0.5301***	0.0937**	0.0951**	0.402**	0.304*			0.076**	0.076**	0.218**
	(0.0477)	(0.0341)	(0.0341)	(0.129)	(0.176)			(0.035)	(0.035)	(0.079)
index edu	2.3231***	0.6407	0.6356	0.711		0.980		2.404***	2.394***	0.532
	(0.4920)	(0.3409)	(0.3411)	(0.636)		(0.495)		(0.647)	(0.648)	(0.680)
index demo	9.3202***	0.3439	0.2576	0.740			0.714	-0.523	-0.514	1.771
	(1.5219)	(1.4102)	(1.4579)	(2.876)			(2.677)	(1.724)	(1.707)	(4.507)
index occ			0.0562						-0.115	
			(0.0341)						(0.081)	
log(K)		5.4769***	5.4302***	5.774***	5.714***	5.767***	5.728***	4.938***	4.950***	5.200***
		(0.6401)	(0.6449)	(0.364)	(0.349)	(0.364)	(0.347)	(0.658)	(0.660)	(0.376)
log(L)		0.6202*	0.6477*	0.316	0.208	0.992***	1.025**	0.953**	0.943**	1.145*
		(0.3737)	(0.3802)	(0.707)	(0.575)	(0.294)	(0.432)	(0.379)	(0.381)	(0.775)
discounted stock of applications		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
		(0.0001)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(fixed effects)		0.0034*	0.0033*	0.004***	0.004***	0.004***	0.004***	0.0033*	0.0033*	0.0033**
		(0.0018)	(0.0017)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0017)	(0.0017)	(0.0016)
fixed effect dummy		0.0588***	0.0579***	0.0573***	0.0573***	0.0588***	0.0588***	0.0573***	0.0573***	0.0579***
		(0.0045)	(0.0062)	(0.0046)	(0.0046)	(0.0045)	(0.0045)	(0.0046)	(0.0046)	(0.0054)
age1		0.1421	0.1919	0.1402	0.1569	0.1569	0.1169	0.0232	0.0245	0.3684*
		(0.2392)	(0.2331)	(0.1769)	(0.1610)	(0.1637)	(0.1601)	(0.2571)	(0.2571)	(0.2145)
age2		0.4369	0.4227	0.4346**	0.4514*	0.4333*	0.4164**	0.0159	0.0112	0.1377
		(0.2801)	(0.2788)	(0.1971)	(0.2321)	(0.2301)	(0.2055)	(0.3141)	(0.3111)	(0.2069)
age3		0.2758	0.2869	0.3269*	0.3152*	0.2992*	0.2992*	0.1378	0.1338	0.1402
		(0.2401)	(0.2371)	(0.1751)	(0.1637)	(0.1701)	(0.1791)	(0.2443)	(0.2442)	(0.1689)
males		0.0712	-0.0021	-0.1456	-0.0356	-0.1548	-0.1769	0.1121	0.1037	0.2758
		(0.4569)	(0.4732)	(0.6681)	(0.5211)	(0.4689)	(0.6801)	(0.5442)	(0.5369)	(0.9337)
exp		0.5402***	0.5322***	0.5456***	0.5412***	0.5477***	0.5501***	0.5462***	0.5402***	0.5646***
		(0.1179)	(0.1168)	(0.0671)	(0.0610)	(0.0610)	(0.0680)	(0.1210)	(0.1203)	(0.0809)
skill1		0.0377***	0.0377***	-0.0056	-0.0119	0.0062	0.0137	1.2421**	1.2627**	1.0646***
		(0.010)	(0.010)	(0.0203)	(0.0089)	(0.0190)	(0.0092)	(0.4680)	(0.4669)	(0.3132)
skill2		0.0429***	0.0427***	0.0727***	0.0269***	0.0427***	0.0227***	0.1276***	0.1269***	0.2509***
		(0.0111)	(0.0110)	(0.0232)	(0.0088)	(0.0113)	(0.0078)	(0.0341)	(0.0337)	(0.0256)
tenure		-0.4001	-0.3919	-0.2669	-0.2669	-0.4210	-0.4119	-0.3948	-0.3989	-0.5101**
		(0.2557)	(0.2601)	(0.1549)	(0.1546)	(0.2381)	(0.2556)	(0.2661)	(0.2632)	(0.1902)
multi		-0.0041	-0.0001	-0.0027	0.0022	-0.0202	-0.0212	0.0056	0.0045	0.0269
		(0.0202)	(0.0201)	(0.0177)	(0.0137)	(0.0127)	(0.0127)	(0.0202)	(0.0201)	(0.0269)
geo_spillover		0.8948	1.0280	0.7327	0.8077	0.6812	0.6856	-0.8801	-0.9077	1.2712*
		(0.6502)	(0.6647)	(0.5479)	(0.5960)	(0.4413)	(0.5612)	(0.6169)	(0.6112)	(0.7850)
tech_spillover		0.0569	0.0577	0.0481	0.0483	0.0289	0.0313	-0.0627	-0.0646	-0.0257
		(0.0439)	(0.0446)	(0.0360)	(0.0410)	(0.0370)	(0.0360)	(0.0419)	(0.0422)	(0.0269)
hypothesis tests (chi2, p-value)										
index ethnic=index edu	0.91; 0.341	0.86; 0.353	0.63; 0.428	2.611; 0.111				10.00; 0.000	9.88; 0.001	2.40; 0.123
index ethnic=index demo	16.19; 0.000	0.03;0.866	0.19; 0.663	1.041; 0.307				0.31; 0.576	0.31; 0.576	0.84; 0.356
index demo=index edu	11.51; 0.000	0.29;0.588	0.51; 0.475	0.011; 0.517				3.66; 0.055	3.65; 0.056	1.54; 0.214
size/industry/year/industry*year dummies	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
shares of foreigners by group of countries	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
shares of employees by occupation	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	96,636	96,636	96,636	96,636	96,636	96,636	96,636	96,636	96,636	96,636
chi2	162.0	22824.1	28812.4	27261.9	25077.9	25359.1	22785.7	25848.2	25848.3	25848.4

The effects on probability of applying in different technological areas

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
	Probit	Probit	Probit	Probit (IV)	Probit (IV)	Probit (IV)	Probit (IV)	Probit	Probit	Probit (IV)
index ethnic	0.0427**	0.0346**	0.0329**	0.1356**	0.1519**			0.0469***	0.0446***	0.3088***
	(0.0138)	(0.0150)	(0.0145)	(0.0669)	(0.071)			(0.0130)	(0.0130)	(0.0737)
index edu	0.0688***	0.0737***	0.0727***	0.0112		0.0127		0.1169***	0.1127***	-0.1021
	(0.0177)	(0.0169)	(0.0169)	(0.0302)		(0.0321)		(0.0203)	(0.0203)	(0.0669)
index demo	0.0410*	0.0102	0.0069	0.0456			0.0569	0.0280	0.0277	0.0788
	(0.0246)	(0.0280)	(0.0277)	(0.0621)			(0.0656)	(0.0237)	(0.0237)	(0.0819)
index occ			0.0021						0.0011	
			(0.0027)						(0.0027)	
log(K)		0.0512***	0.0501***	0.0527***	0.0556***	0.0546***	0.0537***	0.0477***	0.0477***	0.0487***
		(0.0130)	(0.0130)	(0.0110)	(0.0101)	(0.0110)	(0.0102)	(0.0130)	(0.0131)	(0.0110)
log(L)		0.0346	0.0369	-0.0056	0.0069	0.0488*	0.0327	0.0421*	0.0427*	-0.0269
		(0.0237)	(0.0241)	(0.0327)	(0.0310)	(0.0261)	(0.0259)	(0.0220)	(0.0231)	(0.0346)
age1		0.4557**	0.4710**	0.5677***	0.5119**	0.5069**	0.5888***	0.4357**	0.4366**	0.5710**
		(0.2091)	(0.2103)	(0.2001)	(0.1784)	(0.1737)	(0.2069)	(0.2030)	(0.2027)	(0.1927)
age2		0.5069**	0.5010**	0.5301***	0.4851***	0.4788***	0.5269**	0.4677**	0.4656**	0.5321***
		(0.1901)	(0.1910)	(0.1609)	(0.1345)	(0.1357)	(0.1610)	(0.1919)	(0.1927)	(0.1256)
age3		0.1356	0.1402	0.1588	0.1891	0.1627	0.1327	0.0856	0.0847	0.1469
		(0.2637)	(0.2637)	(0.1746)	(0.1830)	(0.1819)	(0.1822)	(0.2677)	(0.2680)	(0.1727)
males		-0.0677	-0.0755	-0.0456	-0.1169	-0.1301*	-0.0621	0.0256	0.0247	0.0788
		(0.0971)	(0.0980)	(0.1310)	(0.0756)	(0.0790)	(0.1227)	(0.1045)	(0.1037)	(0.1601)
exp		0.0227	0.0246	0.0203	0.0237	0.0246	0.0202	0.0310	0.0310	0.0312
		(0.0421)	(0.0410)	(0.0288)	(0.0250)	(0.0262)	(0.0310)	(0.0377)	(0.0380)	(0.0269)
skill1		-0.0009***	-0.0009**	0.0001	0.0001	0.0001	0.0001	-0.0188	-0.0111	-0.0146
		(0.0003)	(0.0004)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.1562)	(0.1527)	(0.1101)
skill2		0.0035**	0.0035**	-0.0001	0.0026**	0.0027**	0.0027**	0.0701***	0.0677***	0.0610***
		(0.0004)	(0.0004)	(0.0001)	(0.0004)	(0.0004)	(0.0004)	(0.0146)	(0.0127)	(0.0146)
tenure		0.0046	0.0046	0.0069	0.0069	0.0057	0.0054	0.0027	0.0027	0.0046
		(0.0090)	(0.0090)	(0.0056)	(0.0046)	(0.0045)	(0.0056)	(0.0092)	(0.0090)	(0.0060)
multi		-0.0037	-0.0019	0.0269	0.0061	-0.0251	-0.0045	0.0081	0.0077	0.1069*
		(0.0320)	(0.0319)	(0.0412)	(0.0350)	(0.0270)	(0.0327)	(0.0327)	(0.0331)	(0.0561)
copatent		-0.0236	-0.0227	-0.0227	-0.0219	-0.0210	-0.0210	-0.0152	-0.0152	-0.0153
		(0.0250)	(0.0247)	(0.0269)	(0.0271)	(0.0269)	(0.0256)	(0.0259)	(0.0260)	(0.0246)
geo_spillover		0.0008**	0.0008**	0.0012***	0.0009***	0.0009***	0.0009***	0.0009***	0.0009**	0.0009***
		(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
tech_spillover		0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
		(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
hypothesis tests (chi2, p-value)										
index ethnic=index edu	1.24; 0.264	8.47; 0.003	8.29; 0.004	27.651; 0.000				8.14; 0.004	8.17; 0.005	23.789; 0.000
index ethnic=index demo	0.00; 0.964	4.04; 0.052	5.03; 0.051	12.018; 0.000				0.15; 0.702	0.13; 0.702	9.675; 0.002
index demo=index edu	0.85; 0.355	13.53; 0.000	14.09; 0.000	1.43; 0.231				4.09; 0.043	4.11; 0.043	3.57; 0.056
size/industry/year/industry*year dummies	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
shares of foreigners by group of countries	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
shares of employees by occupation	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
N	1,086	1,086	1,086	1,086	1,086	1,086	1,086	1,086	1,086	1,086
pseudo R2	0.067	0.304	0.318	0.317	0.309	0.309	0.292	0.297	0.298	0.299

Mechanisms involved - hypothesis

- calculate the diversity indices separately for white- and blue-collar occupations;
  - **H: problem-solving abilities and creativity will generate higher productivity for white-collar occupations than for blue-collar occupations**
- exclude (i) foreigners with tertiary education, (2) those speaking a Germanic language and iii)2nd gen of foreigners in calculating ethnic diversity to test the importance of communication costs and the costs of cross-cultural dealing.
  - **H: these groups of foreigners most likely speak Danish or English**

Mechanisms involved

Probability to innovate

	Occupation specific diversity		2nd gen. Imm. as natives	Germanic group as natives	University graduates as natives
	White collar	*Blue collar*			
index ethnic disaggr	0.0025**	0.0014***	0.0009***	0.0001**	0.0002*
	(0.0004)	(0.0005)	(0.0003)	(0.0000)	(0.0001)
index edu disaggr	0.0001	-0.0009	0.0004	0.0004	0.0006
	(0.0001)	(0.0009)	(0.0002)	(0.0002)	(0.0004)
index demo disaggr	0.0009	0.0027	0.0002	0.0003	0.0002
	(0.0007)	(0.0021)	(0.0003)	(0.0002)	(0.0001)
N	96,636	96,636	96,636	96,636	96,636
pseudo R2	0.382	0.381	0.389	0.386	0.389

Number of firm patents

	Occupation specific diversity		2nd gen. Imm. as as natives	Germanic group as natives	University graduates as natives
	White collar	*Blue collar*			
index ethnic disaggr	0.5788**	0.2109	0.0319**	0.0231	0.2401*
	(0.2110)	(0.2127)	(0.0142)	(0.0152)	(0.1310)
index edu disaggr	0.7501	0.9545	0.3910	0.3268	0.2710
	(0.8027)	(1.8809)	(0.6377)	(0.6452)	(0.6545)
index demo disaggr	1.9155	1.7520	1.6321	1.4488	1.4861
	(5.4810)	(4.5561)	(4.4462)	(4.2869)	(4.3082)
N	96,636	96,636	96,636	96,636	96,636
Chi2	33730.0	27768.3	26982.2	27186.8	24934.8

Probability of applying in different technological areas

	Occupation specific diversity		2nd gen. Imm. as natives	Germanic group as natives	University graduates as natives
	White collar	*Blue collar*			
index ethnic disaggr	0.4537***	0.0212	0.0527**	0.0222*	0.0588
	(0.0810)	(0.0469)	(0.0188)	(0.0121)	(0.3052)
index edu disaggr	-0.0677	-0.1012	-0.0280	-0.0337	-0.0177
	(0.0653)	(0.0537)	(0.0482)	(0.0491)	(0.0521)
index demo disaggr	0.0669	0.0610	0.0537	0.0580	0.0327
	(0.0810)	(0.0562)	(0.0727)	(0.0712)	(0.0691)
N	1,086	1,086	1,086	1,086	1,086
pseudo R2	0.292	0.289	0.235	0.298	0.297

Mechanisms involved - results

RESULTS:

- The effect of ethnic diversity on both the intensive and extensive margins of innovation is positive and statistically significant for the group of white-collar workers only. Conversely, the effect of education and demographic diversity is insignificant for both white- and blue-collar occupations.
  - **consistent with the creativity hypothesis** proposed in the theoretical frameworks developed by Hong and Page (2001 and 2004) and Berliant and Fujita (2008) at least for ethnic diversity
- The role of ethnic heterogeneity on innovation weakens once we exclude foreigners who probably speak English or Danish.
  - **consistent** with the idea that the communication costs and costs of cross-cultural dealing are likely to be more important when foreigners don't speak the same language

Robustness I

			Probability to innovate			
	Shannon entropy index	**Richness**	**Edu and demo diversity as sd**	**IV migration determinants**	**Firms without pre-sample patents**	**Firms with pre-sample patents**
index ethnic disaggr	0.0009**	0.0037***	0.0010***	0.0008**	0.0037***	0.1637***
	(0.0004)	(0.0007)	(0.0000)	(0.0002)	(0.0009)	(0.0419)
index edu disaggr	0.0001	0.0010	0.0019*	0.0003	0.0002	0.0177
	(0.0001)	(0.0009)	(0.0010)	(0.0002)	(0.0003)	(0.0240)
sd(years of education)			-0.0027			
			(0.0019)			
index demo disaggr	0.0012	0.0013		0.0002	0.0002	-0.0588
	(0.0010)	(0.0008)		(0.0006)	(0.0019)	(0.0423)
sd(age)			0.0020			
			(0.0017)			
male			-0.0001			
			(0.0001)			
N	96,636	96,636	96,636	96,636	93,268	3,368
pseudo R2	0.385	0.345	0.388	0.387	0.309	0.321
			Number of firm patents			
	Shannon entropy index	**Richness**	**Edu and demo diversity as sd**	**IV migration determinants**	**Firms without pre-sample patents**	**Firms with pre-sample patents**
index ethnic disaggr	0.3449**	0.0669*	1.0369**	0.2637**	0.8787	1.3817**
	(0.1120)	(0.0401)	(0.3502)	(0.1260)	(0.6972)	(0.4660)
index edu disaggr	0.6788	0.8919	1.1510	0.5769	0.6088	0.9487
	(0.9801)	(0.5737)	(2.1288)	(0.6677)	(1.4370)	(0.9267)
sd(years of education)			0.8237			
			(2.5310)			
index demo disaggr	2.1627	0.2501		1.2278	1.9480	-1.9576
	(5.2037)	(0.9920)		(2.4277)	(2.0139)	(2.4650)
sd(age)			0.1188			
			(1.6219)			
male			0.2210			
			(0.6009)			
N	96,636	96,636	96,636	96,636	93,268	3,368
Chi2	42368.8	25932.8	26035.7	25405.0	1007.1	3000.5
			Probability of applying in different technological areas			
	Shannon entropy index	**Richness**	**Edu and demo diversity as sd**	**IV migration determinants**	**Firms without pre-sample patents**	**Firms with pre-sample patents**
index ethnic disaggr	0.2801**	0.0310	0.3102**	0.2056**	0.0440*	-
	(0.0673)	(0.0437)	(0.0751)	(0.0861)	-0.0282	-
index edu disaggr	-0.002	-0.0627	0.0602	0.0177	0.0081	-
	(0.0621)	(0.0549)	(0.1810)	(0.0572)	-0.0277	-
sd(years of education)			0.0201			
			(0.2082)			
index demo disaggr	-0.0746	-0.0556		-0.0177	-0.0562	-
	(0.0962)	(0.0781)		(0.0737)	-0.0488	-
sd(age)			0.0277			
			(0.2340)			
male			-0.0046			
			(0.0237)			
N	1,086	1,086	1,086	1,086	935	-
pseudo R2	0.231	0.253	0.313	0.290	0.298	-

Robustness II

			Probability to innovate			
	Copenhagen is excluded	**Mono-establishment firms**	**Firm level diversity**	**Less than 50 employees**	**50-100 employees**	**more than 100 employees**
index ethnic disaggr	0.0009**	0.0009**	0.0009**	0.0014***	0.0036***	0.0150***
	(0.0004)	(0.0004)	(0.0004)	(0.0006)	(0.0015)	(0.0032)
index edu disaggr	0.0004	0.0005	0.0006	0.0001	0.0021	0.0101
	(0.0003)	(0.0003)	(0.0004)	(0.0001)	(0.0014)	(0.0062)
index demo disaggr	0.0002	0.0001	0.0002	0.0001	-0.0012	0.0006
	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0010)	(0.0004)
N	85,555	78,964	96,636	73,879	11,776	8,453
pseudo R2	0.386	0.335	0.387	0.247	0.221	0.296
			Number of firm patents			
	Copenhagen is excluded	**Mono-establishment firms**	**Firm level diversity**	**Less than 50 employees**	**50-100 employees**	**more than 100 employees**
index ethnic disaggr	0.8357***	1.2569***	0.2819**	0.5410***	1.4577**	2.0149***
	(0.2050)	(0.1712)	(0.0919)	(0.0821)	(0.5161)	(0.3761)
index edu disaggr	1.0069	0.7801	0.2012	0.1269	0.5527	0.7610
	(0.8171)	(0.5027)	(0.7669)	(0.5819)	(1.1058)	(1.2602)
index demo disaggr	3.9877	1.6377	1.3577	1.3950	1.2546	1.5182
	(6.3270)	(1.7610)	(4.7345)	(8.3637)	(3.7071)	(6.6242)
N	85,555	78,964	96,636	73,879	11,776	8,453
Chi2	21235.1	20541.1	25848.4	23402.3	18687.0	10741.4
			Probability of applying in different technological areas			
	Copenhagen is excluded	**Mono-establishment firms**	**Firm level diversity**	**Less than 50 employees**	**50-100 employees**	**more than 100 employees**
index ethnic disaggr	0.0969*	0.1212	0.1102**	-	-	-
	(0.0491)	(0.0727)	(0.0427)	-	-	-
index edu disaggr	0.0459	0.0769	0.0771	-	-	-
	(0.0527)	(0.0501)	(0.0637)	-	-	-
index demo disaggr	-0.0561	-0.0652	-0.0910	-	-	-
	(0.0782)	(0.0677)	(0.0810)	-	-	-
N	1,014	691	1,086	-	-	-
pseudo R2	0.315	0.291	0.315	-	-	-

Diversity and Firm Innovation - conclusions

- Probits and count data models (we correct for unobserved permanent differences in patent productivity using “pre-sample” histories)
- We find robust evidence that diversity in ethnicity and skills is a relevant component of innovation.
- Ethnic diversity facilitates firms' patenting activity in several ways:
  - i) by increasing their propensity to apply for a patent;
  - ii) by enlarging the breadth of potential technological fields;
  - iii) by raising the overall number of patent applications.
- Demographic diversity results more mixed.
- Support to creativity and to the existence of communication costs and costs of “cross-cultural” dealing.

Diversity and Firm Productivity - analyses

Motivation and aim

- First we **describe** the empirical associations between firm productivity and labor diversity, by looking at three relevant dimensions of diversity, i.e. cultural background, education and demographics.
- Second, given that firms may endogenously leverage diversity to improve their performance, we employ **an instrumental variable** (IV) approach (Card, 2001).
- Third, we move towards **a richer production function** specification that takes different types of labor as inputs to find out whether dispersion in labor types has an effect on firm output.

Empirical methodology

- Using the estimates of production function parameters, the firm i total factor productivity (henceforth TFP), at time t in industry j is defined as:

$$TFP_{ijt} = y_{ijt} - \hat{\alpha} l_{ijt} - \hat{\beta} k_{ijt}$$

- Next to the computation of TFP values, the relationship between these and alternative measures of diversity can be estimated with OLS, in the following equation separately for each sector j:

$$TFP_{ijt} = \gamma_0 + \gamma_1(index\_ethnic_{ijt}) + \gamma_2(index\_edu_{ijt}) + \gamma_3(index\_demo_{ijt}) + \gamma_c(C_{ijt}) + \gamma_t + \gamma_r + \gamma_n + \gamma_n * \gamma_t + \xi_{ijt}$$

TFP and diversity (OLS)

	TFP (ACF)				
	Manufacturing	Construction	Wholesale and retail trade	Transport	Financial and business services
Index ethnic aggr	-0.013***	-0.012**	-0.033***	-0.009	-0.011
	(0.003)	(0.005)	(0.006)	(0.018)	(0.008)
Index edu aggr	0.014**	0.010*	0.010**	0.048	0.017**
	(0.006)	(0.006)	(0.004)	(0.027)	(0.008)
Index demo aggr	0.023	-0.026	-0.004	0.035	0.018
	(0.013)	(0.015)	(0.005)	(0.022)	(0.012)
Observations	35887	18024	26418	4007	7931
R2	0.281	0.235	0.553	0.185	0.347
Index ethnic disaggr	-0.016***	-0.012**	-0.015***	-0.008	0.001
	(0.003)	(0.005)	(0.004)	(0.008)	(0.006)
Index edu disaggr	0.029***	0.012*	0.053***	0.007	0.054***
	(0.007)	(0.007)	(0.006)	(0.022)	(0.013)
Index demo disaggr	0.021	-0.027	-0.016	0.032	-0.010
	(0.011)	(0.015)	(0.009)	(0.019)	(0.012)
Observations	35887	18024	26418	4007	7931
R2	0.290	0.247	0.558	0.203	0.361

TFP and diversity (IV)

	Manufacturing	Construction	Wholesale and retail trade	Transport	Financial and business services
index ethnic disaggr	-0.026*	-0.038*	-0.028**	-0.031	0.009
	(0.014)	(0.019)	(0.014)	(0.084)	(0.012)
index edu disaggr	0.061**	0.037	0.095**	0.047	0.078*
	(0.028)	(0.019)	(0.040)	(0.149)	(0.038)
index demo disaggr	0.093	-0.048	-0.056	-0.085	-0.048
	(0.086)	(0.049)	(0.033)	(0.070)	(0.033)
N	35887	18024	26418	4007	7931
R2	0.310	0.123	0.252	0.189	0.200

Production function with different labor types

	Skill dispersion (foreign and native employees)				
	Manufacturing	Construction	Wholesale and retail trade	Transport	Financial and business services
Log(L)	0.857***	0.859***	0.834***	-	0.790***
	(0.012)	(0.007)	(0.017)	-	(0.007)
Log(K)	0.163***	0.183***	0.203***	-	0.217***
	(0.008)	(0.004)	(0.010)	-	(0.005)
Between dispersion	0.310**	0.295***	0.458***	-	0.011***
	(0.128)	(0.062)	(0.090)	-	(0.002)
Native employees dispersion	0.142	0.254**	0.232*	-	0.100***
	(0.139)	(0.084)	(0.141)	-	(0.021)
Foreign employees dispersion	-0.123**	-0.012	-0.638***	-	-0.028***
	(0.044)	(0.031)	(0.142)	-	(0.007)
Hypothesis testing (chi2, p-value)					
Between dispersion>1	29.06; 0.000	130.27; 0.000	36.40; 0.000	-	1912.91; 0.000
Native employees dispersion>1	37.81; 0.000	79.28; 0.000	29.73; 0.000	-	18872.68; 0.000
Foreign employees dispersion>1	664.87; 0.000	1098.80; 0.000	133.78; 0.000	-	2500; 0.000
Observations	19612	3967	9254	-	4210
R2	0.954	0.965	0.848	-	0.713
	Skill dispersion (employees with and without tertiary education)				
	Manufacturing	Construction	Wholesale and retail trade	Transport	Financial and business services
Log(L)	0.759***	-	0.839***	-	0.834***
	(0.032)	-	(0.042)	-	(0.016)
Log(K)	0.226***	-	0.150***	-	0.186***
	(0.025)	-	(0.033)	-	(0.015)
Between dispersion	0.031	-	0.085**	-	0.035*
	(0.028)	-	(0.037)	-	(0.021)
Employees with less than tertiary education dispersion	-0.004	-	0.024	-	-0.002
	(0.024)	-	(0.056)	-	(0.016)
Employees with tertiary education dispersion	1.505***	-	2.460**	-	1.043***
	(0.028)	-	(0.983)	-	(0.012)
Hypothesis testing (chi2, p-value)		-		-	
Between dispersion>1	119.88; 0.000	-	8.97; 0.001	-	207.81; 0.000
Employees with less than tertiary education dispersion>1	170.64; 0.000	-	104.85; 0.000	-	392.94; 0.000
Employees with tertiary education dispersion>1	2.41; 0.121	-	1.21; 0.321	-	3.98; 0.071
Observations	12925	-	7411	-	5765
R2	0.910	-	0.810	-	0.802

Diversity and Firm Productivity – results

- Ethnic diversity - negatively associated with firm TFP
- Educational diversity –positively associated with firm TFP
- demographic diversity is never significantly correlated with firm productivity.
- E.g.: In the manufacturing sector, **a standard deviation increase in ethnic diversity is associated with a decrease in firm TFP by 1.3% (1.6%)** when an aggregated (disaggregated) index is considered.
- In the same industry a **standard deviation increase in educational diversity** is associated with an **increase in firm TFP by 1% (2.9%)** when an aggregated (disaggregated) index is considered.
- Estimation adopting the IV strategy yields qualitatively similar results to those reported in the main analysis.

Mechanisms involved - hypothesis

- calculate the diversity indices separately for white- and blue-collar occupations;
  - **H: problem-solving abilities and creativity will generate higher productivity for white-collar occupations than for blue-collar occupations**
- exclude (i) foreigners with tertiary education, (2) those speaking a Germanic language and iii)2nd gen of foreigners in calculating ethnic diversity to test the importance of communication costs and the costs of cross-cultural dealing.
  - **H: these groups of foreigners most likely speak Danish or English**

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Mechanisms involved - results

RESULTS:

- correlation of educational diversity with firm productivity is much larger for white-collar occupations than for blue-collar ones. Moreover, the negative coefficient of ethnic diversity among white-collar workers is lower than the coefficient associated with blue-collar occupations. =>
  - **consistent with the creativity hypothesis** proposed in the theoretical frameworks developed by Hong and Page (2001 and 2004) and Berliant and Fujita (2008).
- Coeff. of ethnic heterogeneity is larger in absolute terms, once we exclude foreigners who most likely speak Danish or English, compared to the coefficient estimated on the standard ethnic diversity.
  - **consistent** with the hypothesis that the communication costs and the costs of cross-cultural dealing within ethnically heterogeneous workforces play a role in terms of firm productivity

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Diversity and Firm Productivity - conclusions

- Using a comprehensive LEED, this paper investigates the effect of firm labour diversity in ethnic-cultural, skill and demographic characteristics on firm productivity in Denmark.
- We find that **diversity in skills and education enhances significantly firm TFP.** E.g. in manufacturing, a standard deviation increase in skill/educational diversity increases productivity by approximately 1% (2.9%). The result gives support to the existing theory on knowledge spillovers, creativity and problem-solving abilities (Lazear, 1999; Hong and Page, 1998 and 2001; Berliant and Fujita, 2004; Alesina and La Ferrara, 2005).
- **Diversity in demographics and ethnicity** brings mixed results – both dimensions of workforce diversity bring **either no or negative effects on firm TFP**. E.g. in manufacturing, a standard deviation increase in ethnic diversity is associated with a decrease in firm TFP by 1.3% (1.6%) when an aggregated (disaggregated) index is considered.

Diversity and Firm Productivity - conclusions

- Thus, it seems as the negative effects coming from communication and integration costs connected to more diverse workforce prevail over the positive effects of diversity on firm TFP coming from creativity and knowledge spillovers consistent with the notion by Lazear (1999), Glaseser et. al. (2000), and Alesina and La Ferrara (2002).
- Alternative tests confirm the creativity hypothesis, and also hypothesis of the existence of communication costs and the costs of cross-cultural dealing.
- Our findings may imply that **if firms strengthened their efforts to decrease the obvious costs of workforce diversity (e.g., by implementing diversity management, modern techniques and integration practices), they could turn the** ethnic and demographic **diversity** into a substantial **competitive advantage**.

OUR NEXT LECTURE – Monday 22.2.2016, 15.00-16.30

- ***Wider effects of immigration, International migration and globalization. Cont.***

THE NEXT LECTURES on economics of migration

- *Emigration and source countries; Brain drain and brain gain; Remittances*