IMPACT OF IMMIGRATION; IMMIGRATION POLICIES

IMPACT OF WORKFORCE DIVERSITY ON FIRMS AND ECONOMIES

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Study Materials and Reading List

Slides of the lectures (provided one day in advance or on the day of the class)

All materials provided on: http://home.cerge-ei.cz/munich/labor14/

Mandatory :

*BORJAS George : Labor Economics 6th ed; Chapter 8 Labor Mobility, and Chapter 4 (Policy application 4-5)

*Borjas, G. and K. Doran (2012): "The Collapse of the Soviet Union and the Productivity of American Mathematicians," Quarterly Journal of Economics, August 2012.

*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.

Optional:

BORJAS George J.(2006): Native internal migration and the labor market impact of immigration. JHR, 41:2, 221-258

Borjas G. J. (2003): The labor demand curve is downward sloping: re-examining the impact of immigration on the labor market, Quarterly Journal of Economics, vol. 118, pp. 1135–74.

Card, D. E. (2001). Immigrant inflows, native outflows and the local labor market impacts of higher immigration, Journal of Labor Economics, vol. 19, pp. 22–64.

Card, D. (2005): Is the new immigration really so bad? The Economic Journal, 115:507, 300-323.

Alesina, A. and E. La Ferrara (2005): "Ethnic Diversity and Economic Performance" JEL, XLII, pp 762-800.

George J. BORJAS: "THE ECONOMIC ANALYSIS OF IMMIGRATION", In: Handbook of Labor Economics, Volume 3, Edited by O. Ashenfelter and D. Card (1999); Chapter 28, Elsevier Science B. V.

- Check out sites of George Borjas, Giovanni Peri and David Card

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OUTLINE

- Impact of migration:
  - On destination countries
  - Sending countries
- The role of immigration policies
- Impacts of workforce diversity on firms and economies, effects on:
  - productivity,
  - innovation,
  - exporting behaviour

IMPACT OF IMMIGRATION - on employment and wages of natives and on general welfare

- laws of supply and demand -> a significant increase in the supply of any commodity, including labor, should directly reduce its price => the effect of immigration on the wages of native-born workers should be negative.
- Evidence mixed:
  - **Borjas** – calculated for the U.S. the **negative impact** of immigration between 1979 and 1995 **on the relative wages** of high school drop-outs at about 5 percentage points (Borjas, 1999) and a reduction of 4.0% in the level of real wages of all native-born men between 1980 and 2000 (Borjas, 2004)
  - But Borjas's calculations have long been **challenged** by economists using different methodologies and data, and **many studies continue to find no effect or only weak negative effects of immigration on low-skilled workers or workers in general** (e.g. Card, 2005; Ottaviano and Peri, 2005)
  - Again, it depends if immigrants and native workers are **complements or substitutes**.

What effect do immigrants have on natives?

- Effect of immigration on native wages and employment
- Start with homogenous labor: natives and immigrants do not differ in skills or education
- L = N (natives) + M (migrants)
- Short term effect of demand (K fixed)
- Entry of M migrants shifts the supply curve and lowers the market wage
- Higher employment => higher output
- Immigrants increase the national income that accrues to the native population
- Part of the increase in national income redistributed to immigrants via wages

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FIGURE 1 Effect of Immigration – Homogenous Workers
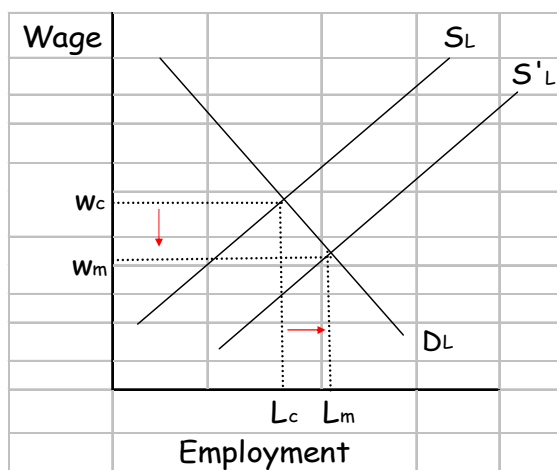
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What effect do immigrants have on natives?

- Assumption of homogenous workers *not realistic*
- Theory implies that gains from immigration will be bigger for natives the greater the differences in productive endowments between immigrants and natives
- Bigger difference between immigrants and natives => less substitutability
- Gainers from immigration: native workers whose labor is complementary in production with immigrants
- Use cross wage elasticities

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Effect of immigrants will depend on

- Size of immigration flows
- Substitutability between natives and immigrants
- Relative abundance of natives in different skills, education, occupation and or experience groups
- Integration of the host labor market with other markets.
- In the extreme case, perfect integration with other labor or product markets can mean that there are no local effects of local immigration since these effects are entirely mediated through general equilibrium impact of the larger market (law of one "world" price)

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Evaluate the Effect of immigrants

- Not a standard program evaluation problem
- Correlation btw immigration and wages of natives will not tell you much about the causality
- If migrants have lower skills than natives => understate effect on low skilled native workers
- Location decisions depend also on labor market opportunities
- Immigrants may move to cities where growth in demand for labor can accommodate their supply
- Even if new immigrants cluster in a few cities (U.S.), inter-city migration of natives (out-migration) may offset negative effects of immigration
- Card VS Borjas debate

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IMPACT OF MIGRATION - on employment and wages of natives
Empirical Evidence – Card (1990)

- Very influential paper
- Natural experiment: impact of arrival of 125,000 Cubans to Miami btw May and September 1980 on the labor market (Mariel boatlift-*Marielitos*)
- Size of Miami labor force increased by 7%
- Idea of the paper: compare wages and unemployment rates of ethnic groups btw Miami and 4 other cities with high % immigration (Atlanta, Houston, LA and Tampa)
- Whether the Mariel immigration reduced the earnings of less-skilled natives in Miami
- Based on education and occupation, Cubans are more likely to compete with Hispanics and Blacks than whites
- Finds no negative effect on American workers
- Real wage of Miami Cubans falls by 9 log points btw 1979 and 1985. But 6 log points due to composition of workforce, only a 3 log points effect due to Mariel = small effect

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Card (1990) - Interpretations

- Striking and unexpected results- wrt effect of Cubans on labor market competition (Miami black residents rioted in 1980 for that reason)
- Why no effect of immigration in the Mariel experiment?
- One possibility is the reduction in native inflows to Miami: natives and older immigrants were deterred from migrating to Miami (national impact but undetectable)
- Another explanation: Miami was set up to absorb Cuban immigrants (growth of industries that utilize low skilled, social networks, high demand for their skills)

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Card (1990) - Interpretations

- The Mariel experiment is not the ideal test- difficult to understand the yearly variations, what about shocks in the comparison cities we do not know about?
- It may not be realistic to treat Miami as an autarkic labor market (i.e. that Mariel only affected Miami and not the other cities)
- Lead to criticisms about how to evaluate the effects of immigration
- Since then, other studies have taken a broader approach (general equilibrium approach – we can not look at the effects of immigration in isolation)

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Critique of Card (1990)

- Immigrants may not be randomly distributed across labor markets. If immigrants cluster in cities with thriving economies, there would be a spurious positive correlation between immigration and local employment conditions (Borjas, 2001).
- Local labor markets are not closed. Natives may respond to the immigrant supply shock by moving their labor or moving firms to other cities, thereby re-equilibrating the national economy. Card argues those internal natives&firm flows are negligible.
    - There is an unresolved debate over whether these equilibrating flows exist.
- Measurement error
    - Source: Borjas (2007)

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An alternative approach (Borjas, QJE, 2003)

- Borjas' focus on the national economy as a whole, styding changes in wages and employment over time
- Borjas pays more attention to the definition of a skill group and argues that occupation may not be the right measure to look at.
- Both schooling *and* work experience determine a person's stock of acquired skills.
    - Immigration is not balanced evenly across all experience cells in a particular schooling group. The immigrant influx will tend to affect some native workers more than others. And the nature of the supply "imbalance" changes over time.
- Impact of immigration on natives earnings in cells defined by decade (1960-2000), education (4 groups) and 5-years experience groups for the U.S.
- Over 1980-2000, immigrants became an increasingly share of U.S. labor supply

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An alternative approach (Borjas, QJE, 2003)

- Focus on effects of immigration on high school dropouts (low educ.)
- Immigrants tend to be younger
- Borjas argues that local labor market may not be the right unit of observation
  -Look at national labor market instead
- Results reconfirms that the labor demand curve is indeed downward sloping:
  An influx of immigrants into a particular skill group lowers the wage of that
  skill group

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Borjas' view with national data
Scatter diagram relating wages and immigration (removing decade effects)
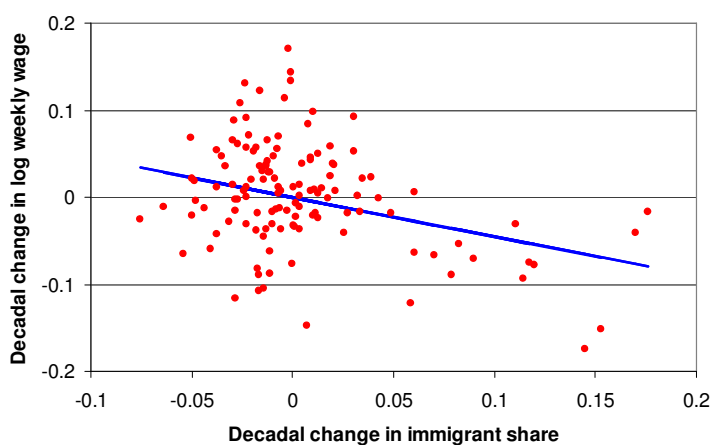
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IMPACT OF MIGRATION - on employment and wages of natives

- summary:
- Migrant workers often complement rather than substitute domestic ones. Immigrants then do not decrease but increase the wages of complementary domestic workers. it appears that migrants are substitutes for low-skilled natives or other immigrants in certain low-skilled sectors (Roy 1997).
- It has been empirically documented that, on aggregate, migrants do not take natives' jobs nor decrease their wages (Card 1990; Roy 1997; Kahanec and Zimmermann 2010; Peri 2014; Constant 2014; also see the meta-analysis by Longhi, Nijkamp, and Poot 2005).
- some studies have found moderate negative effects of immigration (Borjas 2003).

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IMPACT OF MIGRATION – receiving countries

Gains or Losses?

- ***Impacts of Immigration and ethnic diversity on firms and economies:***

  - innovation

  - Productivity

  - 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). Highly educated are much more mobile than less educated.

Percentage of Foreign-Born by Skill Group in the USA, 2005
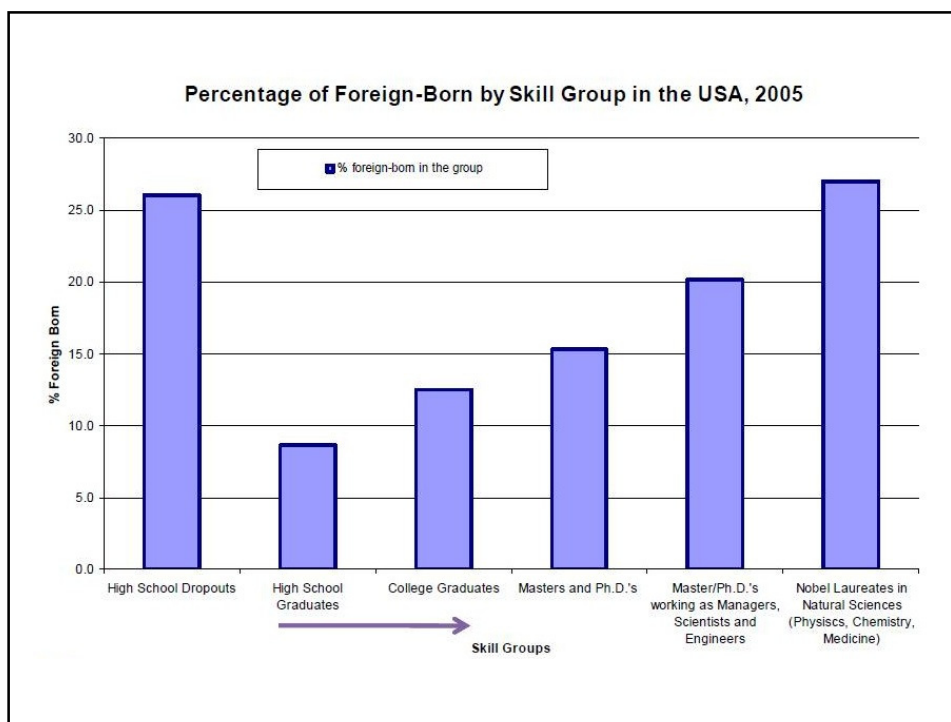
Native and Foreign PhD's in the US

Figure 1. PhD Degrees Awarded by US Universities and National Origin, 1958-2003
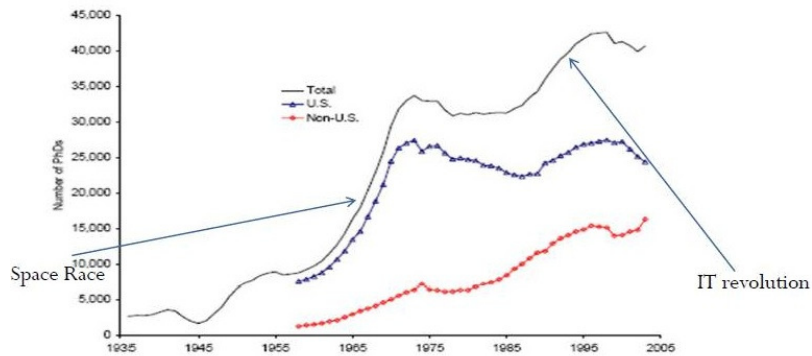
Source: NSF, *Survey of Earned Doctorates* microdata and, before 1958, National Academy of Sciences (1958). National origin is defined by the country in which an individual went to high school.

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)

- Research by Peri and Sparber

- Borjas and Doran QJE2012 - use data on the 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 - on employment and wages of natives and on general welfare – evidence from Denmark

- Gerdes, Schultz-Nielsen and Wadensjö (2011) find:
  - A **net transfers from Western first- and second-generation immigrants to state** funds are **positive**, while those **from non-Western first- and second-generation immigrants** are **negative**.
  - The net transfers from non-Western first- and second-generation immigrants **fell** from DKK -12.8 billion in 2004 to DKK -9.1 billion in 2008, largely due to the improved employment situation in Denmark.
  - The **composition** chosen of the group of non-Western immigrants has a significant effect on the calculation of net transfers, in that these **transfers are reduced** to DKK -2.2 billion **if refugees are excluded** from this group. The negative outcome of -2.2 billion is mostly due to demographic composition of the second generation of immigrants (children at schools/daycare = expensive).
- Rose-Skaksen (2011):
  - high-skilled specialists contribute **positively** to the state budget.
  - **On average 1 high-skilled immigrant with his/her family brings over 8 years of living in Denmark about 1,9 mil DKK.**

IMPACT OF MIGRATION: Ethnic diversity and firm outcomes - theory

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

- labor **diversity** can be a **source of creativity** and therefore **affect the firm performance in a positive way**,

- BUT a heterogeneity among workers may induce **misunderstanding**, **conflicts and uncooperative behaviors** within workplaces and in this way hinder innovation and bring costs to the firm (Basset-Jones, 2005).

- **Distinguishing between cognitive and demographic diversity important**

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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 EMIGRATION on sending countries

- not as well developed as the other directions of international migration, focus on:
  - brain-drain phenomenon,
  - the impact of remittances on the sending country
  - the effects of emigration on wages for non-migrants

IMPACT OF EMIGRATION on sending countries

- **brain-drain**
  - Migration of the most educated from poor to rich countries. Traditionally seen as detrimental to poor countries due to human capital externalities.
  - Using a cross-country dataset, Beine et al.(2008) concluded that a doubling of emigration rate would increase in the human capital formation of natives by 5% (emigration->increase in returns to schooling->more people getting higher schooling)
  - Docquier&Rapoport (2009) show that, depending on specific conditions, the migration of the highly skilled can have a positive effect (the case of Indian IT sector), a mixed effect (the case of African medical staff) or a negative effect (the case of European researchers).
  - **Brain-gain:**
    - Return with enhanced human capital; creation of networks and increased trade and investments

IMPACT OF EMIGRATION on sending countries

• **the role of remittances**

  • Consensus – remittances contribute positively on the source country economies

  • increase in domestic saving as well as an increase in the household's spending on education and health (Ratha et al, 2011). Also, remittances might increase the business formation in the source country, helping households to overcome the credit market restrictions (Ratha et al, 2011, Hanson, 2008)

  • remittances might easily help families to support the schooling expenses of their children

IMPACT OF EMIGRATION on sending countries

• **effects on wages of non-migrants**

  • Research scarce – difficulty with data on emigrants

  • Emigration lowers wages of stayers (E.g. Aydemir and Borjas (2006), Mishra(2007)), the effect differs by skills

  • Dustmann, C., Frattini, T., Rosso, A. (2012), The Effect of Emigration from Poland on Polish Wages, CReAM DP 29/12 - forthcoming Scandinavian Journal of Economics:

Emigration from Poland was largest for workers with intermediate level skills:
- wages for this skill group increased most
- emigration led to a slight increase in wages overall but workers at the low end of the skill distribution made no gains and may actually have experienced slight wage decreases

IMMIGRATION POLICIES

Different immigration policy regimes; e.g.:

• Anglo-Saxon countries - more selective immigration policy

• Western European countries - mostly entry of tied movers and refugees

• Immigration policy and changes hard to measure – effort to document changes -Mayda 2008 index (updated by Ortega and Peri)

More restrictive and selective over time

Differences across countries in rights of immigrants

How did receiving countries laws changed?

From Mayda – updated measure by Ortega and Peri, 2009
Immigration laws changes 1980-2005 in 14 OECD countries (total 250 reforms)
Measure defined as (from Ortega and Peri, 2009):

- Tightness of Entry laws
  - -1 (+1) if lower/increase requirement-documents-fee for entry
  - +1 (-1) Decrease/increase the number of visa, temporary entries
- Tightness of Stay Laws
  - (-1/+1) Decreases (increases) the number of years needed for permanent stay
  - (-1/+1) Eliminates/introduces residence, registration constraints
- Tightness of Asylum
  - Same a Entry, for Asylum seekers

Tightness of immigration laws (from Ortega-Peri 2009)

Canada

Japan

Germany

United States
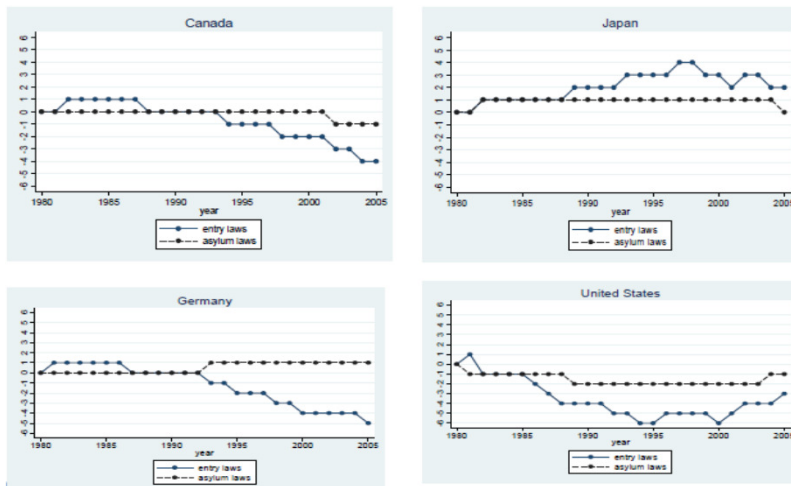
Source: Ortega and Peri, 2009

Immigration policy becomes more selective based on skills - preference for highly educated migrants
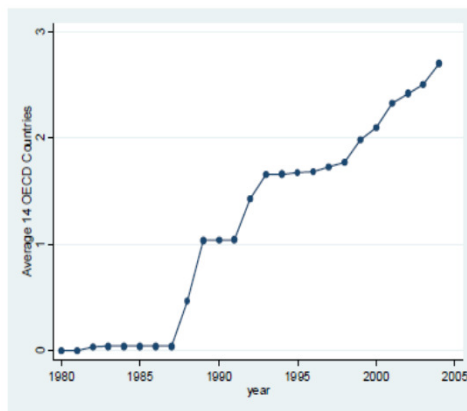
Index increasing by 1 each time a pro-skilled reform is passed in one of the 14 OECD countries, weighted by population of the country.

Source: Ortega and Peri, 2009

IMMIGRATION POLICIES

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More restrictive and selective over time

Differences across countries in rights of immigrants – the higher rights of immigrants (employment, welfare, edu) wrt natives in a given destination, the higher migration to that destination (Palmer and Pytlikova, forthcoming EJP)

Example - IMPACT OF CEE MIGRATION

The Free Movement of Workers in an Enlarged European Union: Institutional Underpinnings of Economic Adjustment

Martin Kahanec
Mariola Pytliková
Klaus F. Zimmermann

Forthcoming as a chapter

IMPACT OF EU MIGRATION and MOBILITY– for both sending and receiving countries

Gains or Losses?

Kahanec, Pytlikova and Zimmermann, 2014:

- Analyses of EU mobility in years 1995-2010, findings:

- destination country's business cycle matters and migration responds to it—stronger GDP growth and lower unemployment lead to additional immigration from NMSs.

- help Europe to adjust to east-west asymmetries, as well as short-run shocks across EU member states

Post-enlargement migrants: education

- Relatively well educated:

EU15+EFTA
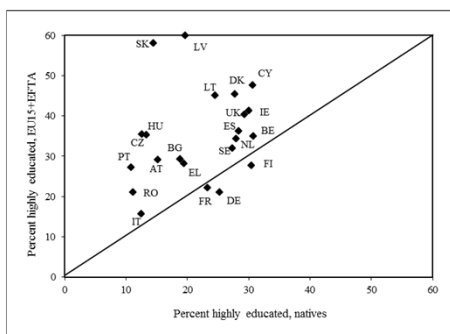
EU12
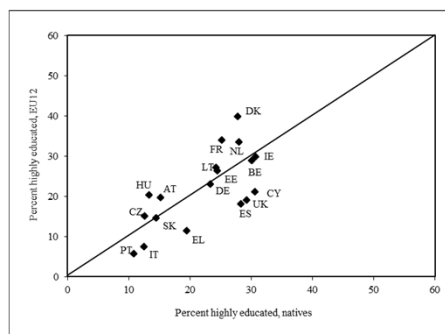
EU12 migrants relatively well educated, EU15 migrants more educated than natives (EU LFS, 2010)

...and they come to work

EU15+EFTA
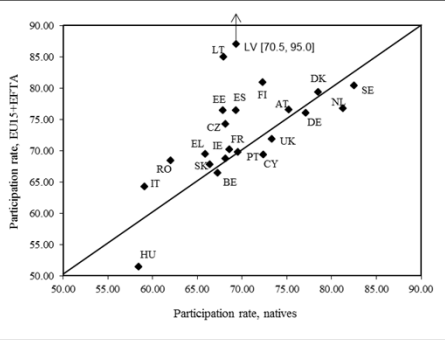
EU12
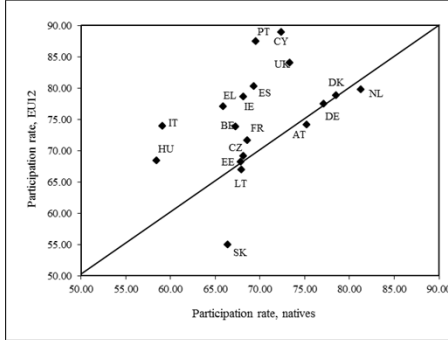
EU15 and EU12 migrants exhibit rather high activity rates, significantly higher than the natives (EU LFS, 2010)

...but not always successful – unemployment

EU15+EFTA
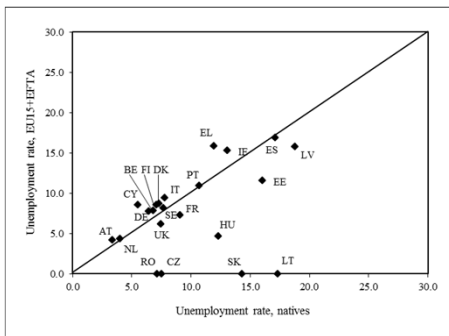
EU12
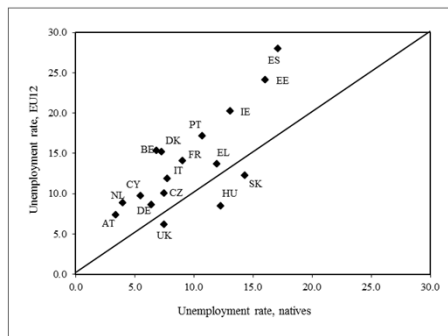
EU12 immigrants have a higher probability of unemployment than the natives, EU15 doing well (EU LFS, 2010)

…and even if have a job – downskilling likely

EU15+EFTA
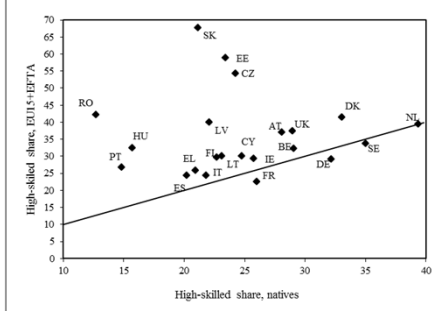
EU12
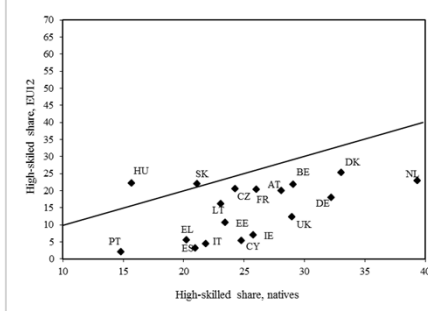
EU15 migrants doing well, but EU12 migrants downskilling

Macro impacts of past EU mobility – receiving countries (based on macro data)

- Kahanec and Pytlikova (2014):
    - Unique data about bilateral migration flows (Pytlikova)
    - Endogeneity of migration – 2SLS
- We find positive effects of migration within the EU on
    - GDP
    - GDP per capita
    - Employment rate
- And negative effects on output per worker

Macro impacts positive

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Example - IMPACT OF CEE MIGRATION – receiving countries

Gains or Losses?

• In general, studies show no negative impact on receiving countries' economies

• as also shown above - In many cases, "occupational downgrading" is common (employment of AC8 immigrants below qualifications)

• Even if displacement took place in some sectors (e.g., in Ireland), since no rise in aggregate unemployment, "upgrade" jobs for nationals

• No evidence of an impact on unemployment

• No wage pressure can be observed even in manufacturing sector with the largest share of new immigrants

• No evidence of "welfare tourism" (number of applications for social assistance negligible)

IMPACT OF CEE MIGRATION – receiving countries

Gains or Losses?

• Overall, *potential* impact of enlargement on welfare and labor markets was estimated to be, in general, positive

• Econometric studies usually find small or no wage and employment effects of immigration

• There is no (early) evidence on the negative impact on the receiving countries' labor markets and public budgets

• Likely that the effect will be different for different "local labor markets": regions, sectors, skills groups…

IMPACT OF CEE MIGRATION – sending countries

Gains or Losses?

> • not much evidence…

• Mostly: temporary migrants

• Decrease in unemployment rate+ Shortages of skilled and also low-skilled in certain professions

• Remittances

• brain-drain or brain exchange through networks or return migration?

• Implications for long-run growth

•Impacts on wages of stayers (Rosso, A. et al, SJE forthcoming)

IMPACT OF ETHNIC DIVERSITY

Does Labour Diversity Affect Firm Performance?

Pierpaolo Parrotta, Dario Pozzoli and Mariola Pytliková

KORA, VSB-TU, Aarhus University, CReAM and University of Lausanne

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.

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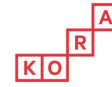
Economic theory suggests that labor diversity may affect firm performance differently and through various channels:

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 **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).

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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);
- Recently, 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
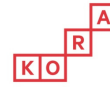
Labor Diversity and Firm Productivity

- **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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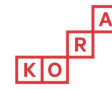
Dimensions of diversity: aggregate specification

- **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 $t\text{-}1$ 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)
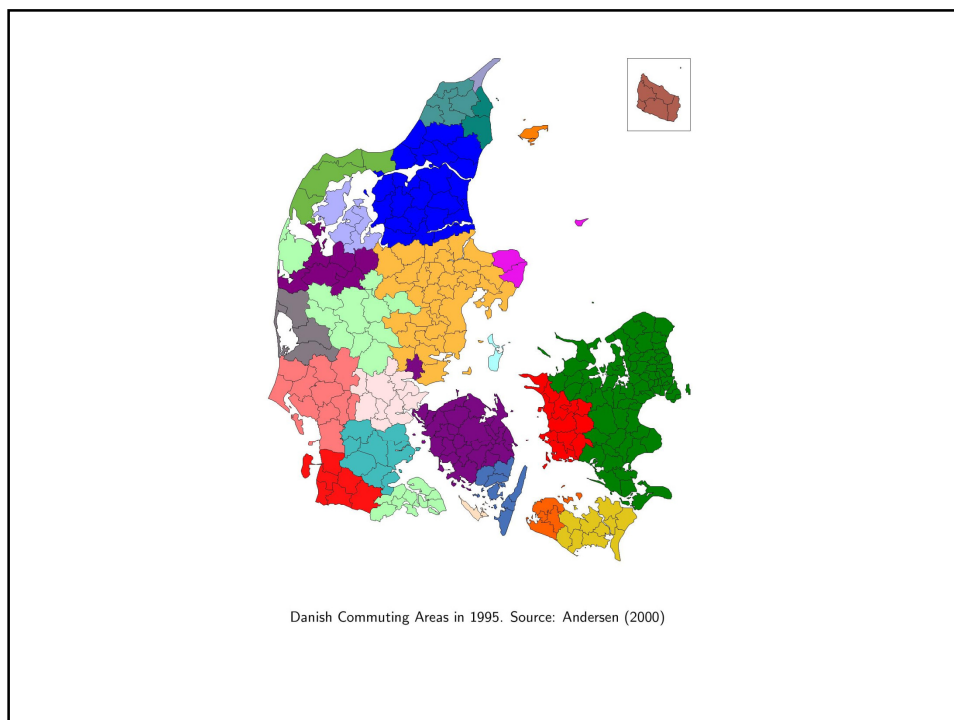
Instrumental variable approach

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) Probit	Model (2) Probit	Model (3) Probit	Model (4) Probit (IV)	Model (5) Probit (IV)	Model (6) Probit (IV)	Model (7) Probit (IV)	Model (8) Probit	Model (9) Probit	Model (10) 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)	
loglK		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)	(0.0002)	(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.

	Diversity based on aggregate specification		
	Probit	**Probit**	**Probit (IV)**
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** [t]
	(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)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
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)	(0.1601)	(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*	0.2902*	0.2992*	0.1378	0.1338	0.1402
		(0.2401)	(0.2443)	(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***	-0.0119	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**

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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 signifficant for the group of white-collar workers only. Conversely, the effect of education and demographic diversity is insignifficant 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

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Robustness I

	Shannon entropy index	Richness	Edu and demo diversity as sd	IV migration determinants	Firms without pre-sample patents	Firms with pre-sample patents
Probability to innovate						
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						
index ethnic disaggr	0.3449**	0.0669*	1.0369**	0.2637**	0.8787	1.3817** [t]
	(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	26055.7	25405.0	1007.1	3000.5
Probability of applying in different technological areas						
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

	Copenhagen is excluded	Mono-establishment firms	Firm level diversity	Less than 50 employees	50-100 employees	more than 100 employees
Probability to innovate						
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						
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						
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

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:

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

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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

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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

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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**

Mechanisms involved - results
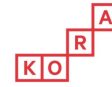
RESULTS:

- 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**.

Ethnic Diversity and Firm's Exporting Behavior *

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Abstract

This article provides novel and unprecedented evidence about the effects of workforce diversity on the firms' export performance. Using a large sample of Danish firms for the period 1995-2007 and implementing a proper instrumental variable strategy, we find that firm-level ethnic diversity increases the probability to export and the extensive margin of exporting, i.e., the number of foreign markets served by the firm and the number of products which the firm exports. Moreover, we also find that diversity positively affects the export volume, i.e. the intensive margin of firm trade. Several robustness checks confirm these findings.

JEL Classification: J15, J16, F10, D21.
Keywords: Ethnic diversity, exporting behavior, fixed costs of exporting.

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Diversity and Firm Export Behaviour

- We study both the direct and network effect on exports
- We use the EU enlargement and the recent and sudden rise of a right wing party in Denmark to construct our IV strategy. We deem both events exogenous to the firms, yet affecting their recruitment of foreign workers.
- We find a positive effect of the ethnic workforce diversity on several dimensions of the exporting behavior of a firm
- More specifically, using our IV-type strategy, we find that **a standard deviation increase in ethnic diversity** enhances the probability to export by 2.5 percent, raises the value of exported sales per employee by 0.18 percent, induces firms to export towards 3.7 additional markets and approximately 3 further products.