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NORDIC ECONOMIC POLICY REVIEW

GLOBALIZATION, LABOUR MARKET INSTITUTIONS AND WAGE STRUCTURE

Globalization, labour market institutions and wage structure

Erling Barth and Kalle Moene

**One Ring to rule them all? Globalization of knowledge
and knowledge creation**

Richard B. Freeman, Comment by Jon Erik Dølvik

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small wage differentials?**

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Nordic Economic Policy Review

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Content

Globalization, labour market institutions and wage structure <i>Erling Barth and Kalle Moene</i>	7
One Ring to rule them all? Globalization of knowledge and knowledge creation <i>Richard B. Freeman</i>	11
Comment by <i>Jon Erik Dølvik</i>	35
Efficiency gains from trade and labor market outcomes <i>Gabriel Felbermayr and Julien Prat</i>	45
Comment by <i>Erling Barth and Kalle Moene</i>	73
Education and labor market policies in an offshoring global economy <i>David Hummels, Jakob Munch and Chong Xiang</i>	75
Comment by <i>Oskar Nordström Skans</i>	99
Immigration and native investments in human capital <i>Marianne Røed and Pål Schøne</i>	105
Comment by <i>Nils August Andresen</i>	131
Why do small open economies have such small wage differentials? <i>Erling Barth and Kalle Moene</i>	139
Comment by <i>Torben M. Andersen</i>	171

Globalization, labour market institutions and wage structure

Erling Barth^{*} and Kalle Moene^{**}

Globalization is increasing on every front. Goods and services, capital, intermediate goods, and workers are now flowing across borders at an increasing speed, making the national economy smaller relative to the world market. The recent surge in globalization appears to challenge the economic systems in the developed world. How should one reap the benefits without being exposed to higher adjustment costs? How can we prevent an unequal distribution of gains and losses? Are the economic and political challenges less in the small open economies of the Nordic countries? In this issue of the *Nordic Economic Policy Review*, we address these questions of how globalization affects us as well as how to respond to the new challenges.

In the first article, Richard Freeman offers a refreshingly new perspective on globalization. While both advocates and critics of globalization have focused on capital flows and migration flows in their analyses, Freeman directs his “attention at an aspect of globalization that has a potentially more important impact on economic life in today’s information economy: the globalization of knowledge and knowledge creation”. One of the great surprises of the era of globalization, he claims, is the rapidity with which developing countries have expanded their higher education systems. In addition, an increasing number of international students obtain higher education in the US. He also shows how R&D activity, academic research and co-authorship have been increasing in

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China and other Asian developing countries. This development has implications for competitiveness, for the relative impact of globalization on different types of workers, and obsolesces the traditional “North-South” life cycle model of trade where the North has the latest technology and the South the imitations. In immigration, the surprise is that many highly skilled workers also migrate to advanced countries, leading to “brain circulation” and knowledge flows going in both directions. The new flows of knowledge have an impact on inequality and labor standards in the developed countries in ways that were not predicted by the earlier analyses of globalization. Offering this perspective, Freeman forces us to renew our thinking on what globalization is and what it means for economic welfare.

But how does increased trade affect key indicators of welfare? Felbermayr and Prat discuss the effect of trade liberalization on unemployment and wage dispersion. Since trade liberalization enhances productivity through a selection effect where more resources are shifted towards the more efficient firms, a key issue is how productivity improvements affect relative prices and the costs of creating new jobs. When the countries are similar, output prices may be normalized to 1 and the cost of opening a vacancy drops in each country, with a subsequent improvement in both wages and unemployment. If countries are sufficiently different, this result may not sustain, and the effect of trade on unemployment becomes “primarily an empirical issue”. Felbermayr and Prat explore this issue empirically, using a panel of countries, and find a statistically and economically significant negative effect of trade openness on unemployment, even after controlling for a host of institutional differences and the output gap, and they conclude that the insights from the simple model, “namely that trade liberalization has either no or a beneficial effect of equilibrium unemployment, are borne out by the data”. The effect on wage dispersion is more ambiguous. Increased openness increases both average wages and the wage premium of exporters. The overall effect thus depends on the share of exporters, in a hump-shaped way. In their policy discussion, Felbermayr and Prat make the point that a reduction in variable trade costs is more likely to improve efficiency and reduce unemployment than a reduction in fixed access costs to different markets. They also stress the point that beneficial effects of trade appear in the steady state versions of

the models, and that short-term adverse effects on labor markets may appear immediately after a discrete shift in trade costs.

An increasing part of globalization takes the form of offshoring. David Hummels, Jakob Munch and Chong Xiang use research on Danish matched employer-employee data to examine how offshoring affects labor market outcomes. The Danish data makes it possible to measure the degree of offshoring based on information on imported products that are used in production. A rise in offshoring leads to a shift in the composition of labor demand in favor of college educated workers relative to other workers. Wage paths also differ between different types of firms (offshorer, exporter) as do wage losses after displacement. They find that workers with communication, language and social sciences skills are in higher demand during offshoring, relative to the so-called STEM disciplines, an observation that may shift some of the focus of the current debate on higher education. They conclude with a caution that some of the skills upgrading that traditionally focuses on vocational programs may strengthen workers' attachment to manufacturing jobs that are likely to be hit by offshoring shocks in the future, and that "perhaps more fundamental educational upgrading may be needed".

Increased migration is a large part of the new globalization. In particular, the Nordic countries have experienced waves of immigration of a scale not seen before. The effects on the host countries' labor markets is a debated issue. Pål Schøne and Marianne Røed take a closer look at the effect of recent immigration on human capital investments in the native population. Since the Nordic countries have a rather compressed wage structure, the main bulk of the immigrants from non-OECD countries and from the new EU members have been manual workers. Schøne and Røed show that native youth moves out of vocational training when immigrants flow into the building and construction industry. In particular, it is the youth with high grade scores that leaves vocational training, thus suggesting that the reallocation is towards higher education. They also present evidence from changes in the occupational structure that natives move into more complex tasks whereas immigrants do more manual tasks. This adaptation of the native population ameliorates the effects of immigration on the host countries' labor market in two ways. First, the segregation of tasks between immigrants and natives improves the position of natives relative to immigrants and, second, the shift in educational choices coun-

ters the immediate supply shock in low paying occupations, reducing the widening effect of low skill immigration on the wage distribution in the longer run.

Small open economies, like the Nordic countries, have always been heavily exposed to globalization. Still, many of them seem to be characterized by a narrow rather than a wide wage distribution. This may seem surprising, since flexible wages and strong incentives would appear to be obvious advantages in a changing world. In our own article below, however, we argue that small open economies are more likely to develop institutions of coordinated wage bargaining than large less exposed economies, to a large extent as a response to the pressures of globalization. One explanation for this development is that coordination in bargaining may both reduce the size of inefficient wage differentials and provide wage moderation, providing benefits for both employers and workers. Furthermore, we suggest that unions in a strong export sector may benefit from coordination also with employers in order to curb wage growth in the sheltered sector, thus facilitating stable coalitions with cooperation and coordination of wage bargaining. Comprehensive unions, a compressed wage structure, and coordinated bargaining may turn out to give a competitive edge for small open economies, rather than being a disadvantage. In this way, the Nordic model seems to be tailored for global competition and it may thus not be such a big surprise that it has weathered both the recent surge of globalization and the recent financial crisis quite well.

One Ring to rule them all? Globalization of knowledge and knowledge creation

Richard B. Freeman^{*}

Summary

This paper directs the attention to the globalization of knowledge and knowledge creation as the fundamental global driver of economic outcomes in today's information economy. It documents the globalization of knowledge and the spread of scientific research from advanced to developing countries and argues that these developments undermine trade models in which advanced countries invariably have a comparative advantage in high-tech goods and services; determine the immigration of skilled workers; boost labor standards; and influence incomes and inequality within and across countries. To the extent that knowledge is the key component in productivity and growth, its spread and creation constitute the one ring of globalization that rules the more widely studied patterns of trade, capital flows and immigration, thus my title.

Keywords: knowledge, R&D, university graduates, scientists and engineers, internationally co-authorship, trade, immigration, brain drain, "North-South model", labor standards, ethnic networks.

JEL classification numbers: F66, F22, F16, F11, J81, J44, J24.

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From the 1980's to the 2010's, globalization was a major driver of economic change worldwide. Analysts and policy-makers debated the rules for international economic transactions and their effects on workers and living standards, focusing on what I will call the "three rings of globalization under the economic sky": trade of goods and services, international flows of capital, and immigration. The fall of the Soviet Empire, China's move to a market-based economy, and the adoption of export-oriented growth strategies by India, Latin America and other developing countries altered all three flows in major ways. World trade increased relative to GDP as global treaties reduced tariffs and related barriers and as developing countries led by China turned into major exporters along global supply chains. International capital flows increased at unprecedented rates. High-skilled immigrants moved across country lines in increasing frequency and low-skilled often undocumented workers and refugees kept the number of immigrants increasing. Far from being substitutes, trade and flows of factors of production in this period were, if anything, complements.¹

Advocates of globalization argued that free trade would improve the economic lives of workers in all countries. Some believed that capital flows would also improve economic well-being, though even ardent free traders expressed concerns over the instability of international capital flows.² Critics of globalization argued that trade without international labor standards would lower the well-being of less skilled workers in advanced countries and create a race to the bottom in labor standards in developing countries. In the ensuing years, some outcomes diverged from what advocates promised and others diverged from what critics feared, but viewed as a project to bring the bulk of humanity into a single market-oriented economic system, globalization succeeded famously.

Without downplaying the role of trade, capital and immigration in altering employment, wages, and working conditions around the world, in this paper I direct the attention to an aspect of globalization that has a potentially more important impact on economic life in today's information economy: the globalization of knowledge and knowledge creation.

My analysis unfolds in two sections.

¹ For analyses of goods and factor flows as complements, see Markusen (1983) and Wong (1986).

² Bhagwati (1998) was particularly outspoken against international capital mobility.

Section 1 presents evidence that the globalization of higher education in the form of rapidly increasing university enrollments worldwide and even greater proportionate increases in international students has altered the locus of the key determinant of modern economic growth – the knowledge base for production, and has globalized the production of scientific research in ways that were unimaginable a short while ago.

Section 2 argues that the globalization of knowledge has wide-ranging effects on economic activity and labor worldwide. By moving developing countries closer to the production possibility frontier, it undermines the “North-South” model of trade that positions the comparative advantage of advanced countries in their dominance of high value added goods and services at the frontier of technology; affects the immigration of skilled workers; boosts the pressures for higher labor standards; and influences the level of incomes and inequality within countries and across the globe. To the extent that knowledge is the key component in productivity and growth, its spread and creation is the one ring that rules them all of my title.

1. Globalization of knowledge and knowledge creation

The rapidity with which developing countries expanded their higher education systems, graduated huge numbers of workers in science, engineering and technology, and moved toward the frontier of science and innovation is one of the great surprises of the era of globalization.

Table 1 records the number of students enrolled in tertiary education (college or university, including two-year colleges) in developing and advanced countries from 1970 to 2010, based on data from UNESCO. Although developing countries constituted about 80 percent of the world population in 1970, they had 54 percent of the university enrollments. As a result of the destruction that the Maoist cultural revolution wreaked on China’s educational system, China had less than 300 000 college and university students. The other population giant, India, had 2.5 million students. Among advanced countries, the US was the pioneer in mass higher education. Although the US had about 6 percent of the world population, twenty-nine percent of the college or university students in 1970 were American. Many other advanced countries had begun expanding

their higher education systems in the 1960's but did not reach the US-level of mass higher education until the 1990's.

Table 1. Millions of enrollments and shares of enrollment (in parentheses) in tertiary education, by area of the world, 1970-2010

Area	1970	1980	1990	2010
World	29.4	55.3	67.6	177.6
Developing	16.0 (54%)	35.0 (63%)	41.0 (61%)	136.5 (76%)
China	<0.1	1.7	3.8	30.0
India	2.5	3.5	5.0	20.7
US	8.5 (29%)	12.1 (22%)	13.7 (20%)	20.4 (11%)
Other adv	4.9 (17%)	8.2 (15%)	12.9 (19%)	23.7(13%)

Source: UNESCO, Institute for Statistics, on line files, 2010 from tables 15, 20A.

By 2010, there had been a marked change in the division of university students and graduates around the world. Developing countries had over three-quarters of the university students. China enrolled 30 million students and graduated 5-6 million people with university degrees, many in science and engineering. India was slower in expanding its higher educational system but still enrolled 21 million people in 2010 and more than doubled the number of Indian Institutes for Technology from 1970 to the 2010's.³ Other developing countries also invested heavily in university education, building new universities and expanding older ones. For example, the International Association of Universities (IAU) listed 82 institutions of higher education for Bangladesh in 2012 compared to the dozen or so that existed in the 1970's. This growth was due to the entry of many private universities as well as public institutions. Similarly, the IAU reports that Chile had 90 universidades and Instituto Profesionales in 2012, as compared to 16 in the 1970's.⁴ By the early 2000's, many advanced countries attained similar or higher rates of enrollment of individuals of the relevant age in colleges and universities than the US. Still, the share of tertiary students in advanced countries beyond the US began a downward trend as the advanced country share of the world population fell and as

³ The six that existed in 1970 grew to 16 by 2012. See http://en.wikipedia.org/wiki/Indian_Institutes_of_Technology.

⁴ http://www.iau-aiu.net/sites/all/files/b_nw.pdf#Bangladesh and Chile. The figures for the 1980's are from Freeman (2010a).

developing countries rapidly increased enrollments. The US share of enrollments was 11 percent in 2010 and shrinking.

At the highest level of academic training, there was a similar pattern of globalization since many countries invested in doctorate programs. China increased the number of graduating PhDs in the natural sciences and engineering and exceeded the number in the US in 2007 (though it fell short of the total science and engineering degrees due to much larger numbers of PhDs in the social sciences in the US). Among the European countries, Sweden graduated more S&E PhDs per person in the relevant age group than the US while the EU overall graduated nearly twice as many natural sciences and engineering PhDs as did the US.⁵ Indeed, the number of American citizens getting PhDs did not change to any considerable extent in the 1990's and 2000's. What maintained US doctorate production were international students, who earned about one third of the PhDs in science and engineering in 2009 and accounted for over half of engineering, computer science, and physics doctoral degrees.

To be sure, the quality of higher education in developing countries that were rapidly building up their universities and increasing enrollments fell below the quality of higher education in advanced countries. In Shanghai's Jiao Tong University ranking of universities, 190 of the top 200 universities were Western (with five of the ten non-Western universities in the top 200 being located in China, including 2 in Hong Kong). And while the US share of degrees fell, US universities maintained their position as global leaders in higher education, holding 40 percent of the top hundred and 37 percent of the second hundred in the Shanghai ranking.⁶ The *London Times* Higher Education ranking of universities shows a similar pattern with 93 advanced country universities in its top 100 and 43 in the US.⁷

Of greater relevance for the labor market, McKinsey's 2006 study of the supply of graduates around the world (published as Farrell, 2006) found that the recruiters of Western firms viewed only 13 percent of university graduates from 28 low-wage countries, including China, India, and Brazil, as "suitable to work in a multinational company". The recruiters based their assessment on English language skills, cultural fit and

⁵ National Science Board (2012, tables 2-35).

⁶ <http://www.shanghairanking.com/ARWU2012.html#>.

⁷ <http://www.timeshighereducation.co.uk/world-university-rankings/2013/reputation-ranking>.

location near major centers with international airline connections. These factors could, however, be irrelevant to national firms operating in those countries, and even 13 percent of tens of millions of graduates create a huge pool of talent for jobs at the multinationals.⁸ As McKinsey did not ask the recruiters about the proportion of graduates from Western colleges and universities that met the standards of the multinationals, it is difficult to assess relative quality from these data.

In any case, the educational standards of universities in lower income countries will surely rise over time as newly developed or expanded institutions upgrade their faculties and improve their academic practices. In addition, students throughout the world will benefit from the newest technology in higher education – the Massive Open Online Courses (MOOCs) that major US universities have developed and make available free of charge over the Internet.⁹ Anyone in the world with Internet access can now take courses given by leading professors at major universities for free and obtain a certificate for completing the course and passing an exam. The two big university-level MOOCs are consortia: Coursera (<https://www.coursera.org/>), which describes itself as a social entrepreneurship company that partners with the top universities in the world to offer online courses for anyone to take, for free; and EdX, an on-line consortium which includes Harvard and MIT, among other universities. EdX had about one million students in its first year of operation, with over two-thirds outside the US. Indicative of the reach and impact on the globalization of education, in the spring of 2013, Amol Bhawe, a 17-year-old from Jabalpur, India, who took MIT's EdX circuits and electronics course over the Internet, was accepted at MIT for regular study on the basis of his performance. The goal of EdX is to educate one billion people around the world in the next ten years.¹⁰

Finally, while relatively few students obtain a higher education outside their own country, the number of international students is the fastest growing part of the global higher educational system. Table 2 shows a near seven-fold increase in the number of international students between 1975 and 2010, producing a growth rate that is about three times as fast as

⁸ Farrell (2006, p. 14-15).

⁹ See http://www.moocs.co/Higher_Education_MOOCs.html for a listing of the massive open on-line courses in higher education.

¹⁰ Edgecliffe-Johnson (2013).

that for all tertiary education students. In the US, the two top supplying countries for international students were China and India. International students are particularly important among the PhDs whose research underpins the scientific and technological base for modern industry. International students are also a major source of supply for immigrant scientists and engineers.

Table 2. International students fastest growing part of higher education

Year	Int'l Students, World
1975	600,000
1980	800,000
1990	1,200,000
2000	1,900,000
2010	4,100,000

Source: OECD, *Education at a Glance* (2012, p. 24) and IIE, *International Students and Mobility*
http://exchanges.state.gov/universitysummit/mobility_report.pdf.

Measuring the globalization of R&D investments is a trickier business because the cost of research varies greatly among countries depending on the wages of researchers and other expenses. A country where researchers are paid 1/2 as much as in another country could spend half as much for the same real activity. In the absence of R&D-specific exchange rates, the US's National Science Foundation (NSF) uses purchasing power parities to compare expenditures across countries in comparable units.¹¹ Such data show that until the 1990's, advanced countries performed the vast bulk of R&D but that in the 1990's and 2000's, China and some other developing countries made huge inroads into global R&D activity. In 2009, the United States accounted for 31 percent of global R&D, down from 38 percent in 1999 and down from 40-45 percent of global R&D in the early 1970's. China was the second biggest performer of R&D, accounting for 12 percent of global R&D¹² while Japan accounted for 11 percent. The largest EU performer Germany spent 6 percent of global R&D but the EU in its entirety accounted for 23 percent. With several

¹¹ See NSF Purchasing Power Parities: Preferred Normalizer of International R&D Data
<http://www.nsf.gov/statistics/seind93/chap4/doc/4s293.htm>.

¹² The revision of China's PPP exchange rate in late 2007 lowered the dollar value of its R&D expenditures, but this reduced the rate of increase of its share of world R&D rather than reducing it.

Asian countries beside China and Japan substantially increasing R&D expenditures and with Brazil increasing its R&D, the concentration of R&D in the US and a few other advanced countries declined noticeably. Battelle predicts that China will outspend the US in R&D by 2023.¹³ Another way of contrasting R&D around the world is to compare R&D to GDP. The ratio of R&D to GDP is high for some smaller countries such as Sweden, Finland and Switzerland in Europe, Israel in the Mideast and Japan, South Korea, and Taiwan in Asia.¹⁴

Table 3. Numbers of scientific papers in the world and percentage of papers by country, 1981-2009

Area	1981	2009
World	369,000 (100%)	788,347 (100%)
Developing	17.6	27.1
China	0.3	9.4
India	3.2	2.5
South Korea	0.2	2.8
US	35.9	26.5
Other advanced	46.5	46.4
Nordic countries	3.6	3.1

Source: 2009, National Science Board (2012, tables 5-27), available at <http://www.nsf.gov/statistics/seind06/tables.htm>. 1981, National Science Board (2006, tables 5-32), available at http://www.nsf.gov/statistics/seind96/chap_5.pdf.

The proof of the pudding for academic research and basic R&D is in the scientific papers that the research produces. Table 3 shows that the number of scientific papers in the world doubled over the nearly thirty years covered in the table. The globalization of research can be seen in the changing shares of papers for different countries or groups of countries. With an increased number of universities with faculties engaged in scientific research, growth of PhD and other S&E researchers, and R&D spending, the developing countries raised their share of papers from 17.6 percent in 1981 to 27.1 percent in 2009, largely at the “expense” of the US share of papers, which fell from 35.9 percent to 26.5 percent. Among

¹³ Battelle’s prediction was reported in Grueber and Stud (2012).

¹⁴ All data except for the early 1970’s estimate of the US share of global R&D are from the NSF Science and Engineering Indicators, tables 4-19. The 1970’s estimate is from National Science Board (1993), which only reports data for the major OECD countries, US, Japan, Germany, UK, Italy, and Canada.

the developing countries, the biggest increase was for China, which produced almost no papers in 1981 and 9.4 percent of all papers in 2009. The share of papers of the Nordic states far exceeds their share of the world population but fell modestly as scientific production shifted to Asian developing countries.

Science has increasingly become a team activity, in which specialists with different skills and knowledge work together, often with complicated equipment, to make discoveries, leading to substantial increases in the number of authors on scientific papers in virtually every field.¹⁵ Figure 1 shows the increasing trend in co-authorship and in international co-authorship in all articles in the world and in US academic articles. In the data for the entire world, the proportion of co-authored papers with an international author increased from 22 percent in 1990 to 35 percent in 2010.¹⁶ In the US, essentially the entire increase in co-authorship took the form of increased international co-authorship. Much as multinational firms use a global chain of production which combines the activities of people in many countries, scientists increasingly rely on the work of individuals of other nationalities and in other locations to produce their papers. Attributing papers to particular countries, as national science agencies do, gives a misleading picture of the actual process of scientific activity. Finally, in 2010, the most important collaborative relation in scientific work was between China and the US. 30 percent of Chinese collaborations occurred with Americans and 14 percent of US collaborations occurred with the Chinese.¹⁷

In short, the evidence for globalization of knowledge and its production is overwhelming. What are the implications for the well-being of workers and economies writ large around the world?

¹⁵ Wuchty et al. (2007).

¹⁶ Calculated by taking the proportion of international co-authored papers divided by the proportion of all co-authored papers, as shown in the tables and the figure.

¹⁷ US NSF, Science and Engineering Indicators (2012, Appendix tables 5-41).

Figure 1. The move to international co-authorships**World articles** **US academic articles**

Source: Science and Engineering Indicators 2012. National Science Foundation, National Center for Science and Engineering Statistics and the Patent Board™, special tabulations (2011) from Thomson Reuters and SSCI, http://thomsonreuters.com/products_services/science.

Note: Article counts from set of journals covered by Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). Articles classified by year they entered database, rather than year of publication, and assigned to country/economy on basis of institutional address(es) listed on article. Articles on whole-count basis, i.e. each collaborating institution or country credited one count. Internationally co-authored articles may also have multiple domestic co-authors.

2. Impacts of globalization of knowledge and knowledge production

Globalization of knowledge has wide-ranging effects on production and labor worldwide. To the extent that knowledge is a key factor in production, the spread and creation of knowledge is critical to economic development, comparative advantage, the flow of labor and capital among countries, and the spread of labor standards and norms about worker rights. Operating with or through the other rings of globalization, the spread of modern technological knowledge has arguably contributed to increased inequality within countries as well as to the convergence of income per capita among countries.

First, consider the impact of the globalization of knowledge and research and development on the competitiveness of workers in advanced and developing countries. Debates over trade treaties and intellectual property rights highlight the importance of higher level education and of the ability to create new technology in advanced countries as providing a comparative advantage compared to developing countries and protecting workers from low-wage competition.

In the 1990's debate over the North American Free Trade Agreement (NAFTA), NAFTA advocates told Americans that Mexico would get labor-intensive industries with "bad jobs" that did not require much education while the US would get high-tech industries with good jobs for well educated workers. As long as US workers maintained their years of schooling edge over Mexicans, the US workers had nothing to fear from lower-wage labor in Mexico. This view of a permanent education edge as protecting US workers from competition has been undermined by the rapid growth of higher education in Mexico and developing countries worldwide and by the ability of firms to outsource the work of the highly educated along global value chains.

In the 1990's-2000's debate over the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS),¹⁸ advanced countries sought to protect the patents, copyrights, and discoveries of the firms that developed new products and processes. The "North-South" or life cycle product model of trade develops the consequences of such protections for labor (Krugman, 1979). This model attributes the higher earnings of

¹⁸ http://www.wto.org/english/tratop_e/trips_e/intel2_e.htm.

workers in advanced countries relative to the earnings of otherwise similar workers in developing countries to the advanced country monopoly of R&D-induced technological change and production of technologically advanced goods and services. Firms pay workers more in the advanced North, because the latest technology makes workers more productive than workers using older technologies in developing countries. The advanced country/developing country wage differential depends on the rate of technological advance in the North relative to the rate of imitation of technology in the South. Jones and Ruffin (2007) analyze the effects of technology transfer, which is a form of imitation of technology, on advanced countries under more complex conditions.

Globalization of knowledge and knowledge creation makes this model obsolete. To the extent that technological development depends on the absolute number of scientists and engineers or other highly educated workers rather than the ratio of such specialists to less skilled workers, highly populous developing countries with large numbers of S&E workers can compete with advanced countries in high-tech sectors. If China has 100,000 engineers working on green technology and France has 10,000 engineers, China is more likely to advance that technology than France. When multinational giants such as IBM and Microsoft first expanded research activities in China or India, their decisions made headlines. By the early 2010's, the availability of highly qualified workers at a low cost had made it commonplace to locate research facilities in developing countries.¹⁹ With global production chains dispersing production worldwide, some analysts argue that the location of manufacturing in developing countries will itself lead to greater R&D in those countries, as firms find that R&D is more efficient in close proximity with the manufacturing facility.²⁰ This reverses the causality on which the North-South model is built. Manufacturing attracts R&D rather than R&D attracting new manufacturing.

¹⁹ Between 1997 and 2008, the share of US-owned affiliates R&D performing in China, South Korea, Singapore, and India rose from a half percentage point or less to 4 percent for China, just below 3 percent for South Korea, and just below 2 percent each for Singapore and India. Over roughly the same period, total business R&D of majority-owned affiliates of foreign MNCs located in the United States has fluctuated narrowly between 13 percent and 15 percent. National Science Board (2012).

²⁰ Pisano and Shih (2012); Tecu (2013).

Table 4. Distribution of knowledge and technology-intensive industries and of exports of high-technology goods by country, 1990-2010

Panel A. Percentage of global value added in knowledge and technology-intensive industries		
	1990	2010
US	35.1	32.5
EU	33.8	27.8
Japan	13.4	8.9
Total	82.3	69.2
China	1.5	6.8
Asia-8	3.4	5.9
All other countries	11.8	18.1

Panel B. Percentage of global exports of high-technology goods		
	1995	2010
US	15.0	11.6
EU	31.9	28.9
Japan	15.1	5.0
Total	62.0	45.5
China	7.6	23.7
Asia-8	21.6	20.6
All other countries	9.8	10.2

Source: National Science Board (2012), Appendix tables 6.1 and 6.24.

The evidence that globalization of knowledge has outrun the North-South model can be found not only in the greater dispersion of R&D facilities worldwide described earlier, but also in increased production and exports of high-tech products in developing countries (subject to the caveat that global supply chains make it difficult to assign products to countries). Panel A of Table 4 shows a sizable 1990-2010 shift in the share of value added in knowledge and technology intensive industries from the US, EU, and Japan to the rest of the world. With its huge investments in higher education and R&D, China made a particularly large gain in its share of value added in the knowledge and technology intensive sectors. Panel B of Table 4 shows an even greater shift in exports in high-tech goods from the US, EU, and Japan to other countries. Once more, China increased its share the most. In 2008-2009, the Obama Administration viewed green technologies as a way of restoring US manu-

facturing jobs but soon discovered that China had become the leading place of production in some areas of solar technology.²¹

2.1 Immigration of highly skilled and less skilled workers

Almost by definition, developing countries have a surfeit of unskilled workers relative to other factors of production compared to advanced countries, and pay those workers less than they would earn if they worked in advanced countries. Accordingly, large numbers of less skilled workers migrate from Mexico, Central America, the Caribbean, and Latin America to the US, many without documentation. Similarly, advanced Europe is the destination of many less skilled workers from Eastern Europe, the Maghreb, and other parts of Africa. Such immigration helps balance factor proportions among countries, consistent with Heckscher-Ohlin patterns of trade.

The surprise in immigration is that many highly skilled workers also migrate to advanced countries, adding to the imbalance in factor proportions via “brain drain”. Underlying this flow are large wage differences across countries of workers with the same skills (Freeman and Oostendorp, 2000) that presumably result from the superior infrastructure and productive knowledge in advanced countries. International students are a major source of this migration. Students build job market skills and connections in the country in which they study that make immigration easier. Some countries, such as Canada and Australia, give visas on the basis of skills, with Australia giving advantages to people who obtain Australian degrees. In the US, over half of the foreign-born science and engineering workers with a bachelor’s degree, and over two thirds of foreign-born master’s and PhD scientists and engineers obtained their highest degree in the US (Freeman, 2010b, table 5). Migration of highly educated workers

²¹ Wikipedia, List of countries by photovoltaics production (http://en.wikipedia.org/wiki/List_of_countries_by_photovoltaics_production) shows China’s share of solar photovoltaics production from less than 1 percent in 2000-2001 to over 40 percent in 2010, while the US share fell from nearly 20 percent to 4-5 percent. The quality of Chinese solar panels has created some problems, however (Woody 2013). http://en.wikipedia.org/wiki/List_of_countries_by_photovoltaics_production shows China’s share of solar photovoltaics production from less than 1 percent in 2000-2001 to over 40 percent in 2010, while the US share fell from nearly 20 percent to 4-5 percent. The quality of Chinese solar panels has created some problems, however (Woody 2013).

to advanced countries strengthens their comparative advantage in skill-intensive sectors and reduces the incentive of multinationals to invest in R&D or other skill-intensive activities in developing countries.

While outflows of educated workers can create substantial skill shortages for small Caribbean islands, Central American, or African countries, the movement of educated people from highly populous developing economies to advanced countries is unlikely to have significant adverse effects on the source country. The number of migrants is modest compared to the increased numbers graduating from universities in those countries. With six million new university graduates every year and 28 000 new S&E PhDs in China and with many Chinese getting doctorates in other countries, the loss of tens of thousands of bachelor's graduates or of hundreds of PhDs migrating to advanced countries barely slows the rapid increase in the pool of highly educated workers.

Moreover, the migration of skilled immigrants to advanced countries has advantages for developing countries. Some immigrants return to their birth countries with greater skills and income. Some move regularly between their birth countries and their country of immigration, creating "brain circulation" rather than brain drain (Saxenian, 2005). Studies of the flow of knowledge, largely based on the location of individuals who co-patent, suggest that immigrants work with people in their birth country to produce and pass knowledge quickly through ethnic networks (Kerr, 2008; Agrawal et al., 2011), which could compensate for the immigrant inventing products or processes overseas. Ethnic networks are also connected with trade flows (Rauch and Trindade, 2002; Epstein and Gang, 2004; Felbermayr et al., 2010) and multinationals forming new affiliates in countries (Foley and Kerr, 2013), expanding manufacturing in those areas (Kerr, 2008) and in future foreign direct investment (Kugler and Rapaport, 2007). The co-movement in skilled labor, trade and capital creates unexpected economic outcomes in part because extant models do not explicitly treat the information and knowledge flows that are part of those movements.

2.2 The pressures of trade on wages and employment

The great fear of globalization critics was that increased trade between advanced and developing countries would adversely affect low-skill

workers in advanced countries and put pressure on developing countries to lower the labor standards as they competed to attract foreign investments.

Since unskilled labor is the relatively scarce factor in advanced countries, that such trade would reduce unskilled wages relative to skilled worker wages fits with standard trade theory and pressures toward factor price equilibrium with trading partners. During the NAFTA debate, however, treaty advocates denied that trade would harm workers and dismissed factor price equilibrium as theoretically “far more frail than currently imagined” (Bhagwati and Dehejia, 1993, p. 8) and rejected factor content evidence that trade reduces the wages of unskilled workers by increasing their implicit supply.²² As trade with developing countries has grown, particularly with China, this position has become untenable. Comparing local labor markets more or less affected by Chinese imports to the US, Autor et al. (2012) find that greater import pressures increase unemployment, reduce labor force participation, and reduce wages with parameters that explain “one-quarter of the contemporaneous aggregate decline in U.S. manufacturing employment”. Diverse studies of the effect of offshoring find both wage and employment effects on workers, usually with evidence from the US.²³ The result is not NAFTA opponent Ross Perot’s “giant sucking sound” of jobs leaving advanced countries due to trade,²⁴ but pressures toward factor price equalization that show up in job displacement (which translates into lower wages on new jobs for the affected workers) as well as reductions in the relative wages of workers in trade-impacted areas.

In the 1990’s-2000’s, the challenge to the factor proportions analysis of the effect of globalization on labor markets has come from a different quarter: “The 1990’s dealt a blow to traditional Heckscher-Ohlin analysis of the relationship between trade and income inequality, as it became clear that rising inequality in low-income countries and other features of the data were inconsistent with that model. As a result, economists moved

²² Similarly, proponents of free trade rejected as unrealistic Samuelson’s (2004) argument that developing country innovation in the products in which an advanced country specializes could shift comparative advantage to harm the advanced economy and ignored Gomory and Baumol’s (2000) simulations of situations where one country’s gain in trade came at the expense of the other. There is no compelling evidence on the possible magnitude of these effects.

²³ Feenstra (2011) summarizes findings from over a dozen studies in his section on offshoring, wages and employment.

²⁴ http://en.wikipedia.org/wiki/Giant_sucking_sound.

away from trade as a plausible explanation for rising income inequality ... a number of new mechanisms have been explored through which trade can affect (and usually increase) income inequality ... within-industry effects due to heterogeneous firms; effects of offshoring of tasks; effects on incomplete contracting; and effects of labor-market frictions.” (Harrison et al., 2010, p. 1). As an example of the more subtle analysis necessary to explain patterns in the data, Amiti and Davis (2009) differentiate between falls in tariffs on outputs and falls in tariffs on inputs on the wages of workers in firms in different positions in the chain of production.

The increase in skill differentials in developing countries with abundant unskilled labor²⁵ is mindful of the Leontief Paradox: the finding that in the aftermath of World War II (and later), the capital rich US exported labor-intensive products while importing products that were capital-intensive. Part of the explanation seems to lie in the greater education or human capital that American workers had over workers in other countries in the period (Keesing, 1966; Kenen, 1965) and part also in differences in knowledge, with US exports concentrated to R&D and knowledge-intensive activities and imports coming from sectors with less knowledge-based activity (Keesing, 1967).

Could the globalization of knowledge and knowledge creation have contributed to the increased inequality in developing economies in the 1990's? Since the increased supply of graduates in developing countries operates to reduce labor market inequality, any knowledge-based explanation must rest on the impact of the supply of graduates and R&D on modes of production that benefitted skilled labor versus unskilled labor. That rapid increases in GDP per capita in developing countries did not sufficiently expand employment in manufacturing and other formal sectors to reduce the share of workers working informally in developing countries suggests that transfer of technology and knowledge may have played a role. Cross section data show a strong inverse relation between the informal sector share of a work force and GDP per capita that implies that in the past, economic development rapidly reduced employment in

²⁵ The increase in inequality is not found in all developing countries nor consistently over time in the same country. For instance, Brazil and several other Latin American countries saw income inequality decline in the 2000's; apparently due to redistributive policies. But the skill premiums increased in Argentina, Brazil, Colombia, India, and Mexico in the 1980's and 1990's as trade increased (Pavcnik, 2011, p. 238).

the informal sector. But in the 1990's-2000's, the share of the work force in the informal sector in developing countries barely changed, making the informal normal (Jütting and Laiglesia, 2009). The growth of global value chains – the fragmentation of production of goods and services into parts and tasks that could be offshored to many different countries – may also have changed the nature of globalization (OECD, 2013) in ways that benefitted skilled workers in developing countries relative to unskilled workers in the informal sector.

Without gainsaying the 1990's increase in income inequality in some developing countries with globalization, evidence that income inequality fell in the 2000's in some of the same countries, including 12 of 17 Latin American countries (Gasparini and Lustig, 2011), also leaves open the possibility that the puzzle could be more about a temporary decadal phenomenon than about a long-term relation.

2.3 Effects on labor standards

The greatest fear of critics of globalization was that globalization would set off a race to the bottom in labor standards as developing countries competed to attract foreign investment and boost exports. Notwithstanding egregious cases of low standards among subcontractors to multinational firms such as the worker suicides at Foxconn (subcontractor to Apple) and the 2013 collapse of the eight-storey Rana Plaza factory building in Bangladesh that killed over one thousand employees of subcontractors for major garment firms,²⁶ globalization tended to improve rather than reduce labor standards around the world.

Why? One important factor was the spread of information about labor conditions that galvanized consumer pressures against bad working conditions. “Human rights vigilantes” – activists devoted to improving the labor conditions in developing countries – succeeded in getting some brand name firms to monitor suppliers, to improve conditions, to identify suppliers so that the activists could independently monitor how their suppliers treated workers, and to develop codes of conduct for themselves and their subcontractors (Elliot and Freeman, 2005). Developing countries enacted protective labor legislation and signed the ILO's conventions on labor standards (Elliot and Freeman, 2003). In 2007, China en-

²⁶ <http://www.bbc.co.uk/news/world-asia-22476774>.

acted a new Contract Labor Law, which pressured firms to give written contracts to migrants and other workers and to pay a legally required social insurance. Brazil increased its resources for implementing labor law. Pressed by unions and activists, the US, Canada and some other advanced countries put labor standards clauses into trade clauses.

Examining the efforts of human rights and anti-sweatshop activists to improve working conditions and raise wages for workers in Indonesia, Harrison and Scorse concluded that "firms touched by the global market place were more, not less, likely to comply with labor standards (due in part) to ... pressure imposed by the United States, which used the GSP as a mechanism to enforce labor standards in Indonesia, combined with increasing human rights activism" (Harrison and Scorse, 2003, p. 80). But they also note that while "activism significantly improved wages for unskilled workers in sweatshop industries, (it) probably encouraged some plants to leave Indonesia" (Harrison and Scorse, 2004, introduction). The job of the activists is to balance improvements in wages and labor conditions against the risk of job loss or plant closure from their campaigns. Overall, the activists appear to have succeeded in doing this. In their review of job accident rates, child labor, and violations of civil rights in Asia, and the linkage between foreign direct investment and labor regulations among all countries, Flanagan and Khor (2012, p. 280) concluded that "a broad improvement in working conditions and labor rights around the world accompanied a significant expansion of international trade and investment".²⁷

3. Conclusion

The globalization of economic activity that has spread the benefits of modern technology around the world and helped improve living standards in traditionally low-income countries produced some unexpected changes in the labor market and economy writ large. Globalization was accompanied by a huge spread of knowledge and knowledge creation that influenced factor flows, productivity, and comparative advantage. It created

²⁷ They stress the importance of GDP growth in improving standards rather than the role of activists in effectuating change and note that immigration also places pressures on countries to improve standards as workers will migrate from countries with low standards to those with higher standards.

some difficult adjustments for workers in both developing countries and advanced countries and produced worldwide pressures for better labor standards rather than creating a race to the bottom in standards. While globalization of knowledge and knowledge creation may not be the key factor underlying the effects of globalization on labor, per my one ring analogy, the evidence in this paper has hopefully convinced the reader that the spread of knowledge is on par with the more widely studied trade, international capital flows, and immigration in determining outcomes and can help explain some otherwise puzzling patterns in the effects of globalization on labor.

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Appendix. Data for Figure 1

World and U.S. academic S&E articles coauthored domestically and internationally: 1990-2010 (percent)

Year	World articles			U.S. academic articles		
	Domestic co-authorship only	International co-authorship	All co-authorship	Domestic co-authorship only	International co-authorship	All co-authorship
1990	32.72	9.52	42.24	42.84	11.71	54.56
1991	33.42	10.64	44.06	43.24	12.91	56.15
1992	33.71	11.43	45.14	43.18	14.01	57.20
1993	33.99	12.37	46.35	42.80	14.85	57.66
1994	34.38	13.12	47.50	43.05	15.77	58.82
1995	35.19	13.93	49.12	43.40	16.61	60.01
1996	35.73	14.67	50.41	43.49	17.55	61.04
1997	36.28	15.62	51.90	43.52	18.49	62.01
1998	36.63	16.26	52.90	43.12	19.62	62.74
1999	37.10	17.14	54.23	43.02	20.74	63.77
2000	37.42	17.69	55.11	42.91	21.68	64.59
2001	38.11	18.64	56.76	43.01	22.90	65.91
2002	38.59	19.24	57.83	42.94	23.74	66.68
2003	39.32	19.75	59.07	43.39	24.41	67.80
2004	40.08	20.09	60.17	43.61	25.10	68.71
2005	40.75	20.43	61.17	43.72	25.61	69.33
2006	41.24	20.87	62.11	44.07	26.25	70.32
2007	41.89	21.62	63.51	43.87	27.77	71.64
2008	42.24	22.15	64.39	43.80	28.84	72.63
2009	42.96	23.10	66.07	43.66	30.39	74.05
2010	43.42	23.83	67.25	43.28	31.57	74.85

Source: Science and Engineering Indicators 2012. National Science Foundation, National Center for Science and Engineering Statistics and the Patent BoardTM, special tabulations (2011) from Thomson Reuters and SSCI, http://thomsonreuters.com/products_services/science.

Note: Article counts from set of journals covered by Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). Articles classified by year they entered database, rather than year of publication, and assigned to country/economy on basis of institutional address(es) listed on article. Articles on whole-count basis, i.e. each collaborating institution or country credited one count. Internationally co-authored articles may also have multiple domestic co-authors.

Comment on Freeman: One Ring to rule them all? Globalization of knowledge and knowledge creation

Jon Erik Dølvik^{*}

Instead of the increased flows of trade, capital and immigrants, the article by Richard B. Freeman focuses on the remarkable spread of knowledge and knowledge creation during the past decades of globalization. Besides having brought the bulk of humanity into a single market-oriented economic system, globalization has thereby altered the key determinant of modern economic growth – the knowledge base for production. As populous low income countries have enough science and education to compete in high-tech markets, and multinationals set up R&D centres in developing countries, the comparative advantages of advanced countries are, according to Freeman, being rapidly eroded even in high value added production. Emerging economies have thus conquered a fast rising share of global high-tech production.

The next question Freeman addresses is how the “four rings of globalization” have influenced inequalities and labour standards. As inequalities have been growing within most countries and have been declining among countries, the effects of globalization have neither confirmed the predictions of its most ardent advocates nor those of its strongest opponents. Contrary to a race to the bottom, globalization has in Freeman’s view generated higher labour standards in developing countries, amongst others influenced by the pressures from consumer activists, codes of conduct, fair trade audits, trade unions, the ILO, and social clauses in trade

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treaties and GSP systems. For instance, MNCs fearing punishment in consumer markets or at stock exchanges have tended to raise the standards, also among companies drawn into the global market place through their supply chains.

Besides these ambiguous effects, Freeman points out that the rising immigration of low skilled labour aggravates inequality in advanced countries, but evens out the factor proportions (and wages) around the globe. High-skill immigration alleviates the advanced countries' loss of comparative advantage, but also spurs education enrolment and can contribute to "brain gain" in populous source countries through circular migration and knowledge transmission in ethnic networks. Although capital and trade flows are complemented by flows of knowledge and people, they have deepened the gap between those drawn into the global circuit and those working in the informal sector in developing countries. Finally, in advanced countries, the pressures for factor price equalization among trading partners have in Freeman's view magnified inequalities at the lower end of the labour market – at least in the US. For the far more open Nordic countries where around 60 percent of trade and the major FDI flows still are with EU countries – to a large extent within the high-cost North – it could be added that the picture is less clear-cut thus far. With further dispersion of knowledge based production, wages will in Freeman's view converge among countries, implying that labour costs in China and other emerging economies, as seen in South Korea, are deemed to rise. A central question, not least in the high-cost Nordic countries, is still how strong the chilling or downward effects on wage costs will be in advanced countries, and to what extent they can be offset or compensated for affected groups through national systems of redistribution.

In the Nordic countries, wage inequalities have only increased modestly so far, and mostly in service production for domestic markets. Having benefitted from cheap Asian imports of labour intensive goods that the Nordics shed decades ago, and from rising global demand and prices for their main export products, the Nordic production structure has evidently been much more complementary to China's rise as the "world factory" than the American production structure. The relatively favourable performance of Sweden during the current crisis (Freeman, 2013) has, for instance, been attributed to such factors. Whether the recent Nordic experience as "globalization winners" is just a transitional phenomenon,

or can be continued, therefore seems critically dependent on the ability to continue adjusting the industrial structure in line with China's changing import demand and the rise in "intra-industry" trade through the global supply chains of Nordic companies establishing overseas. Thus, compared to the far more inward-oriented American production structure, small open economies such as the Nordic ones still appear better positioned to continue riding the wave of globalization; even conquering tiny market shares or product niches in China and other emerging economies can provide a basis for considerable export growth.

In the remainder of this comment, I will complement the broad picture drawn by Freeman with some reflections on the immediate international challenges that the Nordic labour market institutions are currently faced with "closer to home". While it can be argued that the Nordic systems of collective bargaining and social risk sharing have been well equipped to cope with the volatility of world product markets, they have certainly not been designed for handling the recent rise in cross-border mobility of labour and services within the European single market. Compared to the mode of globalization driven by movements of capital and goods – in a context of nationally protected markets for labour and trade in services¹ – the combined effects of the EU free movement regime and the 2004-2007 accessions of ten Eastern European member states have implied much more direct challenges to the institutions of labour market governance in the Nordic countries (Dølvik and Eldring, 2008). Contrasted e.g. with the wired borders between Mexico and USA within NAFTA, the introduction of free movement of labour and services among European countries with comparable wage and welfare gaps – in 2004 ranging from 1:7 to 1:10 in nominal wages – is unprecedented and can be viewed as an ultimate "laboratory of globalization in one continent" (Dølvik and Visser, 2009).

For affluent "old" EU/EEA states, such as the Nordics, this has implied a veritable supply-side shock in the labour market – especially at its lower ends. The access to an almost boundless supply of workers and service providers willing to offer their labour at terms well below established standards in the host countries has recast competitive conditions in parts of the job market and granted Nordic companies ample opportuni-

¹ Trade in services within the WTO is governed by the GATS-system, which basically builds on voluntary national market-opening and presupposes that national (host country) labour standards apply.

ties to alter their hiring strategies. Of the roughly 5 million citizens from the accession states that were employed in the "old" member states by 2010 (Hollande et al., 2011), the Nordic countries have received their fair share – mainly from Poland, the Baltic States and Romania. From 2004 to 2011, more than 335 000 citizens from the new member states took residence in the Nordic countries. Annual inflows rose from less than 10 000 in 2003 to almost 60 000 in 2008 and have risen to similar levels after the financial crisis. Norway has by far received the largest influx, constituting around two thirds of all registered labour migrants from the accession countries in the Nordic countries (Eldring and Horgen Friberg, 2013). EU migrants, including Swedes, now account for more than 10 percent of Norwegian employment and more than 60 percent of job growth in recent years, illustrating the magnet effect of a flourishing job market and high wages and benefits in a context of European crisis and austerity. With shrinking labour markets in major destination countries, such as the UK and Ireland, and surging unemployment in Southern Europe, the relatively favourable situation in the Nordic countries suggests that inflows are more likely to increase than decrease in the years ahead.

Why should this be a challenge to the apparently solid Nordic labour market institutions, given that the EU has enacted rules entitling labour migrants to equal treatment? First, because the rise in job and wage competition has mainly been concentrated in the lower ends of the labour market, where institutional erosion from the outset was strongest and union density and collective agreement coverage were lowest.² The rising supply of job seekers with incentives to accept lower wages to obtain a job offer – incentives that are reinforced by equal access to portable, job-related welfare benefits – has widened the economic basis for companies unbound by collective agreements. The proliferation of such low-cost contenders, in turn, strengthens the incentives for organized companies to escape from the constraints of the collective agreements, e.g. by setting up unorganized daughter companies, hiring foreign subcontractors unbound by host country regulations, or by exiting from the employer asso-

² Such tendencies of erosion are mainly related to endogenous, national dynamics of change, partly associated with the rise in employment in private services, where labour relations tend to be more fragmented; partly with a decline in unionization among youth, and partly with politically determined changes in the Ghent systems of unemployment insurance in Denmark, Sweden, and Finland, which traditionally contributed to high levels of unionization (Nergaard, 2010).

ciations.³ While the conventional view has been that labour migration has very limited effects on employment conditions, more elaborate, recent studies have thus shown significant wage and substitution effects in the most affected branches in Norway (Bratsberg et al., 2013; Bratsberg and Raaum, 2012, 2013).

Second, in the context of enlargement, the freedom to provide cross-border services by posting of workers that are mainly subject to home country rules represents a qualitative shift in the flexibility of Nordic companies regarding hiring practices, remuneration, and labour costs. Especially in branches like construction, yards, and temporary agency work, a marked rise in hiring of labour through foreign subcontractors has been witnessed in all Nordic countries. According to the EU rules, foreign service providers pay taxes and employer levies to the home country and are only bound by a nucleus of statutory rules in the host country (e.g. working time and work environment), including minimum wages laid down in generalized collective agreements or law (PWD 96/71/EC). Since none of the Nordic countries have statutory minimum wages and only Finland and Iceland have a tradition of generalizing collective agreements, this means that low-wage competition – or “social dumping” – by companies hiring foreign sub-contractors has been fully legal in large parts of the Nordic labour markets.⁴

Faced with this new opening for “regime shopping” within the domestic labour market, Denmark and Sweden have stuck to the view that state regulation of wages remains out of the question, and have relied on the tradition that unions, if necessary by industrial action, can force foreign companies to sign national collective agreements. With the rising volume and fluidity of cross-border subcontracting, this soon proved to be a demanding task for the unions (Eldring et al., 2012). When the European Court in the so-called Laval-case in 2007 then declared such practices in breach with EU law, Sweden eventually adjusted its rules so that industrial action against foreign companies is only allowed to obtain certain minimum standards laid down in law or agreements. Lately, this has been condemned by ILO as a breach with its convention on freedom of associ-

³ Another option offered by more and more Nordic employer federations is to remain a member without having to subscribe to their collective agreements.

⁴ From 2013 this option does no longer pertain to workers leased from Temporary Work Agencies, national and foreign alike, who according to the newly implemented EU directive (2008/104/EC) are entitled to the same basic conditions as employees of the user firm.

ation. The Danes followed a more bold approach, merely making cosmetic adjustments in their equal treatment regime. In practice, however, the relegation of the responsibility for regulating and enforcing minimum wages for posted workers to the unions has implied considerable leeway for companies to hire foreign sub-contracted labour at rates well below national standards. This is also the case in Norway where the possibility of demanding generalization of minimum conditions in collective agreements has only been exploited by a handful of unions (at present in construction, yards, agriculture, and cleaning) and the generalized minimum pay rates are usually well below the going national rate. Like in Finland, where the extension of collective agreements has long been routine, it has also become evident that control and enforcement represent a huge challenge for the Labour Inspectorate which reports that circumvention and abuse is widespread (Eldring et al., 2013). Accordingly, the annual meeting of the Nordic Council of Labour Ministers in 2012 decided to launch a joint study of how the risk of “social dumping” could be more effectively prevented.

In effect, the opening of the European labour and services markets for low-wage competition across borders has implied a two-fold challenge for the collective institutions of Nordic labour market governance. First, in several industries, the supply-side shock has altered competitive conditions and power relations in favour of employers – especially in the lower rungs of the labour markets. Further, by opening internal exit options from collective regulations, this has tended to erode, or break up, national wage floors (Dølvik et al., 2013). Such dynamics are most pronounced in the market for sub-contracting, where the hiring of labour from foreign companies applying home country conditions has created a legal opening for the development of a secondary market for cheap, flexible labour. Largely welcomed by the employer side – which has seen this as an opportunity to escape the high Nordic labour costs even on home ground, and to pressure the unions to become more permissive – this indeed represents a significant break with the past tradition where employers and unions saw a common interest in upholding a unified wage floor and taking wages out of inter-firm competition. Yet, the employer approaches to such issues have varied between the Nordic countries; in Finland, Iceland, and Denmark, the employers have agreed to invoke traditional means to defend national standards, at least officially, whereas in Sweden

and Norway, the employer associations have actively used EU rules to challenge union attempts to halt the development of a dualized labour market. Contrary to the Swedish centre-right government, the Swedish business association (SN) explicitly supported Laval in the European Court. In Norway, the employer associations recently brought a dispute over the extension of minimum rates in a collective agreement in yards to the national Supreme Court. The complaints were rejected in that court, however, after having won partial support from the EFTA Court. The employer side in Norway and Sweden has also floated ideas of introducing a statutory minimum wage, which has formerly been *anathema* in Nordic contexts because it would effectively undermine the wage floors set by sectoral collective agreements (Eldring and Alsos, 2012).

Second, as illustrated by the Laval case, the Nordic labour regimes based on autonomous collective bargaining have run into a regulatory clash with the EU regime, which for cross-border service providers only recognizes a narrow set of minimum rules laid down in legislation or generalized collective agreements. Even in those Nordic countries that have introduced extension mechanisms, the increased importance of such minimum rules has caused some concern about their impact on conditions for the growing layers of workers – immigrants and natives – that are bound to compete for work in national companies that take advantage of the new opportunities to operate outside the jurisdiction of collective agreements. Since many companies use the loopholes and constraints of the EU rules to pursue “regime-shopping” strategies within the national labour markets, the external widening of the labour market has interacted with domestic dynamics of change in setting in motion processes that may potentially undermine, or severely weaken, the collective institutions in vulnerable parts of the labour market. Unless adequate countermeasures are taken, such dynamics are likely to propel increased segmentation or dualization of the formerly encompassing Nordic labour regimes.

Except in Finland, most Nordic trade unions have been opposed to legislative interference in wage setting and have therefore also been sceptical of a statutory extension of collective agreements as a means of regulating competition in the labour market. However, the absence of a collaborative employer side experience seems to suggest that reliance on the unions’ autonomous capacity to strike and enforce collective agreements on behalf of subcontracted foreign labour will hardly suffice to prevent

low wage competition from spreading. Without effective support from the state in providing supplementary regulation and enforcement, increased inequalities and growing gaps between the core and the periphery of the Nordic labour markets are thus a likely scenario. As indicated by experience in the UK in the 1980's and Germany from the 1990's, the emergence of a sizable layer of companies that operate outside the collective agreement regimes – and in addition have access to an abundant supply of labour with substantially lower reservation wages – thus seems to represent a much more pressing challenge for Nordic labour market institutions in the short run than the long-standing pressures of global trade and investment flows. The impact of the global dispersion of education enrolment and R&D is too early to assess, but it has certainly contributed to increasing the supply of science students and personnel, and has apparently also made it easier and more attractive for Nordic companies to establish and expand their operations in China and elsewhere. How such shifts in the exogenous conditions of the labour market – be they regional or global – in the longer run will affect national labour market institutions depends on the extent to which they interact with endogenous dynamics of change in domestic arenas. National changes in employer strategies, unionization, and constellations of political power – as recently seen in several of the Nordic countries – may thus prove to be decisive after all.

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Efficiency gains from trade and labor market outcomes^{*}

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Summary

Does trade liberalization increase domestic unemployment? Does it lead to higher wage inequality? In this article, we draw lessons from combining two canonical frameworks: the heterogeneous firms trade model of Melitz (2003) and the search-and-matching labor market paradigm. We focus on productivity or efficiency gains from trade. We argue that trade liberalization is likely to lower the equilibrium rate of unemployment, but that its effect on wage dispersion is ambiguous. We discuss implications for the conduct of trade and labor market policies.

Keywords: trade liberalization, unemployment, search models, firm heterogeneity.

JEL classification numbers: F12, F15, F16.

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Globalization is driven by reductions in trade barriers as well as improvements in transport and communication technologies. These changes raise total factor productivity since fewer resources are sunk in the trading process. Additional productivity gains are also triggered by the reallocation of market shares towards efficient firms. In an economy where companies with widely different productivity coexist, increased competition does not only benefit efficient producers but also weeds out inefficient ones. The importance of this *selection effect* has been documented in a series of empirical papers (see, e.g., Trefler, 2004, Bernard et al., 2006 and Tybout, 2003, for a survey). They show that, following an episode of trade liberalization, the reallocation of resources across firms outweighs the contribution of direct savings to overall productivity gains.

One can hardly overstate the impact of this empirical finding on the trade literature. It has provided the motivation for a burgeoning strand of research on the selection effect of trade. The contributions over the last decades have been so numerous and varied that the overall endeavor is now known by the not overly creative title of “new new trade theory”. Among its many subtopics, we will focus on a particular stream of papers that study what impact within-industry reallocations due to international trade have on labor market outcomes.¹

The idea that labor markets benefit from productivity gains is often advanced in debates on trade policy. An example among others can be found in the 2008 EEAG report on the European Economy. While discussing the pros and cons of deregulation, the panel of experts underlines that: “A wider question is whether international trade in general, including final goods, raises productivity growth. One would expect this to be the case, as more competition is likely to raise the incentives for efficiency improvements. (...) The conclusion is that the cost-saving effects of international outsourcing and trade might significantly reduce the risk that trade with low-wage economies in combination with wage rigidities will cause unemployment. (...) It may very well be that productivity growth is high enough that all real (and nominal) wages can increase without causing unemployment, even though the relative wage of low-

¹ Between-industry effects are the hallmark of the Heckscher-Ohlin model. See Davidson et al. (1988) for a model that combines classical trade theory with frictional unemployment. This treatment features multiple industries and types of workers, but assumes perfect competition, the absence of trade costs and abstracts from within-industry effects.

skilled may have to fall.”² The new new trade theory enables economists to address these questions in a precise and formal manner. Its description of the trade-productivity nexus makes it possible to rigorously analyze how the efficiency gains affect other economic outcomes.

We will concentrate on the transmission channels through which productivity is of importance for unemployment and income dispersion across workers. In order to capture these two dimensions, we have to depart from the Walrasian framework since it builds on the premises of full employment and income equalization.³ A compelling alternative is the Diamond-Mortensen-Pissarides (DMP hereafter) model of frictional unemployment.⁴ By introducing search frictions, the DMP framework explains why a share of the labor force remains involuntarily out of work. The tractability and realism of the search-matching approach have contributed to its establishment as the main workhorse for the analysis of labor markets. The literature surveyed in this paper can therefore be seen as a synthesis of the currently dominant frameworks in international trade and labor economics.

We start our review by considering an economy à la Dixit-Stiglitz with trade and search frictions. We depart from the usual approach in the literature by stressing that firm heterogeneity is not a necessary factor. This stylized setup allows us to characterize the productivity-unemployment nexus in its simplest form. We turn our attention to firm heterogeneity and wage dispersion in Section 3. There, we explain how the selection effect magnifies the productivity gains induced by trade openness. We also identify the conditions under which firms with heterogeneous productivity pay different wages. Section 4 generalizes the results presented until then to cases where countries are asymmetric. We discuss how differences in labor market institutions shape the patterns of competitive advantage and explain why these channels matter for trade policy. The review put special emphasis on our papers, not to suggest that they deserve more attention than the works of others, but because we have a better understanding of their intricacies. We encourage readers to

² See Chapter 3 of the 2008 EEAG report on the European Economy, “The effect of globalization on Western European jobs: Curse or blessing?” (p. 83).

³ The seminal paper by Melitz (2003) has laid the ground for most of the work on firm selection and international trade. It is devised in a Walrasian world so that all workers are employed at a similar wage.

⁴ In 2011, Diamond, Mortensen and Pissarides were awarded the Nobel Prize for their pioneering work.

compensate this bias by evenly allocating their interest to the articles referenced in the bibliography.

1. The trade-unemployment nexus

1.1 Theoretical predictions

Basic model

We begin by introducing a very stylized, somewhat reduced-form framework. We choose the simplest possible model of two-country trade and combine it with a search-and-matching description of the labor market that follows Felbermayr, Larch and Lechthaler (2012b). We adopt this simplified approach because it serves our heuristic purpose without forsaking most of the substantial insights: Arkolakis et al. (2012) show that, at least when abstracting from unemployment, a stylized model such as the one employed below delivers the same macroeconomic implications as more complicated trade models featuring a continuum of goods, imperfect competition and firm entry.

We assume that each country produces one specific good. It is combined with an imperfectly substitutable imported good to produce a final output good that can either be consumed or invested in labor market search.⁵ Imported goods are subject to trade costs so that the price P_H in the Home economy of the final output good is given by

$$P_H = P(p_H, p_F \tau).$$

Lower case prices refer to countries' individual goods (net of trade costs). The variable τ denotes symmetric trade costs on imports from Foreign (F). $P(\cdot)$ is strictly increasing in its arguments. Thus, when trade costs fall, at given individual output prices, the aggregate price index falls as well.

Recruitment is impeded by labor market frictions. Firms post vacancies at the price $P_H c$. The likelihood of successfully filling a vacancy de-

⁵ For simplicity, we only describe the labor market of the Home economy. The description of the Foreign economy (subscripted by F) is similar.

pends negatively on labor market tightness θ_H , i.e., the ratio of the total number of posted vacancies relative to the number of job seekers. Note that unemployment depends negatively on θ_H .

Once a worker is matched with a firm, the two parties negotiate a wage. Anticipating the outcome of this bargain, firms create jobs until an additional vacancy does not yield any additional profit. As in the DMP model, the labor market equilibrium can be described by a set of two equations. The first condition is the so-called *Wage curve*. It captures the outcome of the bargaining process and can be summarized as follows

$$(W): w_H = W(p_H, \theta_H, B_H).$$

The wage in Home w_H is determined by three variables: Domestic price p_H , labor market tightness θ_H , and a summary measure B_H of the other factors that influence the workers' bargaining position.⁶ $W(\cdot)$ is increasing in all three arguments. Consider first the effect of an increase in p_H . It raises the value of output and thus wages as long as workers are able to capture a share of the surplus. An increase in θ_H occurs when there are more open vacancies per unemployed worker. This improves the worker's outside option and strengthens her bargaining position since she has a higher likelihood of finding an alternative job in case of a negotiation breakdown. Finally, it directly follows from the definition of B_H that it must be positively correlated with the negotiated wage.

The second equation is the *Job Creation curve*. It describes how firms adjust their labor demand and reads

$$(JC): w_H = JC(p_H, \theta_H, P_H c).$$

Like the wage curve, it is increasing in p_H as a higher value of output makes firms more willing to create jobs. By contrast, it is decreasing in θ_H : the larger the number of unfilled jobs per job seeker, the smaller the likelihood for an individual firm of filling its vacancy. Finally, job creation is decreasing in the costs of vacancy posting $P_H c$.

Figure 1. Labor market equilibrium and the effect of trade liberalization

⁶ The most commonly analyzed determinants of B_H are the value of leisure or home production along with the workers' bargaining power.

Source: Authors' illustration.

Labor market equilibrium is pinned down by the intersection of these two curves for given output prices and labor market parameters. Figure 1 provides an illustration. θ_H^* is the equilibrium labor market tightness which determines the level of unemployment through the *Beveridge Curve*.⁷

Effect of trade costs

We are now in a position to give a first answer to our motivating question: How does trade liberalization affect the labor market equilibrium? Trade costs have no direct role to play in the Wage or Job Creation curves but they matter through their effect on prices; the aggregate price level P_H as well as the country's output price p_H . The role of trade is most easily seen when countries are perfectly symmetric so that the output prices can be normalized $p_H = p_F = 1$. Then, individual prices drop from

⁷ The Beveridge Curve is a level curve of the matching function; it illustrates the combinations between the numbers of vacancies v and unemployed workers u that yield some given number of successfully filled jobs. If the matching function features constant returns to scale, the Beveridge Curve allows us to back out the equilibrium rate of unemployment from θ .

both the Wage and the Job Creation curves and the aggregate price index P_H depends only on trade costs τ . More precisely, when τ falls, P_H also falls. Thus, the cost of creating a vacancy goes down relative to the value of the output generated by a filled job. This incentivizes firms to create more jobs. In terms of Figure 1, a lower level of τ , and consequently P_H , leads to a right-ward shift of the JC curve: for given wages, firms post more vacancies. The equilibrium level of labor market tightness goes up which raises wages and pushes down the equilibrium rate of unemployment.

When countries are asymmetric due to, e.g., different technology, labor market institutions, or size, things are slightly more complicated because one can no longer normalize output prices in both countries. Rather, a change in trade costs will affect Home's terms of trade $\pi = p_H / p_F$, i.e., the price of its output relative to the world market price of its imports. For example, if Home is the bigger country, it has a relatively larger supply of the good; its price is relatively low on the world market and its weight in the aggregate price index is relatively large. If trade costs fall, this situation becomes even more pronounced. The terms of trade of Home deteriorate, and this can counteract some of the reduction of the aggregate price index described above. The basic insight of Figure 1 can even be turned around when countries are extremely asymmetric: Then, the larger (or more productive) country may actually face an increase in unemployment. We will return to asymmetries in Section 4 below.

Importance of the numéraire

The above discussion suggests that deregulation among symmetric countries always lowers the rate of unemployment. But the conclusion must be treated with caution. It holds true when a reduction in trade barriers leads to a decrease in recruitment costs relative to the value of output. This is guaranteed in our set up by the indexation of vacancy costs to the aggregate price P_H . It seems to be the most natural choice of numéraire, but it is not the only reasonable one. Instead, we could index the cost of vacancy creation to the domestic price p_H . Since output prices can be normalized to one when countries are symmetric, it follows that a decrease in τ leaves the wage and job creation curves unchanged. Then, trade liberalization has no effect on labor market outcomes. It is shown in Felber-

mayr et al. (2011a) that a similar conclusion holds when vacancy costs are measured in labor units.⁸

It is therefore rather easy to come up with indexations of the recruitment costs such that the impact of trade liberalization varies from positive to irrelevant. One may even think of more elaborate scenarios where a reduction in trade barriers raises the rate of unemployment. Such an example is provided by Helpman and Itskhoki (2010) who consider a two-sector model of international trade where one sector produces homogeneous products while the other produces differentiated products. They assume that there are no trade frictions in the homogenous-product sector and, most importantly, choose the homogenous good as numéraire. Given that trade liberalization lowers the ideal price index of the composite goods, it raises the relative price of the homogenous good and consequently any costs that are directly indexed to it. This is why Helpman and Itskhoki (2010) find that, when there are no search frictions in the homogenous product sector, reductions in trade impediments between symmetric countries raise unemployment.⁹

To take stock, the efficiency gains of trade openness seem to matter for the rate of unemployment, but the sign of the relationship differs across models because it crucially depends on the indexation of vacancy costs. In view of these conflicting findings and as stated by Davidson and Matusz (2004), whether trade affects the level of unemployment is “primarily an empirical issue” to which we now turn our attention.

⁸ What vacancy costs are precisely made of remains an open question. Pissarides (2009) argues that in order to fit business cycle fluctuations, fixed fees should account for a significant share of the recruitment costs. Shimer (2010) proposes to consider that vacancy posting is associated with a shift of resources, and especially workers, within the firm. As recruitment takes up employees' time, its cost is in terms of labor rather than goods. When the marginal productivity of labor is decreasing, the reallocation of workers to recruitment tasks is more and more costly. This naturally gives rise to strictly convex vacancy costs whose implications are discussed in Section 3.2.

⁹ Moreover, there is also a composition effect: trade liberalization triggers an expansion of the frictions ridden sector, and therefore a reallocation of workers out from the no-employment numéraire sector. This also contributes towards an increase in aggregate unemployment. Combining the two effects, Helpman and Itskhoki (2010) consider more elaborate scenarios which yield ambiguous outcomes. For example, when there are search frictions in the homogenous-product sector, the overall adjustment depends on the strength of the reallocation effect between the two sectors.

1.2 Empirical evidence

Figure 2. Unemployment and openness: 62 countries, averaged over 1990-2007

Source: Authors' calculations.

Figure 2 plots averages of unemployment rates against averages of openness levels for 62 countries.¹⁰ The averaging is used to smooth out measurement error and business cycle effects. The correlation between the two measures appears to be negative (-0.044), it is statistically significant at the five-percent level (robust t -value of 2.2). So, a ten percentage point increase in openness lowers unemployment by 0.44 percentage points. This evidence is suggestive; however, as discussed by Felbermayr et al. (2011b), there is a number of important caveats.

There are at least two major issues. First, unemployment being an economy-wide concept, any analysis must focus on aggregate data. However, reported unemployment rates are often prone to measurement error and difficult to compare across countries. Second, and more importantly, policy-makers may erect trade barriers as a response to unemployment shocks. This endogeneity problem may result in a spurious negative correlation between trade openness and unemployment rates.

There is not much that one can do to mitigate the data quality problem except running a maximum number of robustness checks. In order to

¹⁰ The openness measure is defined as exports plus imports over GDP, normalized to account for purchasing power differences; see Alcalá and Ciccone (2004).

avoid reporting spurious regressions, one has to carefully control for business cycles and macroeconomic shocks. Moreover, one has to account for the effects of labor market institutions and regulation which may correlate with trade policies and introduce another source of endogeneity bias.

Felbermayr et al. (2011b) use a panel of high-quality unemployment data for 20 OECD countries from 1970 to 2003. In that period, unemployment and openness have increased quite substantially in most countries. At the same time, labor market institutions have also changed dramatically: the generosity of unemployment benefit systems and the strictness of protection have increased. To separate out the roles of labor market institutions and trade openness, the authors apply, besides other methods, GMM panel estimation methods to deal with potentially endogenous regressors. The data are averaged over five-year intervals to net out business cycle variation. The regression equation, based on Nickel et al. (2005), reads

$$u_{i,t} = \rho u_{i,t-1} + \beta \cdot T_{i,t} + \lambda \cdot \mathbf{LMR}_{i,t} + \pi \cdot \mathbf{PMR}_{i,t} + \chi \cdot \ln POP_{i,t} + \gamma \cdot GAP_{i,t} + v_i + v_t + \delta_{i,t}. \quad (1)$$

It regresses the level of the unemployment rate $u_{i,t}$ on its first lag to account for the persistence of the data. The key variable of interest is the degree of openness $T_{i,t}$; also measured in levels. As suggested in the literature, the openness variable is exports plus imports relative to GDP, but adjusted for differences across countries in aggregate price levels (purchasing power parities).¹¹ The regression contains an array of indicators relating to labor market regulation ($\mathbf{LMR}_{i,t}$). These measures come from OECD sources. The most important variable is the so-called tax wedge: the difference between the marginal product of labor and the net advantage of employment over unemployment for the worker. The analysis also includes an array of other labor market variables, such as indicators of employment protection legislation, measures of the type of industrial relations, and proxies of product market regulation ($\mathbf{PMR}_{i,t}$). It contains the log of population ($POP_{i,t}$), a measure of the output gap ($GAP_{i,t}$), and orthogonal macroeconomic shocks (e.g., labor market

¹¹ There are different ways of defining openness. Felbermayr et al. (2011b) explore a number of possibilities which all yield similar results.

shocks, monetary policy shocks, etc.). The model also includes country-level fixed effects v_i , to absorb unobserved heterogeneity, and year effects v_t .

Table 1 reports the key results. Column (1) is a standard cross-country unemployment regression. It explains about 60 percent of the variation in unemployment rates over time (within-variation). The output gap plays the most important role, while amongst the labor market variables, the tax wedge (index of wage distortion) has the most robust effect. It is positively related to the structural rate of unemployment. Adding our openness measure to the equation makes the tax wedge insignificant, but leads to an accurately estimated, strongly negative own effect of openness on unemployment. The share of explained variation goes up to 65 percent. Column (3) adds the lag of unemployment to the right-hand side.¹² This restores the significance of the tax wedge variable without affecting the openness coefficient.

Column (4) reports results for a system-GMM model. Here, we treat openness, the output gap and the tax wedge as endogenous variables. The results very clearly indicate that higher trade openness is associated with lower unemployment. The results are statistically significant and economically meaningful. An increase in the openness measure by 10 percentage points leads to a reduction of the structural unemployment rate by between 0.6 and 1.3 percentage points. These estimates mark the lower and higher ends of an interval of results that are obtained when using more standard methods of panel econometrics on the same data and using similar controls. Hence, endogeneity bias does not seem to matter to any considerable extent once one has eliminated country-specific (fixed or random) effects, and one has controlled for business cycle effects and labor market institutions. In particular, carefully controlling for the output gap is crucial to obtain unbiased estimates. Note that the estimates in Table 1 are likely to be interpreted at sample means (average real openness about 0.30). However, caution needs to be applied to linear extrapolations. Moreover, note that real openness (i.e., adjusted by the PPP price level) is different from the more traditional measure exports plus imports over GDP.

Table 1. Empirical evidence: OECD panel

¹² The lag is instrumented by further lags.

	(1) FE	(2) FE	(3) FGLS	(4) Sys-GMM
Total trade openness		-0.128*** (0.035)	-0.112*** (0.021)	-0.052*** (0.019)
Lag dep. var.			0.305*** (0.047)	0.725*** (0.089)
Wage distortion (index)	0.114** (0.044)	0.065 (0.044)	0.073*** (0.018)	0.085* (0.049)
Employment protection (index)	-0.444 (1.329)	-0.380 (1.378)	-0.589 (0.377)	-1.188** (0.580)
Union density (index)	0.038 (0.041)	0.025 (0.043)	0.025* (0.014)	-0.053* (0.029)
High corporatism (dummy)	-3.668*** (0.822)	-2.325* (1.203)	-2.574*** (0.467)	-1.572 (0.981)
Product market regulation (dummy)	0.745 (0.553)	0.963 (0.591)	0.820*** (0.230)	0.893* (0.476)
Population (log)	-17.578*** (6.007)	-19.689** (6.994)	-13.402*** (3.391)	-0.610 (0.704)
Output gap	-0.606*** (0.082)	-0.624*** (0.089)	-0.589*** (0.047)	-0.842*** (0.125)
R2 (within)	0.602	0.648		
R2 (between)	0.012	0.018		
R2 (overall)	0.004	0.411		

Source: Authors' calculations.

Note: Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%. Number of observations: 100 (20 OECD countries observed for four 5-year periods; 1980-2003). All models control for unobserved country and period effects. FGLS stands for feasible least squares. Openness, output gap and wage distortion are treated as endogenous in the GMM regressions. The constant is estimated but not reported.

Felbermayr et al. (2011b) also work with the larger country sample shown in Figure 2 that extends beyond the 20 rich OECD countries. Here, data quality is an issue and comparable indicators of labor market institutions are more difficult to find. However, in the cross-section, one can apply standard instrumental variables methods that are frequently used in other contexts and that use the exogenous variation in countries' trade openness induced by geography. Results from samples containing about 60 countries fall within the interval of the estimates reported above.¹³

¹³ The median effect of openness estimated in Felbermayr et al. (2011b) is -0.095. The results obtained by Dutt et al. (2009), who use a different sample and a slightly different empirical strategy, lie between -0.065 and -0.024.

The conclusion to be drawn is the following: purging business cycle effects and controlling for labor market institutions and constant country characteristics, one finds a negative correlation between trade openness and unemployment rates. Additionally addressing the potential reverse causality between unemployment and trade openness by either GMM methods or more standard IV methods does not undo this finding. Using different data and specifications, independent work by Dutt et al. (2009) comes to very similar conclusions. Thus, the insights from the simple model presented in Section 2.1, namely that trade liberalization has either a beneficial or no effect on unemployment, are borne out by the data. Importantly, neither the paper by Dutt et al. (2009) nor the paper by Felbermayr et al. (2011a) find any evidence for Heckscher-Ohlin type effects of trade on unemployment.

2. Trade and wage dispersion

In order to simplify the presentation, we have not yet discussed the reallocation of resources across firms that is at the heart of the new new theory of trade. A series of empirical papers substantiate the significance of this mechanism (see Bernard et al., 2006 and the surveys by Bernard et al., 2007 and Redding, 2011). We refer readers to these papers for a careful documentation of the selection effect. We will instead focus on the interpretation of these findings as well as their implications for income inequality. Our approach builds on the now canonical model of Melitz (2003).

2.1 The selection effect

Consider an economy where firms operate a linear technology whose only input is labor l . The main innovation of Melitz is to introduce firm heterogeneity. More precisely, if we use index i to identify firms, their output is given by

$$y_i(l) = z_i l. \quad (2)$$

The variable z_i measures the labor productivity of firm i and varies across producers. The linearity of the production technology is compensated by the imperfect substitutability between goods. As in the standard Dixit-Stiglitz model of monopolistic competition, consumer preferences are defined over a final consumption good that is produced according to a CES function

$$Y = M^{-\frac{1}{\sigma-1}} \left[\int y(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}}, \sigma > 1, \quad (3)$$

where M measures the number of available varieties i , and σ is the elasticity of substitution across varieties.¹⁴ Using the price index P dual to (3) as the numéraire,¹⁵ we find that demand for good i is given by an isoelastic inverse demand function, i.e.,

$$y(i) = \frac{Y}{M} p(i)^{-\sigma}. \quad (4)$$

The partition of firms between exporters and strictly domestic producers is determined by the structure of fixed costs. First, firms need to pay f in order to operate on the domestic market. If they wish to export, entry into *each* foreign market involves an additional fixed cost f_x while units shipped abroad are subject to an iceberg cost $\tau \geq 1$. When trade occurs among symmetric countries, the revenues of a domestic producer which also exports to n countries are given by

$$R(l, z) = \left[\frac{Y}{M} (1 + n\tau^{1-\sigma}) \right]^{\frac{1}{\sigma}} (zl)^{\frac{\sigma-1}{\sigma}}. \quad (5)$$

An increase in the number of export markets raises revenues so that firms would like to serve as many countries as possible. They are prevented from doing so by the fixed cost of export f_x whose outlay is justified

¹⁴ Premultiplying the square bracket in (3) by $M^{-1/(\sigma-1)}$ neutralizes the love of variety channel otherwise present in CES aggregator functions.

¹⁵ Formally, the aggregate price $P = \left(\int p(i)^{1-\sigma} di / M \right)^{1/(\sigma-1)}$.

solely for the most productive firms. Similarly, the least efficient producers cannot raise enough revenues to cover the domestic fixed costs f and are thus driven out of the market. Under the mild requirement that $f_x > \tau^{1-\sigma} f$, the model yields the partition documented in the data: Only a subset of firms ship their products abroad and exporters are, on average, more efficient than non-exporters.

Figure 3. Effects of trade liberalization on profits and activity thresholds

Source: Authors' illustration.

Figure 3 reports a typical cross-section. Firms whose productivity equals z_D^* break even. The second threshold z_X^* corresponds to the efficiency level above which exporting becomes profitable. Firms with productivity levels between z_D^* and z_X^* solely serve their domestic market.

Trade liberalization can take the form of a decrease in distribution costs f_x or in iceberg costs τ . Let us focus on the second possibility, as it most closely resembles a tariff reduction. Such a reform strengthens the incentives to export and thus shifts the threshold z_X^* down. By contrast, the break even threshold z_D^* shifts upwards because the improved competitiveness of foreign firms drives some of the domestic producers out of

business.¹⁶ These changes are depicted in Figure 3. Not only do we observe a truncation to the right of the productivity distribution but also a reallocation of workers towards efficient firms which take up a higher share of total output. These two effects raise average productivity $\bar{z}$.

Felbermayr et al. (2011a) show that the impact on unemployment of an increase in average productivity can be analyzed in a broadly similar fashion as a decrease in the price of the final output good. Thus, the predictions laid out in Section 2 carry over to a more elaborate economy with heterogeneous firms.¹⁷ They also remain sensitive to the choice of index for the vacancy costs. Firms intensify their search effort solely when their productivity increases in comparison to the recruitment costs.

Homogenous and heterogeneous firm models differ in one important dimension: Wage dispersion. In labor markets that are riddled with search frictions, workers and firms share quasi-rents. The intuition suggests that those rents are correlated with firm productivity, so that differences in efficiency translate into differences in wages. We now discuss how this link can be modeled and why it does not necessarily arise.

2.2 Firm heterogeneity and wage dispersion

It is natural to consider that wages are the results of a bargaining process. Most search models follow this approach and assume that wages split rents into two shares whose relative sizes are determined by the bargaining power of workers. The outcome is called the Nash-bargaining solution. It is easily characterized when, as in Pissarides' canonical setup, the environment is perfectly competitive and technology is linear. These two conditions imply that firm size is irrelevant, thereby justifying the assumption that each firm employs only one worker. Extending the solution to an economy where firms have market power is not straightforward because one has to consider multiple-workers firms. This raises the question as to whether wages are set at the individual or the collective level.

¹⁶ As shown in Melitz (2003), this adjustment results from the interaction of the free entry and zero cutoff profit condition. Given that the outcome is rather intuitive, we do not report the formal analysis here.

¹⁷ However, the converse is not true because firm heterogeneity yields additional insights that cannot be derived when firms are assumed to be homogenous. Most interestingly, it makes it possible to fine-tune policy recommendations. See the discussion in Section 4.1 where we compare a reduction in fixed export costs with a decrease in variable costs and explain why the latter is more likely to improve labor market outcomes.

A striking finding in Felbermayr et al. (2011a) is that, independently of the bargaining regime, firm heterogeneity does not generate any wage dispersion. However, the reason why all firms end up paying the same wage rate depends on whether or not workers coordinate.

When all negotiations take place at the individual level, i.e., between the manager and each of his employees, wages are decreasing in firm size. This is because an increase in the labor force lowers marginal productivity and, consequently, the rent that has to be shared. Stole and Zwiebel (1996) prove that firms exploit their monopsonistic power until workers are paid their outside option.¹⁸ Since it does not depend on the firm characteristic, the conclusion that wages are equalized follows.

When negotiations take place at the collective level, i.e., between the firm and a labor union, each party receives a given share of the total surplus which is proportional to the markup of prices over marginal costs. But markups depend on the elasticity of the revenues function and not on its level z . This is why markups do not vary across firms and thus, collectively bargained wages do not depend on z . Notice that the result hinges on the parametric specification (3) and is therefore less robust than its counterpart under individual bargaining.¹⁹

Having wages that are identical across firms greatly enhances the model's tractability but it precludes any discussion of the links between trade and income inequality. To investigate this issue, we have to enrich our framework. There are at least three reasons why firms with different productivities may end up paying higher wages:²⁰

- *Convex recruitment costs*: If hiring an additional worker becomes more and more costly, firms save on hiring costs by slowly converging to their optimal size. The marginal rent is a positive function of the distance between the current and optimal level of employment. Given that efficient producers take a longer time to reach their bigger target size, their employees are able to extract a higher rent. Cosar et al. (2011) show that this mechanism explains

¹⁸ In the presence of search frictions, the cost of replacing the worker is added to the opportunity cost of employment. This does not affect the conclusion as long as workers are homogeneous and recruitment costs are identical across firms.

¹⁹ Montagna and Nocco (2013) develop a model with heterogeneous firms, variable markups and collective bargaining where wage dispersion across firms is obtained.

²⁰ Additional mechanisms are: collective bargaining with variable mark-ups and fair-wage models which link wages to firm profits by assumption (Egger and Kreickemeier, 2012).

why exporters manage to be larger than non-exporters, even though they pay higher wages.

- *Screening*: We have focused on *residual inequality* among homogenous workers. Yet workers are often not truly identical but only indistinguishable. It is in the interest of prospective employers to try to detect an applicant's unobservable ability through a screening process. Provided that efficient firms can put ability to better use, they devote more resources to screening in order to hire a more able workforce. But this implies that their employees can extract a higher rent because they are more costly to replace. Helpman et al. (2010) embed this mechanism into Melitz's model and illustrate that it can reproduce both size and exporter wage premium.
- *Directed search*: Job openings usually advertise pay and benefits. The more generous they are, the more people are likely to apply. Random search models rule out this effect because they build on the premise that job seekers cannot direct their search. Relaxing this assumption, Felbermayr, Impullitti and Prat (2012) show that it can also explain the size and exporter wage premium. When vacancy costs are convex, firms that wish to reach a bigger size decide to save on recruitment expenses by posting a higher wage in order to attract more applicants.

2.3 Trade and inequality

A common feature of the three mechanisms described above is that firms wishing to recruit more workers find it optimal to offer higher wages. They are consistent with the positive relationship between employer size and wages.²¹ Given that, everything else equal, exporters have a higher optimal size, the model is also in line with extensive evidence that exporters pay higher wages than non exporters (Bernard and Jensen, 1995).

The shape of the wage distribution varies with the distribution of firms' productivity. We assume that they are drawn from a Pareto distribution, so that $G(x) = Pr\{z \leq x\}$ reads

²¹ The employer size-wage premium has been studied for several decades (e.g. Mellow, 1982) and is one of the most robust findings in labor economics. It holds independently of the country or industry of interest.

$$G(x) = 1 - \left(\frac{z_{\min}}{x} \right)^\kappa, \text{ with } z_{\min} > 0 \text{ and } \kappa > 0. \quad (6)$$

This parametric restriction is usual in the literature because it fits the observation that firm sizes are Pareto distributed. For concreteness, we will also focus on cases where search is directed.²² Felbermayr, Impullitti and Prat (2012) show that, under these two premises, log-wages are linear in log-productivity with a positive jump at the export threshold z_x^* . More precisely, they can be decomposed as follows

$$\ln w(z) = C_0 + C_1 \ln z + \underbrace{C_2 \ln \tilde{z}}_{\text{Reallocation}} + \underbrace{C_3 \ln(1 + I(z)\tau^{1-\sigma})}_{\text{Export premium}} \quad (7)$$

where $I(z)$ is an indicator that takes the value of one when the firm exports and 0 otherwise;²³ while C_0 , C_1 , C_2 and C_3 are constants depending on the model parameters²⁴ but not on the trade restrictions or on the characteristics of a given firm.

An example of how wages vary with productivity is illustrated in Figure 4 along with the impact of a decrease in variable trade costs τ . As explained in Subsection 3.1, z_D^* shifts up and z_x^* down when τ falls. Aside from this impact on the cross-sectional distribution, trade liberalization affects wages through two channels. First, the reallocation effect raises average productivity $\tilde{z}$ and thus shifts the intercept of (7). Trade raises all wages proportionally. The second effect operates through the exporter wage premium $C_3 \ln(1 + n\tau^{1-\sigma})$. It is positive because exporters increase their sales by accessing the foreign market which raises their willingness to pay high wages in order to attract more job applicants. The overall impact of trade liberalization on wage inequality depends on the share of exporters. To see this, it is useful to compare a closed economy with an economy where all firms export. In the two extreme cases, the wage distribution is Pareto because there is no discontinuity due to the export premium. But the most commonly used measures for inequality,

²² Notice, however, that similar predictions hold in Helpman et al. (2010) where search is undirected but screening is the reason why wages differ.

²³ For simplicity, we focus on cases where there are two countries and thus only one possible destination for exports.

²⁴ Namely the elasticity of the matching, recruitment cost and inverse demand functions.

such as the Theil index or the Gini coefficient, are scale independent and as such solely depend on the exogenously given shape parameter κ of the Pareto distribution. In other words, an open economy where all firms export has the same level of inequality as a closed economy. Trade liberalization matters for residual inequality solely because it determines the share of workers who benefit from the export premium. This implies that inequality is *hump-shaped* in trade openness.

Figure 4. Effect of trade liberalization on the equilibrium wage schedule

Source: Authors' illustrations.

The distributional impact of efficiency gains turns out to be more ambiguous than its influence on aggregate outcomes. We have seen that a reduction in trade barriers is likely to raise the employment rate and wages. In contrast, it may raise or lower the Gini coefficient. Determining the sign of the correlation between trade openness and residual inequality is a promising avenue of empirical research. Early results on the question can be found in Helpman et al. (2012) for Brazilian data and in Felbermayr, Impullitti and Prat (2012) for German data.

3. Economic policy issues and cross-country heterogeneity

In this section we briefly discuss what our analysis implies for the conduct of trade and labor market policies. We stick to the type of models that we have used so far in this paper. In particular, we refrain from discussing policy issues when the economy is composed of several sectors.

3.1 Trade policy

According to the model discussed in Section 2, lower variable trade costs τ increase the gross surplus realized in a match relative to the costs of vacancy creation. This incentivizes firms to post more vacancies which brings down unemployment. In the more elaborate model studied by Felbermayr et al. (2011a), however, not all trade liberalization scenarios have this effect. In that model, there are fixed market access costs both on domestic and export markets. If foreign access costs f_x are larger than domestic fixed costs f then lower τ does indeed increase the productivity of the average firm, and thus, the gross surplus in the average match. If, however, f_x is sufficiently smaller than f , which is not necessarily an unreasonable assumption, a lower τ can lead to a fall in the average surplus. The reason is the following: if f_x is low, a large fraction of firms export and competition is high. Many of the exporters are not very efficient and they charge high prices. A fall in τ lures even more inefficient firms into exporting. Moreover, a larger fraction of varieties that are assembled into the final output good is affected by iceberg transportation costs. Even if these are lower than before, the aggregate output price can rise and the relative attractiveness of job creation may fall. This may sound like a purely theoretical possibility; however, it is important to bear in mind that instances of excessive export participation can exist.

The above argument also makes it clear that lower variable iceberg costs τ are more likely to generate beneficial unemployment effects than reductions in fixed access costs f_x : The former affect the prices of *all* traded goods directly, and this reduces the price of vacancy posting. Lower fixed costs incite entry, and by this they increase the number of varieties available. However, the prices of goods exported before are unchanged (i.e., there are no direct inframarginal effects on prices), so that the overall impact on the price index is subdued.

Finally, it is worth mentioning that the stylized models discussed so far characterize steady states. They are not useful in distinguishing short-run from long-run effects of trade liberalization. But it is clear that a reduction in variable trade costs τ has an immediate effect on the exit of some firms, which lay off their work force, while the growth process of new and old exporters takes some time.²⁵ Moreover, since upfront innovation costs are sunk, the mass of firms does not immediately fully fall to the new lower steady-state level. It is therefore possible that, in the short run, unemployment goes up. This lowers the bargaining power of workers who remain employed, so that wages may initially fall.

Over time, though, the economy converges to a new steady state where unemployment is lower and wages higher than before liberalization. So our model does not imply that there is no need for assistance on labor markets immediately after a discrete change in trade costs. How assistance is to be organized efficiently is an important question of ongoing research; one option would be to increase the unemployment benefits in a transition period, financed by a government budget deficit. This speeds up the destruction of inefficient firms as wages are bid up, but it does not impede the reallocation of labor towards growing firms.

It is very reasonable to assume that countries differ with respect to technology, labor endowments and labor market regulation. Unfortunately, it has proven difficult to analyze such realistic features within the standard Melitz (2003) models. Some of the arguments used in the above discussion already relied on country asymmetries; but they have mostly been based on simulation results.

Felbermayr, Larch and Lechthaler (2012b) have developed a model without firm heterogeneity and monopolistic competition. Regarding aggregate outcomes, this setup produces similar insights to richer frameworks. Moreover, one can analytically analyze the role of country heterogeneity. As is customary in this type of trade models, a given reduction in trade costs benefits the smaller country by more than the larger one since a bigger share of consumed varieties is subject to trade costs in the small country. Small or big essentially refers to GDP: hence, it is not crucial whether a country has a large GDP due to a large labor en-

²⁵ If vacancy creating costs are linear in the number of workers to be hired, firms jump after one period to their desired sizes. In the more realistic case where they are convex, adjustment is more sluggish.

dowment, high average labor productivity, or low unemployment. In other words, a country with bad institutions (and, accordingly, high unemployment) tends to benefit more from globalization than a country with good institutions, *ceteris paribus*.

In the above discussion, we have concentrated on multilateral iceberg trade costs. This is common practice and captures the essential mechanisms, but it disregards the fact that some trade policies, for example import tariffs, generate government income which is usually rebated to tax payers. Felbermayr, Jung and Larch (2012) have shown for the type of models used in Section 2 that such a tariff, imposed unilaterally by a single country, typically improves that country's terms of trade. This translates into more vacancy creation and lower unemployment. However, in an uncoordinated multi-country equilibrium, *each* country has an incentive to set a positive tariff. The Nash equilibrium resulting from a tariff war would leave both countries with higher rates of structural unemployment and lower welfare.

3.2 Labor market policy

Trade integration improves labor market outcomes in our benchmark model because search frictions per se and labor market regulation such as unemployment benefits do not impede the materialization of aggregate welfare gains. This is an implication of the separability result that occurs both in Felbermayr et al. (2011a) and Felbermayr, Impullitti and Prat (2012) despite different characterizations of the labor market institutions. Even economies affected by institutions that generate high rates of unemployment benefit from trade liberalization.

Institutions nonetheless matter greatly for the distribution of these welfare gains between higher real wages and lower unemployment. For example, in the random search model of Felbermayr et al. (2011a), the average welfare gain is distributed between workers and firms through the Nash bargaining process. Free entry implies that additional rents accruing to firms are translated into additional vacancy posting and hence lower unemployment. Since higher effective bargaining power of workers reduces the share of the additional surplus accruing to firms, it reduces job creation. A similar effect occurs from higher search costs. Lower trade costs have no effect on how real wages react relative to unemploy-

ment; again, this is due to separability. What is crucial, however, is free entry: if a higher share of the surplus accruing to firms does not lead to more vacancy creation, then trade liberalization will not lead to lower unemployment. In other words, to benefit from lower variable trade costs, flexible entry regulation is necessary. The policy implications from this analysis are clear: the model does not give rise to any first-order concern about choosing the “right institutions” to be able to tap the gains from globalization. But this does not mean that labor market institutions are unimportant in shaping the *size* of the gains; see below for a brief discussion in the case of country-level heterogeneity.

In a next step, one may ask whether the model provides a rationale for optimal labor market institutions. For the sake of clarity, we may focus on unemployment benefits. In the standard Pissarides text book model of random search, when the so-called Hosios condition is met (bargaining power of workers is equal to the elasticity of the matching function), the optimal degree of unemployment benefits would actually be zero in a closed economy. In the presence of multiple-worker firms, this is no longer the case: here, firms have too much effective bargaining power and there will be excessive vacancy creation.²⁶ Planners can remedy this problem by setting strictly positive unemployment benefits. This continues to be true in an open economy setting. As shown in the asymmetric country model of Felbermayr, Larch and Lechthaler (2012a), where two countries set unemployment benefits in a non-cooperative fashion, and there is trade in goods between them, they choose higher than efficient levels of protection. The reason is that any increase in unemployment and GDP triggered by higher benefits imposes a negative externality on the trading partner, who faces reduced demand for exports. Planners who fail to internalize this effect will provide excessive levels of insurance as part of the “damage” caused by the policy is borne by foreign trading partners.

Notice that lower trade costs exacerbate this problem: countries more open to trade (because they are more central, or because they are smaller in size) will choose higher levels of benefits. This puts upward pressure on their unemployment rates. The data are consistent with this pattern: smaller and more open countries indeed tend to have more generous benefit systems.

²⁶ In contrast, in the directed search model, there is no role for interventionist labor market policies even in the presence of multi-worker firms.

One policy question of considerable interest is whether labor market reform in one country helps or harms its trading partners. There has been some debate in the European Union about German Hartz IV reforms that may have led to higher unemployment in Germany's trading partners and, so, may have been "beggar-thy-neighbor". It is difficult to rationalize such a perception in our framework: Labor market reforms that reduce unemployment in the reforming country will also reduce unemployment in the trading partners. The reason for this is that nudging unemployment benefits closer to their optimal level increases GDP and, hence, demand for foreign good. This leads to additional vacancy creation in Foreign as well. Additionally, Foreign benefits from a terms-of-trade improvement: as Home's wage rate falls due to lower effective bargaining power of workers, its exports become cheaper relative to its imports; Foreign's exports relative to imports instead become more expensive: this lowers the costs of vacancy posting and makes firms more willing to create jobs.

4. Conclusions

The research summarized in this survey is still at an early stage of development. As such, it leaves many questions open. Their answers will help us refine our understanding of the links between trade integration and labor outcomes. Further progress will require testing the theory in order to determine which mechanisms prevail in practice. Disentangling the ambiguous correlations predicted by the model is a prerequisite to policy recommendations.

Theoretical progress is also needed to render the field more policy relevant. Without a better understanding of the interactions between asymmetric countries, it is difficult to contribute to some of the hotly debated topics, such as the effect of labor market institutions on the competitiveness of EU countries. Another important direction for further research would consist in characterizing short-run dynamics. The literature discussed in this survey relies exclusively on steady-state comparisons. But it is of a little use for policy recommendation to know that employment and wages will eventually stabilize to higher levels if we cannot anticipate the length and cost of the adjustment process. We expect the next generation of models to overcome these limitations. Capturing the out of steady-state

interactions between heterogeneous countries is a challenging but necessary task that holds the key to many policy conundrums.

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Comment on Felbermayr and Prat: Efficiency gains from trade and labor market outcomes

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Do the productivity gains associated with international trade and globalization reduce unemployment and income dispersion? This is the question addressed in the fine article by Gabriel Felbermayr and Julien Prat. Since the public discussion is obsessed by the possible adverse effects of trade on jobs and inequality, the overall conclusion that trade liberalization leads to a lower rate of unemployment and has an ambiguous effect on wage dispersion may come as a surprise.

The gulf between the public opinion and the conclusions of Felbermayr and Prat may, however, be less dramatic once we consider differences in time horizons. As Felbermayr and Prat make perfectly clear, their case is based on a comparison of long-run equilibria. The public debate, in contrast, mainly considers short-term adjustments and structural changes induced by globalization. Clearly, even with short-term costs, there can be long-term gains.

Felbermayr and Prat show how unemployment may go down with trade expansion since output prices go up relative to vacancy costs. This seems like a plausible result. In the long run, however, vacancy costs are perhaps as likely to be tied to labor costs and in that case (as the authors showed in 2011), trade has no effect on long-run unemployment. Yet, in the medium run, indexing vacancy costs to the average price level seems

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more reasonable. The frictions associated with structural change may then also be considerable, and unemployment may be higher during times of change, a driving force behind the resistance against globalization in the public debate. All of this points to an ambiguity of the timing of different effects through the transition period.

Long-run equilibria incorporate institutional responses. The most open economies are subject to larger shocks from outside, in terms of both trade and overall demand. Dani Rodrik (1998) has argued that small open economies choose larger public sectors because of this. Others have argued that small open economies have more generous welfare states (Barth and Moene 2012). In our article below, we make a case for how small export oriented economies are more likely to have coordinated wage bargaining. These institutional responses also develop slowly over time, but are not incorporated by Felbermayr and Prat.

To policy makers in the Nordic countries, the conclusions of Felbermayr and Prat should come less as a surprise. The Nordics have a long experience of exposure to international competition. Yet historical unemployment records are quite good in spite of a highly compressed wage structure. The mechanisms discussed by Felbermayr and Prat may clearly have contributed to these long-term outcomes. How the mechanisms are affected by the typical responses of the public, politicians and labor market organizations remain exciting issues to resolve.

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Education and labor market policies in an offshoring global economy^{*}

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Summary

With rising unemployment and increasing income inequality, the labor market consequences of globalization and offshoring are back in the headlines. This paper summarizes recent research using Danish matched worker-firm data to examine how offshoring affects labor market outcomes. First, a rise in offshoring leads to a shift in the composition of labor demand toward particular occupation types within skill groups. Second, workers displaced from offshoring firms suffer more significant income losses than workers displaced for other reasons. Finally, training programs are used more intensively by workers initially employed by offshoring firms and these workers become reemployed with manufacturing firms at a faster pace than other workers. These findings are used to draw some education and labor market policy implications.

Keywords: offshoring, skills, wages, unemployment, training.

JEL classification numbers: F16, J08.

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A key feature of global trade in the new century is the rapid growth of offshoring and trade in intermediate goods. A prominent example is the production of passenger vehicles. For a typical “American” car, 30 percent of its value goes to Korea for assembly, 17.5 percent to Japan for components and advanced technology, 7.5 percent to Germany for design, 2.5 percent to the UK for advertising and marketing services, with the remaining 37 percent generated in the US (Grossman and Rossi-Hansberg, 2007). Production is spread globally even for goods as simple as a plastic Barbie doll, which has value added from Taiwan, Japan, the Philippines, Indonesia, Malaysia, China and the US (Feenstra, 1998). These anecdotal cases reflect broader trends at work throughout the global economy. Hummels et al. (2001) estimate that vertical specialization (foreign value-added embodied in domestic production) accounts for over 30 percent of worldwide trade growth between 1970-1990. Feenstra and Hanson (2003) show that processing exports rose from one-third of China’s exports to over one-half between 1988 and 1998.

How does the rise of global offshoring affect the labor market? One simple tradeoff involves labor substitution versus productivity effects within firms. The decision to offshore production means that at least some work previously done within the firm will be done abroad, that is, foreign labor substituted for labor within the firm. But this reduction in labor demand could be offset by a productivity effect. If offshoring raises productivity or lowers input costs, firms will expand their production. If the effect is strong enough, labor demand for tasks that remain onshore could rise enough to offset substitution. This raises a fundamental and previously unanswered question: Does a rise in offshoring correspond to a rise or a fall in labor demand within the firm, and how does this affect the wages earned by these workers?

Offshoring may also change the composition of labor demand. In the preceding example, some tasks are offshored while some remain onshore, and there may be a systematic pattern to the types of tasks in each category. For example, it may be that tasks performed by unskilled labor are more likely to be offshored, while tasks performed by more highly educated workers remain onshore and indeed expand due to productivity effects. The offshore/onshore distinction may also go deeper than education levels. Particular occupational characteristics, such as the routineness of a task, may lend themselves especially well to offshoring, while other

occupational characteristics, such as knowledge of the local language, may be prohibitively difficult to offshore. Similarly, it may be that productivity effects of offshoring benefit certain categories of skilled workers more than others. This raises a second question: Do firms that offshore shift the composition of labor demand toward particular worker or occupation types, with discernible effects on the wages earned by those workers?

If offshoring leads to a net reduction of labor employed within the firm, or a change in the composition of the workforce, some workers will be displaced by the firm. Involuntary displacement is never a happy occurrence for workers. A large literature in labor economics pioneered by Jacobson et al. (1993) documents that the earnings losses from displacement are substantial. Displaced workers experience extended spells of unemployment and get lower wages when reemployed. But there is reason to think that displacement due to offshoring might be different, and worse, than displacement for other reasons. If a firm fails and lays off workers due to local competition, displaced workers may find employment with the local competitor. However, if certain tasks are systematically being offshored by many firms, displaced workers may find reduced demand for their skill set throughout the economy and suffer more significant losses upon displacement. A third question is then: Do workers displaced from offshoring firms suffer more significant wage or income losses than workers displaced for other reasons?

This brings us to policy. Rising income inequality is a major concern for policy makers in many countries. For those interested in slowing or reversing rising inequality, a first step is to diagnose its causes. Skill-biased technological change and import competition are candidates, but offshoring is a potentially important cause, especially if it raises demand for highly educated workers while lowering demand for the less educated, or if it leads to large displacement-related losses for already-low income workers.

More importantly, a better understanding of how labor markets are reshaped by offshoring can be critical to understanding possible cures. For example, many suggest that inequality can be reduced by increasing educational attainment. This seems perfectly sensible. If inequality results from a rising college wage premium, then boosting educational attainment should increase the number of households benefiting from that pre-

mium while also allowing supply to catch up with rising demand in order to slow growth in the premium itself.

However, there is a growing concern that college is not enough. Since 2000, inflation-adjusted earnings in the US have fallen for every educational group except for doctors, lawyers, MBAs and PhDs (Wessel, 2011). This has contributed to the perception that today's college degrees may simply lead to jobs "that don't exist or don't pay middle-class wages" (Krugman, 2011). Offshoring may be a culprit. Firms in India and China have moved up the value chain from textiles and apparel into sectors that intensively use college-educated workers such as advanced electronics, alternative energy, and computer software. The question is then: What types of education are most valuable? Is it enough to simply send more kids to college, or should particularly valuable degree programs be emphasized as a solution to income inequality in the offshoring global economy?

Finally, if displacement due to offshoring is especially painful, is there anything that can be done to ameliorate the pain? The classical policy for reducing costs of adjustment is training. Most OECD countries subsidize worker training programs directly or indirectly. Denmark stands out as one of the countries investing most in such programs (see OECD, 1999 and Simonsen and Skipper, 2008). The training programs typically take place during working hours, and the firms receive generous wage subsidies. To what extent are these programs successful in maintaining and enhancing the skills of the working population, and/or in easing the transition between jobs?

For the rest of the paper we draw on Hummels, Jørgensen, Munch and Xiang (2011), and Hummels, Munch, Skipper and Xiang (2012) (henceforth HJMX 2011 and HMSX 2012, respectively), which address the questions posed above. We briefly explain our data, methodology, and identification strategy. A common theme in these papers is the use of matched worker-firm-trade data. That is, we observe the offshoring decisions of firms, and can track labor market outcomes for workers employed by these firms before and after changes in offshoring status. This allows us to measure the effects of offshoring on labor demand and wages, including compositional effects that are specific to education and occupational types. We can examine workers displaced after offshoring shocks, and see transitions back to the work force. We can also see how

these workers make use of job retraining programs and whether these programs lead to a more rapid return to the workforce.

A key issue throughout both papers is the need to separate two kinds of firms. The first kind of firm enjoys an increase in productivity and responds to it by increasing many kinds of activities. Firms with rising productivity grow, use more capital, engage in more R&D, and are more likely to import and export, and pay higher wages. Simply correlating rising levels of offshoring and wages within such a firm provides no useful information. The second kind of firm experiences an exogenous shock to its decision to offshore production caused by changes in the price or quality of foreign goods. By looking at changes in offshoring in this kind of firm, we are able to properly identify the effect of offshoring on worker outcomes.

This paper proceeds as follows. Section 2 describes Danish labor market policies. Section 3 describes Danish data on workers, firms, training, and trade. Section 4 summarizes results from HJMX 2011 that show how offshoring affects the composition of labor demand and wages within job-spells. Section 5 extends this work, focused on a sub-sample of displaced workers. Section 6 summarizes results from HMSX 2012 that show how training programs affect transitions from displacement. Section 7 provides a summary and policy conclusions.

1. Danish labor market policies

Denmark is a useful country for analyzing the impact of globalization on labor market outcomes and evaluating education and labor market policies. According to Botero et al. (2004) Denmark has one of the most flexible labor markets in the world. Unlike other continental European labor markets employment protection is relatively weak, and Danish firms may adjust employment with relative ease. As compensation for the high job turnover, workers receive relatively generous UI benefits when unemployed, but the incentives to search for jobs during unemployment are reinforced by active labor market programs, monitoring and sanctions. Together, these ingredients form what has been called the "flexicurity" model. This labor market model has led to turnover rates and an average tenure which are in line with those of the Anglo-Saxon countries.

The Danish labor market is strongly unionized even by European standards. More than three quarters of all workers are union members and bargaining agreements are extended to cover most of the labor market. There are three different levels at which wages can be negotiated: the Standard-Rate System, the Minimum-Wage and Minimum Pay System; and Firm-level Bargaining. Under the Standard-Rate System, the wages of workers are set by the industry collective agreement and the wages are not modified at the firm level. The Minimum-Wage System and the Minimum-Pay System are two-tiered systems in which wage rates negotiated at the industry level represent a floor which can be supplemented by local firm-level negotiations. Under Firm-Level Bargaining, wages are negotiated at the firm level without any centrally bargained wage rates.

The Danish labor market has been undergoing a decentralization process. Since 1991, less than 20 percent of the private labor market is covered by the Standard-Rate System and an increasing share of wage contracts are negotiated exclusively at the worker-firm level. As a consequence, while the influence of unions means that the Danish wage structure is still relatively compressed, the decentralization process has implied that wages are more in accordance with the marginal productivity of the individual workers. Dahl et al. (2013) show that decentralization has increased the wage dispersion in the Danish labor market such that wages better reflect worker and firm characteristics.

Another distinguishing feature of the Danish labor market is that heavily subsidized training programs are available on a large scale. Unique among OECD countries, the Danish government provides and finances worker training at off-the-job training sites, and offers generous wage subsidies for firms offering training during working hours. This results in an unusually high incidence of training participation among employed workers. The government training expenses totaled around 0.5 percent of GDP in most years of our sample window. For more institutional details see Simonsen and Skipper (2008).

2. Data description

This section offers a brief description of our data. We explain our data sources, define our measure of offshoring and provide basic descriptive statistics. Additional details may be found in HJMX 2011.

2.1 Data sources

Our data on firms, workers, trade and training participation is drawn from several administrative registers in Statistics Denmark. We have access to a matched worker-firm dataset covering the total Danish population of workers and firms for the years 1995-2006. For the firms, we have information about total sales, the number of full-time employees, capital stock and a six-digit NACE industry code.

The worker data contains a long list of socio-economic characteristics at annual frequencies. As outcome measures, we focus on individual worker wages and labor market status. The hourly wage rate is calculated as annual labor income plus mandatory pension fund payments divided by annual hours. Labor market status (employed, unemployed or out of the labor force) is recorded in week 48 each year. In addition, we use control variables such as age, sex, education, labor market experience, tenure and four-digit ISCO occupation. We will distinguish between high-skilled and low-skilled workers where high-skilled workers are those with a college degree.

From the Trainee Register, we know the history of training including type of training, timing and duration. The training courses can be grouped into basic, vocational, and post-secondary training. Basic courses focus on literacy and basic skills (at the third to tenth grade level) and target adults with only little or obsolete education. Vocational courses represent most of the training activities in Denmark and account for about 77 percent of the government training expenditures. They last 2-3 weeks and cover firm-specific, industry- or occupation-specific materials. Vocational training typically requires employer sponsorship and takes place during working hours. The government covers most of the expenses and provides firms with subsidies of 60-80 percent of the wages during training, while the workers themselves pay only token tuition (EUR 25 per course per week). Post-secondary training typically takes place during off-work

hours and consists of polytechnical, college or MBA type of courses. They do not require employer sponsorship and have very low tuition fees.

The Danish External Trade Statistics Register provides product-level origin/destination country-specific import and export data for the years 1990-2006. Trade flows are recorded according to the eight-digit Combined Nomenclature product code which encompasses approximately 10 000 different product categories. For comparability to other data sources employed in our instruments, we aggregate these flows to the six-digit Harmonized System. For each trade flow there is information about the trade value in DKK (fob for exports and cif for imports) and the weight in kilos

After merging data on firms, workers, training participation and trade flows, and imposing the sample selection criteria used in HJMX 2011,¹ we have a combined dataset with approximately 1.95 million worker-firm-years and 9 800 firm-years. Our sample represents about 20 percent of the manufacturing firms, but between 50 percent and 70 percent of employment in manufacturing depending on the year.

2.2 Offshoring

A major advantage of the data is that we can construct a firm-specific measure of offshoring based on imported products that are used as inputs in the firm's production process. We follow Feenstra and Hanson (1999) and define "narrow offshoring" as purchases of inputs in the same HS4 category as goods sold by the firm. The idea is that the closer the inputs are to the final outputs, the more likely it is that labor within the firm could have produced those inputs. In HJMX 2011, we present evidence that imports, measured as narrow offshoring, are likely to substitute for firms' own labor. Of note, this measure captures a large fraction of the purchases by the firms but it excludes raw materials as well as machinery which could affect labor demand and wages through other channels.²

¹ We select all 20-60 year old full time manufacturing workers and drop all worker-firm-year observations where the employment relationship lasts a single year. We also drop firms with fewer than 50 employees and less than 0.6 million DKK in imports, which corresponds to the average annual wages for two manufacturing workers.

² One concern is that the firm-level imports we observe may be final goods that the firm purchases for sale within Denmark rather than inputs into production. We capture this by measuring the value of inputs that are purchased and then sold by the firm with no value added. This

We now briefly summarize some descriptive statistics for the trading activities of manufacturing firms from HJMX 2011. The firms in our sample purchase 21 percent of total Danish imports and supply 50 percent of Danish exports. The regional source of imports is largely unchanging over the 12 years of our sample, with 85 percent of the imports coming from European sources, 6 percent from North America, 6 percent from Asia, and 3 percent from other sources. Asia as a source of imports has grown in significance (its share going from 5 percent to 8.5 percent) but remains a small portion of the total. Roughly 71 percent of the imports are within the same HS4 category as that firm's outputs and will be counted as narrow offshoring. Narrow offshoring represents 12 percent of gross output and 27 percent of total (imported plus domestic) material purchases for the average firm. In addition, the offshoring variable exhibits substantial variation across firms and within firms over time, which will be useful in identifying its effect on worker outcomes.

Offshoring firms are different from non-offshorers. In HJMX 2011, we show that offshorers have higher sales, more employment, more skilled employment, a larger capital/worker ratio, and pay higher wages. These differences, consistent with findings in the literature from other countries, suggest an important identification problem. It may be that growth in offshoring causes these firms to be better: larger, more skilled and pay higher wages. Or it may be that all these outcomes are jointly determined as a result of time-varying shocks to the firm's productivity or demand for their products. If so, correlations between offshoring and wages do not indicate a causal effect, so we need to identify exogenous variation in offshoring.

3. The effects of offshoring on wages within job spells

In this section, we draw on HJMX 2011 and briefly summarize the results from estimating the impact of offshoring on wages within job spells. As explained above, it is important to identify exogenous shocks to the firms' offshoring activities. The key element in our approach is the ability to see firms changing their trading behavior due to external shocks, that

"retail share" represents only 2.9 percent of the imports for manufacturing firms in contrast to 35.5 percent for service firms.

is, changes in the foreign supply of inputs, or changes in the foreign demand for their output.

To be more specific, we construct three instruments for the offshoring variable that are correlated with the decision to offshore but uncorrelated with changes in the firm's ability and wage structure. The instruments are exchange rates, transport costs, and world export supply. The first two capture shocks to the delivered price of inputs purchased by Denmark. The last captures changes in comparative advantage for the exporting country, whether arising from changes in production price, product quality, or variety. Additional details on the construction of these variables are found in HJMX 2011.

With the instruments for offshoring in hand, the next step is to relate changes in individual workers' wages to exogenous changes in offshoring for the firms that employ them. We use a standard Mincer human capital wage equation approach where the worker-level (log) wage is regressed on instrumented offshoring controlling for worker-firm "job-spell" fixed effects (see e.g. Abowd et al., 1999), and time varying characteristics of the firm and worker.³

When running this regression on the sample of workers described in Section 3.1 HJMX 2011 find that offshoring raises the skilled wage premium, both by increasing wages (elasticity +3.6 percent) for high-skilled workers and lowering wages (elasticity -1.6 percent) for low-skilled workers. Over the 12 years of the sample, a firm that increases offshoring at the same annual rate (5.5 percent) as Denmark as a whole would raise the wages for high-skilled workers by 2.8 percent and lower the wages for other workers by 1.3 percent. These findings appear consistent with the older literature, that trade raises the skill wage premium and with it, inequality. But HJMX 2011 go further to understand other mechanisms at work.

The Danish data also contains information on the occupations of each worker, which we can use to separately identify the impact of offshoring by occupational category and associated characteristics. HJMX 2011 measure the on-the-job requirements for four categories of knowledge and skills that are closely related to college degrees and thereby to assess

³ The control variables include experience, job tenure, and education for the workers and gross output, capital per worker, the share of high-skilled workers in employment and (instrumented) exporting for the firms.

which college degrees are valuable in a global economy. They find that offshoring has the largest positive effect on occupations that require communication and language (premium of +4.4 percent) followed by social sciences (+3.7 percent) and math (+2.7 percent). By contrast, the premium for natural sciences is close to 0. This may seem puzzling given the policy emphasis on STEM (Science, Technology, Engineering and Math) in many advanced countries, but if these knowledge groups are universal languages, jobs requiring them can be done anywhere with an educated workforce. On the other hand, these findings in HJMX 2011 suggest that workers doing communication intensive tasks become more valuable when offshoring rises. One reason may be that offshoring increases the interactions between domestic workers and foreign workers from different cultural backgrounds, which raises the communicating costs within the firm (Lazear, 1999). Domestic workers with strong communication and language skills and social scientists with knowledge of other cultures and societies may be useful in overcoming offshoring-induced costs of cross-cultural dealing.

4. Earnings losses after layoffs

HJMX 2011 study the wage effects of offshoring and exports for those workers who remain employed. We now examine how trade affects the earnings of displaced workers, drawing on the framework of Jacobson et al. (1993). The specifics of the estimation strategy and sample selection are described in the Appendix. Briefly, we follow a sample of workers who are in the data continuously from 1995-2006. We control for observable characteristics of workers (including worker-fixed effects) and compare the earnings-profile of non-displaced workers to workers who separate from the firm as part of a mass layoff event. We further distinguish between workers who were displaced immediately after their former employers substantially increased offshoring (labeled: offshorers) and all other displaced workers (labeled: non-offshorers). We also examine whether this comparison depends on worker skill levels.

Table 1. Displaced workers and changes in offshoring

	All workers	High skilled	Low skilled
Change in offshoring			
Less than -10%	0.60	0.65	0.59
Between -10% and 10%	0.22	0.18	0.22
More than 10%	0.18	0.18	0.18
Number of workers	3 301	359	2 942

Source: Own calculations based on data from Statistics Denmark.

Note: The change in predicted offshoring is measured between the predisplacement year and the displacement year.

We start with a data sample of all Danish manufacturing workers, and then cut down this sample to match the requirements imposed in Section 2.1. Further, following Jacobson et al. (1993), we focus on high-tenure workers because they are those most likely to have accumulated firm-specific human capital in the pre-displacement firm (see the Data Appendix for more details of the sample construction). We define displaced workers as those separating from firms where at least 30 percent of the particular workers in the initial year are no longer employed by the firm in the following year.⁴ We classify worker *i* as an offshorer if he/she is displaced in a mass layoff event from firms that were increasing their predicted offshoring by at least 10 percent between the pre-displacement year and the displacement year.^{5,6} Approximately 9 percent of the resulting sample (6 208 workers in total) are displaced at least once over the years 1998-2006. The low proportion of displaced workers is typical for the displacement literature, because mass-layoff events are uncommon.

⁴ Our definition uses gross flows, since our data has the full population of workers and firms. The literature (e.g. Jacobson et al., 1993) typically defines mass-layoff events using net flows. Net flows could miss displacement events if a firm substantially changes the composition of its employment, e.g. laying off unskilled workers while hiring more skilled workers. We also experimented with using net flows and obtained similar results.

⁵ Predicted offshoring is measured at the worker level, but predicted offshoring is only observed for displaced workers in the pre-displacement year. Therefore, we measure predicted offshoring in the displacement year for the pre-displacement firm as an average over all remaining workers in the firm. The change in predicted offshoring measured this way is valid, if the within-firm dispersion across workers in predicted offshoring is low. This is indeed the case – the median firm-level coefficient of variation of predicted offshoring is 0.004 with a maximum of 0.056.

⁶ We use the 10 percent cutoff because we want to focus on displaced workers that have been hit by a pronounced offshoring shock. Larger cutoffs become problematic because they cut down on the number of displaced workers from which to estimate the wage profile.

Almost half of the displaced workers do not have an observed change in predicted offshoring in the pre-displacement firm, due to missing instruments for some firms and to the fact that some of the pre-displacement firms closed down. 18 percent of the remaining 3 301 displaced workers are classified as offshorers, see Table 1.

Figure 1. Wages and earnings for displaced workers

Source: Own calculations based on data from Statistics Denmark.

We summarize our results in Figure 1. The three left panels show the profile of log hourly wage rate, annual labor earnings and annual gross earnings for high-skill workers. The panels in the right side show the same profiles for low-skill workers. Changes in earnings and gross earnings are measured in levels of DKK rather than in percentage terms so as to include those workers who exhibit zero labor income. Each panel dis-

plays results for offshorers (light grey) and non-offshorers (black) separately. The comparison group in each case is non-displaced workers.

The top left panel shows that high-skill non-offshorers do not experience a reduction in the hourly wage rate (relative to non-displaced workers), while high-skill offshorers suffer small but persistent wage losses of 4 percent. The top middle panel shows that for high-skilled non-offshorers there are pronounced drops in annual labor earnings, peaking in the year after displacement at DKK 30 000. For high-skilled offshorers the drop in earnings is even steeper, peaking at DKK 64 000.

To put the numbers in perspective, the average high-skill wage in the sample is DKK 419 000 so the peak loss of DKK 30 000 for non-offshorers represents 7 percent of pre-displacement earnings and the peak loss of DKK 64 000 for offshorers represents 15 percent of the pre-displacement earnings. Combined with the small changes in hourly wages after displacement, we can conclude that losses in annual labor earnings are primarily driven by reductions in hours worked. Finally, the top right panel shows that even after accounting for income transfers during unemployment, the earnings losses from displacement are still substantial. Offshorers in particular lose DKK 52 000 the year after displacement, or 12 percent of predisplacement earnings.

Looking at the bottom left panel, we see that for low-skilled workers, offshorers suffer a larger wage loss (8 percent) than non-offshorers (5 percent), and a larger loss in labor earnings (DKK 60 000) than non-offshorers (DKK 44 000). The gap between these groups persists five years after displacement.

These losses in earnings are similar to those of displaced high-skill workers in absolute terms, but since displaced low-skilled workers have lower earnings (DKK 285 000 on average), their losses are higher in percentage terms. Non-offshorers lose 15 percent of their pre-displacement earnings and offshorers lose 21 percent. Finally, income transfers are not close to fully compensating for earnings losses. The bottom right panel shows that one year after displacement, annual gross earnings drop by DKK 30 000 (or 12 percent) for non-offshorers and DKK 50 000 (or 17 percent) for offshorers.

To summarize, Figure 1 shows that all displaced workers suffer substantial earnings losses. Offshorers, in particular, suffer greater earnings losses than non-offshorers of the same skill type. One explanation for this

finding is that offshorers have obsolete skills or have specialized in doing tasks that are now imported from abroad, so they tend to have worse reemployment opportunities in the Danish labor market. To explore this further, we track the labor market status in the year after displacement for offshorers and non-offshorers. We find that a higher proportion of offshorers remain unemployed (19 percent) or out of the labor force (10 percent) than non-offshorers (11 percent and 5 percent, respectively). Among the workers who are reemployed, a higher proportion of offshorers switch four-digit industries (92 percent) than non-offshorers (56 percent), although the proportion of reemployed workers who switch four-digit occupations is similar for offshorers (44 percent) and non-offshorers (43 percent). These numbers suggest that offshoring shocks entail a shared sectoral component and worsened market options for the displaced workers.

Using the results from Section 3, we compare the wage and earnings loss for workers who are displaced from offshoring firms with those for their colleagues who remain employed. For low-skilled workers, the displaced suffer a wage loss of 8 percent and an earnings loss of 21 percent, while the non-displaced have a wage loss of 1.6 percent (inclusive of the productivity effect) if their employers double offshoring within a year and do not enjoy an increase in exports. The comparison is starker for high-skilled workers. The displaced suffer a wage loss of 4 percent and an earnings loss of 15 percent, while the non-displaced enjoy a wage *gain* of 3.6 percent (inclusive of the productivity effect) if their employer doubles offshoring in a single year.

The magnitude of these losses, and the differences across displacement types, provide a useful comparison with existing studies. Jacobson et al. (1993) used data on mass layoffs for workers in the US, and found losses of around 25 percent of pre-displacement earnings. Studies based on European data have also found long-term negative effects of displacement but most studies find more modest effects. For example, Albæk et al. (2002) find that Danish workers earn around 6 percent less than nondisplaced workers three years after displacement. We find similarly modest displacement numbers in the non-offshorer group, and effects comparable to Jacobson et al. (1993) for the offshorer group.

5. Offshoring, transition and training

The profound earnings losses found for workers displaced due to offshoring documented in the previous section suggest that offshoring shocks may lead to economy-wide reductions in the demand for specific tasks. Re-attaching to the workforce may then require a more fundamental re-training of these workers. In HMSX 2012, we combine the matched worker-firm data with the training data described in Section 2 to investigate the relationship between offshoring, labor market transitions and training. This section summarizes those findings.

HMSX 2012 first examine whether workers in offshoring firms are more likely to enroll in training. As in the previous section, we focus on workers employed in firms that had mass-layoff events, but in addition to the displaced offshorers and non-offshorers, we now also consider the outcomes for workers staying in these firms.

HMSX 2012 use a Jacobson et al. (1993) estimating framework similar to the previous section, except that the dependent variable is participation in training programs. The sample of manufacturing workers matches the data requirements imposed in Section 2.1, but unlike in the previous section, short-tenured workers are included in the sample.

Recall from Section 2.1 that vocational training accounts for the major part of government training expenditures. Figure 2, taken from HMSX 2011, shows the vocational training take-up rate around the mass layoff event year t (“x” indicates that the coefficients are significant at the five-percent level). The top graph shows staying workers in the mass-lay-off firms, and the bottom graph shows displaced workers. The comparison group in each case is workers unaffected by mass layoff events.

The first main finding to emerge from Figure 2 is that displaced workers substantially increase their training take-up rate in the displacement year.⁷ Training also spikes for workers displaced from non-offshoring firms, but the effect is almost three times larger for workers displaced from offshoring firms. Displaced workers from offshoring firms increase their training by 7 percent, which represents a training rate that is 36 per-

⁷ Workers displaced from offshoring firms also have a pronounced increase in training take-up in year $t - 2$. This pre-shock spike does not occur for other displaced workers or for workers staying with their firms. In HMSX 2012, we argue that a likely explanation is that there is some relationship between the worker, the need for training, and the offshorability of the task in question.

cent higher than for workers unaffected by mass layoff events. It is a novel finding that workers displaced from offshoring firms require re-training at substantially higher rates than other displaced workers. This is consistent with the finding from the previous section that workers displaced from offshoring firms suffer greater and more persistent earnings losses than other displaced workers. It suggests that offshoring is transforming job availability not only within the firm but throughout the labor market, making it more difficult for the workers to find employment with their existing skill set.

Figure. 2 Vocational training take-up rates

Source: Own calculations based on data from Statistics Denmark.

Another finding is that stayers in offshoring firms also increase their training rates sharply, an increase of over six percent in years t and $t+1$. In

contrast, the training take-up rate for stayers in non-offshoring firms is roughly constant. A likely reason is that offshoring involves reorganization of production within the firm such that the set of performed tasks changes. As a consequence, the firm may adjust its workforce both through lay-offs and by reshuffling the task assignments of staying workers. This reshuffling shows up as higher take-up rates in vocational training if such training helps workers learn their new tasks.

Post-secondary training may seem an especially attractive option for displaced workers since they face low tuition, do not require employer sponsorship and such training may open the door to employment in non-tradable service industries or the public sector, where the offshoring risk is lower. In addition, Section 3 showed that offshoring shocks raise the returns to post-secondary education within manufacturing both absolutely and relative to secondary education. Despite this, displaced workers, both offshorers and non-offshorers, are no more likely to take up post-secondary training than the general population.

We next examine the labor market transitions of displaced workers in the short and medium run. This allows us to assess whether there are differences in the types of employment that workers transition into depending on displacement type (offshorer, non-offshorer) and their history of training prior to displacement.

In Table 2, also taken from HMSX 2012, we track workers over time and examine their labor market status after displacement. We distinguish between four groups of workers, workers from offshoring and non-offshoring firms, and workers that are trained or not (whether or not they are trained, or completed vocational training in the predisplacement year). The top panel of Table 2 shows the short-run labor market status for displaced workers, which we classify into four categories: without employment (either unemployed or out of the labor force), and employment with public plus primary (i.e. agricultural) service, or manufacturing sectors. It is evident that workers from offshoring firms are more likely to be without employment in the year after displacement than workers from non-offshoring firms (24.6 percent versus 16.7 percent). These results are consistent with the findings in the previous section and suggest that offshoring shocks affect the availability of certain tasks economy-wide, reducing the likelihood that offshorers can find employment using the same skills in a new firm.

The bottom panel of Table 2 shows the medium-run (three years after displacement) labor market status. Comparing displaced offshorers with displaced non-offshorers, it is seen that the fraction of offshorers without employment (9.5 percent) is similar to non-offshorers (9.9 percent), and offshorers are more likely to become employed in manufacturing (70.4 percent) than non-offshorers (66.3 percent). Moreover, trained workers are less likely to be without employment than non-trained workers, less likely to become employed in service, and more likely to become employed in manufacturing. This may reflect worker self-selection. Another hypothesis is that readily-available and heavily-subsidized vocational training programs re-enforce these workers' attachment to specific types of manufacturing jobs, making it more likely that they seek employment in manufacturing.

Table 2. Transitions for displaced workers

	One year after mass lay-off (%)					
	Offshorers			Non-offshorers		
	All	Trained	Non-trained	All	Trained	Non-trained
Without employment	24.6	27.5	23.8	16.7	14.3	17.2
Employed in...						
public + primary	2.0	1.9	2.0	2.0	2.6	1.9
service	17.7	15.1	18.4	17.1	16.5	17.2
manufacturing	51.8	48.1	52.8	61.1	63.1	60.6
Sample size	1,241	258	983	8,675	1,603	7,072

	Three years after mass lay-off (%)					
	Offshorers			Non-offshorers		
	All	Trained	Non-trained	All	Trained	Non-trained
Without employment	9.5	3.9	10.8	9.9	7.7	10.3
Employed in...						
public + primary	2.2	3.3	2.0	2.7	2.7	2.7
service	14.1	9.8	15.1	18.0	13.7	18.8
manufacturing	70.4	77.8	68.7	66.3	73.3	65.0
Sample size	850	153	697	6,734	1,075	5,659

Source: Own calculations based on data from Statistics Denmark.

6. Conclusions and policy implications

In several related papers, we have used a matched worker-firm dataset from Denmark to investigate the effects of offshoring on wages, earnings losses after layoffs, and enrollment in training. Consistent with a previ-

ous literature on trade and wages, HMJX 2011 show that the effect of offshoring on labor demand and wages within job spells depends on educational type: college-educated workers gain from offshoring while other workers lose. Taking this analysis further, we can identify additional dimensions along which workers are affected. HJMX 2011 show that, holding education constant, wage growth looks very different for workers depending on the type of firm (offshorer, exporter) in which they are employed, and depending on the specific characteristics of the jobs they hold. We show here that the wage losses after displacement are greater for workers displaced by offshoring firms than for workers displaced for other reasons. This displacement result holds for both unskilled and skilled (college-educated) workers.

What does this tell us about education and labor market policy in an offshoring global economy? First, increasing educational attainment is not a solution in and of itself. Increasing educational attainment does not completely insulate workers from displacement following adverse offshoring shocks. And even those college-educated workers who remain employed in offshoring firms experience uneven wage gains. HJMX 2011 show that in the firms that increase offshoring, the wages rise more for jobs that require communication, language, and social science skills than for those jobs that require natural science disciplines. This suggests that communication, language and social-science skills better insulate workers from offshoring shocks than natural-science skills. In the OECD countries, however, most of the policy discussions for education have focused on expanding the so-called STEM (science, technology, engineering and math) disciplines, leaving out communication, language and social sciences. Our results suggest that it could be useful to revisit the conventional wisdom according to which specific skills are most valuable in a globalizing world.

Displacement from a firm with rising offshoring generates larger and more persistent wage and earnings losses than those suffered by other displaced workers, and workers displaced from offshoring firms have higher rates of unemployment and are less likely to re-attach to firms within the same industry. This indicates that offshoring shocks result in sharp reductions in demand, economy-wide, for specific tasks. Re-attaching to the workforce may then require a more fundamental retraining of workers displaced due to offshoring shocks.

Training programs are widely available and heavily subsidized in Denmark. Most courses are of short duration and have a vocational content. Our stylized facts about the interaction between offshoring, labor market transitions and training participation show large differences between workers whose employers substantially increased offshoring prior to displacement. Workers displaced from offshoring firms train at much higher rates around the time of displacement, which we take as further evidence that offshoring has economy-wide labor market implications for the workers involved. In terms of policy, this might indicate that Denmark, and other OECD countries would benefit from adopting training programs that are targeted towards workers displaced by globalization, such as the Trade-Adjustment-Assistance programs in the US.

Workers displaced due to mass layoffs are no more likely to take up post-secondary training than other workers; instead, many of them enroll in vocational training courses and tend to become re-employed with manufacturing at higher rates than untrained workers. While this would seem to indicate clear benefits of vocational training, there remains a possible concern related to the types of jobs in question. If a two- to three-week vocational program offers sufficient training for a Danish worker to do a job, that same job can likely be taught to a foreign worker with relative ease. This raises the possibility that vocational training strengthens workers' attachment to particular manufacturing jobs that are most likely to be hit by offshoring shocks in the future. Given these findings and the large sums spent on training programs in Denmark, it would be worthwhile to investigate whether these training programs offer only temporary relief from offshoring pressures. Perhaps more fundamental educational upgrading may be needed.

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Appendix

Following Jacobson et al. (1993), we restrict our sample in the following ways. We focus on manufacturing workers who, in at least one of the years 1997-2000, have at least six years of tenure. We require that the worker does not die, emigrate or turn 61 during the sample window 1995-2006. Finally, we require that the worker be employed by a firm that imports at least DKK 600 000 and has at least 50 employees to be consistent with our estimation of within-job spell wage changes in previous sections, and to eliminate very small firms and those with a minimal global engagement from the analysis.

For a sample of workers (displaced and non-displaced), we estimate

$$\log y_{it} = \alpha_i + \alpha_t + x_{it}\beta + \sum_{k \geq -m} D_{it}^k \delta_k + F_{it}^1 c_i \varphi_1 + F_{it}^2 c_i \varphi_2 + F_{it}^3 c_i \varphi_3 + \varepsilon_{it}, \quad (\text{A.1})$$

where $c_i = (S_i, OFF_i, S_i * OFF_i)$.

y_{it} represents the earnings of worker i in year t . We employ three measures: the hourly wage rate (the variable used in Sections 5 and 6), annual labor earnings and annual gross earnings. Annual labor earnings capture the effects on both the hourly wage rate and hours worked, and annual gross earnings are the sum of annual labor earnings, unemployment insurance benefits and social assistance. The vector c_i consists of the dummy for high-skilled worker, S_i , an offshorer dummy OFF_i , and their product. α_i and α_t represent worker and year fixed effects, and x_{it} is a vector of time-varying worker characteristics (e.g. union, marriage and education status) as controls. Conditional on the control variables α_i , α_t , and x_{it} , equation (A.1) estimates the profile of y_{it} for the nine years surrounding the event of displacement: three pre-displacement years ($k = -3, -2, -1$), the displacement year ($k = 0$), and five post-displacement years ($k = 1, \dots, 5$). This assumes that earnings are the same for $k < -3$ given the controls α_i , α_t , and x_{it} . The dummy variables, D_{it}^k , jointly represent the event of displacement, with δ_k measuring the effect of displacement on a worker's earnings k years following its occurrence. Equation (A.1) imposes two types of restrictions on the evolution of y_{it} . First,

it allows y_{it} to differ in level over time, as captured by D_{it}^k , assuming that the level difference is the same across workers for given k . Second, the regression also imposes three restrictions on the rate of change for y_{it} in order to distinguish between different types of displaced workers as captured by the vector c_i . (i) y_{it} grows or declines linearly from three years before displacement until the displacement year. (ii) y_{it} is constant from the displacement year to three years after displacement. And (iii) y_{it} grows or declines linearly from its value three years after displacement until the end of the sample period. The restrictions (i)-(iii) are captured, respectively, by the linear variables $F_{it}^1, F_{it}^2, F_{it}^3$, where $F_{it}^1 = t - (s - 4)$, if worker i is displaced at time s and $s - 3 \leq t \leq s$, and $F_{it}^1 = 0$ otherwise, $F_{it}^2 = 1$, if worker i is displaced at time s and $t \geq s + 1$ and $F_{it}^2 = 0$ otherwise, and $F_{it}^3 = t - (s + 2)$, if worker i is displaced at time s and $t \geq s + 3$, and $F_{it}^3 = 0$ otherwise.

The baseline values for y_{it} are those of non-displaced workers (given controls α_i , α_t , and x_{it}), and the estimates of δ_k and φ show the differences in earnings of displaced workers relative to the baseline values. In addition, the coefficient vector φ shows differences in the rate of change for y_{it} across unskilled and skilled workers, and across offshorers and non-offshorers. Our results in Figure 1 are based on OLS estimates of (A1). The OLS estimates might be biased if firms selectively lay off workers whose performance is unusually poor in the years around separation. Couch and Placzek (2010) address this issue using propensity score matching (PSM), and show that the PSM estimates are similar to the OLS estimates.

Comment on Hummels, Munch and Xiang: Education and labor market policies in an offshoring global economy^{*}

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It is well known from the vast stock of research building on Davis et al. (1998) that labor markets are characterized by massive amounts of simultaneous job destruction and job creation, and that most of this restructuring is unrelated to structural change as measured by regional or sectoral mobility. Recently, the literature has seen a number of examples, trying to provide a better understanding of the underlying sources of this churning process (see e.g. Foster et al., 2008). In this context, the impressive research agenda summarized by Hummels, Much and Xiang is a very important addition. Its focus on offshoring shocks provides insights into a part of the labor restructuring process where too little has been known before. My reading of the results of the paper is that offshoring shocks have a very clear restructuring component, which makes the results even more important. In this comment, I will primarily focus on the policy aspects of the paper as well as touch on some aspects of how the results can be interpreted.

As a first comment, I think it is important to note that the contribution of the paper is to document the consequences of offshoring shocks, but it does not show to what extent offshoring shocks are an important contributor to job loss on the labor market in general. This is important since

^{*} This comment is written in response to a version of the paper dated November 2012.

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the extent to which general policies should be adjusted to accommodate the impact of offshoring shocks naturally depends on what fraction of overall layoffs that can be attributed to offshoring shocks.¹ Given the title of the paper, it would be interesting to know if the public employment services of the Nordic countries live in a global offshoring economy.

An interesting follow-up question, in particular if offshoring shocks show to be a relatively infrequent source of displacement and relative wage adjustments, is whether researchers should care more about changes in relative wages or employment opportunities arising from offshoring, than we care about similar changes arising from other shocks to firms' economic environment. One reason why we should pay particular attention to this process is that people appear to care. According to Calmfors et al. (2012), Swedish survey respondents have substantially more adverse sentiments towards layoffs arising from offshoring than towards layoffs arising from product import competition. Although this result appears somewhat irrational from an economic perspective, it clearly shows the usefulness of a proper documentation of the real impacts of offshoring shocks.

The paper analyzes the wage impact on workers within firms that off-shore due to changes in exchange rates, transport costs and world export supply. This is a clever approach which isolates changes in offshoring that are unrelated to internal changes (such as, e.g., technology shocks or shortage of labor) within the studied firms. A drawback of the approach, although carefully executed, is that it relies on aggregate disturbances, thus making it difficult to separate internal adjustments within the firm from market responses. As shown by Carlsson et al. (2011), wages respond substantially more to productivity shocks that are shared with other similar firms than to purely idiosyncratic shocks, suggesting that changes in workers' outside options are an important element in firm-level wage setting. With the set-up of this paper, it is conceivable that the positive wage impact of high-skilled workers is partly driven by changes in the profitability of the firms that make up the workers' outside options. This will be the case if workers' (potential) mobility patterns are related to the cross-firm correlations in changes in exchange rates, transport costs and

¹ The relative sizes of the number of displayed offshorers and non-offshorers studied in the paper suggest that offshoring is a relatively marginal source of layoffs, but it is possible that this depends on some specific aspects of the sample construction.

world export supply. If, for example, some high-skilled workers have skills that are particularly useful when trading with Japan on the chemicals market, then it is likely that changes in the exchange rate between the Yen and the Danish Krona will not only affect the chemicals firm in which (s)he is employed, but also his or her ability to find a high-paid job in an alternative firm. Here it is, however, important to note that the potential for an outside option interpretation of the wage impact primarily matters for the interpretation of the underlying mechanisms.² It does not question the overall impression that shocks which make it more profitable for firms to offshore affect relative wages in the direction suggested by the estimates.

The paper shows interesting and sometimes surprising patterns of labor demand effects across education groups. These are particularly useful as a warning against too simplistic ideas regarding the fields on which Nordic education policies should focus in the future. However, there is a number of reasons why we should be cautious when thinking about these results in a policy context. First of all, it is not clear that one should pay more attention to changes in labor demand that are driven by offshoring than changes in labor demand that are driven by other processes. Second, the analysis is done for the manufacturing sector, and it is not obvious that changes in the occupational content within a single sector provide a good diagnostic for the best way of designing the education system as a whole. Third, and as should be evident from other contributions to this volume, it is not clear that Denmark's comparative advantages will be the same in the (even near) future.

An interesting question which is not addressed in the paper, but where future research may provide results that are directly relevant to policy makers, is whether a more general vocational training (i.e. at the upper secondary level of schooling) provides a better insulation against the consequences of offshoring shocks than the more specific form of training typically provided in the Danish context. In the Swedish debate it is often claimed, but rarely with the support of empirical results, that the more general type of vocational education provided in Sweden is better at insulating workers against the consequences of structural change. Using the approach discussed in this paper to shed some light on the hypothesis

² In addition, estimates are likely to vary with the exact instrument used since the aggregate component may vary across instruments.

that it is more important to have enough *general* skills to be able to adapt when the economy is hit by restructuring shocks than it is to have the right *specific* skills would be an interesting avenue for future research.

The paper also provides an interesting discussion regarding the role of training programs for reattaching displaced workers to the labor market. Here, it is notable that the training programs discussed in the paper appear to be of a very different form than training programs offered with the system of active labor market programs (ALMPs) in most countries. In contrast to most ALMPs which focus on training for the unemployed, the programs studied appear to be targeted at employed workers (often with a focus on firm-specific skills). In addition, their duration is short, often just a few weeks in contrast to, e.g., 3-6 months for training programs within the Swedish system of ALMP.

Given that the offshoring shocks appear to have a structural component, it appears that providing training courses which allow these workers to acquire skills that are useful in other, presumably expanding, parts of the labor market is well in line with the traditional Nordic rationale for Active Labor Market Training Programs. Surprisingly, the results in this paper suggest that training programs are associated with a *higher* probability of staying in the original sector. However, it is important to reiterate the authors' caveat; these estimates should not be interpreted as causal since trained offshorers may have better labor market prospects than untrained offshorers for other reasons than the effects of training. Given the short duration of the training programs, I would be inclined to favor this latter interpretation before an interpretation building on large positive causal effects. Perhaps the most important implication of this part of the analysis is that a next useful topic for the stream of randomized trials of active labor market programs in Denmark would be to provide evaluations of training programs. Probably longer than those discussed in the paper separately for displaced workers with and without an offshoring background.

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Immigration and native investments in human capital*

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Summary

This article reviews the economic research literature that focuses on how increased labour supply through immigration affects the investment in skills in the receiving country; either through investment in formal education in the educational system or through skill specialisation in the labour market. We discuss the results from the research literature in the context of a welfare state of the Scandinavian type.

The high wage floor in the labour market makes immigration to the Scandinavian labour market particularly attractive for low- and semi-skilled workers. If immigration leads to investments in more education among inhabitants, it will lead to a more educated and more productive inhabitant workforce. This could be considered as positive. One uncertainty is related to the stream of immigrants in the future.

Keywords: immigration, human capital investments.

JEL classification numbers: J24, J31, J61.

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The topic of this article is how immigration may influence different aspects of the human capital accumulation of natives. More specifically, we review recent contributions to the research literature on how investments in formal education, as well as in upgrading of country-specific skill and occupational specialisation, are affected by changes in the influx of labour from abroad. One purpose is to discuss results from the recent literature on this topic, in the context of a welfare state of the Scandinavian type. Hence, we put a particular focus on the scant evidence based on data from this region.

During the last few decades, the Scandinavian countries have, along with many other industrialised countries, experienced a large increase in immigration. In Norway, the proportion of immigrants within the total population increased by 116 per cent from 1995 to 2010. Among the EU countries, only Ireland had a higher growth. The corresponding numbers for Sweden and Denmark are a 60 and 40 per cent increase, respectively. Sweden, however, started out on a higher level in 1995; with a share of immigrants in the total population of 10.5 per cent compared to 5.5 in Norway and 4.5 in Denmark (OECD, 2012). In all three countries, during this period as a whole, the majority of newcomers arrived from developing countries in Asia, Africa and Latin America and stated family reunification or need of protection as their main migration motive. Since the extension of the common EU/EEA labour market to include the new EU member countries in Eastern and Central Europe in 2004, the inflow of labour immigrants from the new EU member states to the Scandinavian countries has increased sharply. This trend has been particularly strong in Norway.

Empirical economic analyses of immigration effects in receiving countries have been dominated by studies of the impact on residents' wages and employment (Card, 2001, 2009; Borjas, 2003; Aydemir and Borjas, 2007; Ottaviano and Peri, 2008, 2012; Manacorda et al., 2012). No general consensus on the magnitude of the total effects of this kind has been reached in this literature. However, a general agreement is that the more similar the skills of resident workers are to the skills of newcomers, the more they stand to lose from larger immigration. That is, the more immigrant workers directly compete with natives in the labour market, the more the relative income of natives may suffer from a larger influx of labour from abroad. Hence, unless the skill composition of new-

comers is the same as in the resident labour force, the reward structure in the labour market will change as a result of higher immigration. In turn, the incentives to invest in human capital will change as well, i.e., since the return on such investments depends on the expected relative wages during total working life.

In this article, we focus on research literature that has investigated this wage structure mechanism through which immigration may affect the resident population's formal educational attainment (Jackson, 2011; Hunt, 2012; Røed and Schøne, 2012), as well as its occupational specialisation (Peri and Sparber, 2009; D'Amuri and Peri, 2012).

A related body of research literature studies the effect of immigration on the geographical mobility of natives within the receiving country (Card, 2001; Borjas, 2006). The main hypothesis tested in this field of work is that stronger competition in local labour markets triggers native outflow. If this is the case, a positive shift in local labour supply caused by immigration will be diminished by the reaction of native workers; either by moving out or not moving in as earlier planned. This point has been one of the major criticisms against the so-called "area approach" to the analysis of the wage effect of immigration. Basically, this method deduces the wage effect from the correlation between natives' wages and the fraction of immigrants in the (skill-specific) local labour market. If natives adjust their mobility – by moving in the opposite direction of immigrants – the wage effect will be underestimated in the local setting.

Whether native mobility in this way constitutes a severe problem to the "area-approach" is still a controversial question within this literature. Borjas (2003) proposes that the wage effect should be identified by the correlation over time between the fraction of immigrants and wage growth in skill groups across the national labour market. He suggests that the skill groups are established by crossing levels of education with the length of labour market experience. His main argument to promote this "national approach" over the "area approach" is that the national borders, as well as the "borders" between these skill groups, are more difficult to cross than the borders of geographically defined labour markets within a country. Thus, the skill groups in the national labour market to a greater extent mimic the closed labour markets which, according to economic theory, is necessary to capture the negative wage effect of a positive labour supply shift. In his study, based on the national approach, Borjas

(2003) presented estimates for the wage effects of immigration to the US that are considerably more negative than earlier estimates deduced in studies based on the “area approach”.

The literature we review adds to the discussion about the labour market effects of immigration in two ways: First, by exploring to what degree natives invest in formal education to avoid stronger competition caused by higher immigration. And, thus, if the immigrant inflow into labour market clusters defined by education triggers a native outflow through the work of the wage structure mechanism. Second, by investigating adjustment mechanisms that work within the labour market clusters, defined by formal education. That is, to what extent does higher immigration to their labour markets induce natives to invest in country-specific skills (e.g., related to communication and cultural knowledge) which lead to occupational specialisations that protect them from the stronger competition.

A welfare state of the Scandinavian type is characterised by a compressed wage structure, created by an interaction between centralised and collective wage bargaining, and generous welfare provisions with universal benefit rights (Barth et al., 2003). From an economic point of view, the high de facto minimum wages and the strong redistribution of welfare make immigration to the Scandinavian labour market particularly attractive for low- and semi-skilled workers.

The high productivity demands that mirror the high wage level, combined with strong employment protection (at least in Sweden and Norway), make the Scandinavian labour market difficult to enter from below. Thus, relatively newly arrived immigrants may compete poorly with native insiders about the jobs they already occupy and may segregate into more narrow segments of the labour market. A prediction of the model developed by Angrist and Kugler (2003) is that employment protection and entry barriers reinforce the negative employment effects of immigration by hampering job creation and productive reallocation of labour. However, it may be that the strongly subsidised educational sector of the Scandinavian countries makes investments in formal education relatively sensitive to changing labour market conditions and thus, facilitates a productive reallocation through this channel.

The article proceeds as follows: The next section gives a brief presentation of the theoretical framework underlying the literature that we discuss. Section 2 presents some empirical work on the relationship between

immigration and inhabitants' investments in formal education and Section 3 focuses on the relationship between immigration and inhabitants' task specialisation and skill upgrading in the labour market. Section 4 ends with a concluding discussion.

1. Theoretical framework

1.1 Who moves where?

Mainstream economics views migration as a human capital investment project, i.e., individual workers take on moving costs to relocate to a labour market where the expected return to their own human capital is higher. Identifying migrants as individuals making a rational investment decision, this framework goes back to Sjaastad (1962). It draws on Becker's human capital model (1962) in which people decide how much to spend on education and training by maximizing the net present value of their future income. Thus, according to this understanding, income differences between countries are the main determinant of labour migration. To analyse the skill composition of migration flows, Borjas (1987) combines the human capital framework with the Roy model (1951), developed to analyse the occupational distribution of people with different abilities.

In what way will the compressed income distribution of the rich Scandinavian countries affect the skill composition of immigrants that move into this region? To highlight some main points, we discuss this question within a simplified version of this Borjas (1987) model: Suppose that the world consists of three countries and that their income distributions may be described as in Figure 1. Income is measured at the horizontal axis and the density (frequency) of people on the vertical axis. Country A is on average poor and income is unevenly distributed in the population. Country B – maybe the US – is on average rich, but the income is just as unevenly distributed as in Country A. In Country C, which mirrors the Scandinavian case, the population is on average equally rich as in Country B, but the income distribution is considerably more compressed.

The relative productivity of the human capital an individual holds entirely determines her or his placement in the income distribution. Since

there is a strong positive correlation between level of education and productivity, these terms are close to interchangeable in this context.

Suppose further that individuals in all three countries have the same rank in the income distribution, irrespective of in which country he or she is located. That is, if moving from Country A to Country B or C, the person of concern will occupy the same location in the income distribution as was the case in the country he or she left. This assumption disregards the fact that some types of human capital are country specific and, thus, lose their value if transferred across national borders.

When individuals only pursue economic goals, i.e., they maximise their lifetime expected income, who moves between which countries? First, if we assume that C is not an option, who moves from A to B? Assuming the cost of moving to be independent of the individual worker's productivity, a representative sample of the population in A will move to B, i.e., the skill composition of immigrants will be equal to the skill composition in the native population.

Figure 1. The income distribution and the composition of migration flows

Source: Calculations from own register data.

Second, now disregarding Country A, who moves between Countries B and C? The answer is that the low-productivity workers move from the bottom of the income distribution in B to the bottom of the income distribution in C, while the high-productivity workers move between the tops of the income distributions, in the opposite direction. The point is that

individuals move to the country in which they get the highest return to their relative position in the productivity distribution.

Third, the migration flow from the poor Country A is divided between the two rich Countries B and C, so that the more productive part moves towards B and the less productive part moves towards C.

The migration costs are high, particularly when the cultural differences between sending and receiving areas are large. Thus, a really strong migration pressure only emerges when the average income differences between countries are huge. Due to the compressed income structure, the economic driving forces will tend to direct the relatively less productive, i.e., low- and semi-skilled immigrant workers, in the direction of the Scandinavian welfare states. In summary, these deductions indicate that larger immigration to Scandinavia first of all will execute a downward pressure in the lower part of the wage distribution. The study by Bratsberg et al. (2013) confirms that poorly educated workers have clearly been overrepresented in the immigration flows to Norway during the last few decades and indicates that this has decreased the relative wage of low-educated Norwegian workers.

1.2 Who gains and who loses from immigration?

Some simplified considerations, based on standard economic theory, can illustrate how immigration may affect the incentives for human capital investments among natives. Once more, the general starting point is the standard theory of investment in human capital (Becker, 1962). To make rational decisions about how much to spend on education or training, individuals must form expectations regarding the future income streams following from different alternatives. Such expectations are clearly affected by many different factors, among which the relative wage differences prevailing between skill groups are probably of great importance.

One main point, underlying the following discussion, is that residents in the receiving country – compared to newly arrived immigrants – have easier access to the educational system and a comparative advantage in exploring country-specific skills in their occupational specialization.

In a manufacturing process, there are roughly two kinds of relationships between factors of production: If the factors in the production process can replace each other relatively easily, we call them substitutes. If a

certain amount of both factors is necessary for each factor to work well, we call them complements. An increase in the supply of one type of skill has a negative effect on the marginal productivity and thus, the competitive wage, of workers holding skills that are substitutes. At the same time, the same supply shift will raise the productivity and, accordingly, the competitive wage, of workers with skills that are complements in production to the type that becomes more abundant.

We assume that the competitive wage is determined in a market where neither employees nor employers have any power to coordinate or manage the aggregated outcome.

This assumption is, of course, far from true in the Scandinavian countries, but this simple “perfect competition” model may still illustrate some basic mechanisms that will also generate an underlying pressure in a labour market of the Scandinavian type.

Two complementary factors are involved in the production process: workers holding skill a and workers holding skill b . Type a may refer to manual skills or low education, while b may be communicative skills or high education. To acquire skill b , investments in human capital (for example through formal schooling and/or on-the-job-training) are necessary. Assume further that all immigrants belong to skill group a , while natives are divided between the two groups.

Given this simple world, we discuss the effects of immigration on the wage structure and on human capital investments in two rounds, illustrated in Figure 2. First-round effects are demonstrated in the upper panel, and second-round effects in the lower panel. The left- and right-hand sides of the figures signify the labour markets for skill a and skill b , respectively.

The relationship between labour demand and wages is represented by the D-curves. Since the marginal productivity of each type of labour decreases with the number employed in the production process, measured along the horizontal axis, the demand curve is downward sloping. In other words, the demand curve represents the wage that an employer is willing to pay to the last employee hired, i.e., given the number of already employed and for a fixed amount of the other type of labour involved in the production process.

The relationship between labour supply and wages is represented by the S-curves. The upward sloping shape of this supply curve in the a -

market signifies that more workers holding skill a are willing (and able) to work if they are paid more. The vertical shape of this curve in the b -market signifies that, since it takes time before more workers are able to acquire skill b , the immediate supply of labour is not sensitive to wage change. The competitive wage is determined where the demand curve and the supply curve intersect. That is, where the last worker the employer is ready to hire is willing to work for a wage that equals the marginal product he or she contributes. As can be seen in the figure, the next worker demands a higher wage than his marginal contribution and this is obviously not good for business.

Due to immigration, the supply curve of workers holding skill a moves outwards; from S_1 to S_2 in the left diagram of the upper panel. The new supply curve intersects with the demand curve for a higher value of employment and a lower value of wage. Thus, more workers with skill a are employed in the production process and due to factor complementarity, the productivity of skill b workers increases. The demand curve in the labour market of these workers accordingly moves rightward; from D_1 to D_2 in the right-hand diagram of the upper panel. Since the supply of skill b is fixed in the short run, the demand shift increases the wages of skill b workers, but their level of employment is unchanged.

Thus, one first-round consequence of immigration is higher relative wages for the workers holding skill b (W_1^b to W_2^b) and, due to their lower wage level, a second consequence is that fewer natives holding skill a are ready to work. A share of these native employees who withdraw their labour supply from E_{1n} to E_{2n} will, due to the higher returns on this kind of investment, allocate their new spare time to acquire skill b .

As a result, the supply curve in the labour market of skill b workers moves outwards, from S_1 to S_2 , in the right-hand part of the lower panel. Due to the factor complementarity, this also moves the demand curve in the labour market of the skill a workers outwards, from D_1 to D_2 in the left part of the lower panel. At the same time, the supply curve in the labour market of skill a moves inwards, from S_2 to S_3 . That is, since the workers who invest in skill b withdraw their labour supply from that market. As can be seen in the figure, this second round of adjustments taking place on both sides of the labour market once more compresses the wage difference which increased in the first round of immigration effects.

Figure 2. Wage and investment effects in a market economy with two types of labour

Figure 2 outlines the direction of changes which are triggered by immigration within this simplified model. However, a new long-term equilibrium is not established by the two first rounds of adjustments. One mechanism which may affect the further process is that the new immigrants will gradually acquire the same investment possibilities as natives, i.e., they will gain access to the school system and accumulate country-specific skills. Thus, their relative supply of labour to the two markets will become more equal to that of natives.

To summarise the main points: By investing in formal education, and/or specialising in occupations more intensively utilizing country-specific skills, natives may reap the return on immigration through the acquirement of human capital that is complementary to that held by newcomers. Such changes in the composition of human capital accumulation among natives may mitigate the distributional conflicts which, due to greater income inequality, could arise in the first round of immigration effects.

2. Immigration and investments in formal education in the receiving country

In this section, we review some recent contributions to the research literature analysing the effect of immigration on investment in education in the receiving country. As already emphasised, we focus on the effect that occurs through the labour market incentives, i.e., the immigration-induced changes in the wage structure.

The empirical literature on the relationship between immigration and investment in education is dominated by US evidence. Jackson (2011) explores decadal US census micro data from 1970-2000 to analyse the relationship between immigration and enrolment of natives in college. He identifies the wage structure effect on human capital investment via the correlation between the ratio of low-educated to high-educated in the states' immigrant workforces and the rate of native college enrolment. There may be a "simultaneity problem" related to the use of geographical variation in immigration to identify its effect on human capital investment. That is, unobserved demand shifts may affect both the inflow of foreign labour to an area and the educational choice of natives in the same area. To isolate a geographical variation in immigration that is independent of the local economic development, Jackson (2011) uses the historical settlement pattern of immigrants. This approach explores the "chain migration" mechanism, following from the fact that people want to live close to others who are similar to themselves. Using historic settlement patterns for this purpose is a well-established strategy within the economic literature analysing different effects of immigration in the receiving countries.

A key finding of Jackson (2011) is that an increase in the share of unskilled immigrants in the labour force of the states clearly raises the rate of native college enrolment through the wage structure mechanism. A one per cent state-level increase in relatively unskilled immigrant labour increases the rate of enrolment in college by 0.33 per cent. This effect is larger for young people who have access to public school attendance. According to the author, this may be the result of the student admission policy, which is more sensitive to the number of applicants in public compared to private colleges (Bound and Turner, 2007).

Using a state panel based on census data from 1940-2008, Hunt (2012) analyses the impact of immigration on the high school completion of native children in the US. According to Hunt, immigrants to the US are strongly overrepresented among the unskilled and also to some extent among the highly educated. Thus, the effect of higher immigration on the wage structure should be to increase the difference in the lower part of the earnings distribution, i.e., between those who drop out of high school and those who complete it. Hunt identifies the wage structure effect on human capital investment via the correlation between the shares of immigrants with less than 12 years of schooling in the state populations (18-64 years of age) and the natives' high school completion rate in the same area. To distinguish between the wage structure effect and the school displacement effect, she includes the share of immigrants in the population aged 11-17 in the relationship analysed. The share of immigrants in the population is measured when natives are aged 11-17, and their educational attainment at the age of 21-27. Similar to Jackson (2011), Hunt (2012) utilises historic settlement patterns to acquire a variation in the level of immigration that is independent of local business cycles.

The results show that the effect of immigration of adults (aged 18-64) with less than 12 years of schooling on natives' completing 12 years of schooling is positive and significant. This supports the hypothesis that the presence of unskilled immigrants in the labour market changes the wage structure to give natives an incentive to complete 12 years of schooling.

Scandinavian evidence on this matter is scant; one exception is Røed and Schøne (2012). They analyse the relationship between immigration to the Norwegian Building and Construction (BaC) industry and the recruitment of pupils to vocational programmes in upper secondary school that are educating workers that are particularly in demand in that industry.

When Norwegian pupils enter upper secondary school, they must choose between an academically oriented track, which provides access to a university or college education, and a vocational track leading to an occupational qualification. If entering the vocational track, the pupil must choose between nine different general vocational programmes. The standard way of acquiring the occupational certificate involves two years of school-based education followed by two years of specialisation in an apprentice position.

The data used in the study is extracted from administrative population registers. Panels of all pupils who started an upper secondary education from 1995 to 2009 are established. Including a wide range of socio-economic background variables, this data set gives yearly information about the pupils' level and field of study, and if they leave the educational system. Røed and Schøne (2012) identify the wage structure effect on educational choice by analysing the relationship between the relative employment rate of immigrants in the BaC industry in their country of residence and two types of dependent variables: i) the probability that new pupils enrol in the program teaching BaC skills and ii) if they do, their probability of entering an apprentice position two years later.

Figure 3 describes the development of the immigrant share in employment from 1995 to 2008 and how it varies between the 19 Norwegian counties and between the BaC industry and all other industries. The figure shows that the relative share of immigrants in the BaC industry increased considerably after the enlargement of the common EU/EEA labour market in 2004.

Bratsberg and Raaum (2012) indicate that immigration has lowered the wage of workers in the Norwegian BaC industry during the period studied by Røed and Schøne (2012). The key result of Røed and Schøne's (2012) study suggests that higher immigration into the BaC industry is clearly negatively related to the probability that pupils enter the BaC programme at the beginning of their upper secondary education. On average, a one per cent increase in the relative employment of immigrants in the BaC industry decreases the enrolment in the BaC programme by approximately 0.29 per cent. The relative immigration to the BaC industry of Norwegian counties increased by 75 per cent from 1995 to 2008. Thus, an interpretation of this result is that the mean probability of all new upper secondary pupils enrolling in the BaC programme decreased by 22 per cent, from 1995 to 2008, due to immigration. To reach causal statements regarding the relationship between immigrants in the BaC industry and pupil enrolment, historical patterns of immigrant employment and settlement are utilised. The results are strengthened after conducting such an exercise. The negative effect of immigration into the BaC industry on enrolment into the BaC programme suggests that pupils do observe and react to increased competition in the labour market by choo-

sing other fields of study that are not as exposed to competition from immigration.

Figure 3. The employment share of immigrants in the BaC industry and in other industries. County average, county with highest (max) and lowest (min) immigrant shares of total employment

Source: Calculations from own register data.

Furthermore, the analyses reveal that the absolute value of this negative relationship between immigration and enrolment increases with the pupils' grade scores (GS) from lower secondary school. This association is presented in Figure 4. As can be seen, the probability of enrolment is positively affected by immigration to the pupils' future labour market for values of GS lower than 30 and negatively affected for values of GS higher than 30. The negative relationship found for the pupils is, on average, explained by the fact that only 14 per cent of all pupils who entered upper secondary school in the period studied had a GS equal to 30 or lower. If we assume that productivity increases with grades, the relationship presented in Figure 4 suggests that the group of pupils who change their field of study as a result of higher immigration is positively selected with respect to productivity.

Figure 4. Per cent change in the probability that upper secondary pupils enter the BaC programme, resulting from a one per cent change in immigration to the BaC industry of their county, conditional on grade score (GS) values

Source: Calculations from own register data.

This suggests that it is the relatively productive natives that move out of the occupations where immigrants move in. This further suggests that the reallocation of labour taking place through the educational channel is productive. A reduction in the wage of BaC workers, following from higher immigration, implies that the economic return on this kind of labour has fallen. Thus, economic growth would be facilitated if the most productive of the BaC pupils invest in alternative skills that pay a relatively higher return in the labour market.

Finally, regarding the second dependent variable, the probability of entering an apprentice position within the BaC programme (conditional on being in the BaC programme), Røed and Schöne's (2012) results show that larger immigration into the BaC industry (their future labour market) is negatively related to the probability of entering an apprentice position, i.e., a similar result compared to the enrolment analyses. Furthermore, and also in line with the enrolment results, the strength of this negative relationship also increases with the pupils' grade scores from lower secondary school.

3. Immigration and investments in country-specific skills

In this section, we review contributions to the research literature that study the effect of immigration on the upgrading of natives' country-specific skill and occupational specialisation. There are no studies on this

topic that are based on Scandinavian data. Therefore, at the end of this section, we present some descriptive evidence from Norway that may serve as a preliminary investigation of this topic in a Scandinavian context.

The starting point for this research literature (Peri and Sparber, 2009; D'Amuri and Peri, 2012) is that natives, compared to immigrants, may have a comparative advantage for work that requires knowledge of country-specific skills. This typically concerns jobs that require a relatively high level of communicative skills. In addition to handling the formal language, effective communication demands the understanding of social and cultural codes, unwritten rules, implicit communication, norms, etc. Thus, according to this literature, natives, and especially less educated natives, may respond to immigration by leaving physical and manual occupations for more communication intensive occupations and tasks.

Since the Scandinavian countries belong to a small language area, natives' comparative advantage related to solving communicative tasks may be particularly large in these countries. In general, however, the technological and organisational evolution in advanced industrialised countries may have increased the scope for exploring such country-specific skills during the last few decades. The introduction of new technologies and work practices are two characteristics of the so-called "new economy" that have emerged. Such changes comprise a move away from traditional assembly-line organisational structures towards production structures characterised by multitasking, job rotation, teamwork, intensive use of computers, reductions in management levels, and decentralisation of responsibilities (Lindbeck and Snower, 2000). Such kinds of technological and organisational practices clearly require greater interpersonal communication than the traditional assembly-line type of production. Accordingly, this development may have both increased the return on such country-specific skills, and the potential for complementarity in the production process between native and immigrant workers.

A study by the OECD (1999) suggests that these types of organisational changes have been more extensive in the Scandinavian countries. Using Norwegian survey data, Rosholm et al. (2013) show that workplaces in Norway that use personal computers intensively, and workplaces that give their employees broad autonomy, hire fewer immigrants who arrived as adults. The negative relationships are especially strong for low-

skilled non-Western immigrants. This result suggests that the introduction of new work practices (measured by personal computers and autonomy) has led to reduced demand for workers that are less endowed with these types of skills, in this case immigrants.

From recent years, there is a small body of literature focusing on the relationship between immigration and upgrading of country-specific skill in the labour market. Peri and Sparber (2009) develop and test the theory of whether immigration of low-skilled labour leads natives with the same level of education to specialise in tasks that demand greater communicative skills. Upon arrival, immigrants are poorly equipped with the language and skills connected to social and cultural codes. These are skills that are important for mastering formal and informal communication in the labour market. If this is true, it may give the native labour force a comparative advantage in areas where these types of communicative skills are well rewarded. Especially, it will give low-skilled natives incentives to invest in and develop these skills. On the other hand, immigrants will have a comparative advantage in tasks that are more manual and routine oriented. Peri and Sparber (2009) test this hypothesis on US data containing detailed information on the complexity of tasks with respect to both communication and manual skills. Their results show that foreign-born workers have specialised in occupations that require manual and physical labour skills, while natives pursue jobs that are more intensive in communication and language skills. The results suggest that immigration is the mechanism behind this pattern. They argue that this specialisation process is partly the explanation for the small wage effects of immigration.

D'Amuri and Peri (2012) analyse the same matter using data from 15 Western European countries during the 1996-2010 period. They also analyse if this kind of occupational adjustment strategies is more prevalent in economies with more flexible labour markets. The 15 European countries give the institutional variation necessary to analyse whether flexible labour markets facilitate the occupational adjustment strategy. Specifically, D'Amuri and Peri analyse whether the occupational response of natives to immigration is stronger in countries with less restrictions and regulations related to hiring, firing and wage setting. Similar to the analysis of Peri and Sparber (2009), their results suggest that, by taking up manual oriented tasks, immigrants push native workers towards more

complex jobs, with more communication and abstract content and that such reallocation takes place without any negative effects on natives' employment rates.

Furthermore, when they split countries into two groups (those with strong employment protection legislation and those with weak employment protection), they find that such reallocation is much higher in countries with more flexible labour laws. This result is consistent with the hypothesis that in countries with high employment regulations (EPL), manual workers tend to remain in simple-manual occupations that are more exposed to wage competition from immigration.

Why then should the degree of natives' immigration induced reallocation towards communication intensive occupations be lower in countries with high EPL? D'Amuri and Peri (2012: 23) argue that "Labour markets with strong employment protection may reduce mobility in and out of employment, they may also keep workers within the boundaries of narrowly defined occupations as workers' protection (via collective contracts) is defined in terms of specific occupations." Referring to Angrist and Kugler (2003), they further argue that more flexible labour markets could increase the absorption of immigrants by facilitating job upgrading and job creation.

In their study of Western European countries, Angrist and Kugler (2003) analyse the interaction between measures of employment regulations, the replacement rate in unemployment benefits and entry barriers in the product markets, on the one side, and the employment effect of immigration, on the other. As one of their conclusions, they state: "Although not entirely clear cut, the empirical results offer some support for the view that reduced flexibility may make immigrant absorption more painful, at least when viewed from the point of view of native employment."

According to our interpretation, Angrist and Kugler's (2003) results indicate that entry-barriers in the product market reinforce the negative employment effects of immigration. However, with regard to employment regulations and the unemployment replacement rate, their results are less strong.

We end this section by presenting some tentative evidence from Norway on the potential for immigration induced reallocation of natives' human capital investments; from manual tasks towards more complex and communicative tasks. Register data from 2005-2010 is utilised. We use

the same construction of complex and simple tasks as in D'Amuri and Peri (2012). The starting point for construction of the task variables is the O*NET data from the US Department of Labor. Different abilities and tasks are assigned to 339 occupations from the Standard Occupation Classification (SOC). These tasks are then used to construct a skill intensity measure for each occupation. From these, we use two measures for the type of ability demanded to solve tasks in different occupations: “complex” and “manual”. Since the SOC codes are more detailed than the European codes of the International Standard Classification of Occupation (ISCO), the SOC codes are collapsed into 21 two-digit ISCO codes. For each task, the intensity can vary between 1 and 100. The 21 occupations with the corresponding task intensities are listed in Table A1 in the Appendix. The interpretation of the task intensities is as follows: Take the occupation “Managers of small enterprises”. It has a complex score equal to 0.97. This indicates that 97 per cent of all workers are using complex skills less intensively than managers of small enterprises.

A necessary starting point for the specialisation mechanism is that immigrants and natives with the same educational level are employed in different occupations with different degrees of complex and manual tasks. Table 1 presents correlations from OLS regressions of the ratio between complex and manual tasks and immigrant status, for all workers and low-skilled workers. The analyses are carried out for all industries (upper half) and for the Building and Construction industry (lower half). We include the Building and Construction (BaC) industry as a separate analysis since this is an industry that has experienced a large influx of immigrants in the period of observation. The dependent variable is the ratio between the index for complex and manual tasks (see Table A1).

Table 1. Correlations between immigrant status and complex/manual tasks 2005 and 2010, OLS, estimated coefficients

	All industries	
	All workers	Workers with low education
Immigrant	-0.309	-0.244
High education	0.729	
	Building and Construction industry	
	All workers	Workers with low education
Immigrant	-0.116	-0.097

High education

0.817

Source: Calculations from own register data.

Note: We use two categories of education: High education (college or university education) and low education (secondary or compulsory level education). All coefficients are significant at the level of 1 per cent.

For all industries, as well as for the BaC industry, there is a negative correlation between being an immigrant and the complex/manual ratio. This is in line with the hypothesis in the task-specialisation literature. The negative correlation applies both for all workers and low-educated workers. Furthermore, and as expected, there is a positive and significant correlation between having higher education and the complex/manual ratio.

Table 2 presents mean values of the complex/manual ratio in 2005 and 2010 for natives and immigrants, respectively. If natives tend to specialise in more complex tasks in response to an increased labour supply of mostly low-skilled immigrants, we would expect this pattern to be especially prevalent in industries that have experienced a large influx of immigrants in the period.

Table 2. Complex and simple tasks of natives and immigrants, all industries and Building and Construction, 2005 and 2010

	2005	2010
All industries		
<i>Natives: Complex/Manual</i>	1.77	1.74
<i>Immigrants: Complex/Manual</i>	1.34	1.33
Building and Construction		
<i>Natives: Complex/Manual</i>	1.14	1.25
<i>Immigrants: Complex/Manual</i>	1.08	1.02

Source: Calculations from own register data.

Note: Complex/Manual is the average of the ratio between an occupation's complex and manual index number.

Looking at all industries, there is a stable pattern when it comes to the complex/manual ratio from 2005 to 2010 for both natives and immigrants. For the BaC industry, there is a tendency that natives move towards more complex tasks (index from 1.14 to 1.25) and immigrants move towards more manual tasks (index from 1.08 to 1.02), as expected if natives specialise in relatively more complex tasks in response to immigration.

In summary, these very simple exercises report results that are in line with the hypothesis in the task-specialisation and country-specific skill-upgrading literature. More thorough analyses are needed to investigate these matters further.

4. Concluding remarks

This article has reviewed the research literature that focuses on how increased labour supply through immigration affects the investment in skills among individuals in the receiving country; either through investment in formal education in the educational system or through skill specialisation in the labour market. One purpose has been to discuss the results from this literature in the context of a welfare state of the Scandinavian type.

The studies by Jackson (2011) and Hunt (2012), based on US data, both indicate that an inflow of disproportionately low-skilled workers from abroad inspires natives to acquire more formal education. A study from Norway (Røed and Schøne, 2012) suggests that the pupils' choice of

programme in upper secondary school is affected by immigration into the local labour market. Larger immigration into the Building and Construction industry (BaC) in the area where they live causes pupils to move away from programmes in upper secondary school that educate workers for the BaC industry.

Therefore, these studies indicate that immigration – through the wage structure mechanism – does affect investments in formal education in the receiving country. We have argued that, due to the compressed income distribution in Scandinavian countries, the influx of labour to this region will be disproportionately low-skilled. Thus, through this mechanism, higher immigration to the Scandinavian countries may increase the native populations' investment in formal education.

By analysing US data, Peri and Sparber (2009) find that immigration induces low-skilled natives to specialise in relatively complex tasks demanding country-specific – and particularly communicative – skills. They argue that this may be the reason why immigration of poorly educated workers has a relatively small negative impact on the wage of similarly skilled natives. Analysing data from 15 European countries, D'Amuri and Peri (2012) find that such a strategic reallocation of country-specific human capital in response to immigration seems to be more prevalent in countries with low employment protection legislation (EPL) in the labour market. Their explanation is that countries with strong EPL may keep workers within narrowly defined occupations, since workers are protected through collective agreements within specific occupations. They argue that this may hamper the absorption of immigrants by not facilitating job upgrading and a productive reallocation of natives.

According to OECD's Indicator of Employment Protection, Norway is only slightly above the OECD average. Furthermore, Angrist and Kugler's (2003) results indicate that it is first of all entry-barriers in the product market that reinforce the negative employment effects of immigration and, according to the OECD (2006), the Scandinavian countries are characterised by well-functioning product markets.

The degree to which immigration creates specialisation effects in the labour market will depend on several factors. Language barriers are one channel through which inhabitants can receive a comparative advantage. This channel may be especially relevant in "small language areas" like Scandinavia.

The study for Norway (Røed and Schøne, 2012) suggests that a significant reallocation of pupils occurs in the educational sector in response to immigration. Therefore, if structures in the labour market limit the reallocation of workers in response to immigration, the educational sector may serve as a compensatory channel in this regard. It may also be that the strongly subsidised educational sector of the Scandinavian countries makes investments in formal education relatively sensitive to changing labour market conditions.

If immigration leads to investments in more education among inhabitants, it will lead to a more educated and more productive inhabitant workforce. This could be considered as positive. One uncertainty is related to the stream of immigrants in the future. The economic growth in many of the sending countries is good. If the welfare gap is considerably reduced, the immigrant stream will also be reduced. Then, the receiving country must rebuild the educational capacity in the fields of study where the immigrants had previously been dominating. If the immigration is mainly low-skilled, it is mainly the educational capacity in low- and semi-skilled studies that must be rebuilt. It is probably easier to rebuild the educational capacity in low- and semi-skilled studies than if the country had to rebuild skill-intensive studies.

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Appendix

Table A1. Skill intensity of occupations

	Manual	Complex
Corporate managers	27	83
Managers of small enterprises	16	97
Physical, mathematical and engineering professionals	34	63
Life science and health professionals	46	89
Other professionals	34	74
Physical, mathematical and engineering associate professionals	36	61
Life science and health associate professionals	63	71
Other associate professionals	15	67
Office clerks	29	44
Customer service clerks	29	46
Personal and protective service workers	59	54
Models, salespeople and demonstrators	18	66
Extraction and building trades workers	62	80
Metal, machinery and related trade work	84	30
Precision, handicraft, craft printing and related trade work	68	35
Other craft and related trade workers	74	22
Stationary plant and related operators	65	40
Drivers and mobile plant operators	82	30
Machine operators and assemblers	88	28
Sales and service elementary occupations	55	28
Labourers in mining, construction, manufacturing and transport	87	49

Comment on Røed and Schøne: Immigration and native investments in human capital

Nils August Andresen^{*}

As immigration of low skilled workers to Western countries has increased, it has become increasingly important to understand its effect on natives' situation on the labour market. In their article "Immigration and native investment in human capital", Marianne Røed and Pål Schøne look at the effects of immigration on the incentives for natives to invest in human capital.

The topic is politically important because of a widespread concern in many countries that immigrants compete with natives for jobs. If immigrants are primarily low skilled, the supply of low-skilled workers will increase, potentially pushing down wages for low-skilled natives, and potentially leaving them worse off than they would otherwise be. However, if lower wages push low-skilled natives to invest more in education, they might become better off. (The investment has a cost, but I shall leave that aside here.)

The article provides new statistical evidence indicating that competition is good for us: That natives do indeed change their human capital investment patterns in the wake of changing immigration patterns. Two distinct findings are presented: First, that an increase in the immigrant share in the building and construction (BaC) industry leads to a decrease in the proportion of students choosing that specialisation in upper secondary school, and an increase in the proportion choosing the academic track.

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And second, that as the number of immigrants in the BaC industry increased between 2005 and 2010, the tasks of natives in that industry became more complex. This finding might be indicative of a conscious attempt by natives to specialise in tasks at their job that require more complexity and where they might enjoy a comparative advantage, such as language or other cultural skills.

The article is a promising start to shed some light on the effects of immigration on human capital formation. Still, in my view, there are three questions in particular that are not sufficiently addressed in the paper.

The first regards the instrumental variable used. To avoid problems of endogeneity – that is, that both immigration and investment in human capital are influenced by the current business cycle – an instrumental variable approach is used. The instrument – described in Røed and Schöne (2012) – is based on earlier immigration patterns and immigrant employment patterns. The authors assume that this instrument is correlated with later immigration based on the chain migration theory, but unrelated to later business cycles. The chain migration theory posits that there exist “primary social relations” between earlier and later migrants (MacDonald and MacDonald, 1964). However, the way in which the instrumental variable is constructed makes it hard to know to which extent the chain migration mechanism is at work here. The early distribution across municipalities is taken from the census in 1980, and divided into only five country groups – Europe, Asia, Africa, North America and South America. However, there have been large shifts within these country groups. For example, the authors cite increased immigration from Eastern Europe following EU enlargements as an important motivation for the study. However, in 1980, immigrants from Eastern Europe constituted less than ten per cent of the immigrants from the relevant country group in the instrumental variable; whereas in 2009, the last year in the study, they comprised about 45 per cent, accounting for more than 60 per cent of the increase in that country group. Furthermore, the immigrants from Eastern Europe who had come to Norway prior to 1980 might have come from very different backgrounds than those who came later. Many came as dissidents or political refugees. To what extent any primary relations existed to newcomers even from the same country is unclear.

Figure 1. Population by country of birth and time. Persons

Source: Statistics Norway.

There have been significant changes in the composition of country background of immigration from Asia and Africa over the period. The implication is that it seems uncertain to what extent chain migration based on patterns in 1980 is an important mechanism in explaining the distribution of immigrants across municipalities between 1995 and 2009. If it is not, then some other mechanism must explain that the instrumental variable “works”. However, whether these mechanisms would convince us that the instrumental variable is uncorrelated with other factors influencing the human capital investment choices of natives is hard to judge. A similar problem applies to the second instrumental variable, based on immigrant employment patterns in 1990. To be sure, the authors do conduct the Hansen J-test in Røed and Schøne (2012), but since theoretical arguments alone are not completely convincing for either instrument, I would have liked to see even better calibrated instruments.

These possible problems with the instrumental variable would not be worth commenting on at length if we could be certain that the authors are right in believing that OLS gives a conservative estimate. That belief is based on a view that thriving industries give the same incentives to immigrants and natives, that is, that a business cycle that attracts low skilled immigrants to the BaC industry would also be a business cycle that would give natives an incentive not to invest in other skills, but to go into that industry. That might well be the case, but in my view, it cannot be ruled

out that such a business cycle would also imply stronger incentives for investment in other skills. The instrumental variable problem thus persists.

My second question concerns the discussion about changes in the complexity of tasks performed by natives and immigrants between 2005 and 2010, assumed to be a consequence of natives investing in informal country-specific skills. The authors look both at the BaC industry and at data for all industries. For the BaC industry, where the concentration of immigrants is especially high, they find a change in the expected direction: The mean complexity goes up for natives and down for immigrants. However, when we look at all industries, there is a small change in the opposite direction for natives (though the article simply refers to it as a “stable pattern”, in spite of a sizable (though smaller than for the BaC industry) increase in the proportion of immigrant workers.

I agree with the authors that the BaC industry seems particularly relevant, and there might be any number of reasons why the pattern for all industries shows a small change in the opposite direction, including that the immigrant share, and the change in it, is too small, and overridden by other trends. However, it could also be seen as a reason for concern about the interpretation. If an increase in the (low skilled) immigrant share of the work force has not led to an increase in the mean complexity of tasks among natives for all industries, how can we be sure that the postulated mechanism – natives specialising in country-specific skills as a result of immigration – explains the change we see in the BaC industry?

Other mechanisms can be envisaged. For instance, if immigration leads to a downward pressure on wages, the least qualified natives might quit the BaC industry, automatically increasing the mean complexity score – but they might end up in other industries, thus preventing an increase in the mean complexity score for all industries.

That reflection leads me to my last comment: A question which is not addressed in the paper, but which merits attention based on its underlying motivation, is whether downward pressure on low skilled labour wages gives the same incentives to all natives.

The theory behind the paper is that it becomes relatively more profitable for natives to spend time, energy and maybe other resources on increasing the human capital. The authors detail some of the institutional factors that might influence the size of this effect, such as employment

protection and whether or not the native language is attractive to learn for migrants. However, they do not discuss whether this strategy is viable for all natives and, if it is not, what the consequences would be. In particular, this situation might arise if the economic return to investment in human capital is contingent on a certain level being reached, which is too costly for some natives to reach, or not possible at all.

At a basic level, changes in relative wages following an increasing share of migrants in the Norwegian BaC industry put natives in a situation where they can either accept lower wages, or make one of two choices: Fight. Or flight. The premise of the article is that they choose to fight. Data cited in the paper from other European countries give some credence to that premise. For instance, a study from 15 European countries found little evidence of a link between unemployment rates and low skilled labour migration.

However, reason for concern remains. For instance, during the period of increasing immigration following the eastward expansion of the EU, Norway has experienced increases in the proportion of very young people, and of the oldest workers, receiving disability pension.

That development might have any number of explanations – but it would be consistent with a story where young natives who are unable to obtain necessary skills to undertake more complex tasks are discouraged from entering the labour market, and where older workers have too few years left in the labour market to bother to invest in new skills. Maybe some more light could have been shed on this issue, for instance by looking at the effects of immigration on choice of upper secondary specialisation dependent on middle school grades.

Røed and Schøne provide important reasons to be hopeful that low-skilled migrants induce natives to invest more in human capital formation. However, I have pointed out questions I believe should be explored more broadly, before we conclude with too much certainty that competition is good for everyone.

Table 1. Recipients of disability pension, according to gender and age. Period 2003-2012. Numbers

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total	298,794	302,100	301,307	298,280	294,975	294,520	294,904	300,006	303,100	309,762
18-19	584	601	667	716	772	815	942	994	879	1,001
20-24	2,534	2,443	2,501	2,542	2,683	2,816	2,963	3,297	3,583	3,789
25-29	4,822	4,609	4,292	4,117	3,937	3,919	3,875	4,091	4,412	5,001
30-34	9,051	8,522	7,823	7,081	6,500	5,994	5,783	5,883	6,308	6,911
35-39	14,944	14,399	13,435	12,456	11,545	10,824	10,258	10,213	10,629	11,455
40-44	21,546	21,035	20,092	19,195	18,313	17,734	17,189	17,365	18,276	19,865
44-49	3,0943	30,607	29,257	27,729	26,386	25,669	25,166	25,847	27,635	30,229
50-54	43,531	42,934	41,715	40,531	39,480	38,402	38,115	38,701	39,311	41,279
55-59	66,521	67,631	67,411	64,321	61,216	59,144	57,967	58,093	58,590	59,587
60-64	72,550	75,966	79,421	85,335	89,870	93,210	93,550	93,392	88,447	84,672
65-679	31,764	33,352	34,693	34,256	34,272	35,989	39,093	42,118	45,009	45,967
Unknown	4	1	-	1	1	4	3	12	21	6

Source: NAV.

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Why do small open economies have such small wage differentials?*

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Summary

Open economies have more compressed wages than countries that are less exposed to international competition. This association disappears once we control for population and coordination in wage bargaining. Bargaining coordination compresses wages and reduces non-competitive wage differentials. We argue that competition in the world market induces employers and employees in the export industries to search for ways of controlling wages in the sheltered industries. These mechanisms tend to facilitate cooperation and coordination in countries with high exposure to world markets, leading to a more egalitarian wage distribution in small open economies.

Keywords: international trade, wage bargaining, bargaining coordination.

JEL classification codes: J5, F6, F16

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Countries with the same level of income per capita seldom have the same distribution of wages. Small open economies, for instance, have the smallest wage differentials in the world, the Nordic countries and Belgium being prime examples. Larger and less exposed countries, such as the United States and England, have bigger wage differentials. Are small differences competitive outcomes and big differences monopoly practices? We claim that there is a positive association between wage equality and exposure to international competition as measured by the share of foreign trade in national incomes.

The link is not direct. We demonstrate that the reason why small open economies have a high wage equality is simply that they have more wage coordination than others. There are two separate issues that need to be explored.

The first issue is why coordination in wage setting leads to more wage equality. Wage coordination simply means that part of the wage structure is taken out of market competition and placed within a system of collective decision making. To understand how wage coordination leads to smaller wage differentials, we must have a more realistic picture of decentralized wage setting than what is given by most elementary textbooks. Decentralization is likely to magnify differentials, and collective decisions are likely to mitigate them.

Some explanations of why wage coordination mitigates wage differentials emphasize how wage coordination enhances efficiency by taming the local monopoly power of unions, or the local monopsony power of employers. Efficiency can also be enhanced by reducing the market power of employers in output markets and over workers in the work process. Other explanations emphasize how collective decision making means that we move the influence on the wage setting process towards low paid groups, and why coordination implies that egalitarian fairness norms and other social preferences are applied for a larger group.

The second issue is why openness leads to higher levels of coordination. To understand the link, we must have a more realistic picture of how coordination arises and is sustained than the one provided by elementary textbooks (which by the way is close to nothing). How coordination works depends on how and why coordination arises. It is important to take a non-cooperative approach to cooperation and coordination. The level of coordination must be explained, not assumed.

Openness seems to induce wage coordination, in part because competitive pressures from abroad make class collaboration, between workers in exporting industries and their employers, more likely. This implicit coalition is formed to "control" wage setting in sheltered industries. It also happens because smallness and openness are positively related and the level of coordination depends on the size of the labor force and the number of employers.

Below, we first demonstrate the basic facts about openness, coordination, and wage equality (in Section 2). We then move to a theoretical discussion of why wage coordination leads to small differences (in Section 3), and why openness leads to wage coordination (in Section 4).

1. Openness and wage equality across countries

The aim of this section is to get the simple facts right. For this purpose, we use internationally comparative data from 23 countries for the period from 1980 to 2009.¹

1.1 Wage coordination and openness

We measure coordination in wage setting by what we denote "wage bargaining coordination".²

Figure 1 shows the average level of wage bargaining coordination during the last 30 years for 24 OECD countries against the average openness of the same countries. There is a clear positive pattern. Countries with high export and import relative to GDP have higher average levels of bargaining coordination.

Figure 1. Wage bargaining coordination and openness

¹ The sources are the ICTWSS data base (Visser, 2009), the Penn World Tables v7 (Heston et al., 2011), the OECD earnings data base and OECD Education at a Glance. The countries included are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States.

² The index we use is obtained from the ICTWSS data base developed and made available by Jelle Visser (see Visser, 2009 for details and definitions). It measures the level at which bargaining takes place and ranges from 1 (local or company bargaining) to 5 (bargaining at the national or central level). Following Wallerstein (1999), we have used the average level of coordination over the last ten years as our index of coordination in wage setting.

Sources: Penn World Tables v7 and the ICTWSS data base.

Note: Coordination measures the level at which bargaining takes place and openness measures $(\text{export} + \text{import})/2$ as a share of GDP.

To describe this pattern in some more detail, Table 1 shows regressions of the bargaining coordination index against openness and a few other covariates, using the panel of 23 countries from 1980 to 2009. The first model shows a strong positive correlation between openness and bargaining coordination. The next model shows a strong negative correlation between country size and coordination. In the third model, we find that bargaining coordination is lower with a more educated work force, and higher with higher union density. The positive correlation between openness and coordination is reduced to less than half its original size, but remains large and significant.

Table 1. Wage coordination and openness

	Model 1	Model 2	Model 3
Trend	-.0777*** (.0063)	-.0571*** (.0063)	-.0270** (.0088)
ln(Openness)	1.4609*** (.0884)	.7815*** (.1177)	.6174*** (.1224)
ln(Population)		-.3634*** (.0451)	-.2130*** (.0502)
ln(Tertiary education)			-.3090** (.1058)
ln(Union density)			.6134*** (.0873)
Constant	-.9093*** (.2465)	4.5694*** (.7179)	.6104 (.8917)
No. of obs.	394	394	394

Sources: ICTWSS data base, Penn World Tables v 7 and OECD iLibrary.

Note: Panel of countries 1980-2009. Dependent variable: Bargaining coordination. Coordination and Union density is obtained from the ICTWSS data base (see footnote 2). Openness ((export+import)/2 as share of GDP) and population from Penn World Tables v7. Tertiary education from the OECD iLibrary.

1.2 Wage dispersion and openness

Figure 2 shows the relationship between wage dispersion and openness. There is a negative pattern, as confirmed by the below regression analysis.

Figure 2. Wage dispersion and openness

Sources: OECD earnings database (OECDiLibrary) and Penn World Tables v7.

Note: Wage inequality is measured by d9d1 of gross hourly earnings for full time workers obtained from the OECD earnings database (OECDiLibrary). A few countries report net earnings, and a few report annual earnings only, see OECD earnings data base for details). Openness measures $(\text{export} + \text{import})/2$ as a share of GDP, obtained from Penn World Tables v7.

Table 2 shows regressions of wage dispersion on openness. In Model 1 we find a positive trend in wage dispersion, and a negative relation between wage dispersion and openness. In Model 2, we introduce the size of the country and bargaining coordination. Large countries have higher wage dispersion and higher levels of bargaining coordination are associated with more compressed wage dispersion. The coefficient for openness switches signs. In the third model, we control for union density and the share of the population with tertiary education. Countries with high union density have a more compressed wage structure, as do countries with coordination of bargaining. The coefficient for openness remains positive.

Table 2. Wage dispersion and openness

	Model 1	Model 2	Model 3	Model 4
	OLS		Fixed country Effects	
Trend	.0134*** (.0015)	.0029** (.0014)	-.0004 (.0018)	.0061*** (.0015)
ln(Openness)	-.1929*** (.0206)	.0712** (.0245)	.0738** (.0247)	-.0017 (.0319)
ln(Population)		.0798*** (.0095)	.0487*** (.0100)	
Coordination		-.0803*** (.0100)	-.0484*** (.0103)	-.0613*** (.0066)
ln(Tertiary)			.0169 (.0263)	-.0542** (.0265)
ln(Union density)			-.1506*** (.0200)	.0925*** (.0207)
Fixed country effects				Y
No. of obs.	394	394	394	394

Source: OECD earnings data base (OECD iLibrary). See note to table 1 for variable definitions and sources.

Note: Panel of countries from 1980-2009. Dependent variable: $\ln(d9d1)$.

1.3 Variations within each country

In the last model, we add fixed country effects to the analysis. In this case, the coefficients are identified from within country variation only. Country size varies very little within country and is now omitted. All three models display a positive trend within country. The coefficient for openness now drops to close to zero and loses significance. The positive trend appears to be occurring within countries, and the share of the population with tertiary education is associated with wage compression. Union density switches signs, but the relationship between coordination and wage dispersion remains strong and significant.

1.4 In sum

Bargaining coordination compresses the wage distribution. There is more coordination in small, open economies. The empirical relationship bet-

ween wage dispersion and openness may be summarized as follows. There is a clear negative cross-country pattern between openness and wage dispersion. This relationship disappears, however, once we control for country size and bargaining coordination and turns positive. Controlling for any fixed characteristic of the country, in addition to bargaining coordination, tertiary education and union density, i.e. all factors that change over time within each country, the relationship between openness and wage dispersion basically disappears.

The key to understanding the relationship between wage dispersion and openness appears to be an understanding of the conditions for coordination of wage bargaining institutions and the effects of such coordination on relative wages – our next themes.

2. Why wage coordination leads to small differences

While decentralized wage setting can magnify wage differences, wage coordination can mitigate them. Coordination can constrain the exercise of power and create inefficiencies because of the exercise of power by local unions and local employers; it can alter the influence of different groups in the wage setting process; and it can enlarge the group over which fairness norms are applied. Therefore, we focus on wage differentials under decentralization that are inefficient, unfair, or both. Clearly, decentralized wage setting can be very different from how it is modeled in elementary textbooks (as discussed in Moene et al., 1993). It may therefore be less obvious to some people how decentralized markets create differentials, than how a collective decision mitigates them.

2.1 Decentralization magnifies differentials

Monopoly Power

Strong unions exist in some industries but not in others, or in some firms in the industry but not in others. Even equally strong unions may differ in the trade-offs between wage increases and employment that stem from differences in the productive process and from the elasticity of demand for output.

Firms with monopoly power hold back their output in order to charge a higher price. This distortion may be strengthened even further by local monopoly unions that set a high wage to reap some of the monopoly profits of their firm. The two monopolies can prey on each other. Both can be part of a self-enforcing equilibrium. On the one hand, the firm obtains monopoly power in its output market because the monopoly union restricts entry into the industry. On the other hand, the union obtains monopoly rents and a monopoly position because of the market power of the firm. The interaction increases the negative impacts of the market power of their firm, while the market power of the firm enhances the monopoly power of the union. The end result is even lower production levels and higher monopoly prices for outputs.

Figure 3. Monopoly

Source: Own illustration.

The case is illustrated in Figure 3. The demand curve shows the value of the marginal product of the firm. Point **a** represents the competitive equilibrium as long as the opportunity wage is the equilibrium wage. The impact of the firm's monopoly power in the output market is represented by a movement from **a** to **b**, where the marginal revenue equals the opportunity wage. Union power implies a sharing of the rents in excess of the opportunity wage, represented by the wage bargaining curve. The

isolated impact of the monopoly power of the union is therefore represented by a movement from **b** to **c**, where marginal revenue equals the wage obtained by the wage bargaining curve. As seen, each step is associated with lower employment and production and hence, with higher prices.

Monopsony Power

A similar effect can also appear among employers of non-unionized labor. Some firms may have substantial monopsony power because of frictions in the labor market, while other firms have none. Monopsony gains are achieved by restricting the demand for labor to obtain a lower wage. Monopsony power in output markets raises the benefits of monopsony power as the output price increases when the demand for labor is reduced. Both monopsony in the labor market and monopoly in the output market induce output contractions.

Figure 4. Monopsony

Source: Own illustration.

The case is illustrated in Figure 4. Point **a** represents the competitive equilibrium where demand and supply intersect. Again given the competitive wage, the movement from **a** to **b** represents the isolated effect of monopoly power in the output market. The movement from **b** to **c** in the figure illustrates the additional effect of monopsony power in the labor

market, with the resulting wage given at point **d** on the labor supply curve. The firm faces an upward sloping supply curve and thus an even steeper sloping marginal cost curve. It equates the marginal revenue with its marginal wage costs. The associated wage level is given by what is necessary to pay to sustain optimal employment. As seen, each step is associated with lower employment, rising output prices and either constant or declining wages.

Global Competition

The mechanisms that we have sketched may generate less wage inequality when firms become more exposed to international competition from globalization and market integration. Yet, globalization may also generate extra rents from extending the size of the market for outputs.

Andersen and Sørensen (2011) point to the possibility of a U-shaped relationship between product market integration and wage inequality. They explore two counterweighing mechanisms, both related to wage effects of changes in firms' rents in the product market. The first is a reduction in protection rents, arising in firms that are initially protected from international competition, and the second is an increase in specialization rents, arising in firms that become more productive as their markets expand internationally. The first effect is likely to dominate for low levels of openness, whereas the specialization effect is likely to become bigger as the economy becomes more integrated.

Efficiency Wages

Efficiency wages may also create inefficient differentials. Traditional efficiency wage mechanisms imply that both wages and effort are higher than they would otherwise have been (see Shapiro and Stiglitz, 1984, Weiss, 1994, Bowles and Gintis, 1993). It pays for the employer to raise wages to induce higher effort in particular in high-productivity jobs.

Efficiency wages can thus generate different kinds of inequality within the industry. Some of the inequalities are efficiency enhancing, such as those that arise because it pays for the individual firm, and for society as a whole, to motivate workers in high-productivity firms by paying higher wages than what they would obtain in low-productivity firms. Yet, some of the inequalities are inefficient, such as the differentials between the employed and the unemployed that are created as each

firm tries to remunerate its workers by paying more than the average wage. The resulting unemployment from this competition works as a discipline device (Shapiro and Stiglitz, 1984). Unemployment is wasteful, even though it can be second best optimal. The link between efficiency wages and unemployment is not discussed further here.

There is also another source of inefficiency of efficiency wages that is normally overlooked. It is associated with a profitable employer strategy of lowering the wage in low- productivity jobs, knowing that efforts decline. As long as the decline in effort is relatively lower than the reductions in wage costs, the profits may increase. This mechanism does not create any large differentials at the low end of the wage distribution, but, as we shall now see, it can generate huge differentials between the top and the bottom of the distribution.

How differentials arise in good and bad jobs

While high wages may have a positive encouragement, low wages may have a negative encouragement. As Adam Smith said, “[t]he liberal reward of labour, as it encourages the propagation, so it increases the industry of the common people [...] Where wages are high, [...] we shall always find the workmen more active, diligent, and expeditious, than where they are low” (WN, Book I, Ch. VIII, p. 91).

Can employers benefit from setting a low wage, knowing that a lower pay would lead to a less active work force? If so, why are they not always doing that? The answer points to the importance of fairness and a power balance in the workplace to achieve efficiency (Rabin, 1993). To see how, consider the case where jobs and workplaces differ in their “productivity”, denoted p , depending on the level of specialization and the type of production technique that employers apply. An employer with productivity p earns a profit $\pi = pe - w$ where his work force (normalized to 1) puts in an effort e and is paid a wage w . There is a distribution of p in the industry.

The efficiency wage story can be visualized by just relating effort e positively to wages was in $e = e(w)$. The effort response of higher wages is positive, but with a declining rate (thus $e(\cdot)$ is increasing and concave). (For more elaboration on this type of efficiency wages, see Moene, 2011.) Each employer is maximizing his gross profits $\pi = pe(w) - w$ subject to the participation constraint $w \geq w_0$.

Good and bad jobs: The traditional story is that employers would like to increase wages to induce higher efforts, until the marginal benefit of higher efforts equals the marginal costs, $pe'(w)=1$ with $w > w_0$. This is the outcome in good jobs where productivity p is sufficiently high.

There may be jobs with such low productivity that no wage can solve the first-order condition, $d\pi/dw=0$. In such bad jobs, it pays for the employer to lower the wage down to the participation constraint. The productivity threshold between good and bad jobs, denoted p^* , is defined by $p^*e'(w_0)=1$. Clearly, for $p < p^*$ we have that the marginal gain of higher wages is lower than the marginal costs, and the employer benefits from lowering the wage. It is reduced until it reaches the level of the participation constraint w_0 , determined by the pay-offs as unemployed. The wage distribution at the lower end of the wage distribution would just reflect the distribution of costs and benefits of being idle. Most likely, the distribution is rather flat.

In good jobs there is positive reciprocity. Employers raise wages above the norm, and workers respond by a work effort above the norm. The reason why wage reductions are not profitable in these jobs is that the retaliation power is sufficiently high relative to the productivity of the jobs.

In high-productivity jobs, the (initial) raise in revenues from the job is higher than the (initial) raise in wage costs, implying that profits go up as wages are raised. More productive jobs pay higher wages. This is efficiency enhancing in the sense that the total value added goes up. In fact, the wage distribution that maximizes the total value added in high-productivity jobs is one where the wage in each job equals the productivity of the job, that is where $w=ep$. This wage distribution, however, is clearly not profit maximizing. In addition, there may be more to the story than what is captured by our simple exposition. There might be additional mechanisms related to capital investment and other inputs, for instance. It is nevertheless worth noting that from a pure efficiency wage consideration, profits to owners are costly, reducing worker efforts below what would maximize the value added.

In bad jobs there is negative reciprocity. Employers reduce wages below the norm and workers respond by a work effort below the norm. While employers might think that “workers pretend to work, so we pretend that we pay them”, workers might think that “employers pretend to

pay us, so we pretend to work". How much the work effort is reduced depends on workers' retaliation power, something that again depends on how much local influence they have over working speed and quality of work.

The gain to the employer of inducing higher efforts in low-productivity jobs may not support the higher wage costs, while it does in high-productivity jobs.

In low-productivity jobs the (initial) raise in revenues from the job is lower than the (initial) raise in wage costs. Thus, the gain to the employer of inducing higher efforts by higher wages does not pay off. The employer would therefore instead prefer to lower the wage as much as possible. By so doing, the efforts decline, but this decline is less than the corresponding decline in wage costs, implying that the profits go up as wages are reduced.

The result of all this is that the wage differential for equal work between good and bad jobs is magnified. More local worker influence over own work performance and over contract negotiations would generate more equal wages since a negative reciprocity would be less tempting for employers.

To society as a whole the low-wage trap, where employers reduce wages and workers reduce their work effort, represents social waste. In the trap, employers gain by employing human resources inefficiently.

2.2 Coordination mitigates wage differentials

Encompassing monopolies

In the labor market, the law of one price seldom holds. In all cases we have considered, the wages for equivalent workers can vary with local productivity and power. In some low-productivity jobs, a low-wage trap may emerge where employers reduce wages and workers reduce their work effort. This is unlikely to happen in unionized firms. Here, however, the wages for equivalent workers may differ according to the workers' share of monopoly rents which differ across industries and firms.

Wages in non-union firms would differ according to the monopsony and monopoly power of employers. Both in markets where workers' wages are higher than textbook-competitive levels due to monopoly power,

and lower than the textbook-competitive levels due to monopsony power, employment is inefficiently low and the relative prices of output too high.

There is both a misallocation of labor and a misalignment of prices. One explanation for why coordinated wage setting is implemented could just be to take wages out of local market competition in order to correct some of the inefficient wage differentials that can emerge in decentralized interaction between employers and workers in one way or another.

Although there might be huge efficiency gains by eliminating inefficient differentials, there is no guarantee that it is done. Whether centralized negotiators correct the miscalculations and misalignments is an open question. One indication that they might not correct all inefficiencies is that coordination seems to allow considerable discretion at the local level.

In counties with central wage coordination, the wage drift (the supplementary wage increases given at the local level) easily adds up to more than half of the wage increases given. Such observations should not, however, be taken as clear evidence of a failure to internalize the costs of inefficient differentials. Central negotiators might very well perceive the local additions when the coordinated wage structure is implemented at the local firm level. As long as there are more constraints on industrial actions at the local level (peace clauses that limit strikes and lock-outs), central wage negotiators may *de facto* determine the entire wage structure by incorporating the likely additions at the local level.

How collective decision making can create competitive outcomes

Numbers count in collective decision making, whether it is democratic or quasi-democratic. The outcome of wage coordination is therefore dependent on whose interests that are represented and how participatory the decision process is. Efficiency improvements via wage coordination might be viewed as a parallel result to a famous theorem in cooperative game theory. In this theory, the allocations that cannot be blocked by any sub-coalition shrink to the perfectly competitive and efficient allocation as the number of participants increases. This theoretical result holds even in the absence of a price mechanism and markets.

To see the parallel to wage coordination, consider a union association that negotiates wages at a central level with employers who can unilaterally set employment levels after the wages are fixed. This is the classical case of monopoly unions that care about both the pay and the number of

jobs. Now, instead of increasing the number of participants of each type (as in the shrinking of the core), we can derive the consequences of making the union movement more and more encompassing. Then, we may end up with a union demanded wage structure that pays equal wages for equal work. Since the union movement is sufficiently encompassing, it may also care sufficiently about employment levels so that wage levels are set such that full employment is achieved. Hence, coordinated wage setting with encompassing unions may generate a wage distribution that may be closer to the textbook model of perfectly competitive labor markets.

Although some workers and some firms may be worse off, aggregate income may be higher if local rents are reduced through a process of encompassing coordination in wage setting. This may result even though a decentralized labor market would not yield anything like what the textbooks claim due to insider-outsider mechanisms and unequal wages for equal work as revenue sharing in local wage setting ties wages to the different productivity levels of each separate firm. Hence, coordinated wage setting may produce a “textbook competitive” outcome, while decentralization may fail to do so.

However, there are many reasons why the reductions of wage differentials might lead to lower rather than higher efficiency. Even in situations where greater equality is more efficient, an explanation in terms of efficiency is insufficient in the sense that a change, which increases total income, but harms some, may be blocked by those who lose.

How wage coordination changes the influence of different groups

A more political explanation of the association of coordinated wage setting with egalitarian wage distribution is simply that coordination alters the influence of different groups in the wage setting process.

Low paid groups: In their classical work on “What Do Unions Do?”, Freeman and Medoff (1984) argue that the wage structure in non-union labor markets is shaped by the preferences and outside options of the most mobile workers who employers are trying to attract or retain.

In contrast, the structure of wages under collective bargaining may refer to the interests of the median voter in elections for union leadership or contract ratification. Thus, a mean preserving reduction in wage inequality which raises the pay received by the median wage earner and all other

workers below the mean would obtain majority support inside the union association, given the positively skewed shape of the wage distribution.

Encompassing groups: Wage coordination determines the bargaining unit over which fairness norms are applied. Concerns for fairness³ exist whatever the institutional environment. The coordination of wage setting may have a large impact on how the fairness norm is implemented. In decentralized bargaining, the norm of equal sharing results in a wage structure that depends on the workers' usefulness to the firm and her alternative opportunities. With a coordinated wage setting, the same norm of equal sharing results in a pay that depends on the importance of the work force as a whole and its outside opportunities as a group. The larger the fraction of workers who are considered as a group, the more egalitarian is the potential of equal sharing rules.

In other words, when wages are determined at the firm level, unions compress the distribution of wages within the firm; when wages are set at the industry level, unions compress the distribution of wages across firms within the industry; when wages are set at the national level, unions compress the distribution of wages across firms, industries and occupations throughout the entire nation. More coordination is associated with less wage inequality.

Weak groups in worker-worker arguing: When wages are taken out of local competition, worker-employer bargaining is to some extent replaced by worker-worker arguing where it is difficult to utilize the same type of industrial actions as in worker-employer bargaining. This strengthens the power of weak groups. Forming a union of workers with different productivity levels implies that the union bargains on behalf of its members who, in turn, must have a way of distributing the total union rent between themselves. Further unionization and coordination between unions have a stronger influence on relative wages than on the functional distribution of wages and profits (Wallerstein, 1999; Freeman, 1982; Card, 2001; Moene and Wallerstein, 1997; Moene et al., 1993).

Consider, for instance, organized workers in a position with productivity p that would obtain $w(p) = \omega + \alpha p$ if they bargained directly with their employer, where αp is the wage increase.

If they coordinate their wage claims with workers within a bargaining unit with an average productivity of $\hat{p}$, they would on average obtain

³ Thaler, 1989; Rabin, 1998; Fehr and Schmidt, 1999.

$\omega + \alpha \hat{p}$. Worker-worker arguing would result in $\omega + \beta(p, \hat{p})\alpha \hat{p}$, where $\beta(p, \hat{p})$ is the arguing power of workers with productivity p in a unit of average productivity $\hat{p}$. Clearly, if $\beta(p, \hat{p}) \equiv 1$ for every position p we have equal sharing rules. All workers get the same addition to their fall-back position ω , implying a rise in the lowest wages compared to decentralization. In contrast, if $\beta(p, \hat{p}) \equiv p / \hat{p}$, the rents are distributed according to merits only.

We suggest that the arguing power is somewhere in between the two extremes, implying, for instance, $\beta(p, \hat{p}) = r + (1-r)(p / \hat{p})$ where $r \leq 1$ is the weight put on equal treatment (equal sharing rules), while $(1-r)$ is the weight put on local results in the form of local productivity. The coordinated wage structure can then be expressed as $w(p) + r\alpha(\hat{p} - p)$. As long as $r > 0$, coordination implies that the lowest wages rise relative to the non-cooperative benchmark, while the highest wages fall. For workers in positions for which the difference $(\hat{p} - p)$ is large, even a small dose of equal treatment (a small value of r) can contribute to a significant wage compression by raising low wages and holding back high wages.

Two-level bargaining: When $w(p) = \omega + r\alpha \hat{p} + (1-r)\alpha p$ is the result of a two-level bargaining system, we can interpret $(1-r) \leq 1$ as the constraint on local bargaining due to a peace clause, for instance. The system can be considered to be coordinated as long as central negotiators perceive local additions (drift) on top of the tariff wage. They know that the additions will be related to local productivity. They also know that local unions have a bargaining power $(1-r)\alpha$ which is lower than α since there are restrictions on industrial actions after the tariff wage is determined. Obviously, central negotiators cannot fine-tune the tariff wage to each local union, so they predict the local average drift to be $(1-r)\alpha \hat{p}$, and thus reduce the additions to the tariff to $r\alpha \hat{p}$ in order to achieve $\alpha \hat{p}$ on average. In this way, the two-level system, where central negotiators predict average drift, determines the average wages at the same time as it compresses the wage distribution.

Employers: Employers may also gain from a wage policy that raises the wage of low-wage earners and lowers the wage of high wage earners even when wage compression is inefficient, as shown in Moene and Wallerstein (1997) and Barth et al. (2013). These papers examine models with heterogeneous firms and heterogeneous workers in which wage differentials arise from competition among firms to obtain more skilled workers.

Wage differences associated with decentralized wage setting may be efficient, but unfair in the sense that the wage distribution is more unequal than the distribution of worker productivity as firms pay differentials between high- and low-skilled workers that exceed the differences in workers' abilities.

Reducing the differentials, while maintaining full employment, means that the expected wage costs over the life time of new investments decline. Thus, as long as the average wage is kept low enough to clear the labor market, wage compression increases both profits and investments. Higher investments increase the demand for labor, making it possible to raise the pay to low-skilled workers without creating unemployment. As more jobs are created in each vintage, workers become more concentrated in high-productivity vintages (enterprises, firms, industries).

Surprisingly perhaps, the average wage goes up with more wage restraint at the same time as the expected wage costs for each investment project decline. The explanation is simple: More creative destruction, induced by lower expected wage costs, moves a larger share of the work force to more productive enterprises, thereby raising average wages. In short, wage compression fuels capitalist investments in the process of creative destruction, increasing the average productivity and the average wage for a constant employment level. The possibility that employers gain from wage compression is important in understanding the history of wage coordination in northern Europe. As we shall discuss further shortly, centralized wage coordination in Scandinavia was created with the active support from the employers' association.

3. Why openness leads to wage coordination

As stated in the introduction, to understand the small wage differentials in small open economies, the level of coordination must be explained, not assumed. So far, we have pointed to reasons why some groups may gain by cooperation, in one way or another. We have not, however, discussed how coordination can be supported by stable coalitions that cooperate voluntarily.

Pay-offs and coalitions

Cooperation may require that the participating groups share the cooperation gains. Some coalitions are able to generate mutual gains from wage coordination. Others are not. The differences do not stem from what the participating unions care about. Unions, whether they organize workers in sheltered or exporting industries, are basically very similar. They care about the real wage and the number of jobs for their members. The basic trade-off between real wages and the number of jobs is also rather similar, and employers in both sectors have the same right to manage employment levels after wages are set.

The basic difference across possible coalitions stems from the ability to influence the economic factors that they care about. Unions in sheltered industries have the advantage of being able to pass on part of the wage increases to higher output prices. This is not possible in exporting industries where prices are given on international markets. The advantage of being sheltered against foreign competition also shows up in the wage aspirations. In the sheltered industries, a wage increase costs less in the form of lost jobs than it does in the exporting industries (the Mathematical Appendix provides a formal model of this). Union wage aspirations therefore become highest in sheltered industries. These wage aspirations are reflected in decentralized bargaining and in all wage setting systems that do not constrain sheltered wage setting. Higher wages in sheltered industries have considerable indirect effects as they affect the living costs for all workers.

Competitive pressures from abroad increase the gains from class collaboration between workers in exporting industries and the employers. This export lead coalition can generate gains for both sides as long as it manages to “control” wage setting in sheltered industries. Employers and unions in the export sector provide “coordination gains” by *forcing* the wages to sheltered workers to be in line with the wages in the export sector. The coalition may back these coordination attempts by implicit threats of lock-outs against sheltered workers who do not follow the wage pattern in the export sector. The mutual gains are clear. Each reduction in the wage of sheltered workers lowers the living costs for all workers and raises the profits for employers both directly via lower wage costs and indirectly due to prices on domestic inputs.

A coalition of employers and workers in sheltered industries is unable to generate such mutual gains by wage coordination. Higher wages to sheltered workers mean higher costs and lower profits to employers. Lower wages to export workers mean higher profits for their employers, but no gains for workers in the sheltered sector. A class struggle coalition, consisting of workers from both sectors against the employers, is another example that would not yield any considerable gains from wage coordination within coalitions. The weapons of industrial actions are more efficient in situations of divide and conquer than they are in pure conflicts of labor against capital. Threats of lock-out against groups of workers, for instance, are most efficient with a tacit support by the rest of the workers.

Table 3 provides an example of the pay-off structure that we have just sketched. We use this example in the discussion below where we contrast two different stories of how openness affects cooperation and whose interests benefit the most from full cooperation in small open economies.

Two competing ideas

The first idea highlights how sheltered workers would benefit from decentralization, and from more explicit protection based arrangements, that allow them to shift some of the wage costs over to higher prices. If the central agreement does not account for these advantages for sheltered workers, sheltered workers will refuse to cooperate. Since they are strong in some of the alternatives to full cooperation, they must be especially compensated in the cooperative agreement. As we shall see, the traditional theory of cooperative games supports this story. If it were right, sheltered workers would call the shots in any cooperative agreement in small open economies.

- The first idea thus predicts that openness makes sheltered workers strong relative to export workers. Sheltered workers may thus obtain wage premiums or excessive employment relative to exposed workers. If full cooperation arises, it will just confirm the privileges of sheltered workers.

The second idea highlights how economic openness is particularly gainful to workers in the exporting industries and for major employer interests. The export lead coalition can therefore be more profitable to its members than coalitions based on protection and class struggle. Decentra-

lization would also somewhat favor the sheltered industries as they do not face international competition in output markets. Being so strong and profitable, however, suggests that the export lead coalition has a decisive influence on the final outcome from full cooperation. In part, this is the case since it can block some of the alternative coalitions and arrangements. As we shall see, the non-cooperative approach to cooperation supports this kind of reasoning.

- The second idea thus predicts that openness makes the export lead coalition strong and profitable. It may thus restrict any wage premiums to sheltered workers. If full cooperation arises, it will reflect the interest of the export lead coalition in establishing an alternative wage structure to that in decentralized labor markets and more protection based arrangements.

In both interpretations of cooperative game theory, we focus on players who jointly make a collective agreement and who agree to allocations that nobody can block. The agreements are stable in the sense that nobody can do any better by breaking away and operate on their own. The two stories differ in how blocking opportunities are incorporated.

Traditional cooperative game theory may lead us astray

The traditional core has two basic requirements. The first is Pareto optimality as total pay-offs must sum up to what is to be shared. The second requirement says that each coalition must at least receive as much as it can obtain by breaking away. Allocations, or outcomes, that satisfy these requirements belong to the core. (See the Mathematical Appendix for a more precise definition.)

Table 3. Wage coordination

	Group1 Export	Group2 Sheltered	Group3 Employers	Coalition
Cooperation				13
Export lead		1		11
Protection	1			9
Class Struggle			8	2
Decentralization	1	2	10	

Source: Own illustration.

Consider now the example in Table 3, listing the pay-offs in the case of different coalition partitions. It mimics a hump-shaped connection between the level of wage setting and efficiency. Both decentralization and full cooperation are Pareto optimal, yielding the same efficient sum of pay-offs. Intermediate coalitions are less efficient. What will the groups agree on, if anything? Traditional cooperative game theory is based on a rather mechanical perception of blocking opportunities. Writing x_i for the pay-off to group i , we have the following:

- preventing the export lead coalition from blocking requires $x_1 + x_3 \geq 10$ and $x_2 \geq 1$;
- preventing the protection coalition from blocking requires $x_2 + x_3 \geq 9$ and $x_1 \geq 1$; and finally
- preventing the class struggle coalition from blocking requires $x_1 + x_2 \geq 2$ and $x_3 \geq 8$;
- preventing any to block from obtaining decentralization requires $x_1 \geq 1$, $x_2 \geq 2$, and $x_3 \geq 10$.

It is easily checked that the only feasible solution of $x_1 + x_2 + x_3 = 13$ that fulfills all constraints is the pay-off vector $(x_1, x_2, x_3) = (1, 2, 10)$. Hence, with these pay-offs, nobody can do better by breaking out from the core, and the outcome (1,2,10) is the unique equilibrium allocation in the core. Note that the equilibrium favors sheltered workers. Openness, if anything, makes the relative position of sheltered workers stronger, which is once more reflected in the core compromise.

As we shall now see, this solution does not hold once we take a more realistic view on what happens when a coalition breaks away from full

cooperation. The threats that are used in traditional cooperative game theory are based on what each coalition maximally can guarantee itself, whatever the other players do. But this may imply unrealistic expectations. The solution in the traditional core must, for instance, satisfy non-credible threats of moving to situations that will never arise.

To see this, let the pay-off in Table 3 to export workers increase from 1 to 1.5 in the case of protection. With this change, traditional cooperative game theory suggests that cooperation breaks down as $(x_1, x_2, x_3) = (1, 2, 10)$ will be blocked. But this possible blocking threat is based on a completely unrealistic expectation that workers in the export sector obtain $x_1 = 1.5$ by breaking away. Whether the protection coalition will at all arise, or whether it represents a stable partition, are questions never asked. These are the basic questions that are addressed by the alternative non-cooperative approach.

A non-cooperative approach to cooperation

In game theory, the game is either cooperative or non-cooperative. What we see in practice, however, is very often a mixture. Each coalition agrees to a course of actions in a cooperative fashion, but plays non-cooperatively towards other coalitions. Cooperative game theories apply for the formation of coalitions of unions and employers' associations. There can be within class as well as across class coalitions. Non-cooperative Nash-equilibria apply for the determination of the actions taken by each coalition towards other coalitions and other players. There is an important simultaneous interdependence. Which coalitions that are stable depend on the non-cooperative equilibria; and the non-cooperative equilibria depend on which coalitions that form. The literature is sparse on this kind of mixed cooperative and non-cooperative play, but Johansen (1982) and Ray (2007) are good starting points (see also Moene, 2013).

The non-cooperative approach to cooperation asks what is the equilibrium partition of unions and employers once a group breaks away from the central agreement? The traditional procedure in cooperative games tests for whether the grand coalition is stable, or not, to the temptation for any set of players of breaking out and forming any sub-coalition. The theory does not check, however, whether this sub-coalition itself is stable to similar temptations for any sub-set of players to break out and form another sub-sub coalition. If a sub-coalition is not stable, the temptation

of the sub-coalition to break away from the grand coalition is not a credible threat and should not affect the allocations in the grand coalition (Ray, 2007).

In short, one has to think about the worth of a coalition as an equilibrium outcome in the Nash equilibrium partition of players into coalitions. Table 3 can again help clarify this.

Credible threats make cooperation more likely and alter the equilibrium pay-offs: Once more, consider Table 3. As we have seen, in line with the traditional reasoning in cooperative games, one should think that groups that are favored without coordination cannot lose from coordination. But they can once we take a non-cooperative approach to cooperation.

In theory, one might think that full cooperation cannot give sheltered workers less than what they achieve under decentralization. But this is not the case. If a coalition can benefit from blocking decentralization, the outcomes under decentralization are of no relevance for the allocations in the core. We have also seen it in practice. In the early attempts of wage coordination in Sweden and Norway, workers sheltered from foreign competition lost even though they were among those workers who would have been best off within the old type of wage setting. The *de facto* power was altered with the strength of new intermediate coalitions.

In Table 3, when employers and export workers operate together and sheltered workers operate alone, the export lead coalition achieves 11, while sheltered workers only obtain 1. As long as this is the case, decentralization will never be reached since the export lead coalition will always do better by sticking together. Hence, sheltered workers cannot threaten to break away from coordination if they obtain less than 2. Decentralization is not a Nash equilibrium in the case of a breakdown of full cooperation, and therefore it does not constitute a credible threat.

If full cooperation fails, there is only one equilibrium partition of the players, the export workers in coalition with the employers and the sheltered workers playing alone. Clearly, the protection coalition would fail to form since employers can get more by cooperating with workers in exporting industries. The class struggle partition would fail to form since workers in exporting industries would rather gain from cooperating with employers. The export lead coalition is a stable coalition since there are feasible allocations in that coalition such that neither employers nor ex-

porting workers have any reasons to break away, in the absence of full cooperation.

Thus, sheltered workers would just obtain 1. The export lead coalition would obtain 12 together (at least 1 to the export workers and at least 10 to employers, since both these groups can credibly threaten with decentralization). Within the export lead coalition, any split of the gain of full cooperation of 1 is an equilibrium. Full cooperation now remains stable even when we raise the pay-off to the export workers in the case of protection as the pay-offs from protection are irrelevant as long as the export lead coalition can do better by blocking it.

Conflict and cooperation in the union movement in the 1930's

The simple numerical example captures important features of wage negotiating in the 1930's in both Sweden and Norway. Construction workers in Sweden and Norway were highly paid, militant and sheltered from foreign competition. When foreign demand collapsed in the 1930's, workers in the export sectors such as metal workers accepted large wage reductions in order to stem the decline of employment. Construction workers came under no such pressure, in large part because of increased government spending on housing. Since construction workers were employed in the export sector as well as in home construction, higher construction wages raised the labor costs in the export sector, which threatened the jobs of metal workers.

When construction unions called a strike in support of higher wages, the national confederation of unions intervened to force the strike to an early, and from the construction workers' point of view, unsuccessful conclusion. The intervention of the national union confederation to end the strikes in construction was the initial step in a process of centralization of authority within the union movement in both Norway and Sweden, a process that was encouraged and supported by employers.

Thus, the political coalition that prevailed in the 1950's and established the pattern of centralized and solidarity bargaining was comprised of export-oriented unions and employers. High-wage unions in sheltered industries were prevented from leaving the centralized negotiations by the threat of lockouts. It is unlikely that the low-wage unions and the leadership of the union confederation would have been able to force high-wage

unions to accept an egalitarian wage policy without the backing of employers and the threat of lockouts against recalcitrant unions.

Pattern bargaining

The political coalition that established coordinated wage bargaining in Scandinavia has prevailed, under the name of "frontfagsmodellen" in Norway. Based on implicit lock-out threats from employers, the *de facto* bargaining power of sheltered workers is reduced. In practice it means that the sheltered union follows the pattern of negotiated wages in exporting industries. Interestingly, the "solution" to the conflicts of interests within the union movement implies class collaboration and implicit threats against the most sheltered workers. As this form of wage coordination reduces the power of sheltered workers to capture monopoly gains in the labor market, coordination leads to a more compressed wage structure. International competition that reduces the price of exports may strongly increase the economic demand for wage coordination. It becomes more important for employers and export workers to control the wages in sheltered industries. Thus, coordination by a cross-class coalition between employers and workers in exporting industries is most likely to emerge in small open economies.

4. Concluding remarks

We have made a case for an empirical association between economic openness and egalitarian wage distributions across countries. The association seems to disappear, however, once we control for country size and bargaining coordination. But it reappears once we account for the empirical fact that small open economies have more wage coordination than other countries and for the assertion that wage coordination compresses the wage distribution.

To understand how coordination works, we need to attack the most simplistic assessments of decentralized labor markets. Contrary to what most elementary textbooks claim, we insist that wages for equivalent workers can vary with local productivity and power. In some low-productivity jobs, a low-wage trap may emerge where employers reduce wages and workers reduce their work effort. This is unlikely to happen in

unionized firms. Here, however, wages for equivalent workers may differ according to workers' share of monopoly rents which differ across industries and firms.

Wages in non-union firms would differ according to monopsony and the monopoly power of employers. Both in markets where workers' wages are higher than the textbook-competitive levels due to monopoly power, and lower than the textbook-competitive levels due to monopsony power, employment is inefficiently low and the relative prices of output too high.

One explanation for why coordinated wage setting produces wage compression is that it may eliminate such inefficient wage differentials. It may to some extent correct the misallocation of labor and a misalignment of prices. There are also complementary explanations of how coordination may reduce efficient wage differentials that are considered unfair by the majority of workers. Egalitarian wage compression may be associated with wage coordination, because a quasi democratic coordination moves the influence in the wage setting process towards low-paid workers, and because coordination broadens the group over which fairness norms of wage setting are applied.

Trying to explain how coordination arises, we speculate on how competition in the world market induces employers and workers in the exporting industries to search for ways of controlling the wage setting in sheltered industries. This competitive pressure from global forces is more heavily felt in small open economies with a high level of foreign trade relative to national incomes. The most open economies are also relatively small with a smaller workforce and fewer employers. All these factors facilitate cooperation and coordination as the number of interests to coordinate is smaller than in other countries.

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A. Mathematical Appendix

Wage aspirations

We focus on the interaction of consumer real wages and producer real wages. Workers in sheltered industries can pass on part of their wage increases to higher output prices p_s . The elasticity of p_s with respect to w_s is denoted $\eta \in (0,1)$. The price of exports, p_e , is given on international markets.

There can be economy-wide costs of excessive wage increases in sheltered industries in the form of higher living costs for all workers. The costs of living, as captured by the consumer price index P , depend on the price level in sheltered industries p_s in addition to the price q on imported commodities. The consumer price index $P = P(p_s, q)$ has an elasticity with respect to p_s denoted $\theta \in (0,1)$.

Each union cares about both its own real wage and the number of jobs in the own industry

$$u_s = U\left(\frac{w_s}{P}, L_s\right) \text{ and } u_e = U\left(\frac{w_e}{P}, L_e\right). \quad (\text{A.1})$$

Once the wages have been determined by collective negotiations, employers have the right to manage employment levels unilaterally by maximizing profits, $\Pi_i = p_i F_i(L_i) - w_i L_i - \pi_i$ for $i = s, e$ where π_i are required returns to capital. The resulting employments can be written as downward sloping demand functions

$$L_i = L_i\left(\frac{w_i}{p_i}\right) \text{ for } i = s, e \quad (\text{A.2})$$

where w_i / p_i is the producer real wage in sector $i = s, e$. In general, the profits after maximization can be expressed by the indirect profit functions $\Pi_s(w_s)$ and $\Pi_e(w_e)$.

The union wage aspiration is the wage determined by maximizing the union utility. In sheltered industries, wage aspirations are determined by

$$\frac{dU}{d(w_s/P)} + \gamma \frac{P}{p_s} \frac{dU}{dL_s} L'_s(w_s) = 0 \quad \text{where } \gamma \equiv \frac{1-\eta}{1-\eta\theta} < 1.$$

The second-order condition for a maximum implies that the wage aspiration is a negative function of γ . In the exporting industries, the union wage aspirations are determined by

$$\frac{dU}{d(w_e/P)} + \frac{P}{p_e} \frac{dU}{dL_e} L'_e(w_e) = 0.$$

Now, all else being the same, union wage aspirations are highest in sheltered industries, reflecting that the costs of job losses are reduced by the factor $\gamma < 1$.

The traditional core

The basic idea of the core is that the n players tend to agree to one of the feasible allocations in the core, since nobody can then do any better by breaking out and operating on their own.

Consider the two following types of requirements on the set of pay-off vectors (where x_i is the pay-off to player i). The pay-off x_i can be wages or profits depending on who i is

$$\sum_N x_i = v(N) \text{ where } \sum_S x_i \geq v(S) \text{ for every } S \subset N. \quad (\text{A.3})$$

The first requirement in (A.3) is Pareto optimality – total pay-offs must sum up to what is to be shared as represented by the characteristic function $v(N)$, the worth of the grand coalition. The second requirement says that each coalition must at least obtain as much as indicated by its characteristic function, $v(S)$ for coalition S , including the characteristic function of degenerate coalitions that consist of single players. Allocations, or outcomes, $(x_1, \dots, x_n)$, that satisfy these requirements belong to the core.

Comment on Barth and Moene: Why do small open economies have such small wage differentials?

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It is well known that labour market institutions differ significantly across countries. Yet much work on labour market issues is conducted within settings neglecting or suppressing institutional structures, implying that labour market policies are assumed to work similarly across countries with widely different institutional settings. This is clearly a highly questionable approach. One may even take this one step further and ask whether we are able to assess the effects of various labour market policies if we do not have a full understanding of why the institutional structure has developed and how it may be affected by policies.

The paper by Barth and Moene is a forceful contribution to the understanding of labour market institutions and the role they have for labour market performance. The starting point of the paper is the observation that small and open economies tend to have small wage differentials (compressed wage structure). The paper presents some stylized facts which support that small and open economies tend to have more wage or bargaining coordination than other countries, and that wage coordination tends to be associated with smaller wage differentials; hence, the observed tendency for small and open countries to have smaller wage differentials.

Many aspects related to the empirical evidence can be discussed, but various statistical issues should not foreshadow the fact that there are

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some important and interesting empirical facts to be explained and understood. However, given the discussion of globalization in recent years, it would be interesting to know more about the developments in these key variables over time. In most countries, there has been a tendency towards more wage dispersion. Is this associated with less wage coordination or some other mechanisms affecting the wage structure without affecting wage bargaining institutions? Knowledge of this would also be of interest in relation to the empirical power of the theoretical propositions of the paper.

The paper essentially falls into two parts. First, the paper explores the implications of wage coordination for wage setting and why it may lead to a compressed wage structure. Second, the paper asks the fundamental question why wage coordination arises, “coordination must be explained, not assumed”.

The paper has a very interesting discussion of wage coordination and wage compression. The standard approach in the literature is to think of wage compression as something which impairs the market mechanism and thus is associated with inefficiencies. This need not be the case. The paper makes a strong point in arguing that decentralized labour markets in the real world do not often come close to the textbook model of competitive markets (implying that mingling with the wage structure would cause inefficiencies). Due to entry barriers, informational problems and many other aspects, decentralized markets may be associated with monopoly and monopsony effects which cause wages to deviate from the competitive benchmark model, in particular, violating the premise of equal pay for equal work!

The efficiency wage model is usually considered to show how a wage difference can be efficiency enhancing by inducing more effort; that is, by paying higher wages in high-productivity firms, productivity is enhanced. However, as argued by the authors, the effect may also go in the opposite direction. Not only may the implied unemployment be inefficient, it may also be a profitable employers’ strategy to lower wages in low-productivity jobs; the point being that wage dispersion cannot necessarily be taken to be efficiency enhancing.

Institutions – like wage coordination – may thus, via wage compression, eliminate inefficient wage differentials. In this way, the institution corrects a misallocation of labour. Clearly, wage coordination may go bey-

ond this, and a consideration of fairness may compress wage differentials that are efficient.

In the discussion of wage compression, it is somewhat surprising that the employment implications are not discussed more explicitly. Empirically, the small and open economies considered in the empirical part do not only stand out by having a compressed wage structure, but also by having achieved high employment rates (also for unskilled). How should we reconcile these facts? Does this underline the point that wage coordination is not necessarily associated with inefficiencies? Or does it point to an interrelationship with labour market policies and welfare state design which are not discussed in the paper (since the small and open economies also tend to have extended welfare states)? Can the compressed wage structure be seen independently of educational and labour market policies which explicitly have had the target of enhancing the qualifications of the labour force, inducing a compressed qualification structure by reducing the number of unskilled?

The second part of the paper asks the more fundamental and difficult questions: “Why does wage coordination arise?” and “Why are such institutions stable?”. The theoretical part is based on a theory of coalition formation combining cooperative and non-cooperative game theory. Cooperative game theory accounts for coalitions and non-cooperative game theory for the interaction between coalitions, with an important simultaneous interdependence between the two.

Cooperative game theory is criticized for relying on a too strict condition for a coalition to be stable. It is argued that although coalitions can be sustained by social attitudes and norms, we should seek more robust explanations. The paper argues that the usual approach to identify stable coalitions does not take into account whether the contesting coalition itself is stable. The stability of coalitions should be considered under the proviso that contesting coalitions should be “credible threats”; i.e. a coalition is only threatened by a sub-coalition if this itself is stable!

This is related to the discussion of refinement of equilibrium concepts in non-cooperative game theory, and it raises questions on the degree of foresight which can reasonably be assumed by the actors. This question is not trivial since the argument already assumes that the labour market is organized in unions and employers’ federations, and coordination bet-

ween these entities is considered. Why is it a stable coalition that all employers are in the same confederation?

The theoretical considerations are supplemented by numerical examples showing that a coalition between unions representing workers in exposed (tradeable) sectors and employers is a stable coalition dominating the decentralized outcome. Importantly, workers in sheltered (non-tradeables) sectors are worse off under this coalition. A model for a two-sector small open economy is sketched which may support this outcome. This analysis is very interesting and brings forth important points, and it has wide implications. It is of interest to have this further developed to clarify the conditions supporting this particular coordination outcome. Will this coalition always support wage compression?

The particular coordination outcome involving employers and workers in the exposed sector is very interesting since this is the coalition which developed in Norway and Sweden in the 1930's. It is intimately related to what in other contexts has been discussed under the heading of the Scandinavian model of inflation. The important point is that this coalition may cause wage compression and be of benefit to society at large in small and open economies because it ensures that competitiveness is not threatened by "unsustainable" wage increases originating in the sheltered sector. The link between wage coordination, wage compression and openness is thus apparent.

The paper does not discuss how this coordination outcome may be affected by "globalization forces". Product market integration driven by lower trade barriers and cheaper transport implies that the dividing line between exposed and sheltered sectors is changing; that is, sectors which were sheltered in the past are now becoming exposed to trade. For some, this opens an opportunity for export while for others it constitutes a threat from imports. Does this reinforce the particular coalition? At the same time, producers have gained increased opportunities to relocate production and this has changed the threat point of employers. Does this tend to make the coalition less stable and, if yes, which coalition (class struggle or decentralization) would take over?

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