Education and Labor Market Policies in an Offshoring Global Economy[1]

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Abstract: 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 reemploy with manufacturing firms at a faster pace than other workers. These findings are used to draw some education and labor market policy implications.

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I. Introduction

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% of its value goes to Korea for assembly, 17.5% to Japan for components and advanced technology, 7.5% to Germany for design, 2.5% to the U.K. for advertising and marketing services, with the remaining 37% generated in the U.S. (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 Phillipines, 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% 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 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 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 routine-ness of a task, may lend themselves especially well to offshoring, while other occupational characteristics, such as knowledge of 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, Lalonde and Sullivan (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 displacement due to offshoring might be different, and worse, than displacement due to 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 on 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. 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 premium while also allowing supply to catch up to rising demand in order to slow growth in the premium itself.

However, there is a growing concern that college isn't enough. Since 2000, inflation-adjusted earnings in the US have fallen for every educational group except for doctors, lawyers, MBAs, and Ph.D.s (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 classic policy to reduce 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 2009). The training programs typically take place during work 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 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 II describes Danish labor market policies. Section III describes Danish data on workers, firms, training, and trade. Section IV summarizes results from HJMX 2011 that show how offshoring affects the composition of labor demand and wages within job-spells. Section V extends this work, focused on a sub-sample of displaced workers. Section VI summarizes results from HMSX 2012 that show how training programs affect transitions from displacement. Section VII provides summary and policy conclusions.

II. 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 high job turnover workers receive relatively generous UI benefits when unemployed, but 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 process of decentralization. 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 individual workers' marginal productivity. Dahl et al. (2012)

show that decentralization has increased 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 at 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 work hours. This results in an unusually high incidence of training participation among employed workers. The government training expenses totaled around 0.5% of GDP in most years of our sample window. For more institutional details see Simonsen and Skipper (2008).

III. 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.

III.1 Data Sources

Our data on firms, workers, trade and training participation are 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, 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 training activities in Denmark and account for about 77% of 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 work hours. The government covers most of the expenses and provides firms with subsidies of 60-80% of wages during training, while the workers themselves pay only token tuition (€25 per course per week). Post-secondary training typically take place during off-work hours and consist of poly-technical, college or MBA type courses. They do not require employer sponsorship and have very low tuition.

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[2], we have a combined dataset with approximately 1.95 million worker-firm-years and 9,800 firm-years. Our sample represents about 20% of manufacturing firms, but between 50% and 70% of employment in manufacturing depending on the year.

III.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 purchases by the firms but it excludes raw materials as well as machinery which could affect labor demand and wages through other channels.[3]

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

[2] We select all 20-60 year old full time manufacturing workers and drop all the worker-firm-year observations of which the employment relationship lasts for a single year. We also drop firms with fewer than 50 employees and less than 0.6 million DKK in imports, which corresponds to average annual wages for two manufacturing workers.
[3] 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 "retail share" represents only 2.9% of imports for manufacturing firms in contrast to 35.5% for service firms.

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 imports coming from European sources, 6 percent from North America, 6 percent from Asia, and 3 percent other. Asia as a source of imports has grown in significance (its share going from 5% to 8.5%) but remains a small portion of the total. Roughly 71% of imports are within the same HS4 category as that firm's outputs and will be counted as narrow offshoring. Narrow offshoring represents 12% of gross output and 27% of total (imported plus domestic) material purchases for the average firm. In addition, the offshoring variable exhibit 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, and so we need to identify exogenous variation in offshoring.

IV. 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 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 is found in HJMX 2011.

With the instruments for offshoring in hand, the next step is to relate changes in individual worker's 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.[4]

When running this regression on the sample of workers described in section III.1 HJMX 2011 find that offshoring raises the skilled wage premium, both by increasing wages (elasticity +3.6%) for high skilled workers and lowering wages (elasticity -1.6%) for low skilled workers. Over the 12 years of the sample a firm that increases offshoring at the same annual rate (5.5%) as Denmark as a whole would raise wages for high skilled

[4] 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.

workers by 2.8% and lower wages for other workers by 1.3%. 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 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%) followed by social sciences (+3.7%), and math (+2.7%). 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 interactions between domestic workers and foreign workers from different cultural backgrounds, which raises 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.

V. Earnings losses after layoffs

HJMX 2011 study the wage effects of offshoring and exports for the 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.

We start with a data sample of all Danish manufacturing workers, and then cut down this sample to match the requirements imposed in section III.1. Further, following Jacobson et al. (1993) we focus on high-tenure workers because they are the ones 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% of the particular workers in the initial year are no longer employed by the firm the following year.[5] We classify worker *i* as an offshorer if he/she is displaced in a mass layoff event from firms that were increasing

[5] 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.

their predicted offshoring at least 10% between the pre-displacement year and the displacement year.[6,7] Approximately 9% 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 of the displacement literature, because mass-layoff events are uncommon. 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. Of the remaining 3,301 displaced workers, 18 percent are classified as offshorers, see Table 1.

We summarize our results in Figure 1. The top three panels show the profile of log hourly wage rate, annual labor earnings and annual gross earnings for high skill workers. The bottom panels 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 displays results for offshorers (light grey) and non-offshorers (black) separately. The comparison group in each case are non-displaced workers.

The top left panel shows that high-skill non-offshorers do not experience a reduction in 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,

[6] 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.

[7] We use the 10% 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.

peaking in the year after displacement at 30,000 DKK. For high-skilled offshorers the drop in earnings is even steeper, peaking at 64,000 DKK.

To put the numbers in perspective, the average high skill wage in the sample is 419,000 DKK so the peak loss of 30,000 DKK for non-offshorers represents 7% of pre-displacement earnings and the peak loss of 64,000 DKK for offshorers represents 15% of pre-displacement earnings. Combined with the small changes in hourly wages after displacement, we can conclude that losses in annual labor earnings are driven primarily 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% of predisplacement earnings.

Looking at the bottom left panel, we see that for low-skilled workers, offshorers suffer a larger wage loss (8%) than non-offshorers (5%), and a larger loss in labor earnings (60,000 DKK) than non-offshorers (44,000 DKK). 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 (285,000 DKK on average), their losses are higher in percentage terms. Non-offshorers lose 15% of pre-displacement earnings and offshorers lose 21%. 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 30,000 DKK (or 12%) for non-offshorers and 50,000 DKK (or 17%) 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, and 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%) or out of the labor force (10%) than non-offshorers (11% and 5% respectively). Among the workers who are reemployed, a higher proportion of offshorers switch four-digit industries (92%) than non-offshorers (56%), although the proportion of reemployed workers who switch four-digit occupations is similar for offshorers (44%) and non-offshorers (43%). These numbers suggest that offshoring shocks entail a shared sectoral component and worsened market options for the displaced workers.

Using the results from section IV, we compare the wage and earnings loss for the 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% and an earnings loss of 21%, while the non-displaced have a wage loss of 1.6% (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% and an earnings loss of 15%, while the non-displaced enjoy a wage *gain* of 3.6% (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, provides 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, van Audenrode and Browning (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.

VI. 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 demand for specific tasks. Re-attaching to the workforce may then require a more fundamental retraining of these workers. In HMSX 2012 we combine the matched worker-firm data with the training data described in section III 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 III.1, but unlike the previous section short-tenured workers are included in the sample.

Recall from section III.1 that vocational training account 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 coefficients are significant at the 5% 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 are 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.[8] 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 training by 7%, which represents a training rate 36% higher than workers unaffected by mass layoff events. It is a novel finding that workers displaced from offshoring firms require retraining 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

[8] 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.

within the firm but throughout the labor market, making it more difficult for the worker to find employment with their existing skill set.

Another finding is that stayers in offshoring firms also increase their training rates sharply, an increase of over 6% 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 involve re-organization 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 the 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 IV 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 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 the 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% versus 16.7%). 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 (3 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%) is similar to non-offshorers (9.9%), and offshorers are more likely to employ with manufacturing (70.4%) than non-offshorers (66.3%). Moreover, trained workers are less likely to be without employment than non-trained workers, less likely to employ with service, and more likely to employ with 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.

VII. 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 previous 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 wage losses after displacement are greater for workers displaced by offshoring firms than 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, wages rise more for jobs that require communication, language, and social science skills more 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 about 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 vocational content. Our stylized facts about the interaction between offshoring, labor market transitions and training participation show large differences between the 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 involved workers. In terms of policy, this might indicate that Denmark, and other OECD countries would benefit from adopting training programs that are targeted towards the workers displaced by globalization, such as the Trade-Adjustment-Assistance programs in the U.S.

Workers displaced from 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 re-employ with manufacturing at higher rates than untrained workers. While this would seem to indicate clear benefits to 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 minimal global engagement from the analysis.

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

$$\log y_{it} = \alpha_i + \alpha_t + x_{it}\beta + \sum_{k \geq -m} D_{it}^k \delta_k + F_{it}^1 c_i \varphi_1 + F_{it}^2 c_i \varphi_2 + F_{it}^3 c_i \varphi_3 + \varepsilon_{it}, \quad \text{where } c_i = (S_i, OFF_i, S_i * OFF_i). \tag{A1}$$

y_{it} represents the earnings of worker *i* in year *t*. We employ three measures: the hourly wage rate (the variable used in sections V and VI), annual labor earnings and annual gross earnings. Annual labor earnings capture the effects on both 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 (A1) 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,…,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 workers earnings k years following its occurrence. Equation (A1) 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 $s-3 \le t \le s$, and $F_{it}^1 = 0$ otherwise, $F_{it}^2 = 1,$ if worker i is displaced at time s and $t \ge s+1$, and $F_{it}^2 = 0$ otherwise, and $F_{it}^3 = t-(s+2),$ if worker i is displaced at time s and $t \ge s+3$, 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 4 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 OLS estimates.

Tables and Figures

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	3301	359	2942

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

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

Figure 1: Wages and Earnings for Displaced Workers

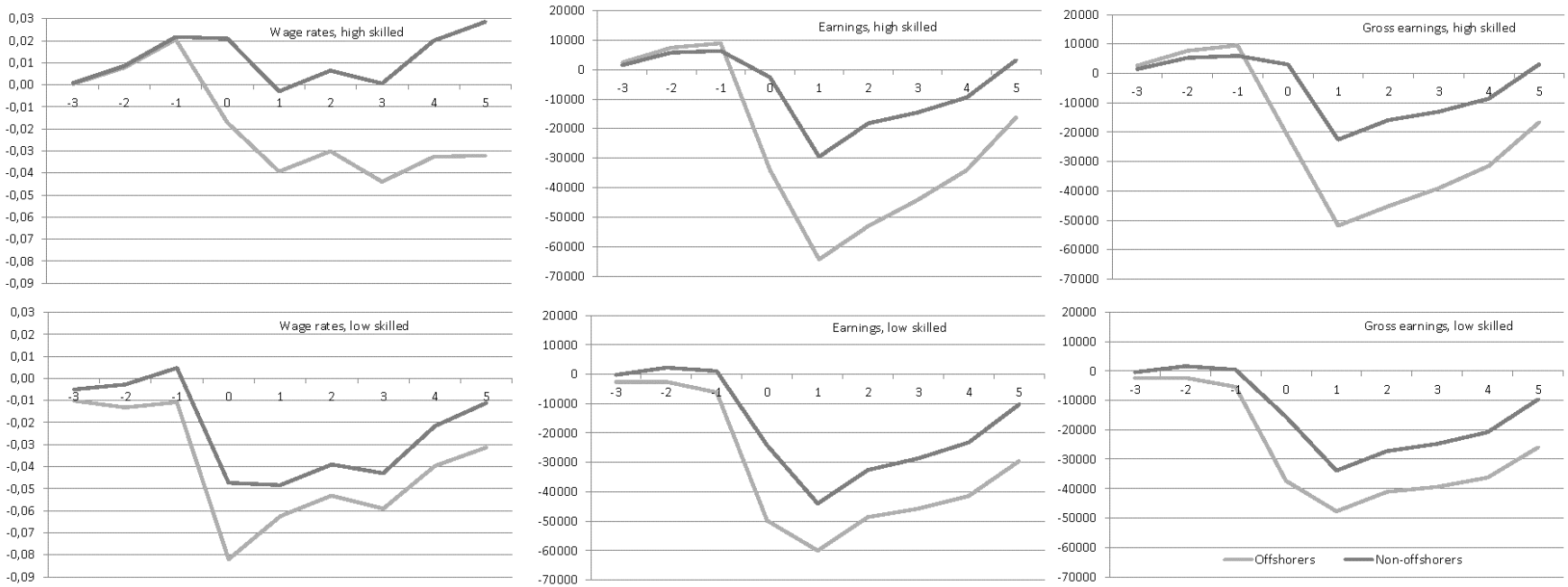

Figure 2: Vocational training take-up rates