Research Proposal

Vocational Education and Local Industrial Development

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Abstract

The following paper describes a research proposal to investigate the effects of closing vocational educations on nearby industrial environments in Denmark. In the period 1990-2010 I find 114 cases of permanent closing of vocational educations in a municipality. To understand the potential effects of closing these educations I propose a theoretical framework that emphasize the knowledge, skills and learning capacity of newly trained workers and link these to firm performance. Using firm-level performance measures from the Danish registers, I further suggest a differences-in-differences approach to estimate the effects of changes of education structure. This introduces comparison of largely similar local areas that either experience or do not experience a stop of the education in the local area.

1   Introduction

In this research proposal I will sketch a framework for investigating the impacts on local industrial development of closing vocational educations. In recent years an increasing amount of research has emphasized the effects of universities on local industrial development but little progress has been done on understanding the effects of changes in the vocational education system.

At the university level recent examples on firm and industry performance include Andersson et al. (2004) showing increased productivity in Sweden and Baptista et al. 2011 documenting increased high-technology firm startup-rates in Portugal following university new university establishments. In a Danish context Drejer et al. (2014) also show that Aalborg University has an integrated role in regional and national development in several areas which include knowledge development and dissemination, and demand effects from physical capital development.

The existing research on vocational education often emphasize the returns to this type of education (see e.g. Meer 2007, and Neuman and Ziderman 2003), education system efficiency in terms of individual outcomes (Armstrong and McVicar, 2000; Kelly and Price, 2009; Wolf, 2011). Classic human capital discussions have taken on the externalities related to vocational training (Becker, 1993), and more recent developments in the political economy literature often emphasize the vocational education system, serving as a part of a larger systems of institutions that have effects on macroeconomic performance, and redistribution and education preferences (Busemeyer, 2009; Busemeyer and Jensen, 2012; Estevez-Abe et al., 2001; Hall and Soskice, 2001). Left out from these discussions, however, are the firm- and industry-level effects of changes to the structure of vocational education.

To understand the potential effects I propose a theoretical framework that emphasize simple microeconomic principles in combination with elements of knowledge, skills and learning capacity (Lundvall and Johnson, 1994; Jensen et al., 2007). A key part of the argument is that graduates from the vocational educations bring new learning capabilities and skills to the firm which can provide firms with competitive advantages in a developing economic environment.

The theoretical framework suggests several hypotheses on the effects of closing local vocational educations on firm-level industrial performance. To test the hypotheses, I will make use of the Danish Register data[1] which include firm-level information on such factors revenue, profits, wages paid to employees and total employment. A differences-in-differences methodology allow for estimation of any such effects by comparing developments in characteristics of relevant firms in the treated areas (that is, those areas losing an vocational education) with those of firms in nearby areas that do not experience the treatment.

In the following sections I first provide a broad introduction to the Danish vocational training system, followed by the theoretical framework. I then introduce the data and methodology, and finally I end the research proposal with a preliminary conclusion.

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[1]For the English speaking audience a description of the Danish registers, and in particular the IDA database on which this work is based, has been written by Timmermans (2010)

2   Vocational Education In Denmark and Local Business Environment

The Danish vocational education system is characterized by a high degree of specialization and cooperation with industry. The typical vocational education is aimed at young students, providing an alternative to entering high school, and has a length of 4.5 year. It consists of a one-year basis-course followed by a 3.5 year main course in which the student alternates between classes at the vocational school and an apprenticeship position at a firm (The Danish Ministry of Education, 2011).

This structure is similar to that of the famous dual system in Germany and provide a relatively high degree of specialization for the participating students compared to such systems as the U.S. and the U.K. (Newman and Winston 2016, pp. 130-135; Prais et al. 1989). The apprenticeship structure also fosters strong connections between the vocational schools and firms, which are potentially strengthened through firms participating in negotiations on the development of vocational educations.

The vocational education system also makes up the main part of the education in terms of the amounts of students. Over the period of 2005 to 2015 the share of vocational education students to the total population of students declining from just below 30 percent to approximately 23 percent from 2005 to 2015 (see figure 1). However, the vocational education students remain the second largest group of students in Denmark above primary school, overtaken only in later years by high school students that rise from about 25 to 27 percent over the same period. Similar developments occur in terms of graduating students with a slightly higher initial share of graduating students for the High school level (figure 2). This suggest firstly that vocational education is an important part of the Danish education system as measured in the share of students, and secondly that the vocational education has been on a decline in Denmark in recent years. The latter development may potentially pose problems for comparisons across local areas. However, in a working paper soon to be published (Eriksen, 2017) I show that the only region for which declines in vocational students to the population is large city municipalities, and in particular for the Capital Region. For the remaining part of the country the shares of vocational students remain near constant. While higher education is accumulating in the large city municipalities, this suggest that an analysis of vocational education should emphasize the intermediate and peripheral parts of Denmark.

The mere size of the vocational education system makes it compelling to ask why so little research has been done on the vocational education system. In the next section I will provide a suggestive theoretical framework to investigating the effects of changes in this system.

3   Theoretical Framework

The characteristics of the Danish vocational education system, namely apprenticeships and specialization, suggests high importance of knowledge and learning capacities among students

to hiring firms. In this section I will attempt to sketch a theoretical framework that rests on this notion.

To characterize the types of knowledge that I will be working with, I draw on categories set up by among others Lundvall and Johnson (1994) and later Lundvall (2004). These divide knowledge into four types: know-what, -why, -how, and -who, which each carry are varying degrees of tacitness and codifiability. Know-how is the most tacit and least codifiable of the four, and potentially the most important for vocational education. When the vocational students pursue their educations they are taught the 'tools of the trade' through encountering and solving new tasks; that is, they engage in *learning by doing* (Arrow, 1962). Through participation in activities in the firm, the student learns the routines of the firm in relation to solving these tasks, and accumulates know-how. This type of learning is also emphasized by Jensen et al. (2007) who add learning through *using and interaction* (DUI) to the within-firm and task related learning that may take place in an organization. What is not incorporated in the framework of Jensen et al. (2007), however, is the fact that DUI learning in the school also, potentially, can be important.

When students return to the school during the main course, they can engage with the latest knowledge and technology from their field. If the technological development in a given field is rapid, it is likely that the student acquire know-how yet unfamiliar to the local firms, as well as increase the potential learning capabilities of herself[2] - that is, the learning capacities of the student may potentially be an increasing function of the amount of interaction with the latest technological developments. With increased learning capacity and the latest know-how and -what (the student will most likely also be required to learn what it is that she is working with), students potentially become more of an asset for hiring local firms.

Extending the argument of rapid technological development, we may see that even if the firms are less likely engage in innovative activities (often associated with organization engagement in "Science, Technology, and Innovation" learning Jensen et al. (2007)), the firms will still be affected by technological developments in the field. Increased interaction from younger workers with these types of technologies can improve the firm's relative competitive advantages, and thereby their profitability or potential wage payouts.

So far I have discussed the importance of particularly DUI learning for creating know-how, and to some extend the necessary know-what to employ the skills related to the know-how. However, know-who may also arise from the students school parts of the year. The sharing of information among individuals in and outside of industrial clusters is an extensive part of discussions in agglomeration economics (see e.g. Audretsch et al. 2007 and Glaeser et al. 1992 for discussions of these). In a Danish context, Dahl and Østergaard (2004) show that among engineers in the former ICT cluster in the Northern Region of Denmark informal informa-

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[2]This makes the assumption that learning curves for interaction with the latest technology are steeper than for older technology and that the student accumulates learning capacity through the act learning. An example is the use of computers in cars which increasingly requires auto-mechanics to upgrade their knowledge of the use of computers and basic programming. The rapid development in computer technology may favour younger workers with more experience and higher potential in learning recent programmatic developments as driver-less cars enter the economy.

tion sharing what not just uncommon, but happened even with otherwise sensitive business information. If we assume that engineers and vocationally skilled individuals have somewhat similar behavior, then the know-who of the younger vocational workers can potentially provide firms with further possibilities for increasing their knowledge-base, and enhancing competitive advantages.[3]

I have now set a fundamental framework within which student learning, learning capacities and accumulated skills can be of benefit to the employing firm. However, potential benefits are not enough when discussing local industrial development. The local firms must actually employ the younger workers to gain these benefits. A vocational school may provide the nearby area with a relatively thick labor market with relatively specialized skills. Arguments of local labor markets and industry effects, however, depend on the argument that the mobility of the vocationally trained workers is low, and that vocationally trained individuals have a high propensity to stay in a particular area.[4] As a first step in the analysis I therefore propose to investigate the mobility of vocationally skilled workers in the Danish context.

The above framework suggest several important implications from removing vocational educations from a local area. Removing the education would in a geographically limited location thin the labor market. Let me initially sketch the immediate results that follow in simple labor market models. If we assume that skills are industry specific and substitutions for other skill-types is not feasible, then firms can be forced to pay higher wages to the remaining workers in the local area (I also assume non-discriminating employers and that unions have little effect on wage-setting). As wage levels increase, it may become feasible for other skill-holders to commute to work at the local firms (as commuting bears costs), and the new composition of workers is a mix of local and non-local workers. The increased wages may force firms to also lower their demand for workers as their marginal costs increase. However, of higher importance, we may expect squeezed profits and less entry into and higher exit from the industry.

This example is, of course, higly simplified, but may serve as an initial guidance of the effects that we can expect from closing a local education. The picture becomes muddier when skill-substitutions is feasible, as firms can substitute to other skills at potential training costs and lower productivity (Becker, 1993). However, we may still expect lower profits and higher costs for the firm - partly in terms of lost productivity.

So far the scenario has assumed a static competitive environment. Assuming again that the technological environment is changing, the firms may come under further pressure if it relies on skill-substitution. This can happen as newly employed workers may not have acquired the

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[3]Naturally, this type of interaction can also foster inter-firm linkages, or *interactions*. Lundvall (1985) and the following literature emphasize the learning from interactions as potentially fostering product innovation. This may in turn improve competitiveness of the firms as well. In the current context, however, I will assume *for now that product innovation is not the main driver of competitive advantages due to technological developments external to the firm.*

[4]Drejer et al. (2014) show that university graduates from outside of the capital tend to migrate there following graduation due partly to smaller regional job markets. To what extend this applies to vocational school graduates in Denmark will be included in the paper.

necessary know-how and learning capabilities to efficiently engage with new technology. This would can over time raise the likelihood of firm exit as the local firms loose competitiveness compared to non-local firms. We can also imagine that firm start-up rates may fall as new firms find it harder to find relevantly skilled labor for developing their firm. As before, increased costs and squeezed profits will be the case. The more important the knowledge and learning capabilities of the younger workers and apprentices, the stronger would these effects be.

The above exposition of effects can be summarized in particular hypotheses as to the firm reaction to losing a local source of skilled-labor supply in the face of losing local vocational educations:

Hypothesis 1 Firms react to the loss of local sources of new workers by drawing on non-local labor. This can result in higher wage costs.

Hypothesis 2 Firms substitute the particular educational background and related skills of their workers with alternative types of skills, increasing costs and lowering productivity.

Hypothesis 3 In industries with relatively fast technological development firms with less access to updated skills may experience higher likelihoods of exiting the industry. Entrepreneurs may find it difficult to find workers with relevant skill sets, resulting in lower likelihoods of industry entries. Together, these mechanisms suggest a relative decline of the local industry compared to non-local industries.

The three hypotheses above need not be mutually exclusive, but can rather constitute a complex system of coping mechanisms of local firms in the face of structural changes to the education system. In the next section I introduce the data and methodology that I propose to use to examine the hypotheses.

4 Methodology

In this section I describe the data, particular definitions and the identification and estimation strategies that I propose to employ in the project.

To investigate the three hypotheses, I will make use of the Danish register data that allows for studies using both individual and firm-level information. In particular, using the register data, it is possible to identify local areas where a vocational education is no longer offered, resulting in no graduates from the local area.

An initial definition that I make is that of local areas. Administratively, Denmark is divided into 98 different municipalities and 5 Regions. Prior to 2007 the corresponding number of municipalities was 270, and 13 counties took the place of the regions. In the analysis I propose to use the 98 municipalities as a first approximation of a local area. I do so partly due to the data structure: the geographical location of education institutions, and hence the places where students pursue their education can, can be identified in accordance with municipalities,

whereas better approximations of location are difficult to produce. However, we may note that a municipality potentially not large enough to be considered a local area, the answer to which is to merge municipalities, noticing the limited spacial span of single municipalities, or using a radius around education institutions. The latter option would appear a more organic choice of local area, but lacking information on the exact locations of vocational schools as far back as 1992 makes this practically impossible. As a result I initially define local areas as the municipal area that a firm is located in, and will consider the effects of using merged municipalities, and more organic divisions for the results later on.

To determine what constitutes relevant firms and industries I take an inductive approach. For each case of a closing education, I propose to identify which firms and industries in the local area as well as in Denmark broadly speaking, that have the highest concentration of graduates from this type of education. This inductive approach avoids any issues of misidentification of industries *a priori* which could potentially create large sample-induced biases in the estimated effects.

To identify potential cases of closing educations in a local area I use register information. In particular I gather information on the time and type[5] of highest achieved education of all individuals in Denmark as of 2013.[6] From this information I create datasets with amounts of graduates by municipality and education type by year. A case is identified by a permanent stop of production of graduates in a given year. Using this method I have identified a total of 114 cases in Denmark distributed across 55 municipalities and 28 education types.

An important consideration in this study is that of potential endogeneity. To estimate effects of changes to the education structure I require that the choice of closing the particular education in the particular local area is exogenous to the local firms. Reasons for endogeneity can include a declining industry size and high rates of unemployment from local de-population if these induce administrative or political choices to close educations. Another example of a third variable determining both the dependent variable(s) and the assumed independent variable could be legislative changes forcing specific types of industries to close their production in Denmark. To argue for exogeneity in a particular case, I will use comparisons of local and national industrial developments prior to treatment. I will also use administrative information to infer rationales behind closings when available.

To estimate the effects I propose to use a differences-in-differences estimation strategy (Angrist and Pischke, 2009, pp. 228-242). Each 'treated' area will be matched with a control area that does not experience the treatment of a loss of education. The areas will be matched based on location and developments in main industrial characteristics prior to the treatment. The estimated effects of treatments is then the differences in the ex ante and ex post industry characteristics of interest.

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[5]The type of education is identified using the *Undergruppe* information in *forspalte1* from Statistics Denmark. A full description of the categories can be found at `http://www.dst.dk/da/Statistik/dokumentation/Nomenklaturer/Forspalter`. An example of a subgroup is "*Carpenters etc.*" which include the educations of carpenter, glazier, and flooring carpenter.

[6]in a more elaborate attempt to identify cases, I would utilize the total span of the register data (1980-2013) to find cases.

The use of this estimation strategy allows me to look past discussions of developments that are not particular to a local area, but affect the total industry, or even economy. Examples of such that have particular relevance for the types of skills- and knowledge arguments that I have set forth is those of skill-biased technological change (Card and DiNardo, 2002) and the potential developments related to the industry 4.0 (Davies, 2015), as well as national level policy changes, for example through environmental laws. It naturally also take into account the macroeconomic environment, including whether the economy is in recession, or see macroeconomic growth.

I am currently working on producing initial results based on 14 particular cases.

5   Conclusion

Above I have outlined a research project that attempt to investigate the effects of closing vocational educations for local industrial development. In the theoretical framework I emphasize the skills, knowledge and learning capabilities that graduates from vocational educations in Denmark bring to firms. The relevance of these characteristics may potentially increase with relatively higher technological development within an industry. The potential effects cover increased wages, lower productivity, and substitution to workers with inferior skill characteristics. At an industry level I expect declines in size as the likelihood of firm exists increase and firm entry decline. To identify the effects I propose to use Danish register data, in which I find 114 potential cases of municipality specific education closing. The estimation strategy of choice is differences-in-differences, comparing treated local areas with nearby untreated areas. This allow me to disregard questions of macro-level developments, such as changing industrial compositions, national policy, and the macroeconomic environment.

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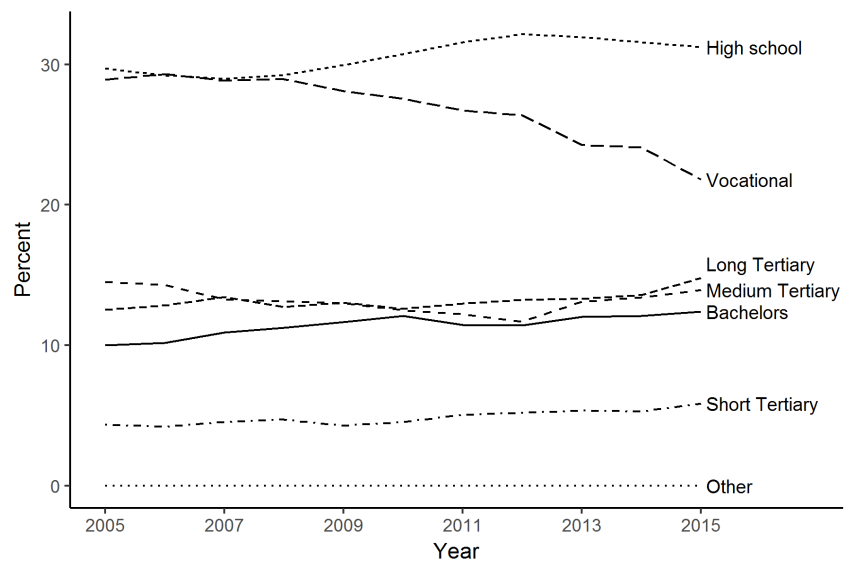
A Students by Level of Education

Figure 1: Active students above primary education by level of education, 2005-2015
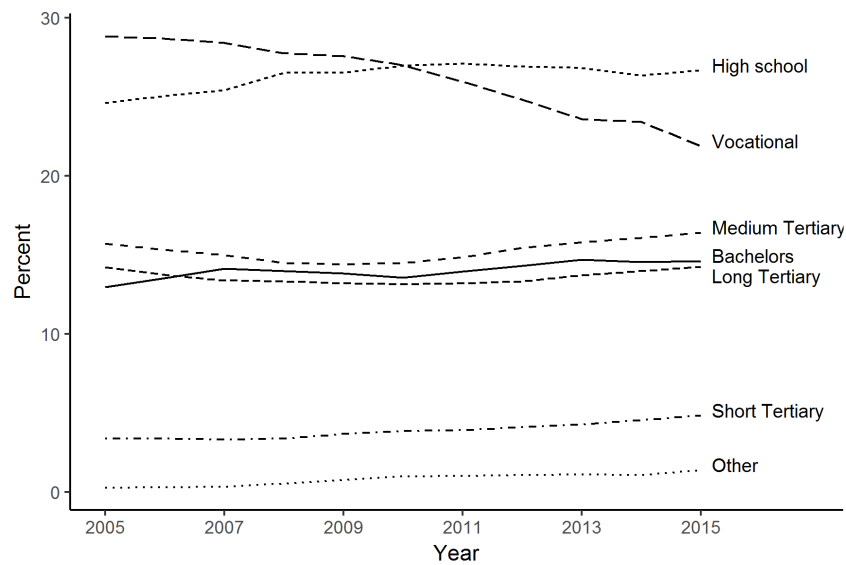
Note: Distribution of active students above primary education by education level, based on data from www.statbank.dk.

Figure 2: Graduating students above primary education by level of education, 2005-2015

Note: Distribution of graduating students above primary education by education level, based on data from www.statbank.dk.