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VOCATIONAL EDUCATION, MANUFACTURING, AND INCOME DISTRIBUTION: INTERNATIONAL EVIDENCE AND CASE STUDIES

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Vocational Education, Manufacturing, and Income Distribution: International Evidence and Case Studies

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ABSTRACT

Economic integration has brought about not only benefits and opportunities but also required adjustment, especially for the youth entering the labour force. The lower growth rates characterizing the post Global Financial Crisis era and the concerns about income inequality put to the fore the degree that better targeted investment in human capital may ameliorate the challenges facing the working poor. Using cross-country data, we find the association between the income shares of the working poor, dependence on manufacturing sector, and the availability of vocational education. Conditioning on tertiary educational attainment, improved access to better vocational education will probably contribute more than large increase in regular college attainment. Comparing the US to Germany suggests that pushing more students to BA granting colleges may no longer be the most efficient way to deal with the challenges caused by the decline in manufacturing employment affecting in particular lower-income households. We also note that a tracking of technical training and educational budget, shown in the case of Vietnam in comparison to Thailand, as well as government subsidies for reskilling of labour fource throughout their career in Singapore, is a potential explanation for their relative manufacturing competitiveness.

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1. Introduction

The Global Financial Crisis (GFC) and the resultant growth deceleration eventually focused attention on increasing inequality, and specifically on the declining real incomes of the working poor. The evidence of the increasing inequality is meticulously documented, most notably by Piketty's (2014) now famous *Capital in the 21st Century*.

At the same time, the role of education and acquired skills in upward mobility and in generating growth has also been well appreciated (e.g., ILO, 2014. Behar, 2016). The potential for job-related training as a means to achieve growth in incomes and reductions in inequality has been noted, as well (e.g., Attanasio et al., 2017). However, lingering questions remain about the types of educational programs associated with the most effective improvement in incomes at the lower end of the income distribution; and what factors shape the effectiveness of these programs.

This generated a significant debate and disagreement in the recent US elections. "Free college" was an effective rallying cry for Clinton's primary opponent, Bernie Sanders. At the Democratic Convention, Sanders gave a speech endorsing Clinton, in which he said: "We have come together on a proposal that will revolutionize higher education in America. It will guarantee that the children of any family [in] this country with an annual income of $125,000 a year or less…will be able to go to a public college or university tuition-free." Clinton herself also backed universal free community college. Both these two proposed programs taken together are estimated to cost half a trillion dollars if phased in over four years (CRFB, 2016). Obviously, these plans will not be implemented soon given the election results, but the public debate about the cost of higher education in the United States has certainly not been resolved.

In this paper we question this focus on higher education as a solution to the declining low incomes and increasing inequality problems. With limited resources, what should be the focus of subsided education? Is (nearly) free college education the key for a solution to these problems? Will it likely address the problems of the working poor? In order to answer these questions, we examine the data.

Looking at the OECD countries, an observed pattern and a tentative answer is that improved access to better vocational education can probably contribute more than large increases in college attainment. Using the OECD data, we confirm an observed quantifiable association between the income shares of the working poor and the availability and take-up of vocational

education. Contrasting the United States and Germany suggests that pushing more students to degree-granting colleges may not be an efficient way to deal with the declining real incomes of the working poor. Such policy may induce private and public overinvestment in higher (degree) education by some segments of the population, with little observed economic returns. Before we turn to the evidence (in section 2 and 3), we add a few more observations from the literature that has examined the efficacy of vocational training programs in specific countries.

Previous empirical research on vocational training, from LaLonde (1986) onward, has largely focussed on specific training programs training the under- or un-employed, and more recently usually within the context of randomized control trials methodology for treatment identification. Recent examples include Attanasio et al. (2017) which provides a long-term analysis of such a program in Colombia, Blattman et al. (2014) which focus on a training program in Uganda, and Card et al. (2011) on youth vocational training in the Dominican Republic. The findings from this literature are mixed, with, not surprisingly, differing levels of efficacy associated with different programs.

More similar to our interest, another strand of the literature has posed the question whether public policy should prefer more generally investment in vocational or academic training, but this literature is generally older and also focuses on specific country experiences—e.g., Yang (1998) on China. Moenjak and Worswick (2003), for example, examine individual data from Thailand and the choice between general and vocational education, and finds a financial benefit associated with vocational training. El-Hamidi (2006) examines this choice in Egypt, and arrives at the opposite preference, arguing that general education coupled with on-the-job training provides the highest benefit. Chen (2009) and Newhouse and Suryadarma (2011) using detailed data from the Indonesia household panel survey, find more nuanced differences in the employment outcomes of those who received academic vs. vocational education at the upper-secondary level; heterogeneities appear to depend on the gender, the cohort, and the socio-economic background of the students examined.[1]

There are other important factors affecting the mode of education and patterns of inequality. We do not intend to capture all of them in this paper. Students may choose to take up vocational

[1] Malamod and Pop-Eleches (2010), examining evidence from Romania, conclude that identified differences between those who pursue the academic vs. the vocational track are largely driven by self-selection into these two options, rather than by any impact of the tracks themselves. Meer (2007) finds evidence from US data that accounting for self-selection overturns previous conclusions in favour of vocational tracking.

training rather than pursue their passion in university degree of choice because of financial reasons. This can represent a form of inequality in educational access. It is also not clear that denying educational desire at the personal level (e.g. giving up a BA in English to pursue vocational training in healthcare because of the latter's financial advantage) will lead to an improved wellbeing, even if increased incomes materialise.

In the next section, we describe the previously unexamined cross-country evidence which forms the backbone of our analysis, while we discuss some comparative case studies contrasting the US with Germany and Thailand with Vietnam in Section 3. We end with some concluding remarks in Section 4.

2. Cross-Country Evidence

2.1. Data

We combine data from several sources. We use the World Wealth and Income Database (Top 10% Income Share) and OECD data (S80S20, P90P10, GINI)[2] for measurements of inequality. For manufacturing and exports, we use data series from the World Development Indicators: Manufacturing value added as share of GDP, manufacturing exports as share of merchandise exports, high-technology exports as share of manufactured exports, and trade as percentage of GDP. For access to vocational education, we use OECD data on the share of vocational programmes as percentage of upper secondary education, UNESCO data on the share of youth (15-24 years old) enrolled in secondary education, Eurostat data for the number of enterprises providing continuing vocational training (CVT) as share of all enterprises, percentage of employees from all enterprises participating in CVT courses, and cost of CVT courses as percentage of total labour cost. The estimation sample includes at most 21 countries, depending on the variables used in estimation, covering the years 2003-2013. Table 1 provides a country list and summary statistics; the vocational training data is only available for 10 countries, so these constitute our most restricted sample.

For inequality, we see in the data in Table 1 a wide variation across measures and countries. The top 10% income share ranges from 14.6% in Mauritius to 61.0% in South Africa, with a standard deviation of 9.0% for the full 21-countries sample. Our sample drops to 13 OECD

[2] The bottom 80% / top 20% income ratio and the 90/10 ratio, respectively.

countries when we examine the S80S20, and gini data. These three measures are very highly correlated with the 13 countries for which we have data, so it is of little importance which of the three is used in the regressions described below.[3] According to all three inequality measures for this very limited subset of countries, the most unequal countries are Portugal, Spain and the United Kingdom, while the most equal ones are the Scandinavian countries, the Netherlands, and Germany (the United States is not included because of the lack of vocational training data).

On the size of the manufacturing sector, China has the largest in our sample (31.6% of GDP), while Norway has the smallest (8.9%). According to Deloitte (2010, 2013, 2016), four of the biggest five manufacturing countries are in our sample: China, Germany, Japan, and the UK. We also include measures of exports, and the variability in this measure is very high: Some countries hardly export any manufacturing, while others export almost exclusively manufacturing; there is similar variability in the amount of high-tech exports, and the total trade to GDP ratio.

On the share of vocational education, Netherlands has the highest indicator (68.3%), while South Africa has the lowest (8.9%). As we noted previously, South Africa has the highest top 10% income share, and the lowest share of vocational education, while the Netherlands has almost the opposite. Across countries, the correlation between a measure of inequality (top 10% income share) and measures of vocational education is always negative. It is about -0.3 for the share of vocational education, -0.5 for the share of continuing vocational training (CVT) enterprises, -0.4 for the share of CVT employees, and -0.4 for the CVT costs.

3. Empirical Specification

Most of our regressions are limited to the 10 countries for which there is CVT data, so we choose to exploit the time dimension of the available data for countries for which the CVT is available. We estimate a panel model, and use a fixed-effects estimation:

$$Inequal_{it} = \alpha + \beta manuf_{it} + \gamma edu_{it} + \delta(manuf_{it} * edu_{it}) + \mu_i + t + \varepsilon_{it} \quad (1)$$

where $\alpha, \beta, \gamma, \delta$ denote parameters for estimation; μ_i is the country fixed-effects, t is the linear time trend and ε_{it} is the vector of regression residuals (assumed iid).

[3] The correlation coefficient between the first two measures in 0.97, while between the second two measures the correlation is 0.92.

Table 2 reports coefficient estimates for equation (1). In column (1), we find that both the relative size of the manufacturing sector and the share of vocational education are positively associated with the top 10% income share. In a standard trade model, both terms-of-trade adjustment and technological bias for skilled labor can give rise to the increasing inequality. Interestingly, we find that an interaction of the relative size of the manufacturing sector and the share of vocational education is negatively associated with the top 10% income share. As manufacturing sector becomes more important in a country's income, relatively unskilled labors benefit from access to vocational education, thereby narrowing the income gap with skilled labor. Alternative specifications using manufacturing/GDP and high-tech exports/total exports provide the same qualitative results.

Table 3 provides coefficient estimates using alternative measures of inequality and educational access to vocational training. As we have previously observed that these measures of inequality are highly correlated in our sample, these robustness checks are largely supportive of the baseline estimates. There is less variation in other measures of inequality relative to the top 10% income share (as shown in the summary statistics), but the effects of manufacturing sector and share of vocational education remain statistically significant also for S80S20, and GINI.

Figure 1 illustrates the marginal effects of vocational share on inequality for three different levels of manufacturing's contribution in two baseline and two robust models (low, medium and high corresponds to the 25^{th}, 50^{th} and 75^{th} percentile of manufacturing). Specifically, at low level of manufacturing contribution, increasing vocational share is correlated with either an increase or only a small reduction in inequality, ceteris paribus. However, as manufacturing increase its relative share in the economy, incremental improvement in vocational education's access for students is associated with significantly larger decline in inequality. This phenomenon might be explained by the supply and demand in the market for skilled labour. Unless improving acess to vocational education is accompanied by simultaneous increase in manufacturing jobs, the potential reduction in inequality might be missed.

Most importantly, the alternative measures of educational access to vocational training—share of vocational education in upper education, the cost of vocational training, share of youth (15-

24 years old) enrolled in secondary education —all yield consistent results with our main findings.[4]

In order to examine the relative importance of tertiary versus vocational education in tackling inequality, we include the ratio of labour force with tertiary qualification and its interaction with manufacturing to our baseline model.[5] The regression results as well as the comparison of two interaction effects are reported in Table 4 and Figure 2, respectively. Even though both vocational and tertiary share are positively correlated with rising inequality, the interaction effects are negative and significant. Moreover, the interaction of vocational share is much higher in absolute term, which suggest that as manufacturing contributes more and more to the economy, vocational education appears to be a better complementary policy that can reduce inequality.

4. Case Studies

4.1. Germany versus USA

The post GFC dynamics in the US put to the fore the decline in manufacturing employment there. A narrative gaining political momentum (and the presidency) has been that US manufacturing employment decline is the outcome of globalization. Accordingly, NAFTA, the WTO, and other trade agreements, and the sizable current account deficits of the US were the key drivers for the decrease in manufacturing employment. In contrast, according to this narrative, China and Germany are prime examples of countries benefiting from globalization. This section reflects on these arguments, focusing on the contrast between Germany and the USA.

To put these claims in the longer-term perspective, Figure 3 reports the manufacturing employment shares, 1970-2012, vividly showing that the trend decline in manufacturing employment is common to both Germany and the US. While Germany's level of manufacturing employment remains well above that of the US—higher by 13% in 1970 and about 10% in 2012—both countries experienced continuing employment declines, at annual rate of loss of

[4] These results are consistent with micro-econometric case studies dealing with emerging markets—e.g., Moenjak and Worswick (2003) for Thailand, and Attanasio et al. (2011 and 2017) for Colombia.
[5] This is used to represent the relative importance of tertiary education instead of the share of general prorammes in upper secondary education to avoid perfect colinearity

0.47% in Germany, and 0.38% in the US. Indeed, similar trends apply across other OECD countries, and even beyond the high-income countries to many emerging markets.[6]

Figure 4 provides pertinent information on the main driving factor, reporting the manufacturing value added/GDP for Germany and the US during 1997-2015. Remarkably, despite the decline in manufacturing employment share in Germany, the manufacturing GDP value added share in Germany has been stable, at about 23%, recovering fully after a V shape adjustment during and after the GFC. In contrast, during that past two decades, the US experienced a drop of about 5% in the manufacturing value added, at the same time that manufacturing employment share dropped by 6%.

These trends are in line with the view that technological changes were the key drivers affecting both the US and Germany, though German overall increases in labor productivity generated these differing outcomes. Figure 5 reports the index of real Unit Labor Costs in the Manufacturing Sector, 1992-2016. The chart is consistent with the superior performance of manufacturing in Germany relative to the US: the real unit labor cost in the US dropped by about 10% in the US relative to Germany, at times that the manufacturing value added declined significantly in the US, while it was constant in Germany.

The differential manufacturing performance of these two countries may be the outcome of structural factors, as well as policies. While we cannot pin down a causal interpretation, we note several structural differences between these countries that we think are important. The educational attainment aggregate numbers of the two countries differ sharply. The labor force in Germany is relatively more replete with workers with upper-secondary education, and the labor force in the US with those who have tertiary education credentials. The share of workers with upper secondary in Germany exceeds that of the US by about 15% points, and share of workers with tertiary education in the US exceeds that of Germany by about 17% points (see Table 5). On its face, therefore, the US labor force is more educated or more highly skilled.

Other noteworthy difference are the design of public policies more generally and specifically the patterns of inequality and redistribution. The safety net in Germany is deeper and wider than in the US, covering more people and with more resources, and the income inequality in the US is substantially higher than that in Germany (see Table 5). Given the relative success

[6] Globalization, thus, does not appear to be a zero sum game of winners and losers in the struggle for trade. It hard to see how globalization can explain the almost universal declines in manufacturing employment.

of German manufacturing value added in recent decades, it is likely that Germany's education system fits better the needs of modern manufacturing. It is likely, as had been hypothesised before, that modern manufacturing requires more upper-secondary and vocationally trained labor rather than more workers with tertiary academic education.

The public policy concern about over-investment in four-year colleges in the US largely concentrates on the newer for-profit and online sectors (e.g., Deming, Goldin, and Katz, 2012). Yet, the rise in the cost of college education at rates that are out of line with the expected employability and the financial return associated with college education are found in all the different components of the tertiary education system—from two-year public institutions that are the cheapest, to the four-year private for-profits that are generally the most expensive and show the lowest return on investment. The very large system of tertiary education in the US is very heterogeneous, but it puts the main emphasis on the four-year college system (both private and public, and for- and non-profit). This overinvestment is found in all parts of the system, and is partly driven by a lack of information about the distribution of the college premium in all types of institutions.[7]

Other concerns, beyond escalating costs and overinvestment, are the limited information available to students regarding the alternatives available to them. There are also concerns about the information regarding co-funding with federally subsidized loans, which allows many colleges to survive despite delivering a low-quality education with clearly negative financial returns. These funding models saddle the working poor with high debt burden that appears unjustified by the low return on their investment.

The total outstanding student loan debt in the U.S. is US$ 1.2 trillion, the second-highest level of consumer debt behind only mortgages.[8] These facts are consistent with the mismatch hypothesis -- there are too many four-year colleges serving too many students, and too few

[7] The college premium is the return to college education in terms of additional lifetime income. We know very little about the distribution of these premiums at the lower end of the income distribution.
[8] Marketwatch (2016) reported that about 40 million Americans hold student loans and about 70% of bachelor's degree recipients graduate with debt. One in four student loan borrowers are either in delinquency or default on their student loans, according the Consumer Financial Protection Bureau. http://www.marketwatch.com/story/americas-growing-student-loan-debt-crisis-2016-01-15. An overview of the heterogeneity of the US college system can be found in http://nces.ed.gov/programs/coe/indicator_csa.asp.

institutions with greater focus on vocational education and training. This mismatch is sustained by the skewed assistance scheme that is facilitated by the federal government.[9]

While manufacturing employment share has declined substantially in both countries, the shallower safety net in the US may explain why this issue has generated greater social impact in the US than in Germany. The first-ever decline in life expectancy in some parts of the US, and the growing despair of the displaced less educated workers in the US, identified by Case and Deaton (2015 and 2017), probably reflects these shallower safety net. It may resemble more the dynamics in Russia after the collapse of the Soviet Union and its own de-industrialization, rather than the dynamics observed in Germany.[10]

The vocational employment training (VET) in Germany is much more developed. The CESifo database on Institutional Comparisons in Europe (DICE) includes a lot of institutional detail about the VET found in many European countries (and where the data is available, also the US).[11] For example, Germany starts identifying students who are struggling in the 'academic' track in middle school (7th grade), and has various mechanisms in place to assist these students to succeed in VET programs, while in the US, any assistance that is available, is only for students once they drop out of a 'normal' high-school, and can get assistance to receive a GED (a certificate that is considered equivalent to completing high-school). Vocational training even after that (post-secondary) is still rare, and is almost only found if it is organised privately for specific professions.

Rebalancing the post-secondary education system in the US with more vocational training may not be a panacea.[12] Yet, overlooking the need to align the education system with the demands

[9] A Brookings study, Looney and Yannelis (2015), found that a large share of the growth in the number of students struggling to pay off their student loans is from students borrowing to attend for-profit schools. These public policy concerns are magnified by the fact that student debt in the US is not erased if one declares bankruptcy, unlike credit card debt. Mortgage debt is even easier to walk away from. Hence, student debt is especially pernicious and damaging as it is more long-lasting.
[10] Germany had its fair share of socially costly dislocation associated with the unification of East and West Germany. The contrasting dynamics between the US and Germany validate Rodrik (2011)'s conjecture that deeper safety is conducive towards smoother globalization and the adjustment to new technologies.
[11] http://www.cesifo-group.de/ifoHome/facts/DICE/Labour-Market/Labour-Market/Training.html.
[12] Notably, Hanushek et al. (2017) concluded that vocational education is harmful in the later phases of work careers - vocationally qualified workers are the first to be laid off after the age of 50 because their specific skills are likely to be outdated. Yet, Forster et al. (2016) noted that, while it may be true that people with vocational qualifications are less likely to be employed later in their career, this pattern may be unrelated to the way that vocational education is organized. Specifically, they argue that the warning of Hanushek et al. (2017) to the proponents of a German style vocational training system should imply that the late career disadvantage of vocational degrees would be more

of the real economy comes with growing personal and social costs. We close this case study by noting that the US mortgage debt crisis of 2008-2010, and the education debt overhang in the US may both be indicative of structural differences that led to over-investment in both real estate and in college education in the US relative to Germany.[13]

3.2 Thailand versus Vietnam

Thailand and Vietnam are middle-income countries striving for export-led manufacturing success in global markets.[14] In the Global Manufacturing Competitiveness (GMC) report (Deloitte, 2016) they are, together with Indonesia, Malaysia and India, have been considered as the "Mighty Five" or the potential substitutes for China in terms of new manufacturing hubs. For the past three decades, cheap labour, favorable demographics characteristics, and proximity to Japan, Korea, and China have contributed to their performance in manufacturing exports. The past decade, however, saw even cheaper labour, from other middle-income countries, eroding the comparative advantage of both Thailand and Vietnam, while the learning-by-doing increasing returns dynamics that are sometimes associated with participation in global supply chains has proved to be rather elusive for these two emerging economies.[15]

Figures 6 illustrates the structure of the educational system in Thailand and Vietnam. With regards to the technical and vocational training, an earlier start of tracking and differentiation in Vietnam (lower secondary) than in Thailand (upper secondary) is a notable difference. For Thailand, the vocational programmes are under the Ministry of Education, while Vietnam legislated its two institutions (Ministry of Education and Training, and Ministry of Labour-Invalids and Social Affairs) to oversee the technical training.[16] In both countries, there is a

pronounced in countries with a large dual system (i.e., work and school based). Looking at the data, they did not find evidence of that difference. On the contrary, German-like education systems with a strong emphasis on dual tracks are characterized by less disadvantage late in the careers of vocationally qualified workers. The negative effect of vocational training at the end of the career are observable statistically only in countries that do not have dual-track systems, like the United States and Canada.

[13] This over-investment may reflect structural factors such as the differential use in leverage in funding housing and education services in the two countries, the differential tax system, and the greater role of private and for-profits education in the US (see Aizenman and Noy, 2012).

[14] According to the World Bank's Development Indicators, in 2015, GDP per capita in Thailand was almost USD 6000, while in Vietnam it was about USD 2100.

[15] At least partially, this difficulty is surly rooted in the political challenges Thailand and Vietnam are facing. The former is currently ruled by the military, following a coup in 2014, the latter is under the absolute rule of the Communist Party of Vietnam.

[16] In fact, since January 2017, vocational education's management has been fully transferred to the Ministry of Labour, Invalids and Social Affairs in Vietnam.

lack of micro-level evidence on the effectiveness of vocational training. The preference for university education in both countries also stigmatizes the acquisition of vocational certification and reduces the desirability of vocational degrees. This, of course, implies that those who self-select into the vocational track may do so not out of a preference but because the academic track is closed for them. Consequently, if academic performance might be considered as positively correlated with ability and earning potential, these vocational graduates would end up with lower income and therefore even worsen public perceptions on vocational education. On the other hand, in both countries, low quality of training and lack of harmonized skill accreditation system also prevented vocational qualifications from being sufficiently recognized by employers (Huang, 2012). Together with poor public perception, these inadequate recognitions have contributed to relatively low enrolment rate of vocational education at all levels in both countries.

The contrasts between Thailand and Vietnam are noticeable in the budget allocation for education. Both countries spent close to 5% of GDP on education, similar to more advanced economies such as Germany and the United States. Yet, as shown in Figures 7.a and 7.b, Vietnam allocated almost 20% of the education budget on upper-secondary education (vocational training included), while Thailand expensed only 10% for the upper-secondary level.[17]

In terms of institutional framework, only Vietnam has issued the Law of Vocational Training (2006), which has been continuosly reviewed and revised. Since its adoption, the law has substantially improved the management of vocational education and its quality in Vietnam (Hilal, 2013). Perhaps its investment in vocational training and institutional difference help explain the forecast that Vietnam is about to overtake Thailand for its global manufacturing competitiveness[18].

Figures 8.b and 8.b provide the level of manufacturing competitiveness together with some underlying factors. Based on the survey of CEOs by Deloitte (2010, 2013, 2016), by the next

[17] According to Vietnam Vocational Training Report 2013-2014, on average, expenditure on vocational education & training accounts for approximately 7.9% of Vietnam's total government expenditure during this period (around 40% of total education budget.)

[18] Younger labour force as well as more competitive unit labour cost in manufacturing might also partially contribute to this forecast. Latest Labour Force survey in both countries reveal that youth (age 15-24) account for 10.6% and 15% of the total labour force in Thailand and Vietnam, respectively. In addition, Thailand's unit labor cost in manufacturing is approximately 40% higher than in Vietnam (GMC report, 2016)

decade Vietnam is expected to rise to be the 12th among the top manufacturing exporters globally, while Thailand will remain at the 14th place.

Currently, not enough data is available to determine if indeed Vietnam's additional investment in technical and vocational training, and its add-on effects to the manufacturing sector, would eventually translate into lower income inequality in Vietnam (and to a lesser extent in Thailand). Currently, the richest 20% have more than 40% of national income in both countries. Shown in Figures 9.a and 9.b, the gap between the top 20% and the bottom 20% has been fairly constant for the past three decades. Access to vocational training may be an important component of a possible strategy for reducing this inequality.

5. Conclusions

Labour saving technological innovations probably account for the decline in manufacturing employment share more than international trade. The declining employment share in manufacturing resembles the earlier collapse of employment share in agriculture, though the speed of the adjustment has accelerated substantially. As information technology and more recently artificial intelligence impact more sectors, there is as yet no evidence that the new disruptive technologies will open up new lines of employment at a rate that will be sufficient to compensate for the disappearance of employment in old industries (Acemoglu and Restrepo, 2017). Furthermore, it is not clear that the skills required for these new jobs will be matched with those workers whose jobs disappeared. This renewed need for better matching of skills between workers and new jobs will most definitely be affected, to a certain extent, by the quantity and quality of vocational training available in each country. It is this vocational training that we see as playing a central role in determining the outcomes for the low-skilled, low-wage, workers that populate the lower part of the income distribution. It is thus this vocational training that can have a large impact on income inequality.

The quantitative evidence on the role of vocational training is imperfect, but both the limited cross-country evidence analysed here, and the comparisons we made convinced us that well-resourced and well-targeted vocational training can prove to be a better long-term investment in skill acquisition and can assist in ameliorating the difficulties faced by those workers whose jobs are currently disappearing and whose prospects look, in many cases, to be quite bleak.

A key challenge for the countries on the technological frontier will therefore be to provide this vocational training and re-training that will hopefully prevent the jobless future whose consequences we do not yet quite understand. Failing to do this, countries will either have to rapidly upgrade their safety net to avoid increasing destitution, or to face the consequences of the greater political instability and the social costs associated with the hollowing-out of the middle class—political instability that is most likely associated with such anomalies as the Brexit vote, the US election of 2016, and other recent electoral surprises.

An example of government playing very active role in vocational education is Singapore. Since 2016, the government has subsidised any training courses (currently about 9,000) from educational providers, including universities and online learning, for SGD500 to Singaporean workers above the age of 25, and up to 90% for workers above the age of 40 (The Economist, January 12, 2017). While Singapore is known for its entrepot and manufacturing economy, this type of government program has a potential to help reskill and protect workers from adverse trade effects and adjustment in the global competitive market landscape.

In the future, we hope to work on extensions that will examine: (i) the importance of vocational training in the service sectorss (manufacturing is the declining sector in the OECD and in some emerging countries), (ii) more detailed accounting of the quality of vocational and college education, and (iii) the impact of vocational training on poverty (i.e., the income share of the working poor).

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Table 1. Country List and Summary Statistics.

Country	Top 10%	S80S20	P90P10	GINI	Manu/GDP	Manu/EXP	Hitech/EXP	Trade/GDP	VET share	youth VET	CVT Ent	CVT employ	CVT cost
Australia	29.7	5.9	4.4	34.3	10.6	23.6	12.9	40.9	56.2	10.8			
China	37.7	9.3	7.6	46.9	31.6	92.2	25.5	50.0	45.1				
Denmark	25.7	4.3		27.5	15.0	64.4	18.9	87.3	53.4	14.5	91.0	37.0	1.8
Finland	31.1	4.0	3.0	26.3	25.0	83.2	21.9	73.8	55.1	17.3	74.0	40.0	1.4
France	30.7	5.0	3.6	31.6	13.3	79.6	22.3	53.9	50.2	16.6	76.0	45.0	2.5
Germany	37.9	5.0	3.5	31.2	22.4	84.3	16.1	70.4	58.5	19.0	73.0	39.0	1.5
Ireland	36.3	5.2	3.9	31.9	21.7	85.3	30.1	155.2	33.1	6.9			
Italy	33.2	6.1	4.3	33.0	18.1	86.4	8.0	49.2	49.4	16.3	56.0	36.0	1.1
Japan	40.7	5.4	5.2	32.9	21.5	91.8	23.0	24.7	24.7	6.5			
Korea	39.1				28.4	90.2	30.5	77.0	29.8	8.1			
Malaysia	24.0	11.3		46.3	26.7	72.5	52.0	182.7	15.4	3.1			
Mauritius	14.4				21.4	68.7	2.5	119.8	12.6	3.3			
Netherlands	30.0	4.6		29.4	13.7	60.3	27.1	126.5	68.3	23.7	79.0	39.0	2.2
New Zealand	31.3		4.2	32.8	13.1	23.5	9.8	58.0	29.6	5.7			
Norway	29.2	4.2	2.9	27.5	9.6	19.9	16.8	70.7	56.6	19.8	97.0	46.0	1.7
Portugal	36.9	7.1	5.4	38.4	16.4	83.4	7.0	63.4	27.8	7.0	65.0	40.0	1.9
Russian	46.8	8.1	5.9	41.0	16.0	17.6	9.7	52.5	46.6				
Singapore	40.9				22.1	73.7	47.6	400.4	11.2				
South Africa	61.0	27.2		63.2	14.3	48.4	5.1	61.1	8.9				
Spain	34.1	6.5	4.8	33.8	15.6	75.3	6.8	55.2	39.1	6.8	75.0	48.0	1.6
Sweden	29.8	4.0	3.2	26.9	20.1	78.4	16.0	83.4	53.4	17.3	87.0	47.0	1.7
Switzerland	32.2	5.5		33.5	19.4	89.2	23.6	100.5	65.1	20.4			
United Kingdom	40.8	6.0	4.4	35.4	11.9	74.0	26.3	54.1	30.9	12.5	80.0	31.0	1.1
Uruguay	49.9	10.7		45.8	16.2	25.8	6.2	52.5	29.1	6.8			

Table 2. Baseline Results

Independent variables	Dependent variable							
	Income shares of top 10%							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Manufacturing/GDP	.86098			.79657				
	(.10848)***			(.07873)***				
Manufacturing/Export		.11948			.03872	.16430		
		(.04350)***			(.03151)	(.11840)		
High-tech/Export			.23241				.50532	
			(.06598)***				(.10730)***	
Trade/GDP								.18603
								(.05284)***
Vocational share in upper secondary	.18266	.08477	.02578					
	(.04661)***	(.05494)	(.02547)					
Ratio of youth enrolment in vocational				.44950	.14812			
				(.09199)***	(.06825)**			
Vocational training cost/total labour cost						Time-invariant: 2010 value		
Interaction term	-.01180	-.00164	-.00444	-.02943	-.00327	-.12370	-.25588	-.08755
	(.00253)***	(.00072)**	(.00140)***	(.00557)***	(.00111)***	(.06815)*	(.06140)***	(.02827)***
Linear time trend	x	x	x	x	x	x	x	x
Number of countries	24	24	24	20	20	11	11	11
Number of observations	260	262	262	272	276	230	230	230
Time period	16	16	16	24	24	25	25	25

Note: Fixed-effects estimation with linear time trend. ***, **, * denotes statistically significance at 1, 5, 10 percent. Countries included: AUS,CHN, CHE, DEU, DNK, ESP, FIN, FRA, GBR, IRL, ITA, JPN, KOR, MUS, MYS, NLD, NOR, NZL, PRT, RUS, SGP, SWE, URY, ZAF. Years covered but with some missing observations: 1990-2014.

Table 3. Alternative Inequality Measures

Independent variables	Dependent variable							
	S80S20				Gini			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Manufacturing/GDP	.34193		.00166		.14353		.23537	
	(.09242)***		.25786		(.10153)		(.08835)***	
Manufacturing/Export		.08268				.05911		
		(.02412)***				(.02662)**		
High-tech/Export				.07294				.19748
				(.03820)*				(.10192)*
Vocational share in upper secondary	.13434	.20606			.06301	.12124		
	(.03742)***	(.03428)***			(.03936)	(.03778)***		
Ratio of youth enrolment in vocational			.20772				.12311	
			(.10866)*				(.11035)	
Vocational training cost/total labour cost				Time invariant - 2010 value				Time invariant - 2010 value
Interaction term	-.00502	-.00295	-.01194	-.02894	-.00285	-.00188	-.00827	-.06870
	(.00189)***	(.00052)***	(.00565)**	(.02336)	(.00203)	(.00057)***	(.00590)	(.06439)
Linear time trend	x	x	x	x	x	x	x	x
Number of countries	65	65	55	27	68	68	68	27
Number of observations	516	511	413	293	552	550	550	355
Time period	16	16	17	19	16	16	16	26
F-statistic	58.439	47.510	47.976	23.260	122.540	104.664	117.744	45.035

Note: Fixed-effects estimation with linear time trend. ***, **, * denotes statistically significance at 1, 5, 10 percent. Years covered but with some missing observations: 1990-2016. *S80S20: S80/S20 income quintile share ratio - Gini: Gini coefficient (%)

Table 4: Vocational versus tertiary education

Independent variables	Dependent variable			
	Income shares of top 10%		Income quintile shares S80S20	
	Model 1	Model 2	Model 3	Model 4
Manufacturing/GDP	.26129	.99403	.22989	.28772
	(.06666)***	(.13847)***	(.05218)***	(.04151)***
Vocational share in upper secondary	.76289		.52867	
	(.14116)***		(.10216)***	
Ratio of youth enrolment in vocational		.78201		.24302
		(.10034)***		(.06952)***
Labour force with tertiary qualification	.12979	.16093	.05908	.11915
	(.03888)***	(.02459)***	(.04937)	(.02790)***
Interaction (Manufacturing x Vocational share)	-.01249	-.04666	-.00844	-.01059
	(.00308)***	(.00642)***	(.00215)***	(.00472)**
Interaction (Manufacturing x Tertiary share)	-.00246	-.00933	-.00165	-.00331
	(.00113)**	(.00187)***	(.00109)	(.00177)*
Linear time trend	x	x	x	x
Number of countries	23	20	56	44
Number of countries	236	229	432	348
Number of observations	16	22	16	17
F-statistic	183.315	161.835	65.332	73.792

Note: Fixed-effects estimation with linear time trend. ***, **, * denotes statistically significance at 1, 5, 10 percent.

Table 5: Education: Germany versus the USA (% of population – average 2011-2015)

	USA	Germany	Difference
Below upper secondary	10.5	13.2	-2.7
Upper secondary	44.9	59.2	-14.3
Tertiary	44.6	27.6	17
S80/S20	18.6	11.0	
Gini	0.45	0.27	
Manufacturing/GDP	12	22	

Source: World Development Indicator and Poverty and Equity Database, World Bank

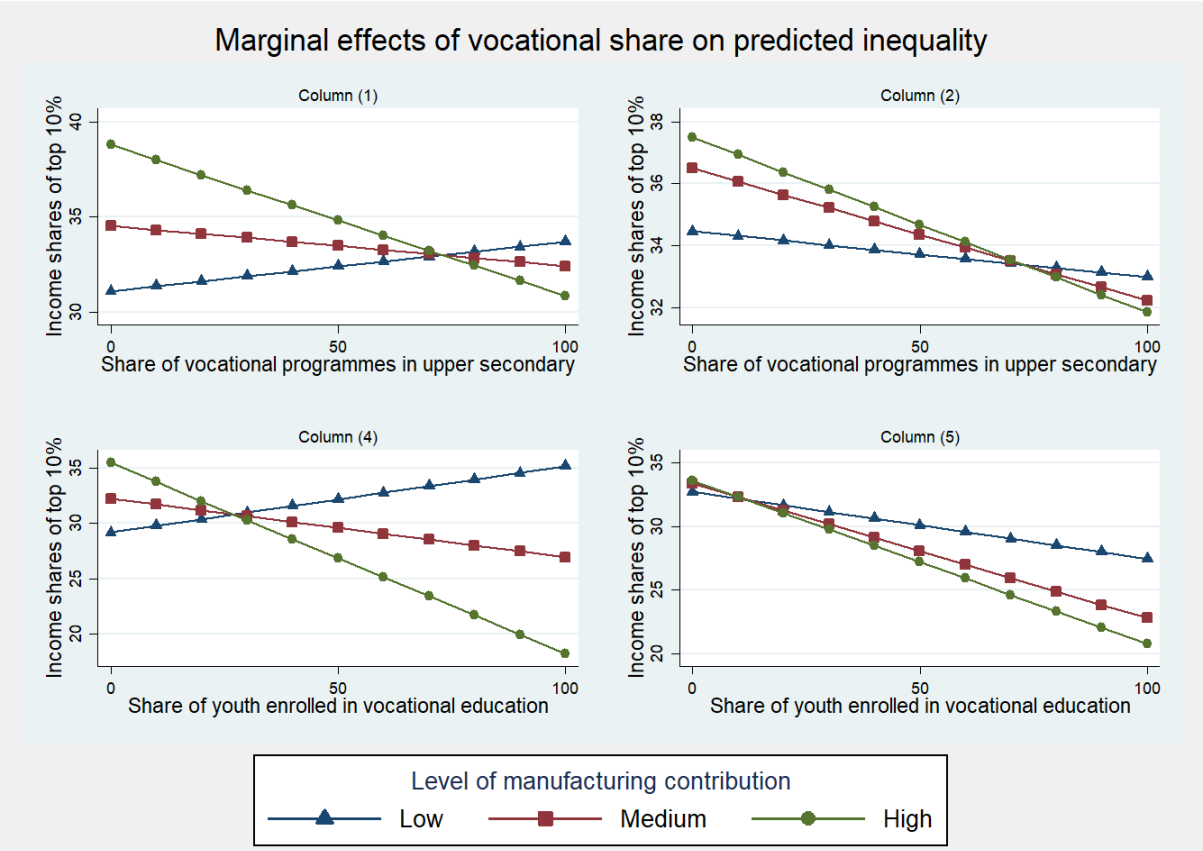


Figure 1. Marginal effects of vocational share on predicted inequality

Note: The marginal effects of vocational share on predicted inequality are constructed by holding manufacturing variable constant at the 25th – 50th – 75th percentile, which correspond to Low – Medium - High level of manufacturing's contribution to the economy. Manufacturing contribution is measured by manufacturing share in GDP (% value added) or manufacturing share in total merchanise export. Each graph corresponds corresponds to one specification in Table 2 and Table 3.

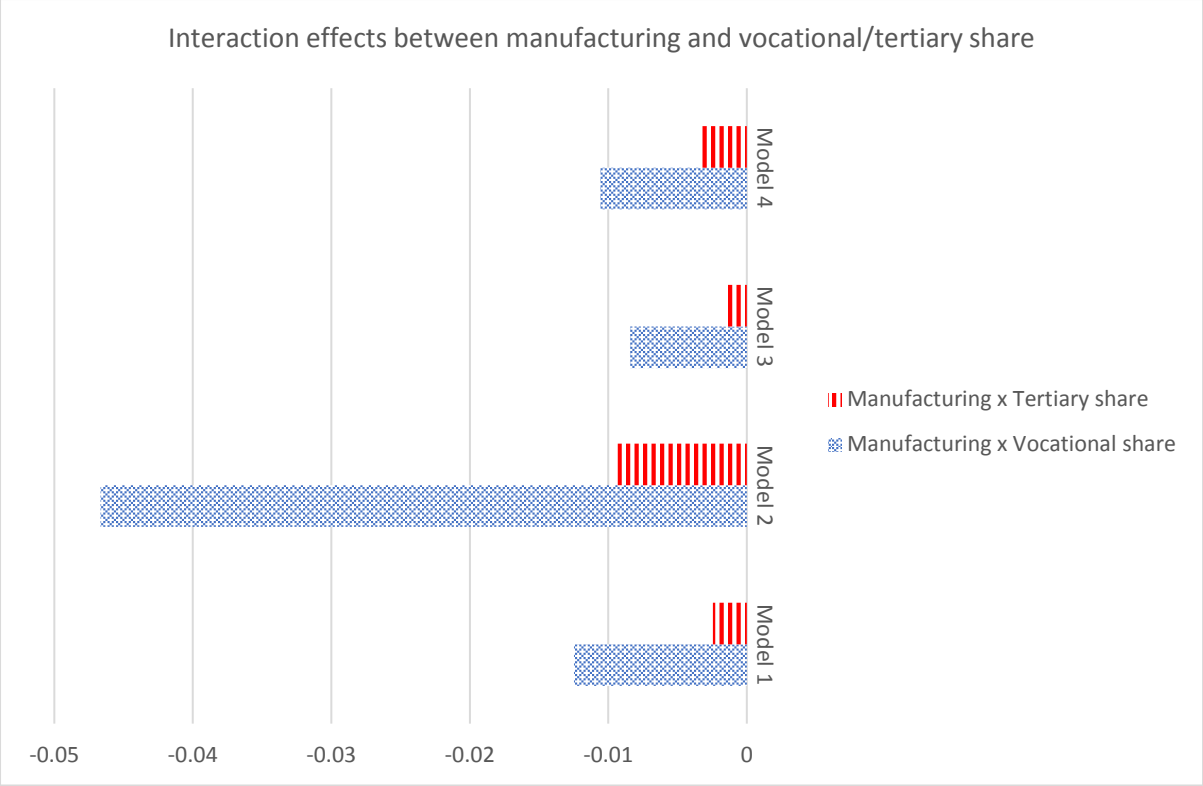


Figure 2. The interaction effects between manufacturing and vocational/tertiary share

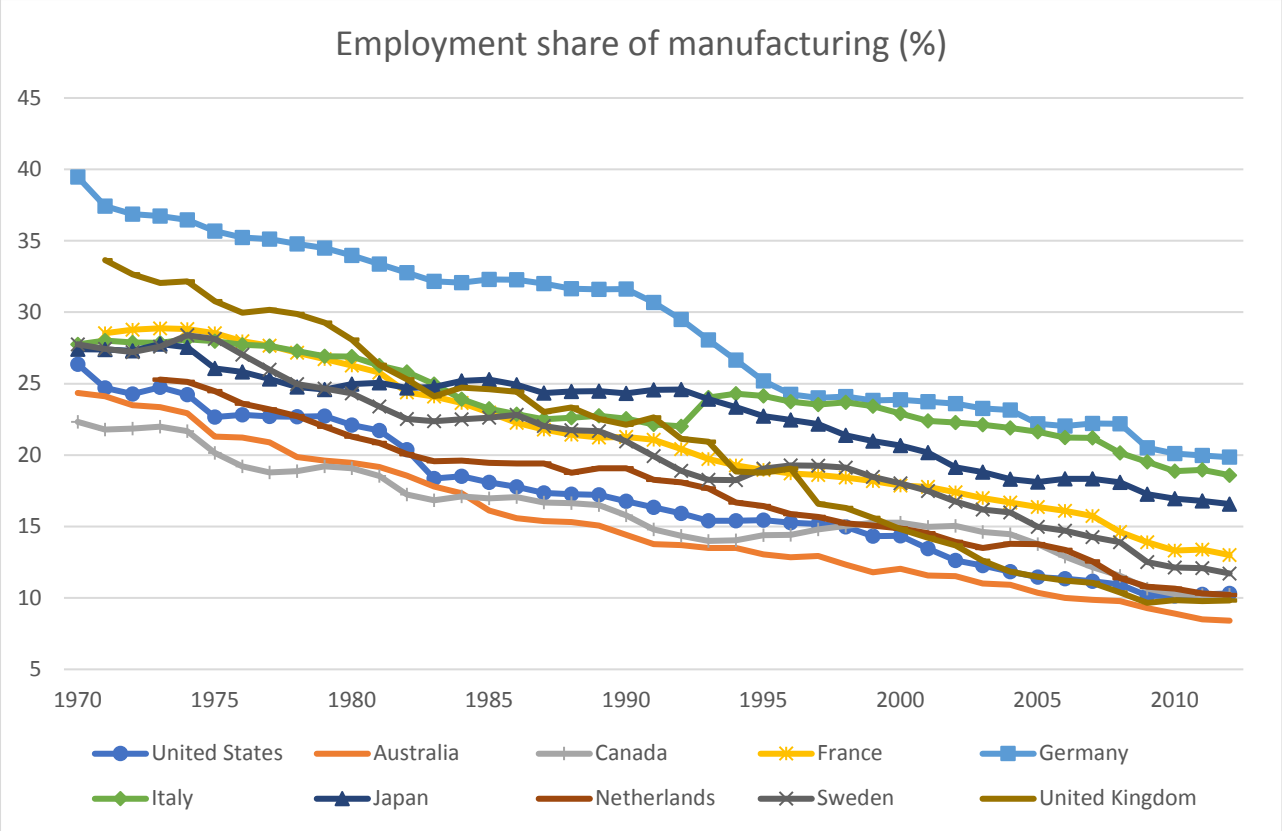


Figure 3. Manufacturing employment share, 1970-2012

Source: Division of International Labor Comparisons, U.S Bureau of Labor Statistics

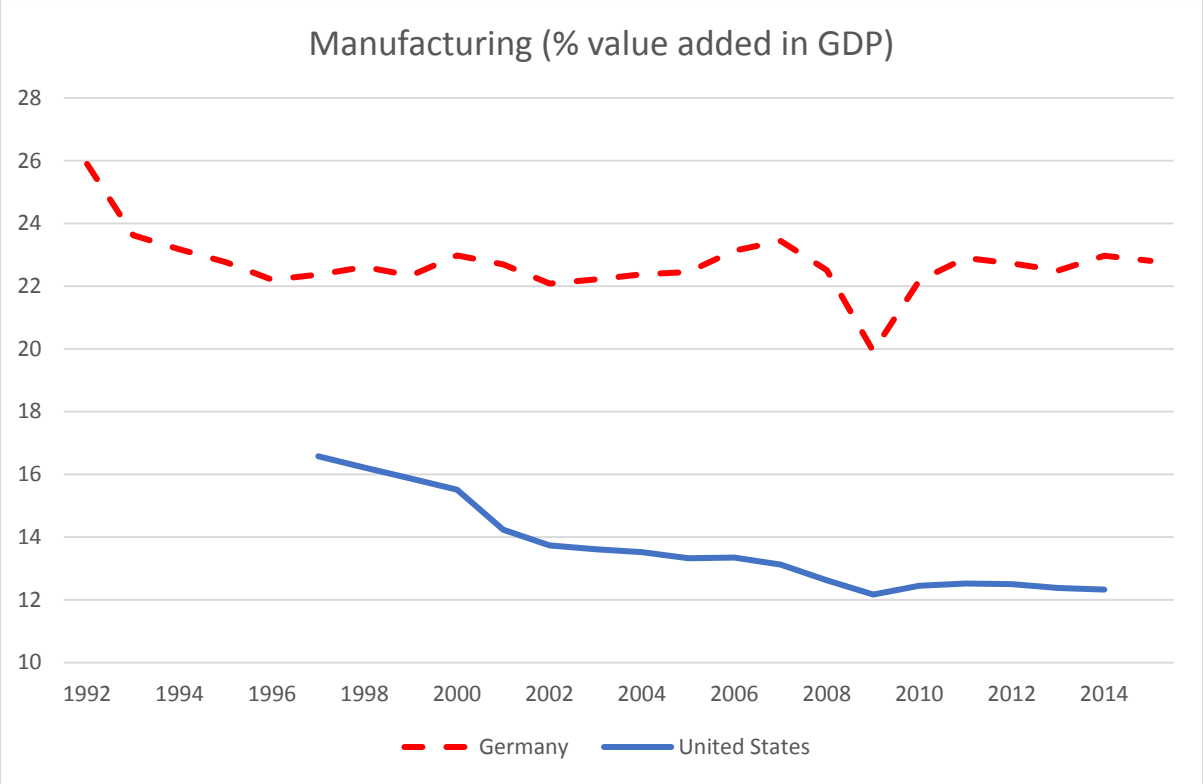


Figure 4: Manufacturing (% of value added in GDP)

Source: OECD

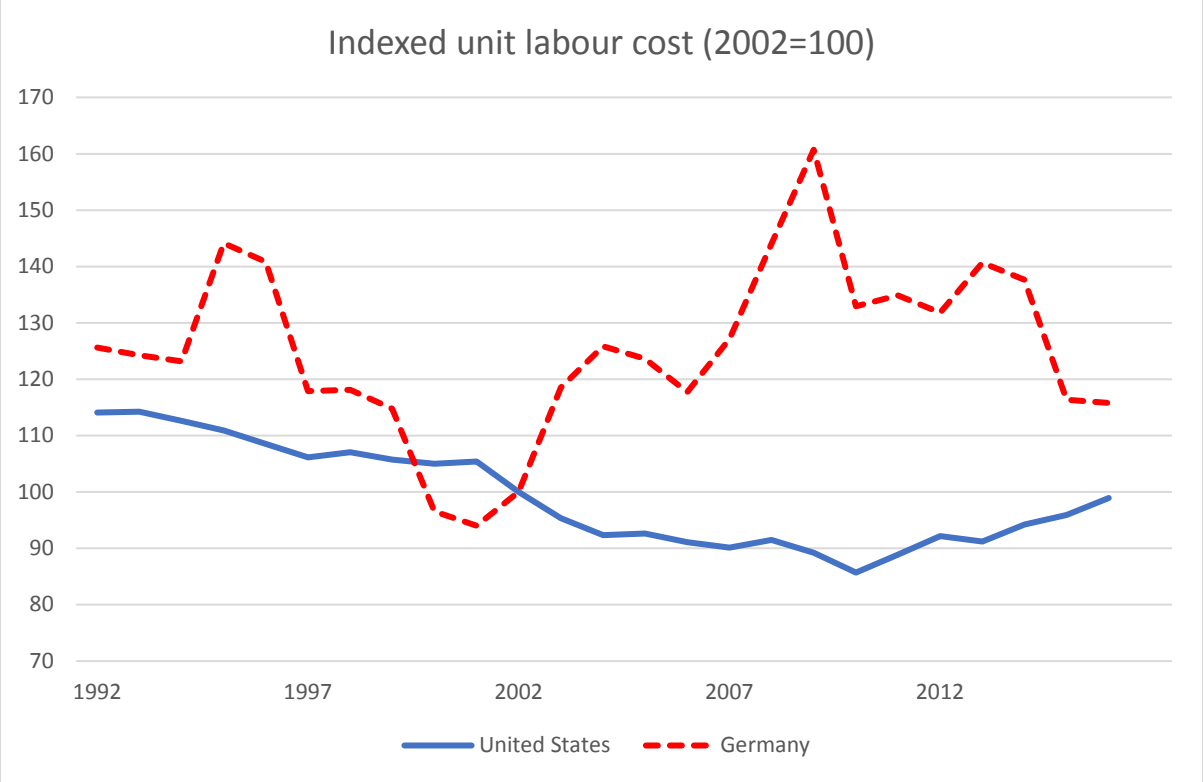
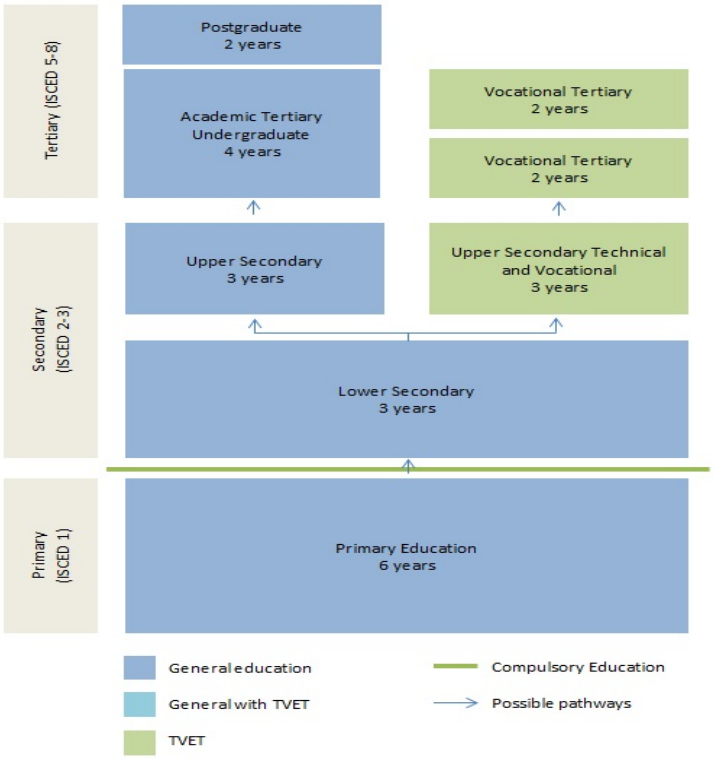
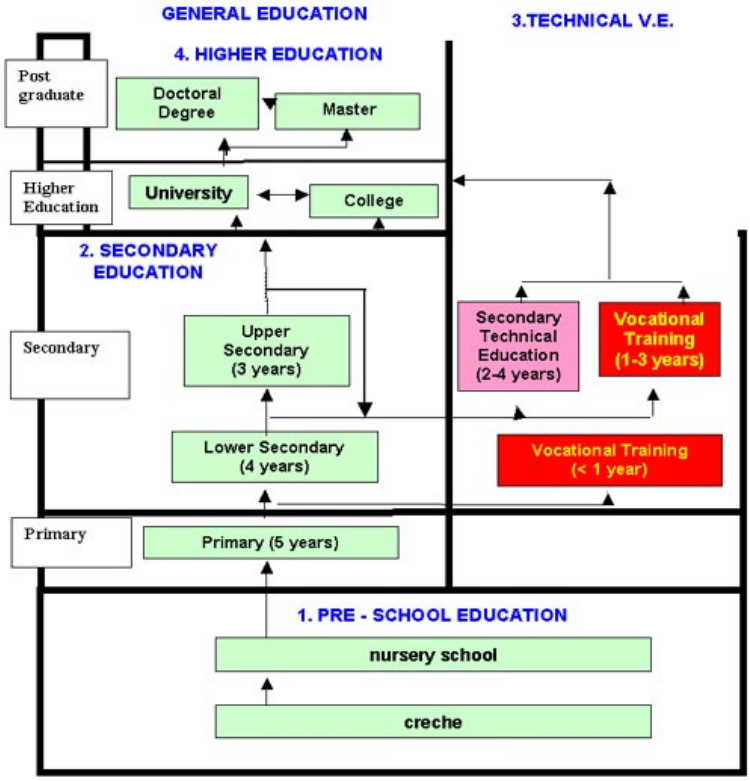


Figure 5. Indexed Unit Labor Costs in the Manufacturing Sector, US dollar basis, 1992-2016

Source: The Conference Board, International Labor Comparisons Program, May 2017



6.a Education System in Thailand



6.b Education System in Vietnam

Figure 6. Structure of Educational System in Thailand and Vietnam

Source: Implementing UNESCO / ILO Recommendations for Technical and Vocational Education and Training, Japan National Institute for Educational Policy Research (2002)

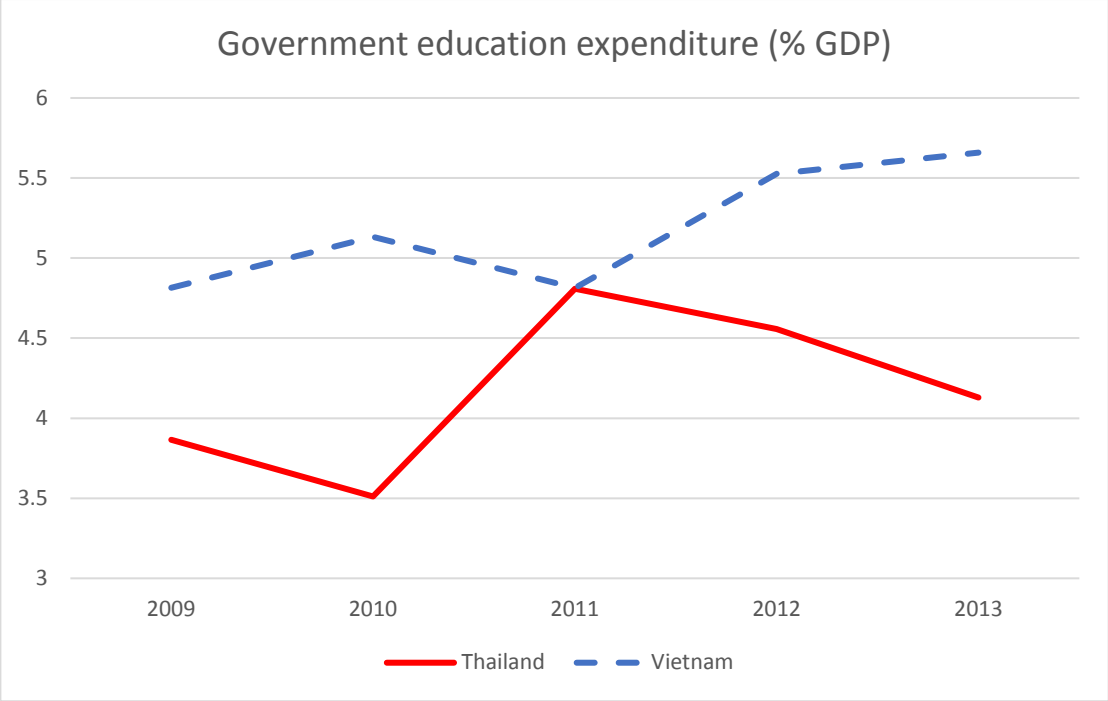


Figure 7a: Education expenditure as % of GDP

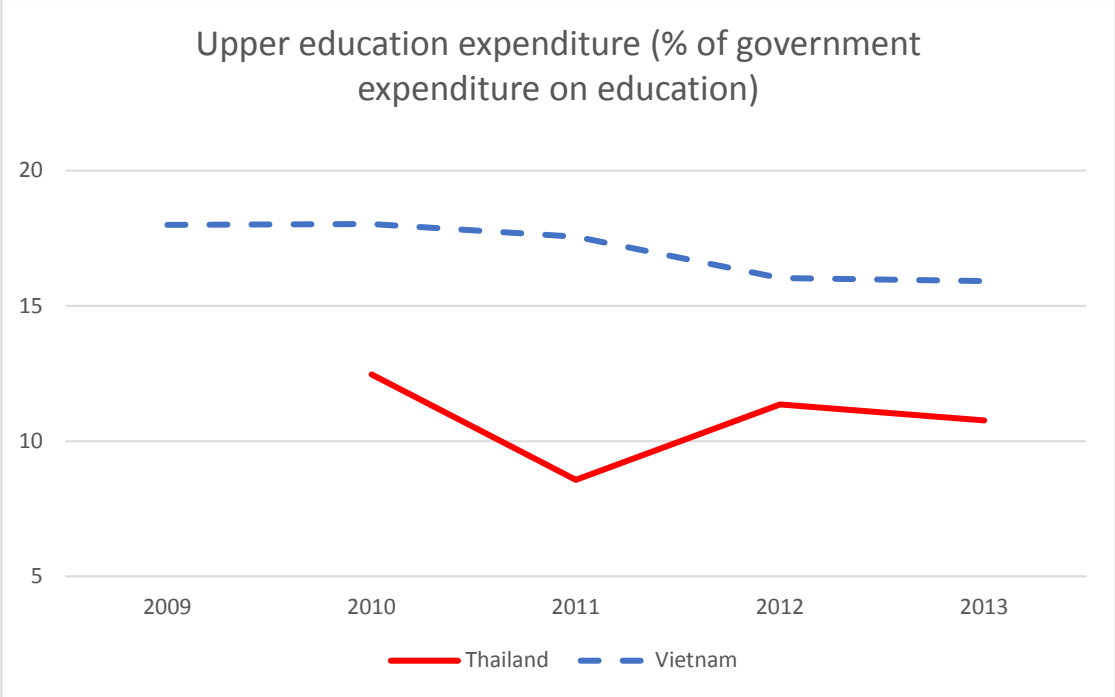


Figure 7b: Upper secondary education expenditure as % of total government expenditure on education

Figure 7 Education Budget

Source: UNESCO Institute for Statistics

	Ranking				
Country	2010	2013	2016	2020 (projected)	
China	1	1	1	2	
United States	4	3	2	1	
Germany	8	2	3	3	
Japan	6	10	4	4	
South Korea	3	5	5	6	
United Kingdom	17	15	6	8	
Taiwan		6	7	9	
Mexico	7	12	8	7	
Canada	13	7	9	10	
Singapore	9	9	10	11	
India	2	4	11	5	
Switzerland	14	22	12	19	
Sweden		21	13	18	
Thailand	12	11	14	14	
Poland	10	14	15	16	
Turkey		20	16	17	
Malaysia		13	17	13	
Vietnam		18	18	12	
Indonesia		17	19	15	
Netherlands	16	23	20	21	
Australia	15	16	21	22	
France	23	25	22	26	
Czech Republic	11	19	23	20	

* *2020 index is projected only*

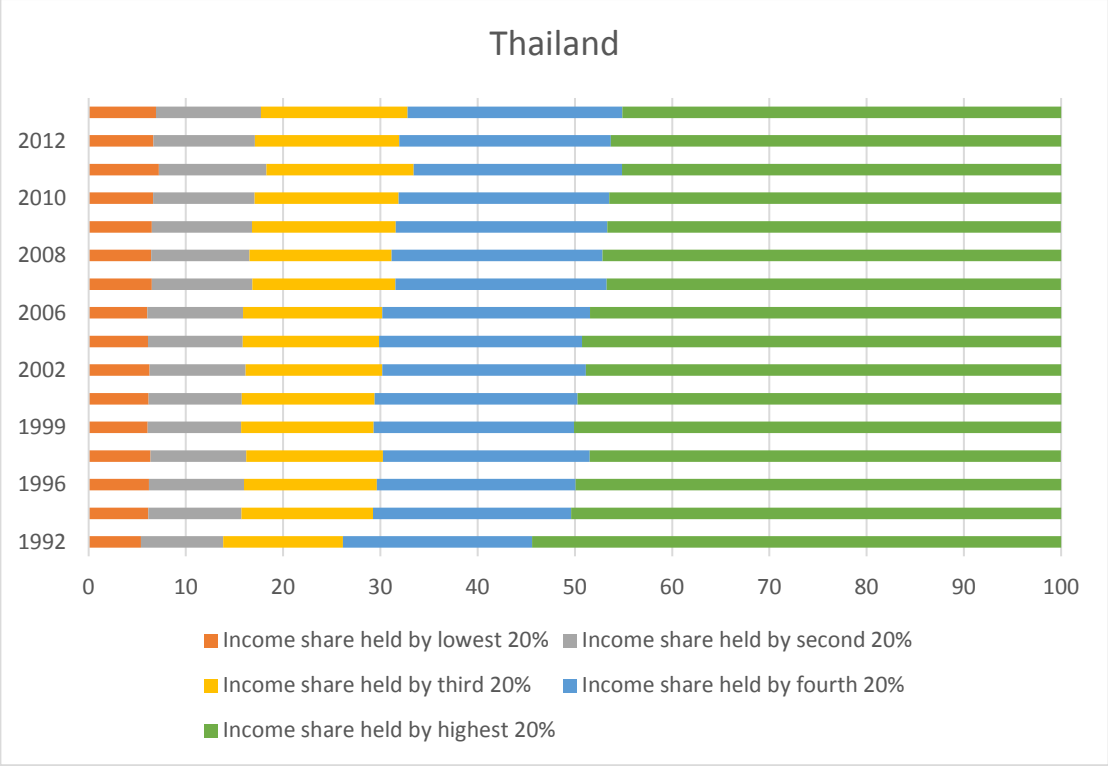
8.a Overall Competitiveness

		Thailand	Vietnam	Germany	USA
Manufacturing	bil.$	71.9	21.3	663	1,820
Size (2013)	%GDP	25.7	17.5	22.2	12.3
	3-Year Growth (%)	0.7	8.1	2.8	0.8
Manufacturing Labour Cost (2015)	per hour ($)	2.78	1.96	40.54	37.96
Productivity (2014)	GDP/person ($)	23,862.70	8,935.90	87,208.3	110,049.5
Manufacturing Exports	bil. $	167.1	107.9	1,248.6	1,034.2

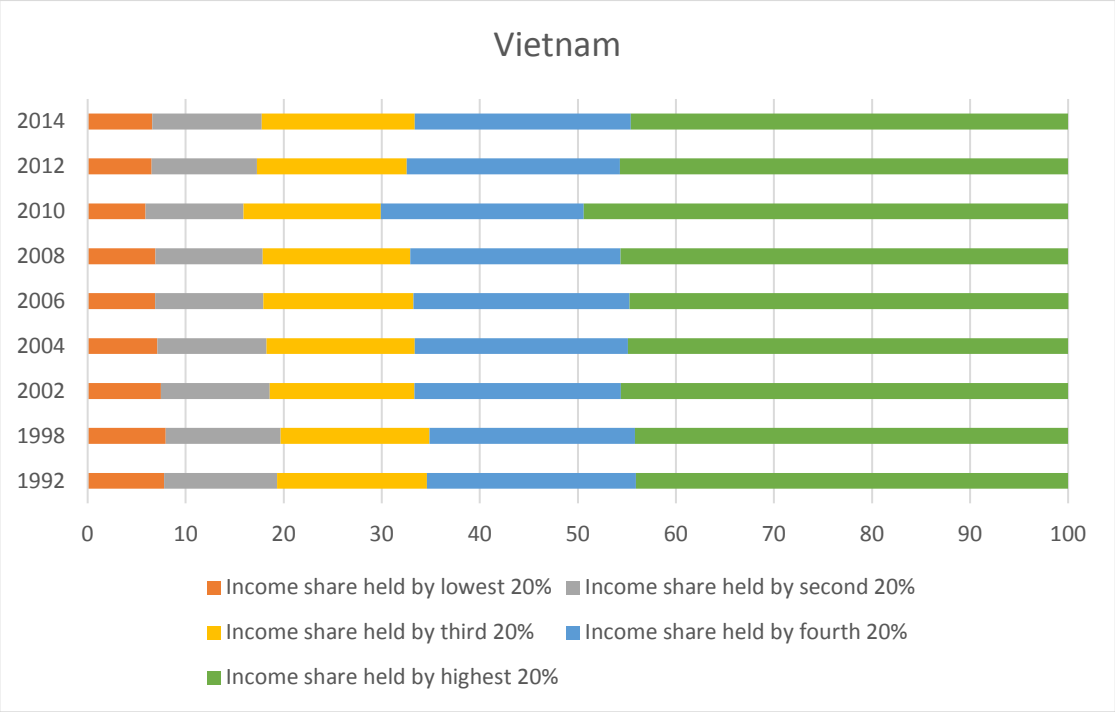
8.b Competitiveness Factors

Figure 8 Manufacturing Competitiveness

Source: Global Manufacturing Competitiveness Report 2010,2013,2016, Deloitte



9.a Inequality in Thailand



9.b Inequality in Vietnam

Figure 9. Distribution of Income

Source: Poverty and Equity Database, World Bank

Appendix Table A: Country list

Name	ISO code	Income group	Sample	
			Baseline	Robust
Albania	ALB	Upper-middle		x
Argentina	ARG	Upper-middle		x
Australia	AUS	High	x	x
Austria	AUT	High		x
Azerbaijan	AZE	Upper-middle		x
Belgium	BEL	High		x
Bulgaria	BGR	Upper-middle		x
Bosnia and Herzegovina	BIH	Upper-middle		x
Belarus	BLR	Upper-middle		x
Brazil	BRA	Upper-middle		x
Botswana	BWA	Upper-middle		x
Canada	CAN	High		x
Switzerland	CHE	High	x	x
Chile	CHL	High		x
China	CHN	Upper-middle	x	x
Colombia	COL	Upper-middle		x
Costa Rica	CRI	Upper-middle		x
Cyprus	CYP	High		x
Czech Republic	CZE	High		x
Germany	DEU	High	x	x
Denmark	DNK	High	x	x
Dominican Republic	DOM	Upper-middle		x
Ecuador	ECU	Upper-middle		x
Spain	ESP	High	x	x
Estonia	EST	High		x
Finland	FIN	High	x	x
Fiji	FJI	Upper-middle		x
France	FRA	High	x	x
United Kingdom	GBR	High	x	x
Georgia	GEO	Upper-middle		x
Greece	GRC	High		x
Croatia	HRV	High		x
Hungary	HUN	High		x
Ireland	IRL	High		x
Iran	IRN	Upper-middle		x
Iceland	ISL	High		x
Israel	ISR	High	x	x
Italy	ITA	High	x	x
Jamaica	JAM	Upper-middle		x
Japan	JPN	High	x	x

Kazakhstan	KAZ	Upper-middle		x
Korea	KOR	High	x	x
Lithuania	LTU	High		x
Luxembourg	LUX	High		x
Latvia	LVA	High		x
Mexico	MEX	Upper-middle		x
Macedonia	MKD	Upper-middle		x
Montenegro	MNE	Upper-middle		x
Mauritius	MUS	Upper-middle	x	x
Malaysia	MYS	Upper-middle	x	x
Netherlands	NLD	High	x	x
Norway	NOR	High	x	x
New Zealand	NZL	High	x	x
Panama	PAN	Upper-middle		x
Poland	POL	High		x
Portugal	PRT	High	x	x
Paraguay	PRY	Upper-middle		x
Romania	ROU	Upper-middle		x
Russian Federation	RUS	Upper-middle	x	x
Singapore	SGP	High	x	x
Serbia	SRB	Upper-middle		x
Slovakia	SVK	High		x
Slovenia	SVN	High		x
Sweden	SWE	High	x	x
Seychelles	SYC	High		x
Thailand	THA	Upper-middle		x
Turkey	TUR	Upper-middle		x
Uruguay	URY	High	x	x
Venezuela	VEN	Upper-middle		x
South Africa	ZAF	Upper-middle	x	x

Appendix Table B: Statistics by income group

Income group	**High income**			
	countries	**count**	**mean**	**sd**
Income share of top 10%	38	406	33.3	5.2
Income quintile share ratio S80S20	38	346	5.8	2.3
GINI index (World Bank estimate)	38	449	31.9	5.8
Manufacturing (% value added in GDP)	38	891	17.4	5.5
Manufactures exports (% of merchandise exports)	38	978	65.2	25.3
High-technology exports (% of manufactured exports)	38	947	14.7	10.8
Trade (% of GDP)	38	995	97.1	67.0
Share of vocational programmes in upper secondary education	38	528	46.5	18.4
Share of youth (15-24y) enrolled in secondary vocational education	38	571	14.1	7.1
Cost of CVT courses as % of total labour cost (all enterprises)	38	675	1.5	0.5
Income group	**Upper-middle**			
	countries	**count**	**mean**	**sd**
Income share of top 10%	32	80	35.1	12.3
Income quintile share ratio S80S20	32	384	12.1	7.5
GINI index (World Bank estimate)	32	389	43.6	10.0
Manufacturing (% value added in GDP)	32	773	17.2	7.1
Manufactures exports (% of merchandise exports)	32	702	48.6	26.8
High-technology exports (% of manufactured exports)	32	678	10.1	19.9
Trade (% of GDP)	32	829	79.6	37.5
Share of vocational programmes in upper secondary education	32	381	32.1	22.2
Share of youth (15-24y) enrolled in secondary vocational education	32	301	6.6	6.1
Cost of CVT courses as % of total labour cost (all enterprises)	32	54	1.4	0.3
Income group	**Total**			
	countries	**count**	**mean**	**sd**
Income share of top 10%	70	486	33.6	6.9
Income quintile share ratio S80S20	70	730	9.1	6.5
GINI index (World Bank estimate)	70	838	37.3	9.9
Manufacturing (% value added in GDP)	70	1664	17.3	6.3
Manufactures exports (% of merchandise exports)	70	1680	58.3	27.2
High-technology exports (% of manufactured exports)	70	1625	12.8	15.4
Trade (% of GDP)	70	1824	89.1	56.2
Share of vocational programmes in upper secondary education	70	909	40.5	21.3
Share of youth (15-24y) enrolled in secondary vocational education	70	872	11.5	7.7
Cost of CVT courses as % of total labour cost (all enterprises)	70	729	1.5	0.5