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RESEARCH ARTICLE

German-style dual apprenticeship training in the Greater Shanghai Area - Spatial Agglomeration Dynamics

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Abstract

A considerable number of German multinational enterprises (MNE) are located in the Greater Shanghai Area. German MNE in the industrial sector show an inclination to export German forms of technical training—more specifically German-style dual apprenticeship training—to their worldwide subsidiaries. Within China, this is especially the case for the Greater Shanghai Area, which has established itself as a 'hotspot' for dual apprenticeship training in the last 15 years. This paper explores what makes the Greater Shanghai Area such a 'hotspot' for dual apprenticeship training—in international comparison—by focusing on factors influencing the spatial agglomeration of dual apprenticeship training activities in this region. The paper finds unevenly distributed institutional resources regarding the attraction of German Foreign Direct Investment as well as unevenly distributed resources at the skill formation system level as important influencing factors. Both factors show 'self-reinforcing' dynamics strengthening already existing spatial agglomeration of dual apprenticeship training activities.

INTRODUCTION

As part of the coastal area of China, with its distinct history of Foreign Direct Investment (FDI) in special economic zones, the Greater Shanghai Area has made a development from a low-tech manufacturing region (associated with low-skilled workers) to a high-tech manufacturing region with considerable local research and development facilities (associated with high-skilled workers) (Cao et al., 2019; Liu & Daly, 2011). This development to more complex forms of manufacturing in the Greater Shanghai Area[1] has also created a considerable demand for technically trained shop floor employees (Hao, 2012).

As insights gathered from the empirical data of this study show, German manufacturing enterprises (MNE) in the Greater Shanghai Area are confronted with considerable difficulties to hire this kind of technical specialists on the regional labor market. Due to these difficulties, they often address their need for technically trained workers by transferring German dual apprenticeship training programs to their subsidiaries in the region (Freund & Gessler, 2017). The Greater Shanghai Area is also home to a considerable number of German MNE (CIIPAG & FDI Center, 2019). German manufacturing MNE show a tendency to 'export' German forms of technical training—more specifically German-style dual apprenticeship training—to their worldwide subsidiaries (Aring, 2014; Körbel et al., 2017; Pilz & Li, 2014b).

In Germany, dual apprenticeship training consists of three to three-and-a-half-year structured courses for technical specialists organized by collaborations between vocational schools/colleges and companies. Apprentices learn through theoretical instruction periods, and hands-on technical training. This characteristic of both vocational education institutes and companies, as well as the binary nature of theoretical and practical training being involved gives the 'Dual' Apprenticeship System its name. In Germany, roughly a half of all secondary school graduates choose a career path by enrolling in one of the over 300 occupations provided by the Dual Apprenticeship System. The Dual System is often considered a major reason for Germany's relatively low youth unemployment in comparison with other industrial countries around the world. The training curricula are designed by the German government in collaboration with chambers of industry and commerce, and trade unions. Moreover, the curricula are updated periodically in order to suit the newest technological advances (Bundesinstitut für Berufsbildung, 2014).

The practice of 'exporting' dual apprenticeship training by German MNE is not particular to their subsidiaries in the Greater Shanghai Area. Dual apprenticeship training run by German MNE can be found in a large number of countries around the world. Among them are, for instance: the USA, Mexico, and Brazil in the Americas; Spain, Portugal and Greece in Europe; and South Africa and India (DIHK, 2016a; Peters, 2019; Pilz et al., 2018; Pilz & Li, 2014b; Wiemann, Wiemann, et al., 2018). Most frequently 'exported' are dual apprenticeship training courses for industrial-technical[2] occupations (DIHK, 2016b, p. 13).

Moreover, the transfer of dual apprenticeship training to locations around the world is not a mere business issue. The idea of exporting German-style dual apprenticeship training has been taken up by educational transfer politics as well as development cooperation policy (Stockmann, 2018). As part of the German vocational education cooperation, Heitmann (2018) shows how the establishment of dual apprenticeship training has been a central piece of the international vocational education strategy by Germany at least since the 1980s. Due to the reputation of the German Dual System as a key factor for reducing youth unemployment, governments of industrialized as well as developing countries approach the German government with an interest in establishing dual apprenticeship training programs.

Comparing dual apprenticeship training activities outside of German speaking countries, however, the Greater Shanghai Area shows an especially high concentration of dual apprenticeship activities. Between the years 2016 and 2020, the German Chamber of Commerce (AHK[3]) in Shanghai reports having overseen between around 4000 and 5800 apprentices per year in the whole of China (see Table 2) — a large portion of these apprentices were or are located in the Greater Shanghai Area.

Thus, the activities regarding dual apprenticeship training in the Greater Shanghai Area deserve special attention. In this article, I therefore explore what makes the Greater Shanghai Area a 'hotspot' for dual apprenticeship training by asking which factors influence the spatial agglomeration of dual apprenticeship training activities in this region.

To address these questions, the existing literature on the transfer of dual apprenticeship training is discussed in the next section. Shortcomings of this literature regarding phenomenon of subnational spatial agglomeration of dual apprenticeship training activities are worked out. The section on "Methods" presents and discusses the methodological scope of this study. The following section "Scope of Spatial Agglomeration of Dual Apprenticeship Training in the Greater Shanghai Area" narrows it down to the spatial distribution of dual apprenticeship training in the Greater Shanghai Area. This is followed by the discussion of two key factors, which are possible explanations for this spatial agglomeration and their self-reinforcing dynamics in the section on "Two Self-Reinforcement Loops for Regional Agglomeration". The "Summary of Conceptual Contribution and Implications of the Findings For Policy and Practice" concludes the paper by summarizing the conceptual contribution of the study and by working out possible implications for policy and practice.

LITERATURE DISCUSSION AND CONCEPTUAL FRAMING

Education systems (including vocational education and training systems) are frequently thought of as national education systems. Even though the conception of a vocational education system also includes notions of the micro and meso levels, the system is still typically associated with being the vocational education system of a specific country (e.g., the definition of vocational education system by Deissinger & Pilz, 2018).

Of course there are exceptions in the literature focusing on regional vocational education (e.g., Beer & Meethan, 2007), however, with regard to the 'export' and transfer of dual apprenticeship training around the world — which is a revolving political and business issue as discussed in the introduction — this aspect is still underexplored.

Evidence from the dual apprenticeship training in China suggests a considerable regional concentration of dual apprenticeship training activities in the Greater Shanghai Area (see "Scope of Spatial Agglomeration of Dual Apprenticeship Training in the Greater Shanghai Area").

This paper, thus, is based upon existing work on the characteristics that facilitate the transfer of dual apprenticeship training. However, it explores them from a new angle, by focusing on how these characteristics are influenced by spatial agglomeration.

Through the course of this article, the transfer of dual apprenticeship training is conceptualized as the *transfer of a training practice* from one institutionally shaped context to another,[4] not as the *transfer of an educational policy*. Even though political actors are involved in the transfer of dual apprenticeship training to China — mostly through local and regional politicians — the political engagement does not aim at reforming the Chinese educational policy but at providing German MNE with technically trained workers (Interview C1_April 2021).

From international business literature, we know that MNE frequently transfer their organizational practices — such as production practices or management practices — to their international subsidiaries (Chiang et al., 2016). In this literature, the differences between institutional contexts of the country of origin, and the country of destination are conceptualized as 'institutional distance' (Kostova, 1999; Kostova & Roth, 2002). This institutional distance then needs to be overcome in order for the practice to be transferred between two institutional environments. The transfer of dual apprenticeship training in German MNE has also been explored from this perspective (Fortwengel, 2017; Fortwengel & Jackson, 2016).

Research on the transfer of practices suggests that practices are considerably transformed due to their transfer (Fortwengel, 2017). As colleagues and I have shown elsewhere (Gessler, 2017; Wiemann, 2020, Wiemann 2021), this is also — and especially — true for dual apprenticeship training. Dual apprenticeship training needs to be adapted considerably to fit into the new institutional environment. However, in this paper the effect of a transfer of dual apprenticeship training on the functioning of this practice itself is left aside in favor of assessing *what has led to the high concentration of dual apprenticeship training activities in the Greater Shanghai Area*.

Fortwengel (2014, p. 16) especially notes that dual apprenticeship training is a practice, which in contrast to other business or manufacturing practices is not exclusively an organizational practice: Dual apprenticeship training cannot be organized exclusively by the MNE. Instead, it is a practice, which requires cooperation with the local vocational education system, due to its dual nature of school-based and company-based training. This fact makes dual apprenticeship training an especially interesting practice to study regarding its interactions with the receiving institutional environment.

Fortwengel (2014, p. 30) follows the varieties of capitalism literature in considering institutions as "resources supporting different kinds of behavioral patterns, notably including non-market coordination. From this perspective, institutions matter in international business processes insofar as they provide particular distinct kinds of solutions to certain common coordination problems." This article goes along with this conception of institutions as resources that matter in the transfer of dual apprenticeship training, as they provide resources for the implementation of this training practice. What is new in this article is the focus on understanding how these resources can be unevenly distributed within the territory of a country and how this is related to patterns of spatial agglomeration of dual apprenticeship training activities in specific regions.

Insights about specific factors involved in the transfer of dual apprenticeship training can be gained from the literature stemming from policy and education transfer, even though the transfer of dual apprenticeship training is mostly not framed as a practice transfer (Wiemann, Li, et al., 2018). Regarding the transfer of dual apprenticeship training as an educational policy transfer, there is an extensive literature from political science and education studies mostly focusing on transfer activities on a systemic level. Establishing the impossibility of transferring the entirety of a vocational education system, Euler (2013), for example, distinguishes eleven constitutive elements of the Dual System[5] which a receiving country can adopt in accordance with their preconditions.

Comparative vocational education studies, on the other hand, focus on the analysis of factors for success as well as barriers for the transfer of dual apprenticeship training (Wiemann, Li, et al., 2018, p. 39). Pilz (2016) systematizes the typologies comparing vocational education and training systems. On this basis, he develops a vocational-education-and-training-typology based on a multilevel (micro, meso, and macro) perspective, which can also be used to assess differences in the adoption of dual apprenticeship training in different institutional contexts (e.g., Wiemann, 2020).

A still small subset of this literature (e.g., Gessler, 2017; Jansen & Pineda-Herrero, 2019; Krzywdzinski & Jo, 2020; Peters, 2019; Pilz & Li, 2014a, 2014b; van der Burgt et al., 2014) concentrates

on the companies' perspective regarding the implementation of dual apprenticeship training to their subsidiaries outside of Germany. These studies find a list of factors influencing the implementation of dual apprenticeship training on a company level. Some important factors are, among others:

- Existence of German MNE subsidiaries in a country (Pilz & Li, 2014b);
- Demand of technical specialists (with flexible qualifications) in the production process (Backes-Gellner, 2008);
- Supply of qualified personnel on the labor market and employee turnover rates (Wiemann, Wiemann, et al., 2018);
- Potential of cooperation between schools and companies regarding educational levels, certification processes, qualification of teaching personnel, possibilities for public funding (Euler, 2013; Wiemann, 2020);
- Societal acceptance of dual apprenticeship training as a viable education option;
- Existence of alternative training practices (Wiemann, Wiemann, et al., 2018);

For the purpose of this article, I sort this array of factors into two primary drivers of spatial agglomeration of dual apprenticeship training: (1) the institutional resources for attracting German FDI and (2) the institutional resources at the skill formation level. These two primary drivers are most certainly not the only relevant factors driving agglomeration. However, based on existing literature in the field and empirical insights gathered from the data analysis (see "Two Self-Reinforcement Loops for Regional Agglomeration"), I dare to argue that the two primary agglomeration drivers are of major importance. The spatiality of these agglomeration drivers is systematically explored.

Moreover, based on empirical insights generated from the data analysis of this study and demonstrated in the heuristic framework in Figure 1, both primary agglomeration drivers set in motion regional agglomeration self-reinforcement loops for dual apprenticeship training activities.

As will be conceptually underpinned and empirically supported in "Two Self-Reinforcement Loops for Regional Agglomeration", (1) the spatial agglomeration of German MNE in the Greater Shanghai Area sets in motion a self-reinforcing loop which strengthens dual apprenticeship training activities on the regional scale (see "Patterns of FDI Settling Dynamics", and Figure 2).

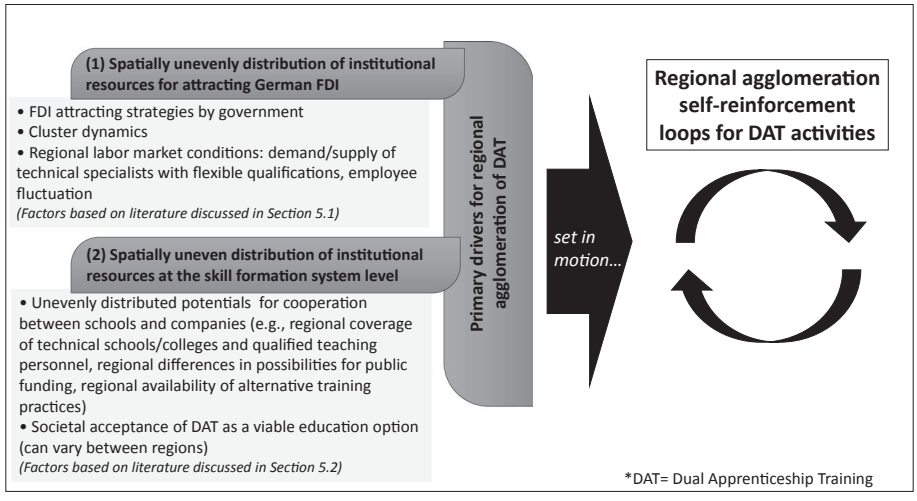

FIGURE 1 Heuristic of dynamics of regional agglomeration of dual apprenticeship training activities.
Source: Own representation

Similarly, (2) the institutional resources in the skill formation system in the Greater Shanghai Area start a self-reinforcement loop through dynamics of economies of scale and educational specialization (see "Regional Economies of Scale and Education Specialization Effects", and Figure 4). The conception of the two primary agglomeration drivers is grounded in existing research and conceptually developed in detail in "Two Self-Reinforcement Loops for Regional Agglomeration". This structuring of the argumentation has the purpose to provide the reader with a smooth comprehensive experience. Since the two primary agglomeration drivers impulse the agglomeration feedback loops, being presented with the conceptual underpinnings of the primary drivers immediately before discussing their respective feedback loops will — hopefully — make the functioning of the feedback loops more accessible.

Before jumping into the conceptual-empirical deliberations in "Two Self-Reinforcement Loops for Regional Agglomeration", it is necessary to first discuss the methods used in this study in "Methods" and give an overview of the nature of the spatial agglomeration of dual apprenticeship training activities in the Greater Shanghai Area in "Scope of Spatial Agglomeration of Dual Apprenticeship Training in the Greater Shanghai Area".

METHODS

The empirical insights of this study are based on semi-structured expert interviews. The interviews were conducted during two fieldwork periods in 2016 in the Greater Shanghai Area and a third research phase in 2017 in Germany. One interview was conducted in April 2021 with the AHK Shanghai as an update.

In total, 45 interviews were conducted with a total of 54 experts. Of these 45 interviews 30 were conducted with German MNE subsidiaries located in the Greater Shanghai Area. The rest of the interviews were conducted with experts from vocational schools and different German organizations (e.g., German embassy, German Chamber of Commerce, German training providers) based in the research region. These interviews especially served the purpose of deepening the understanding of the institutional context in the Greater Shanghai Area.

The sample of interviewed German MNE subsidiaries is purposefully diverse. The German MNE differ from one another with regard to the number of employees and the respective industrial sectors in order to achieve a wide picture regarding the different training needs of the subsidiaries (Table 1).

TABLE 1 Number of interviewed MNE subsidiaries per industry sector

Industry sector	Number of interviewed MNE subsidiaries in the Greater Shanghai Area
Automotive OEM	4
Automotive supplier	8
Machine engineering/construction	7
Chemical industry	4
Electronic industry	3
Others	4

Source: Own representation based on data from the research project "Global strategies and local forms of technical vocational education and training in German multinational companies: A regional comparison in Emerging Economies" (Grant No. FU424/16-1) financed by the German Research Foundation.

The interviews were fully transcribed and analyzed with a software for qualitative data analysis. In the first coding cycle a combination of structural and descriptive coding (in accordance with Saldaña's (2013) terminology) was used to broadly assess and structure the content of the information. Based on this, themes regarding the spatial agglomeration of dual apprenticeship training activities in the Greater Shanghai Area were worked out and systematized as mind maps and diagrams specifically for this paper.

SCOPE OF SPATIAL AGGLOMERATION OF DUAL APPRENTICESHIP TRAINING IN THE GREATER SHANGHAI AREA

In order to explore the factors influencing the spatial agglomeration of dual apprenticeship training activities in the Greater Shanghai Area in the following section "Two Self-Reinforcement Loops for Regional Agglomeration", it is, first, necessary to take a closer look at the scope of the agglomeration in the research region.

The German Chamber of Commerce—the AHK Shanghai—started to implement dual apprenticeship programs in 2006/2007 with a dual apprenticeship course in industrial mechanics/mechatronics. Since then, their activities have continuously grown and now include several training courses. However, they mostly focus on chemical and mechatronic technicians.

Overall, the numbers of apprentices inscribed at the same time in dual apprenticeship training courses supervised by the AHK Shanghai for the whole mainland China ranged between 4136 and 5858 in the years between 2016 and 2020 (as can be ascertained from Table 2). The considerable drop in numbers in 2020 is associated with the Covid-19 pandemic.

In Table 2, the number of apprentices certified by the AHK each year are significantly lower than the number of inscribed apprentices in the given years, since the inscribed apprentices count for three generations (first year, second year, and third year). Moreover, not all of the apprentices decide to take the AHK exam.

To assess the significance of the scope of the dual apprenticeship training activities in China in comparison to the rest of the dual apprenticeship training activities outside of German speaking countries,[6] it is necessary to gain perspective. Globally — concerning dual apprenticeship training — the Association of German Chambers of Commerce (DIHK[7]) reported 8200 AHK-supervised apprentices outside of Germany in 2019 (DIHK, February 2019). Thus, the portion of the AHK supervised apprentices in China, with a strong agglomeration of activities in the Greater Shanghai Area, is very large, counting nearly 5,000 apprentices in the same year.[8]

Furthermore, Table 2 shows the numbers of apprentices for China at a country level, not the number of apprentices in the Greater Shanghai Area as such. Locating these apprentices within China was only possible by proxy of the location of the vocational institutes involved. Two vocational education institutes are especially driving this development in the Greater Shanghai Area:

TABLE 2 Number of apprentices in AHK programs in China

Year	2016	2017	2018	2019	2020
Number of apprentices inscribed in AHK related dual apprenticeship programs	5128	5011	5858	4943	4136
Number of certified apprentices by AHK	900	954	979	986	737

Source: Data AHK Shanghai.

the *Suzhou Chien-Shiung Institute of Technology* and the *Shanghai Petrochemical Academy*. There is a third vocational education institute also driving the development of dual apprenticeship training in China, which is not located in the Greater Shanghai Area: the *Jinan Vocational College* in the Shandong Province. The AHK counts these three vocational institutes as their major cooperation partners, but also works with a high number of other vocational education institutes, many of which are located in the Greater Shanghai Area. Nevertheless, around two thirds of the apprentices overseen by the AHK are part of the three main vocational institutes. Two of which are located in the Greater Shanghai Area, as mentioned before. The significant spatial agglomeration of dual apprenticeship training activities in the Greater Shanghai Area was also confirmed by the interviews conducted as part of this study.

In the following section, reasons for this spatial agglomeration of dual apprenticeship training activities in the Greater Shanghai Area are explored.

TWO SELF-REINFORCEMENT LOOPS FOR REGIONAL AGGLOMERATION

In this section of the article, the two primary drivers of regional agglomeration of dual apprenticeship training ((1) institutional resources for attracting German FDI, and (2) institutional resources on the skill formation system level) — briefly introduced in the literature discussion in "Literature Discussion and Conceptual Framing" — are embedded in existing research. This way providing a more substantial conceptual underpinning than presented in "Literature Discussion And Conceptual Framing". Additionally, the resource distribution in the Greater Shanghai Area is discussed in more detail. In a second step, two self-reinforcement loops for regional agglomeration are presented: FDI settling dynamics ("Patterns of FDI Settling Dynamics"), and the dynamics of regional economies of scale and educational specialization ("Regional Economies of Scale and Education Specialization Effects").

Patterns of FDI settling dynamics

For any technical training program to be of significance, there has to be a need for the skills it can provide. Dual apprenticeship training provides future technical specialists with their skills (in different technical fields according to the training course (e.g., mechatronics, chemical technicians) in question). These skills need to be demanded on the labor market. Whether they are demanded or not depends on the structure and kind of economic activity and its production-related prerequisites (Backes-Gellner, 2008; Wiemann, Wiemann, et al., 2018, p. 367).

While assessing the spatiality of this driver of agglomeration regarding the engagement in dual apprenticeship training, we come across the fact that labor markets are strongly space-bound. Labor market segmentation approaches tell us that the matching on labor markets is not only segmental with regard to professional and technical differences, but that the matching is also of a regional nature (Mathes, 2018).

There are two main reasons for this space-bound nature of labor markets. For one, on a more general note, labor power is the one production factor which has to 'go home every night', as the economic geographer David Harvey (1989) famously states. The second reason is given by insights from cluster theories stemming from economics and economic geography, which tell us

how similar economic activities tend to cluster in space (Porter, 1998, 2003). Cluster research has so far been interested in the role of knowledge in forming and successfully maintaining clusters (Bathelt et al., 2004). The importance of human capital, or in other words of a highly educated workforce, specifically trained to fit the needs of the companies in the cluster in question has been noted as a critical characteristic for a cluster's success. Even though studies on economic clusters typically focus on academically trained employees, whilst technically trained shop floor workers — as are dual apprentices — are often left aside (Fuchs et al., 2016; Okada, 2004), the clustering of specific economic sectors in spatial proximity equally affects these regional labor markets and creates locally concentrated needs of technical specialists for a specific industrial sector.

Empirical evidence from the Greater Shanghai Area suggests that the high spatial agglomeration of German MNE subsidiaries in the sectors of chemical industry as well as the automotive sector (including suppliers) in the Greater Shanghai Area (CIIPAG & FDI Center, 2019) has a significant influence on the spatial agglomeration of dual apprenticeship training in the region. How this comes about is discussed in the following paragraphs.

The AHK Shanghai reports working with around 200 companies regarding dual apprenticeship training at any given time in the last years. However, the companies involved in dual apprenticeship training change over time. Companies tend to engage in dual apprenticeship training with significant numbers of apprentices especially in the phase of the establishment of their subsidiary. More important, however, is the observation that with only very few exceptions — e.g., one MNE from Sweden and one from Austria — these companies are subsidiaries of German MNE. The clear dominance of German MNE subsidiaries in the program has stayed true for the whole existence of dual apprenticeship training assisted by the AHK since 2006/2007. This nearly exclusive participation of German MNE in dual apprenticeship training can be attributed to two reasons: first of all, German MNE are familiar with the qualities of dual apprenticeship training due to their origin and are, therefore, more willing to engage in this training practice; and secondly, the AHK is an organization with the mandate to facilitate German-Chinese commercial and economic exchange, not the relationship to a third country (Interview_C1_April 2021).

Li et al. (2019) show that by far not all German MNE in China adopt dual apprenticeship training, and especially small and medium sized companies might be reluctant to engage in this training practice and prefer engaging in local training practices.

Nevertheless, the geographic concentration of German FDI in the years from 2013 to 2018 in Shanghai and its neighboring province Jiangsu (where the city of Suzhou is located, which is part of the Greater Shanghai Area as defined for this study) paints a clear picture. German FDI show a strong clustering in the Greater Shanghai Area (see Table 3).

From the literature in business studies and economic geography about the location selection factors in the productive industries, we know that these decisions typically depend on a range of factors (Bathelt & Glückler, 2012; Beugelsdijk & Mudambi, 2013; Dunning, 2000), such as ownership, geographic location, and internalization[9] advantages among others. Since almost exclusively German MNE operating in China participate in dual apprenticeship training, the spatial agglomeration of dual apprenticeship training activities in the Greater Shanghai Area can be explained at least partially by location selections of German FDI in China.

However, we are confronted with an endogeneity problem in this context — meaning it is difficult to determine causality here. The same literature on location decisions also tells us that one important factor for the location decision of an MNE is the availability of the rightly skilled personnel (Dorozynska & Dorozynski, 2015). These personnel can be provided by dual apprenticeship training in a specific area. Consequently, this causal relationship can at least partially

TABLE 3 Top 10 Chinese provinces for German FDI projects

		Number of FDI projects by German MNE						
Rank	**Province**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
1	Shanghai	24	35	17	9	23	30	138
2	Jiangsu	15	11	21	9	12	21	89
3	Guangdong	9	11	4	2	2	24	52
4	Beijing	2	6	7	2	10	9	36
5	Zhejiang	5	4	3	1	7	11	31
6	Anhui	0	2	3	1	1	14	21
7	Shandong	4	4	1	1	6	3	19
8	Sichuan	3	3	7	0	3	3	19
9	Tianjin	0	7	3	0	0	4	14
10	Liaoning	2	3	5	1	1	1	13

Source: CIIPAG & FDI Center (2019, p. 9).

be turned on its head: since German MNE have a need for dually trained personnel, they prefer to establish their subsidiaries in regions where dual apprenticeship training is easily accessible.

Interviews with German MNE conducted as part of this study indicate that such a causal relationship is at least to some degree in play in the Greater Shanghai Area. However, the qualitative scope of the presented empirical material lacks the possibility to assess the relative importance of the dual apprenticeship training activities as an incentive in the decision-making regarding location selection of German FDI. The AHK Shanghai, however, reports frequently getting inquiries by local government officials regarding the possibilities of establishing a dual apprenticeship training in their administrative area in order to specifically attract German FDI (Interview_C1_April 2021).

In sum, the local skill demand on the labor market formed through the location selections and spatial agglomeration of German MNE in the Greater Shanghai Area is a driver for the pattern of spatial agglomeration of dual apprenticeship training in China. This effect also

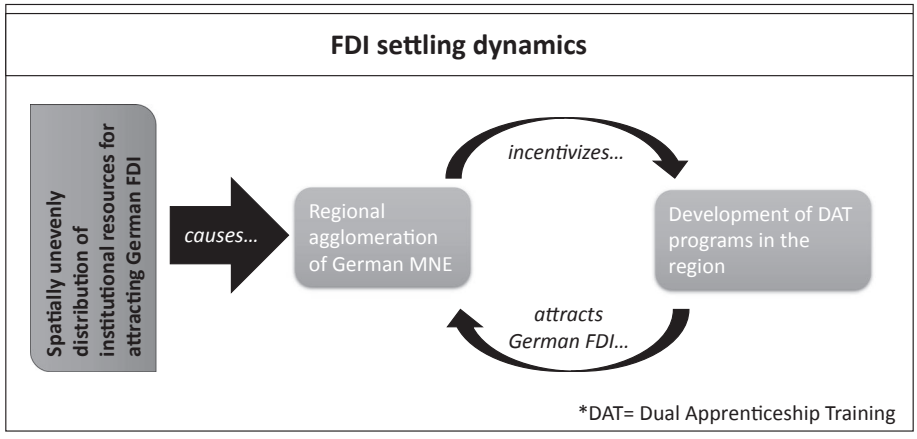

FIGURE 2 Heuristic of first regional agglomeration self-reinforcement loop.
Source: Own representation.

has a self-reinforcing moment: Wherever a larger number of German MNE locate their subsidiaries, a demand for dually trained employees arises. Once dual apprenticeship training in a region is established, this in turn makes the establishment of additional German MNE subsidiaries in that same region more likely. This pattern can be observed in the case of the Greater Shanghai Area.

Regional economies of scale and education specialization effects

The possibilities for a cooperation between vocational education institutes and companies for organizing dual apprenticeship training *in a country* is significantly influenced by the type of vocational education system the country possesses. The importance of this influencing factor for the establishment of dual apprenticeship training in an institutional environment outside of Germany has been shown by a variety of research (Fortwengel, 2017; Gessler, 2017; Peters, 2019; Pilz & Li, 2014b; Wiemann, 2020).

In the afore-mentioned typology of vocational education and training systems by Pilz (2016), the distinction of skill formation systems originally developed by Busemeyer and Trampusch (2012) is taken up in order to differentiate vocational education systems at a macro level. According to Busemeyer and Trampusch (2012), two distinctive features of a skill formation system are who finances vocational education and training (company, employee, state) and who provides it (company, state, private training companies). All three stakeholders (companies, employees and the state) invest and engage in vocational education in a country to some degree. However, there are tendencies through which countries can be differentiated. The intensity of the involvement of the three stakeholders determines the categorization of a country according to the typology.

Pilz (2016) categorizes China as a country with a clear state dominance. In other words, in China the state is considered responsible for the organization of vocational education and covers the brunt of the costs of vocational education.

Now, what does this mean for dual apprenticeship training and its integration in the Chinese skill formation context?

By nature of its 'duality', dual apprenticeship training requires company-based as well as school-based training. Figure 3 shows (as a schematic curriculum) the frequent interaction between learning periods in different settings, such as: the training workshops where practical hands-on training is imparted, and classroom periods, as well as the introduction to real work projects on the shop floor in the last two years of this curriculum. In the case of the MNE subsidiary whose dual apprenticeship curriculum is represented in Figure 3, the training workshop is run as a joint effort between two German MNE subsidiaries and a local vocational institute.

What becomes evident here is that a substantial cooperation between vocational education institutes on the one and companies on the other hand is necessary for dual apprenticeship training.

The AHK Shanghai helps to organize and establish these cooperations in China. As indicated in the previous subchapter, German MNE typically — though there are exceptions — start dual apprenticeship training as part of the process of establishing a new subsidiary. Since in Germany the examination and certification process for all dual apprenticeship training carriers is organized and overseen by the local Chambers of Industry and Commerce (IHK[10]), the German MNE, when interested in starting dual apprenticeship training outside of Germany, contact the AHK. The AHK takes over respective tasks and responsibilities with regard to dual

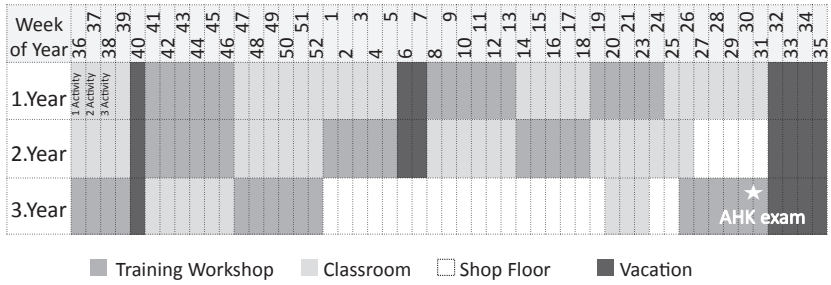

FIGURE 3 Schematic curriculum for dual apprenticeship training for toolmaker technicians in one German MNE in the Greater Shanghai Area.
Source: Own representation based on photography of a poster

education as IHKs (and if applicable other chambers) undertake in Germany. In sum, the AHK is instrumental in organizing the initial establishment of cooperations between vocational education institutes and German MNEs. The AHK China has a number of offices in different parts of the country. However, the AHK office organizing the establishment of cooperations between vocational colleges and German MNEs in all of China is situated in Shanghai. As we know from the proximity literature in economic geography, spatial proximity can facilitate the interaction substantially (Boschma, 2005), reinforcing the hotspot of dual apprenticeship training in the Greater Shanghai Area.

Due to the state dominance in Chinas vocational education and training system, it is not far-fetched for vocational education institutes to get involved in dual apprenticeship training, because vocational education is considered a task the state is responsible for. On a regional scale, because of its industrial history, the Greater Shanghai Area has a number of vocational colleges with the kind of specialization required for the desired dual training carriers. Moreover, as mentioned in the previous subchapter, the regional governments are very interested in attracting German FDI and therefore support the creation of cooperations between vocational colleges and German MNE monetarily. In the case of the *Suzhou Chien-Shiung Institute of Technology*, for instance, the local government supports dual apprenticeship trainees with an extensive stipend program including the possibility of academic stays in Germany (Interview C1_April 2021). The willingness to engage in dual apprenticeship training by the local vocational colleges is also manifested in that vocational education institutes in the Greater Shanghai Area have established training workshops within their facilities. Moreover, they bear the costs of the teaching personnel in these workshops. In Germany, the workshop installation and adjacent personnel costs are typically taken up by the companies.

The involvement of companies in dual apprenticeship training is a different matter, however. As discussed in the previous section, hardly any non-German companies get involved in dual apprenticeship training. The German MNE are familiar with dual apprenticeship training and are, thus, to some degree predisposed to engage in dual apprenticeship programs, even though by far not every German MNE subsidiary in China gets involved in this training practice. An important reason for this are the considerable costs associated with dual apprenticeship training. Dual apprenticeship training is not a cheap training course to finance. Especially costly, besides salaries of trainers, are the training workshops and training laboratories. These costs can go up to several million Euros, when they are first installed.

The remarks so far discussed are initializing the relatively high dual apprenticeship training activity in the Greater Shanghai Area compared to China as a whole. Following the line of the

enquiry this study addresses, the question now is: *how do the potentials for cooperation translate into a self-reinforcement loop for spatial agglomeration of dual apprenticeship training in the Greater Shanghai Area*?

It is evident that *economies of scale* are at play here. As mentioned above, two thirds of the apprentices supervised by the AHK Shanghai in China are inscribed in only three vocational education institutes, two of which are located in the Greater Shanghai Area. Overall, the costs of dual apprenticeship training for German MNE are lower than in Germany, and also lower than in other emerging economies with a considerable activity in dual apprenticeship training, such as Mexico (Jansen et al., 2015; Wiemann, 2017; Wiemann, Wiemann, et al., 2018). Lower costs for dual apprenticeship training by pooling the apprentices in programs that serve a large portion of the regional labor market thus strengthen the spatial agglomeration, since lower costs make participation more attractive for companies.

Participating in large dual apprenticeship programs also makes it more convenient for German MNE subsidiaries to participate. They do not have to commit to a yearly number of apprentices sent to the program in order to keep dual apprenticeship training alive in the region. Instead, they can enroll apprentices in a flexible manner—in some years more, in other years less—according to their company's skill demand predictions. As mentioned above, many German MNE have an especially high demand of dually trained technicians in the first establishing phase of their production facilities. Many German MNE thus opt out of the dual training program during different stretches of time. This flexibility also reduces financial risks for companies to get involved in dual apprenticeship training and thus strengthens the spatial agglomeration of dual apprenticeship training in the Greater Shanghai Area.

There is another positive effect for the larger dual apprenticeship training programs in the Greater Shanghai Area: *the quality of teaching in these facilities can be much more easily maintained*. For one, the educational quality can be maintained more easily through a higher number of teaching staff specialized in dual apprenticeship training — and mutual learning curves between them. In addition, the quality can be controlled through the AHK Shanghai. As studies on the transfer of dual apprenticeship training have shown (Pilz & Wiemann, 2017; Stockmann, 2018; Wiemann, Wiemann, et al., 2018), the possibilities for evaluating and certifying dual apprentices play a significant role in the establishment of dual apprenticeship training programs. Larger and locally centralized dual apprenticeship programs make the evaluation and certification easier.

The achieved good quality of the larger dual apprenticeship training programs in the Greater Shanghai Area also translates into a good reputation of the program as an educational option in the region. Since vocational education is mostly seen as a less attractive career path than general education in China (Li & Pilz, 2012; Stockmann & Meyer, 2017), this good reputation helps the application process in attracting better applicants and thus better future apprentices.

To sum up, as indicated in Figure 4: Through the mentioned pooling of dual apprenticeship training activities lower costs (for all engaged stakeholders) and high-quality apprenticeship programs can be achieved. These are factors how the possibilities of cooperation between companies and vocational education institutes — which are already comparatively good in China — can be positively enhanced through spatial agglomeration. This way, a self-reinforcement loop for regional agglomeration of dual apprenticeship training activities is initiated and maintained.

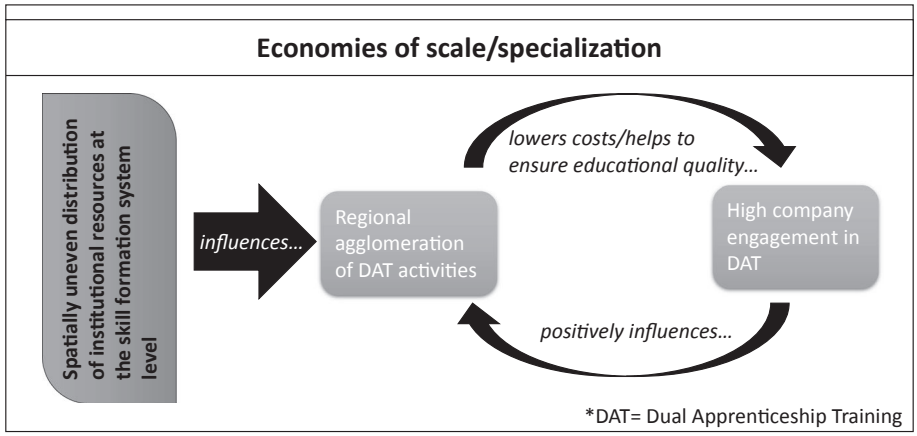

FIGURE 4 Heuristic of second regional agglomeration self-reinforcement loop.
Source: Own representation

SUMMARY OF CONCEPTUAL CONTRIBUTION AND IMPLICATIONS OF THE FINDINGS FOR POLICY AND PRACTICE

As one interview partner stated, when considering the size of the Chinese labor market, around 5000 apprentices per year are "only a drop in the ocean"[11] (Interview_C1). However, in and of itself, it is an unequaled number in worldwide comparison. Moreover, there is a considerable regional agglomeration of dual apprenticeship training activities in the Greater Shanghai Area. This regional agglomeration is driven by a spatial concentration of institutional resources for (1) attracting German FDI as well as (2) on the skill formation level in the Greater Shanghai Area. This regional agglomeration is made even more prominent through the two self-reinforcement loops presented above. Together, these factors might be to some degree responsible for the overall high numbers of dual apprenticeship training in China as a whole in comparison to other countries.

This paper follows existing arguments on how institutions, when seen as resources, influence the establishment of dual apprenticeship training. The paper contributes to academic debates on the transfer of dual apprenticeship training by showing how these institutional resources can be unevenly distributed within the territory of a country (see "Literature Discussion and Conceptual Framing" and "Scope of Spatial Agglomeration of Dual Apprenticeship Training in the Greater Shanghai Area"). More importantly, on the basis of empirical insights, this study develops the notion of 'regional agglomeration self-reinforcement loops' (see Figures 2 and 4) for dual apprenticeship training activities. This concept grasps how an initial agglomeration of dual apprenticeship training in a region causes an even stronger regional agglomeration of this training practice. As elaborated more extensively in the literature discussion, so far, the regional scale has been severely underexplored in studies on the establishment of dual apprenticeship training outside of Germany (as well as in studies on practice transfer and in vocational education studies). Both the notion of unevenly distributed institutional resources as well as the understanding of regional agglomeration self-reinforcement loops open up conceptual explanations for the empirical phenomenon of regional agglomeration of dual apprenticeship training. These two

avenues of explanation are — of course — developed based on the presented case study on the Greater Shanghai Area and their applicability to other regional contexts has yet to be supported by further research.

Now, what can policy and practice learn from the 'hotspot' of dual apprenticeship training in the Greater Shanghai Area?

Dual apprenticeship training is, by nature, a practice requiring the frequent cooperation between a number of different organizations: vocational institutes, companies, and certification entities. For one, this makes dual apprenticeship relatively difficult to transfer and establish outside of Germany in comparison to other training practices also frequently transferred by German MNE (Wiemann, 2021). However, the need for constant interaction between the different dual apprenticeship training stakeholders makes regional networks and the agglomeration of dual apprenticeship training more efficient than a widespread distribution.

Moreover, policy makers with the goal to establish dual apprenticeship training as an educational option in their country can intentionally capitalize on regional agglomeration self-reinforcement loops and scale up the dual apprenticeship training activity in their country this way.

The first self-reinforcement loop for spatial agglomeration of the FDI settling dynamics offers only limited possible learning avenues for policy and practice to positively influence the establishment of dual apprenticeship training. Even though, this first loop possibly has the stronger pull when it comes to explaining the spatial agglomeration of dual apprenticeship training in China through the patterns of location selection for German FDI. Nevertheless, the insight that the existing possibilities for dual apprenticeship training in a region play a role in the FDI location decision process might be of interest for local politicians. Still, the Chinese case cannot be easily replicated around the world, since China's impressive number of German FDI and their spatial concentration in the Greater Shanghai Area is a result of the economic relationship between China and Germany and processes of globalization (CIIPAG & FDI Center, 2019).

With regard to the second self-reinforcement loop, we can see for one that geographically concentrating and pooling the efforts of dual apprenticeship training activities in selected vocational education institutes helps especially in two ways. Firstly, it lowers the costs and enhances the flexibility for companies — and even possibly vocational education institutes — through economies of scale. Secondly, it helps in maintaining a high-quality training program. For practitioners involved in transferring dual apprenticeship training thus only offering cooperation for dual apprenticeship training to German MNE on a basis of a cooperation between one vocational institute and one German MNE (as it is the case for instance in Mexico (Wiemann, 2017)) is less recommendable. Instead, it might be a good idea to connect a number of German MNE with a single vocational institute and focus on building up regional networks, which can efficiently sustain dual apprenticeship training in addition to achieving a critical mass of dual apprentices in the same region to lower costs for all stakeholders.

The case of the spatial agglomeration of dual apprenticeship training activities in the Greater Shanghai Area is worthwhile to take a close look at, even though not all factors that work in China apply to other contexts.

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ENDNOTES

[1] For the purpose of this study, the Greater Shanghai Area is loosely defined as the administrative divisions of Shanghai and the neighboring administrative areas such as Suzhou.

[2] German: *Gewerblich-technische Berufsausbildungen*.

[3] Außenhandelskammer.

[4] The training transfer problem in the disciplinary area of vocational education and training studies is also often used in the context of transferring the competencies gained in training to real work situations, see for instance Hughes et al. (2018). In the case of this study, however, the transfer of training practices between countries or regions is center stage.

[5] These elements are: "1. Broad objective: vocational training as a means of achieving economic, social and individual goals; 2. The main objective of vocational training: to produce skilled workers with flexible qualifications who are mobile and capable of working in their chosen fields; 3. Alternating learning situations in accordance with the dual principle; 4. Vocational training as a task to be carried out in partnership between the government and the business community; 5. Joint funding of vocational training; 6. Complementary programs run by schools or non-business entities; 7. Codifying quality standards; 8. Qualifications of teachers and training personnel; 9. Balance between standardization and flexibility; 10. Creating a solid basis for decisions and design; 11. Social acceptance of vocational training." (Euler, 2013, p. 3)

[6] Switzerland and Austria have similar Dual Apprenticeship Systems to Germany.

[7] Deutscher Industrie- und Handelskammertag.

[8] From previous research undertaken by a research team including the author of this article, it is evident that dual apprenticeship training is also 'exported' by German MNE without the involvement of the AHK. However, AHK involvement has been shown to be frequent.

[9] Internalization advantages are given when it is more profitable for company to produce a particular product in-house in contrast to contracting a third party.

[10] Industrie- und Handelskammer.

[11] Non-literal translation by the author. German original: „ein Tropfen auf den heißen Stein", which in English literally translates to 'a drop on a hot stone'.

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