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The rise of outward direct investments by Chinese multinationals in the German automotive sector

a Global Production Network analysis

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INTRODUCTION

In a period of doubt and rise of mercantilist ideals, after the partial devolution of some industrial clusters in the West, it is essential to theorize the economic development in a globalized world. To understand the underlying force interacting in the current global trade, this paper analyzes the impact of **outward direct investment of Chinese multinational enterprises in the German automotive market,** and infer the risks for the German economy.

In the last decades, Europe has been the target of multitudes of Chinese investments. **Chinese outward direct investments** in Europe have been bottling up since 2014 and have increased by a factor of 50 since 2000 (Han, Chu, & Li, 2014). Europe became the favorite destination for China's outward foreign direct investment in 2015 (EEAS, 2019).

This inflow of capitals raises a set of new questions. While western Europeans are not new to internal and external foreign investments from the US to Japan, the Chinese outward direct investments are particular because they come **from an emerging market**. In 1980, twelve developed countries accounted for 94% of the total stock of outward direct investments. While the investments of Europe and Japan increased significantly between 1980 and 2000 (John H. Dunning & Lundan, 2008), they were both from developed regions. The literature on the impacts of outward direct investment was therefore mainly focused on the investment from developed countries to emerging markets and are somehow limited to the opposite capital flow consequence.

This inflow is also particular as it does not come from a capitalist country, but a highly centralized economic and political system. Even though "socialism with Chinese characteristics" has some free-market components, it is still **"socialism-marxism"** in many aspects.

In the West, some condemned the influence of such a power in Europe for ethical, cultural, or political reason. However, this paper aims to develop a **scientific approach** and to focus on the underlining economic consequences for the

European industrial landscape, in particular for the high-end value creation of European production network.

China invested massively in knowledge-intensive commodities (Thierry & Barthelemy, 2013). This article, therefore, focuses on an industry with high production complexity, in which Europe is dominant and has been at the forefront of innovation, an industry that has been the center of Chinese investment since 2012 (American-Entreprise-Institute, 2019): the **automotive sector**.

This paper targets a country at the heart of Europe manufacturing, with strong automotive brand and global recognition, a country where Chinese automotive outward direct investment skyrocketed in the last then years: **Germany**.

China development has been built partly by the massive inflow of foreign direct investment and the opening of their supplier market to large foreign multinationals, after a global production fragmentation. Indeed, to derive the most out of the ongoing process of globalization, some multinationals have resorted to an extensively spatial and organizational fragmentation of their production units and processes. The growth archetype of China, an east Asian giant, followed the development model of its predecessors, the "four Asian tigers." The "four Asian tigers," namely Hong Kong, Singapore, South Korea, and Taiwan, underwent rapid industrialization growth between 1960 and 1990. They are now considered developed economies with upgraded industrial and trading capacities as well as ongoing investments abroad and high innovation capacity. However, the gigantic size of the Chinese market and its unique political system, change the world development vision for the West. They start to **be concerned they might lose their technological edge** over the world and consequently, their competitive production advantage.

Despite the concerns, Europe has a more positive view of Chinese investments than, for example, the USA (Christiansen & Maher, 2017). Moreover, China has a more peaceful view and therefore, less risky vision of Europe (Hunter, 2009). In addition, European growth has been weak and requires investment to stimulate its economy (Thierry & Barthelemy, 2013). In 2003, the **EU and China** announced a comprehensive **strategic partnership** in economic, political, and even security

domains (EEAS, 2019). Since then, trade and FDI between Europe and China have spiked up. Nowadays, trade between China and Europe counts, on average, over €1 billion per day. Aggregated trade between the EU and China increased to €514 billion in 2016 (Christiansen & Maher, 2017) and 604 billion in 2018 ("European commission trade policy: China," 2018), up from €260 billion in 2006 (Meunier, Burgoon, & Jacoby, 2014). In the meantime, China is seeking to develop land and maritime trade routes to mains trade actors through the New Silk Road, the Belt and Road Initiative. (Christiansen & Maher, 2017). In conclusion, Chinese impacts significantly increased in recent last decades, and China will continue to be one of the main actors in the European economic landscape. These impacts must be tracked.

This paper analyzes the impact of outward direct investment from Chinese multinationals in the German automotive industry. This analysis will be demonstrated by relevant **data** from the United Nations Statistical Department, the ComTrade database, and China Global Investment Tracker between 2007 and 2017. We will also use the framework of the **transnationality index**, **the Eclectic (OLI) Paradigm**, **the global value and commodities chain, the global production network, the global trade network, and the network centrality theory** as a conceptual framework for mapping and analyzing economic globalization.

We will use different tools from changing and adaptive science of Global Economy. Foremost, in Chapter one, we will define the transnationality mechanism of multinational enterprises (MNEs) and how a local enterprise become global. We will define the key characteristics of MNEs as well as how to differentiate and rank them with the transnationality index. In Chapter Two, we will define the concept of foreign direct investment, and explain the micro-mechanism of international investment on MNEs level through the Internalization Theory and the Eclectic (OLI) Paradigm. We will demonstrate that patterns of international production and decisions of MNE to undertake activities abroad are the results of interactions of three categories of benefits: Ownership, Location, and Internationalisation. We will then discuss how these benefits create incentives for MNEs to invest abroad and categorize them.

Afterward, we will aim to understand how Entreprise investments abroad change production scheme and how local institution influence it. In order to do that, we need to understand the fragmentation of the production mechanism in Chapter three. We will aim to theorize the economic development with two types of models – chain models and network models. We will investigate the value chain fragmentation of Porter and the global commodities chain of Gerrefi, and how researchers attempted to integrate the model in a ever-changing world of production. We will then investigate two representations of an economical sector through networks: Firstly, a network illustration of the production, the Global Production Network (GPN), with its fours dimension: the firms, the sectors, the institution, and the networks. Secondly, the network representation of global trade, the Global Trade Network. In Chapter four, we will explore how global production at a local level can evolve with time. We will understand the actor involved, the action of local institutions, and how regional asset can couple with specific industrial production networks. Finally, in Chapter five, we will try to quantify the impacts of changing local production networks by mapping global trade in a global trade network and understanding the centrality of countries in specific commodities networks.

This paper will seek to answers the following questions:

- What are the motivations, repartition, and type of investment for Chinese outward investment in the German automotive sector? Do they differ from the rest of Europe?
- How Chinese multinationals differ from European multinationals? Why are they internationalizing?
- What are the structural specificities of the automotive sector? How is it embedded in the german market?
- What are the key factors explaining Europe and China's position in the automotive Global Production Network? How might Chinese multinationals influence Germans embedding in it?
- What are the risks for the German production capacity?

In our case analysis in Chapter 6 we focus on the state of Chinese Outward Direct Investment in Europe. We will describe their history, the drive of Chinese MNE in

Europe, and their different types of investment, namely the greenfield, joint venture, and acquisition. We will finish the Chapter by analyzing the data from China Global Investment Tracker on the large ODIs of Chineses MNEs by subdividing the Outward direct investments per sector, per countries and per share of acquisition.

According to Yeung and Cole (2015), GPN is the predominant organizational feature of the world economic system, which is the main focus of case analyais in Chapter seven. The chapter describes the four dimensions of the global production network in the German automotive sector focusing on Chinese and German actors. First, we will look into the German and Chinese automotive firms, and their specificities and range of actions in the local german GPN. Secondly, we will take an overview of the automotive sector, the current state, and the incoming technological change. Thirdly, we will review the institutional impacts from Germany, China, the EU, and non-governmental institutions. In the dimension of the network, we will review the networks architecture and map the Global Trade Network based on the ComTrade database trade dataset. We will filter the trade data specifically on the automotive industry and subdivide the traded goods into finished goods and intermediates goods trade networks. With a python tool we developed, we will map the network, visualize key component, and compute the centrality of the countries overtimes. In the analysis, we will focus specifically on German and Chinese actors, extract in the German regional asset and comparing them to Chinese investment in Chapter 8. In this section, we will analyze the future development of the automotive sector by analyzing the coupling between German regional asset and the global production network, as well as the risk of decoupling between this asset and the automotive global production networks from Chinese policies. Finally, we will compute the lagged correlation between Chinese outward direct investments and change of German centrality in the Global Trade networks of finished goods in the last ten years.

PART 1: SYNTHESIS OF RELATED LITERATURE

CHAPTER 1: MULTINATIONAL ENTERPRISE: DEFINITION & TRANSNATIONALITY INDEX

If we aim to understand the motive of Chinese Multinational Enterprise, we should define theorize what a Multinational Enterprise (MNE) is. In this section, we will define the concept of MNE, highlight the type of transnationality, and explain an index to rank the transnationality degree of an enterprise.

1.1 WHAT IS A MULTINATIONAL?

Professor Dunning at the University of Leeds is an eminence in internalization and global trade (H. W. Yeung, 2009). In his book "Multinational Enterprises and the Global Economy" (John H. Dunning & Lundan, 2008), he conceptualized and summarized the literature of the intrinsic relation between multinational enterprise and global trade.

According to the OECD (Organisation for Economic Co-operation and Development), a multinational or transnational enterprise is a company that engages in foreign direct investment (FDI) and controls value-added activities abroad (OECD, 2018).

This definition does not differentiate among all different levels of transnationality. Indeed, MNE can be transnational at a different level (Ramaswamy, 1996; Sullivan, 1996). Sullivan and Ramaswamy assessed the degree or intensity of an enterprise's transnationality with seven keys characteristics collected by Dunning:

1. The scale of owned companies (or companies it exercises control over) by the transnational entreprise.
2. The quantity of countries that are part of its value chain, number of countries that are a part of its production/support activities happens.
3. The proportion of its global assets, revenue, income or employment in foreign countries in comparison to its home country.

4. The degree to which management and shareholders are international and diverse (diversity of nationality of people involved in decision making).
5. The degree to which its higher-value activities (marketing, research, and development (R&D)), are internationalized. The part of high value-added activities and knowledge production outside of the home country.
6. The systemic advantages coming from its transnational activities. The competitive advantage arising from its network of activities located in different countries
7. The spread of responsibilities across its cross-border activities. The degree to which decision making of governance, are in part decentralized to foreign subsidiaries (diversity of nationality of institutions involved in decision making).

These seven-point enable to measure the transnational degree that each MNE can have. For instance, a large state-owned company, that holds a small supplier or producer is not multinational to the same extent as, for instance, a service company massively present in five continents. A multinational company might have different regional subsidiary headquarters, with various level of independence, research, and development capabilities. This fundamental difference will impact the company global strategy and how it undertakes activities abroad. A company can have, therefore, different approaches and objectives to transnationality. This situation can generate one-dimensional knowledge exchange or a two-way directional knowledge exchange with its affiliate, affecting the power-law or the influence on the global production supply chain.

1.2 THE TRANSNATIONALITY INDEX: HOW GLOBAL IS A MULTINATIONAL?

Nevertheless, how can the transnational degree of a multinational be measured by number?

In 1995, UNCTAD (United Nation Conference on Trade and Development) established the Transnationality Index report on leading Multinational Enterprises (MNE). Each year, UNCTAD publishes the TNI of the 100 largest MNEs

in the world in the "World Investment Report." Transnationality Index is a way to rank transnational companies. It is computed as an arithmetic means of three ratios(J.H. Dunning, 1991):

$$TNI = \frac{A_f}{A_t} + \frac{S_f}{S_t} + \frac{E_f}{E_t}$$

Where:

- The first part of the sum is the ratio of foreign assets (A_f) to total assets (A_t),
- The second part of the sum is the ratio of foreign sales(S_f) to total sales (S_t),
- The third part of the sum is the ratio of foreign employments (E_f) to total employments(E_t).

This framework assesses the degree of embedding of an MNE in its home country. Generally, a high transnationality index correlates to the impact a multinational has on the global stage. A high TNI of MNE corresponds to a high transnationality. Vice-versa, a low TNI might correspond to local enterprise owning some small retailer abroad.

CHAPTER 2: INTERNALIZATION THEORY AND MOTIVATIONS FOR OUTWARD FDI

Now that we defined the specificity of multinational enterprises, we will explain the processes and causes that make a local enterprise aims for transnationality. In this section, we will define what foreign direct investment and the internationalization framework is. Then we explain the Ownership-Location-Internationalisation (OLI) framework of Dunning, that clarifies the strategy behind globalizing its activity. We will develop more in detail the O of the OLI framework, the ownership. Indeed, the ownership advantage has been later

extended by scholars to be more exhaustive. Afterward, we will try to explain the motivation for an MNE to conduct Foreign Direct Investment (FDI).

2.1 STRATEGY BEHIND TRANSNATIONALITY: OWNERSHIP-LOCATION-INTERNATIONALISATION (OLI) FRAMEWORK

The Eclectic paradigm, also called Ownership-Location-Internationalisation (OLI) framework determines the reasons for sales and productions across different countries in which the MNE operates. One historical trade framework, The Heckscher-Ohlin model, explains global trade arise because countries produce and export goods if they have more abundant factors of production than others, and import products with scarce internal factors of production (R. C. Feenstra, 2004). This model makes the assumptions of perfect goods and service markets, defined as:

- Free trade,
- No transport costs,
- Identical tastes worldwide, or without the economy of scale.

However, in practice, perfect goods market does not exist. The framework of internalization states that Foreign Direct Investments arise from imperfections in the goods and service markets (Rugman, 1980). This imperfection of the global market can become a benefit or competitive advantage for local enterprises that undertakes foreign direct investment abroad, in case of free trade.

The United Nation defines foreign direct investment FDI as the following:

"Foreign direct investment (FDI) is the category of international investment that reflects the objective of a resident entity in one economy to obtain a lasting interest in an enterprise resident in another economy." (United Nation, 1993)

The concept of Outward Direct Investment (ODI) refers to any FDI made outside the country except for financial investments, by a member of that country. FDI is the inflow, while ODI is the outflow. ODI is sometimes also referred to as Outbound Direct Investment and Outgoing Direct Investment. However, the meaning remains the same.

Professor John H. Dunning in "Trade, Location of Economic Activity, and the MNE" in 1977 developed the now-famous Ownership-Location-Internationalisation (OLI) framework that he later extended in "The Eclectic (OLI) Paradigm of International Production: Past, Present, and Future." (John H. Dunning & Lundan, 2008; John H Dunning, 1977, 2001)

In this framework, the pattern of international production and decisions of MNE to undertake activities abroad results from the interactions of three categories of benefits (John H Dunning, 2001):

I. Ownership (O)

   Ownership advantage is any sort of asset producing value that allows firms to engage in activities in multiple countries. O advantage exists if MNE possesses competitive advantages over national enterprise on the supply of markets. This advantage comes from the ownership and/or access to a set of different assets not available to a national firm, or how they organize these assets with other transnational assets in a better way comparate to potential competitors. The assets are the capability of the MNEs to internalize markets.

II. Internalization (I)

   Internalization is how firms perceive the benefit from internalizing foreign market. It is the willingness of MNEs to internalize cross border outsourced activities and how it can reduce its transaction costs between countries. Internalizing markets is based on the advantages of the markets to produce and/or use of the owned assets, and how the internationalization adds value to these assets.

III. Location (L)

   The location is the degree to which MNE locate these value-adding activities their national boundaries and in which location. The advantage location arises from the availability of resources, networks, and institution in the host country.

2.2 UNDERSTAND THE OWNERSHIP OF THE OWNERSHIP-LOCATION-INTERNATIONALISATION FRAMEWORK

In 2010, Eden and Dai rethought the ODL model of Dunning in "Rethinking the O in Dunning's OLI/Eclectic Paradigm (Eden & Dai, 2010). They principally focused on the Ownership benefit. Historically, Dunning O modelized ownership benefit as purely manufacturing capacities; manufacture strategic decision could be based either on a single plant, multi-plant, and/or multi-country advantage. This definition of ownership aimed to understand international production but was limited to understand MNE strategic advantage at internationalization. Because this O framework was not collectively exhaustive and criticized in the scientific communities, Dunning reframes it. Ownership benefit is of three types:

I. Asset-based advantages (Oa)

Dunning defined Asset-based advantages as an exclusive possession and use of assets generating revenue. For instance: economies of scale, knowledge advantages, distribution networks, product diversification, and credit advantages

II. Transactional advantages (Ot)

Transactional advantages are advantages coming from the coordination of value-added activities across countries; and their capacity to reduce environmental and financial risks.

III. Institutional advantages (Oi)

Eden and Dai reckon that nowadays ownership-based advantages are not only internal asset, but also intangible external assets. It can also be diverse competence that generates or influences the innovation and quality of assets of other institutions to whom they have cooperative relationships (Eden & Dai, 2010).

Institutions are defined as a set of rules and procedures that enforce the rules. Institution coordinates the global network of value-added activities that are controlled and managed by MNE. They set up rules that govern the interaction between different steps of their production supply chain. Internationalization

might then rise from cross-border institutional differences in institutions. The proximity of various institutions is essential for long-term competitiveness. Institution benefit can be formal, setting up law, they have headquarters in the localization and are globally recognized, with a legal dimension (i.e., European Union). Institutions can also be informal, which refers to non-State rules and/or enforcement (Anderson, 2004). An informal institution can be, for instance, the set of tradition and network that governs relations between IT suppliers in the city of Shenzen.

Formal institutions develop trade policy, such as tariff. However, their influences are not limited to the laws, but they can also create barriers to international trade at bureaucratic and judicial level with opportunistic behavior. These powers can be corrupted, unreliable, or even omnipresent. Therefore, it exerts a direct influence on international trade outside of the formal regulatory context. For example, South Americain trade in 1996 was restricted more by lack-luster institutions than formal tariffs. (Anderson & Marcouiller, 2002)

The critical concept behind institutions is the concept of a sovereign state. Indeed, the primary interests of a sovereign state are not always in line with the global production network of an MNE. Secondly, sovereign states provide opportunities for competitive behaviors. Undeniably, an informal institution can also be influenced by the language, value, tradition, and nationalism of the state. The concept of a sovereign state does not limit to institutions. On the macro level, the World Trade Organization (WTO), and other cross-border institutions are incrementally increasing their influences over national institutions. On the micro-level, many regional institutions have an increasing impact. However, the sovereign state remains as the most influential institution in modern trade and are increasingly the most crucial factor which must be taken into account.

2.3 FOUR-FOLD CATEGORIZATION OF MOTIVATIONS FOR FDI

After identifying the competitive advantage MNE might be looking for globally, it is essential to identify the types of transnational activities MNE might be engaged in to attract the OLI advantages.

Foremost, there are two types of foreign direct investment (FDI): horizontal and vertical. (Baldwin & Okubo, 2014). On the one hand, for Markusen, **horizontal** foreign direct investment of MNE are investments in production facilities abroad that produce the same type of goods or services than its home country. On the other hand, if the MNE invest in production facilities of specialized intermediate or finish goods that are part of their supply chain, it will be named **vertical**(Markusen, 1984).

Additionally, researchers identify four types of MNE activities: natural resource seekers, market seekers, efficiency seekers, and strategic asset seeker (John H. Dunning & Lundan, 2008). The model had been first developed by Jack Behrman in 1974 (Behrman, 1974) and then extended by Dunning in 1991 (J.H. Dunning, 1991). Moreover, MNE activities can be aggressive in case of proactive action for strategic goals, or defensive in case of reaction to competition or foreign institution to defend their market position (John H. Dunning & Lundan, 2008). The four descriptions of the motive of FDI come from its book "Multinational Enterprises and the Global Economy" (John H. Dunning & Lundan, 2008).

Primary, MNE invest in **resource seekers** FDI in order to acquire particular resources or to improve the quality and reliance of the supply of such resource. These FDIs aim to be more competitive in their home markets. There are three types of resource seeking — first, MNEs research for physical resources, such as raw material. Second, MNEs research for cheap skilled labor resources. These resource seekers FDI are capital intensive and mostly location-based. Third, MNEs research for high value-added resources such as technological expertise, management, or marketing capabilities.

Subsequently, MNE might do **market seeker** FDI to supply goods or services to markets they have no or difficult access to otherwise. The aims are often to bypass tariff and cost-raising barriers from the host countries. It could also happen when the size of the market subsequently increase to a point where local production

becomes cost-effective. Another cause is to follow a lead business-to-business customer that increases its global reach, in which case the market seeker has to maintain its relationship with customers. Another case is when MNE product needs to be adapted to local tastes and specifities, and therefore needs to be developed for the host market. Finally, market-seeking investments might happen when MNEs aim to have a local presence in the leading markets of its competitors. MNEs aims to improve their production chains by confronting higher competition and incorporating strategic coupling of the local production network. This point will be further discussed in the next chapter.

Besides, MNE might look for **efficiency-seeking** FDI when they can benefit from unified governance of dispersed activities worldwide. Efficiency-seeking FDIs can be divided into at least three types: economies of scale, economies of scope, and economics of reduction of risk by diversification. Efficiency seeking happens when MNE can reduce its cost or increase its competitive advantage by investing in specific local production networks. It might arise from labor optimization, or by the availability of local knowledge or supply network.

Finally, **strategic asset seekers FDIs** of MNE occur by acquiring the assets of foreign competitors to achieve strategic objectives for global competitiveness. MNEs could follow an established global strategy or as local firms seeking access to global competitive advantage. The aim is to obtain assets and human knowledge that will increase their competitive advantage or reduce the advantage of their competitors.

In resume, firms will internationalize to aim for competitive advantages of superior access to ownership of resources such as access to raw material and cheaper labor, access to a location with superior market and production capabilities, or finally to reduce transaction cost by internalization of efficient value chain part abroad. Their investment can have four motives, resource seeker to acquire specific resources, market seeker to supply in a new market, efficiency-seeking, to improve their production systems and finally, strategic asset seekers to fulfill strategic objectives against the global competition.

CHAPTER 3: THEORIZE THE ECONOMIC DEVELOPMENT IN A GLOBAL WORLD, GLOBAL VALUE CHAIN, AND GLOBAL PRODUCTION NETWORK

Now that we defined the transnationality of an enterprise, and how MNE became international at an entity level, we will try to highlight the main drives of global internationalization. What causes the imperfection in the market, and why advantages of ownership, location, and internationalization exist. We will demonstrate the global trade driving forces.

3.1 INTRODUCTION: THE CHAIN CONCEPT VERSUS THE NETWORK CONCEPT

In this section, we will review the implication of production networks on a global scale. We will develop the consequence for those networks of a changing legal, cultural, and economic background. Furthermore, we will investigate how the strategy of modern MNE was not only molded by the new trade landscape but also shaped it.

To understand how structure and relations between firms can reshape our world trade landscape, we will first focus on two different frameworks to study trades aspects. These models predated the global production network and created the basis of the concept. Indeed, the Global Production Network (GPN) model incorporates different theories of subdivision of trade, with common grounds on various concepts (Gereffi, Humphrey, Kaplinsky, & Sturgeon, 2001). To begin with, we will develop the **Global Commodities Chain** and the **Global Value Chain** (GVC), then we will describe the specificities of **network analysis leading** to the **GPN**.

In 2001, Sturgeon (T. J. Sturgeon, 2001) and Dickens & Cie (Dicken, Kelly, Olds, & Yeung, 2001) designated a need to standardize global production framework. At that time, multiple models were competing. Henderson & Cie tried to organize it in the article “Global production networks and the analysis of economic development.” In their analyses, they use the approach of Henderson & Cie and

divided the framework of global production and ultimate supply chain in two types: the **chain concept** and the **network concept** (Henderson, Dicken, Hess, Coe, & Wai-Chung Yeung, 2002). While these frameworks differ by their approach, nevertheless, they share many similarities (Dicken et al., 2001).

Table 1 - Model of global production

	GCC	Value Chain	GPN
Structure	Chain	Chain	Network
actors	Multiple	One or multiple	Multiples
Type of actor	firms	The lead firm, outsourcing partners	Firms, institutions, and every actor influencing production.
Chain Governance	Buyer-driven vs Producer driven	One lead firm	Power relationship, relational
Focus	Governance between lead firm, supplier, and retailer.	Internationalization by subdivision of production of value-added activities	Inter-relation between actor embedded in a network of value-added and power relation
Variable of internationalization and development	External to the lead firms	Internal to the lead firm	Embedding of the actors in the networks with the GPN

Moreover, the **chain concept** divides production in a sequential and interconnected structure of economic activities (Gereffi, 1999). It identifies the stages of economic activities from a production sequence of a good starting with raw material to finalized products (John H. Dunning & Lundan, 2008). Porter developed first this concept in 1986 (Porter, 1986). Its global extension, the **global value chains**, is defined by Gereffi as the relative value of phases of production and distribution of value-added activities products or services go through from origin to final consumers. This definition can also include final disposal after use by the customer (Gereffi, 1999). This concept has been widely recognized and applied in business management because of its practicability, which facilitated

extensive uses. Researchers and managers are able to efficiently compute the value-added activities as part of the total payoff of a product. This value is then used to measure the impact of each activity and to compare it to his cost.

In parallel of Porter's value chain, in 1970, French economists, like Lemoigne, developed the concept of "filière": a system of agents producing and delivering goods or services for a final demand. (Bencharif & Rastoin, 2007). The main specificity of the filière trade framework was to map the agent impacting the production in function of the commodities flow. (Raikes, Jensen, & Ponte, 2000). It was predominantly used to model the agri-food sector. Later, after the new world division of labor of MNE in the 1980th, the filière framework will be extended into a chain framework with the **Global Commodity Chain** (GCC). Gereffi based the Global Commodity Chain on the dynamics of the global organization of production. GCC emphasizes the governance structure of supply chains and on the role of lead firms in global production and sourcing (Gereffi 1994). The cornerstone of this framework is the distinction between producer-driven vs. buyer-driven chain. This distinction is grounded on the relation of power inside of the supply chain.

However, some argue that production is not only a one-way relationship between outsourcing and a Lead firm but also a **network concept** of actor interconnected in cooperation. A network is made of two or more value-chains that share at least one actor (T. J. Sturgeon, 2001). The global value chain can be limited because it only represents a sequential linear economics relationship. A **Global Production Networks (GPN)** is defined as an organizational arrangement of interconnected economic and non-economic actors around globals MNE (Neil Martin Coe & Yeung, 2015). A production network produces, distributes, and consumes specific goods or services across the global markets. It is the interactive framework that aims to include all the actors of production systems in one network.

3.2 THE GLOBAL FRAGMENTATION OF THE SUPPLY CHAIN

Understanding how Multinationals interact with their global environment is essential for understanding the impact of Foreign Direct Investment. A

multinational enterprise interacts by engaging in **production**, which is defined as any value-creating or adding activities (John H. Dunning & Lundan, 2008). The **supply chain** is an input-output structure of value-adding activities, beginning from raw materials and end with the finished product. (Gereffi et al., 2001). During this process, raw materials are first processed into intermediate goods - manufactured goods necessary for the production of the finished product. Subsequently, intermediate goods are transformed into final goods distributed to the consumer. Mentzer and Cie extended this definition in their article "Defining supply chain management" to *"a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and information from a source to a customer*." (Mentzer, Keebler, Nix, Smith, & Zacharia, 2001) This definition underlines the distinction between upstreams flow, close to the customer and therefore, the final goods, and the downstream flow, close to raw and intermediate goods. Incorporated within this definition, Mentzer and Cie classified three degrees of supply chain complexity into three types of channel relationship. In order of complexity, they consist of a direct supply chain, an extended supply chain, and an ultimate supply chain as described in fig 1. The direct supply chain is divided by a company, a supplier, and a customer involved in the upstream and/or downstream activities and flows. An extended supply chain of a firm, besides direct supply chain actors, includes suppliers of the immediate supplier and customers of customers. An ultimate supply chain, besides extended supply chain actors, consist of all the organizations involved in all the upstream and downstream activities and trade flows.

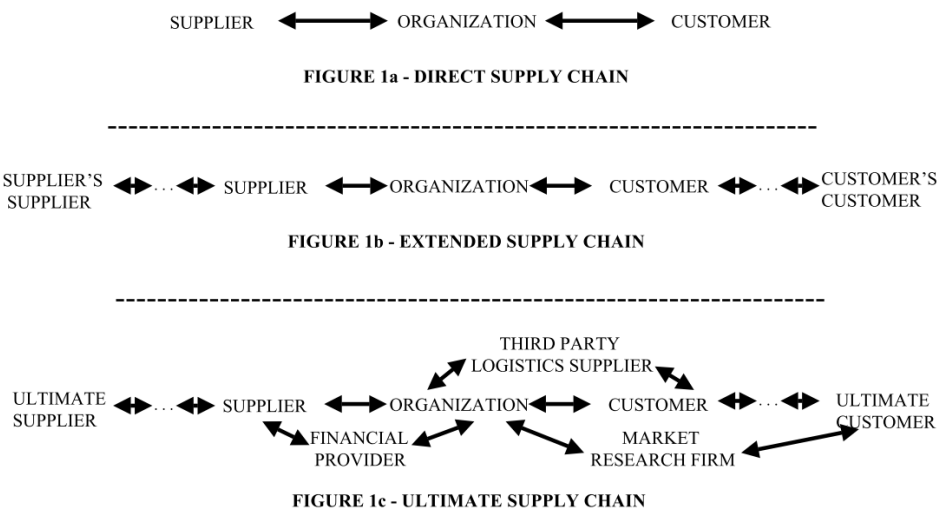

Figure 1 - Types of channel relationships (Mentzer et al., 2001)

Since the 1960s, there has been a gradual disintegration of supply chain processes across countries due to three main factors (Antras, 2015). First, the rise of **new information and communication technologies** reduced the cost of transmitting information and knowledge significantly. Secondly, **trade liberalization** treaties, along with falling transportation costs, made trade considerably less costly. The creation of the WTO, EU (CEE), NAFTA, ASEAN, China's WTO accession changed the global landscape and broke trades barriers. Finally, after the fall of communism, a **global ideological shift** to capitalist and free markets systems in the majority of the world expanded the reach of globalization.

This integration shift led to slicing of the supply and the fragmentation of the production process worldwide, from north to south, from east to west. Indeed, the share of intermediates good imported from other countries grew from 5.3 percent of total U.S. intermediate procurements in 1972 to 11.6 percent in 1990. (R. Feenstra & Hanson, 1996)

Nowadays, the global export of intermediate goods surpasses significantly the trade of final good (Neil Martin Coe & Yeung, 2015). Besides, international trade has grown faster in components than in final goods (Yeats, 1998). In modern manufacturing, final-good producers often do not keep the full control of all their supply chains and therefore their all manufacturing process. MNEs combine intermediate inputs provided by various suppliers and outsource different part

of their supply chain at different stages of the production. Often, the outsourcing is found in strategic trade-offs between domestic and foreign suppliers of intermediate good with lower variable costs in the emerging countries and lower fixed costs in the developed countries (Antras & Helpman, 2004). Lower variable costs came from lower wage, while lower fixed costs are the result of infrastructure and knowledge availability. These outsourcers/suppliers are themselves actors in the development of the due product, with a certain level of control and information over it. This chain of production is itself governed by a set of rules, power, and institutions.

In summary, in this manufacture structure, various actors revolve around leading companies. The Supply Chain of a product is a net of interactions of supplier-buyer, internal and/or external to the company, as well as an environment that governs these interactions. These lead firms have now two main organizational decisions, the location of the part of its supply chain, and the extent of control over its production.

3.3 THE VALUE CHAIN, THE IMPORTANCE OF INTERNAL PRODUCTION FACTORS

In the article "Changing Patterns of International Competition," M. E. Porter stated, there are two types of main drivers behind the growth of world trade: the principle of comparative advantage of countries and the growth of sizeable multinational firm capable of exploiting intangible asset coming from it (Porter, 1986). The concept of countries' comparative advantage was not new. The global industry competition was considered the result of the difference in know-how and intangible asset, allowing global MNE to compete and adapt in different markets (Caves, 1982).

Porter defined global industries as markets in which the competitive state in one country is directly influenced by the same industry in other countries in a sizable way. Global industries are not a simple assembly of each country's industries, but a series of linked domestic industries, with a competition at a global level with MNE as actors (Porter, 1986). Global industries are opposed to multi-domestic

industry. In a multi-domestic industry, a company internationalizes its activities if potential profit overcomes the extra costs of entering and competing in foreign markets. Global industries may include aircraft, semiconductor, automobiles, whereas multi-domestic may include retailing, distribution, insurance. In global industries, a company should internationalize and integrate its activity to capture the linkages among countries (Porter, 1986).

Based on the concept of global industries, Porter, for the first time, defined the concept of global value chains. A company is a collection of discrete activities, which produce directly or indirectly revenue and therefore add values, which occurs within its scope, called the value chain. Those **value-added activities** are physically and technologically distinct, and the value chain can be consequently divided. Finally, the total value added to a product can be computed as the final consumer price (Mentzer et al., 2001).

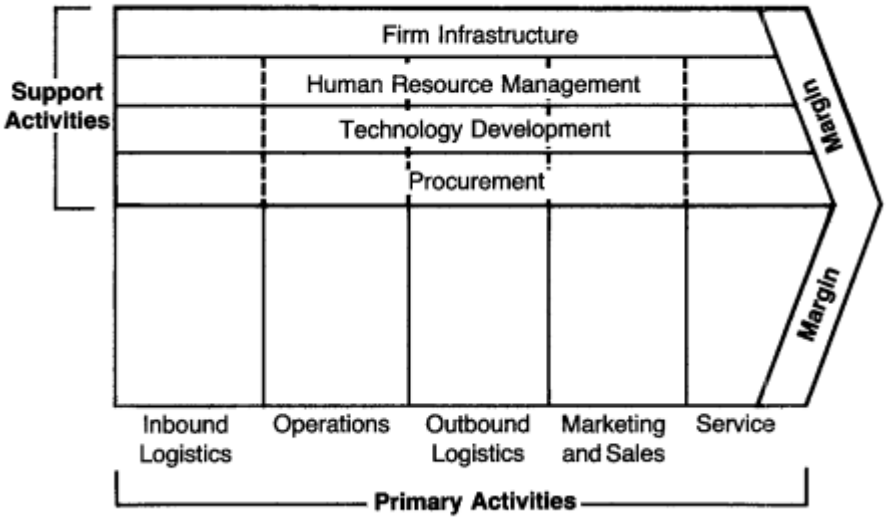

Figure 2 - The Value Chain (Porter, 1986)

As presented in figure 2, nine different categories divided the value chain into value-added activities; these categories are further divided into two different subtypes.

Firstly, the primary activities are directly involved in the physical creation of products and services. They are completed gradually by steps, namely, in the following order of Inbound logistics, operations, outbound logistics, marketing

and sales, and services. Secondly, support activities provide inputs and/or infrastructure for the primary activities, namely without order, infrastructure, human resources, technology and R&D, and procurement. Primary and support activities have been extended since then, in articles including " Making the case for the added-value chain." (Mcphee & Wheeler, 2006). This extension is, firstly, due to the increased importance of intangible assets, networks, and knowhow in the current economy of knowledge. Secondly, it is due to the willingness of researchers to include the full life cycle of products in the value chain, therefore adding activities after first customers use. This model includes supply chain management, product use, and end of primary use as primary activities. It also adds external networks as support activities.

Economic activities in the Porter value chain are distinct, independent activities but are connected along a chain. It focused on the core activities from which MNE derive value(Mcphee & Wheeler, 2006). The main point of the global value chain is that each value activity can be outsourced to other external supplier or relocated internally in other countries. It focuses on endogenous variables of the global production model, based on relation inside the production model. GVCs is a framework that links MNE, labor, and consumers globally, and that provides opportunities for large company and workers in emerging markets to become major actors in the global economy (Gereffi & Fernandez-Stark, 2016).

For an MNE, the main strategy to compete in global industries is to spread each value-added activity to countries with the best global competitive advantage for each specific activity. In this spread, a new distinction needs to be made regarding the type of activities: :

- **Upstream Value Activities**, related directly to the buyer of the final product,
- **Downstream Value Activities**, decoupled from the final buyer

Upstream value activities location is buyer-driven and thus specific to the buyer country, while Downstream activities locations are not production-driven and do not have spatial restrictions. Therefore, the location and intensity of these value-added activities are optimized from a global perspective (Buzzell, 1968).

Upstream Value Activities are local, while downstream value activities are global. (Gereffi & Fernandez-Stark, 2016). However, nowadays, with the rise of online shopping, this distinction becoming more and more ambiguous.

From this model, we can deduce that industries, where upstream activities are the source of competitive advantage, tend to be multi-domestic. Multi-domestic means that each country has its iteration of a business model and that there is no competitive gain to globalize its activity for an MNE. In the opposite side, industries where downstream activities are the source of competitive advantage often follow global competition pattern (Vance, 2006).

3.4 GLOBAL COMMODITY CHAIN (GCC), THE IMPORTANCE OF EXTERNAL PRODUCTION FACTORS

Gary Gereffi and Miguel Korzeniewicz extensively developed the framework of the global commodity chain in the book "Commodity chain and global capitalism" in 1994 (Gereffi & Korzeniewicz, 1994) . This concept was created previously by Terence Hopkins and Immanuel Wallerstein at an enterprise level (Hopkins & Wallerstein, 1986) It was then essential to understand the power relationship between the different actors of an ultimate supply chain. Gary Gereffi is a Professor of Sociology and director of the Center on Globalization, Governance & Competitiveness at Duke University. He defined the **Global Commodity Chain (GCC)** as inter-organizational systems grouped around one commodity. The chain links customers, producers, suppliers, and countries into the global economy. These systems are specific to the situation, rooted in social backgrounds, and integrated locally; it emphasizes the social embeddedness of economic organization. (Gereffi & Korzeniewicz, 1994). Instead of a linear sequence of value-adding activities for a finish good, the commodity chain is a matrix of interconnected relationships through interdependent productions, distribution and exchange systems. (Bair, 2008)

According to the book "Global industrialization in global Capitalism," global capital exchanges is the result of an integrated system of production and trade. The global commodity chain determines connections between various economic agents interacting with and in a supply chain, for instance, the raw materials suppliers, factories, traders, and retailers. In the GCC, the existence of globalization and MNEs are the result of international buyer/producer relationship and not to the segmentation of the production itself. The rise of global capitalism is not only characterized by a geographical spread of enterprises but also by administrative coordination between physical actors and between countries (Ross & Trachte, 1990). GCC enhances the importance of the external actor of the production and the regulatory landscape between the firms. State policies influenced GCC on export and import and therefore are more suited for policymaking.

Global commodity chain has three main dimensions (Gereffi & Korzeniewicz, 1994):

- First, an input/output structure dimension where service/product are linked to each other in a distinct sequence of raw material, intermediate and finished goods, hence an internally nonfragmented chain of production.
- Secondly, a territoriality dimension, with potentially different geographical repartitions of production and distribution.
- Finally, a governance structure that structure power relationships between the actors. Actors may be impacting how finance, material, and human resource are distributed into the chain.

The governance of a GCC capture dissimilarities in the entreprise organization of their cross-border production systems (T. Sturgeon, 2008). The governance structure of GCC is divided into two different types (Storper & Harrison, 1991), the producer-driven commodity chain (Hill, 1989) and buyer-driven commodity chain:

1. The **producer-driven commodity chain** refers to industries where a MNE controls widely one production system, often corresponding to capital/knowledge-intensive industry (automobile, computer, etc.). The reach of these industries is transnational. However, the quantity of

countries involved in their GCC is limited. The internal and external networks of production emanate from large multinational manufacturing firms (T. Sturgeon, 2008) and are investment-based. MNE, in this case, often outsource labor-intensive component. In producer-driven commodity chains, the principal barriers to the entry of new firms are access to the complexity of the production (Humphrey & Schmitz, 2002). Control over the production by manufacturer MNE headquarters characterized producer-driven production system.

2. **The buyer-driven commodity chain** is a supply chain controlled by large retailers, big brands, and intermediary traders, with a decentralized production network. The principal barrier to entry buyer-driven chains is restricted/limited access to the market (Humphrey & Schmitz, 2002). It is focused on the dominant roles of well-known brands and big retailers, such as Tesco, Apple, WalMart, have in the global commodities chain governance. These Global buyers help to produce, shape and organize the global chains of supply of their commodities (T. Sturgeon, 2008). Therefore, the internal and external networks of production are trade-based. Developing countries and labor-intensive industries are often the centers of trade led decentralized production pattern, without control of the supply chain. The global buyer outsources the goods but specified and design it to decentralized manufacturers. Nowadays, branded merchandisers also outsource different part of their development activities to different actors of a GCC to minimize their cost and only focused on their value-added, their brand.

For Gereffi (1994), a production system links the economic activities of a firm with technological and organizational production networks of commodities. Variation in production system generates patterns of specialization in trade. This specialization resulted in a global manufacture system with production expertise varying between developing and industrialized countries (Harris, 1987).

The following model describes in figure 3, help us to characterize both organizational dimensions

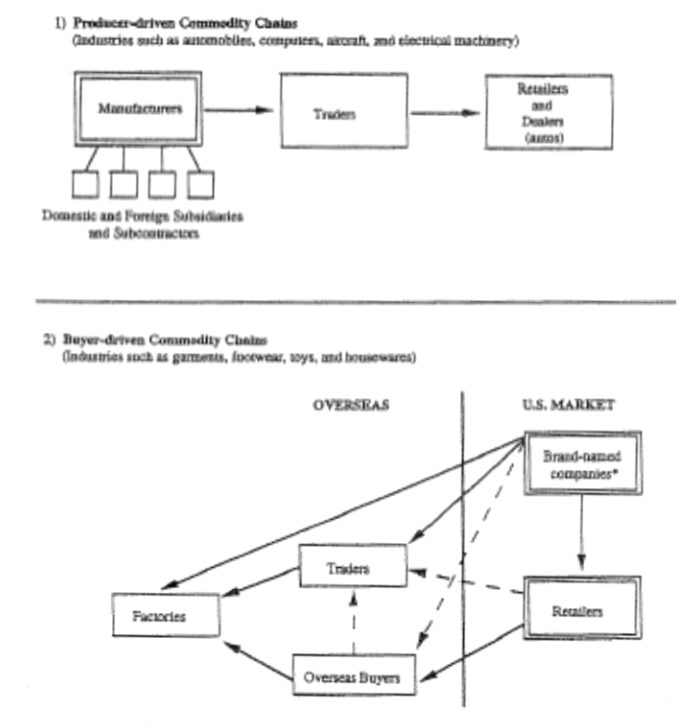

Figure 3 - The organisation of Producer-Driven and Buyer-Driven Global Commodity Chains (Gereffi & Korzeniewicz, 1994)

In a specific regulatory environment, in product-driven GCC, production pattern shapes the character of the demand. Whereas in buyer-driven GCC, the organization of the demand characterizes the production. (T. Sturgeon, 2008)

In conclusion, three dimensions characterized Global commodity chains: an input/output structure (a Supply Chain), a territoriality dimension, and a governance structure. This governance structure is divided into two types: producer-driven and buyer-driven. If Global commodities chain identifies a structure in value-added of an industry, its focus is a producer-buyer relationship, with power relation governed by control over the industry and the state regulation that influence it. Its focus is on exogenous variables of the global production model, the actors.

3.5 LIMIT OF THE CHAIN STRUCTURE

If we want to analyze the economics of development, the chain approach of the value analysis of Porter has a restricted utility since, first, it is limited to a firm or an interfirm network, the endogenous variables of the supply chain. In other words, it limited to the MNE supply chain and not the other factor influencing the

creation of value. Then, it is mostly vertical; it divides enterprises into value-added activities and is sequentially linear (T. J. Sturgeon, 2001). It does not identify the exogenous variables, for instance, the corporate power, the institutional contexts, and the territorial arrangements (Henderson et al., 2002). It is more relevant for the managerial issues than for policymaking.

The GCC exogenous dimensions also display limits (Henderson et al., 2002). The producer/buyer-driven governance dimension is mostly based on barriers to entry to explain localization, and thus do not include all subdivision of global production aspect (Dicken et al., 2001). Secondly, it is incomplete because its input-output approach is static and does not describe non-existing possible fragmentation - hence, outsourcing of different part of the value chain. Thirdly, it does not describe the firm ownership perspective, for instance, how its social embedding or the private/public structure influence its production. Finally, firm in GCC are determined by their exogenous variable and thus cannot develop their internal global strategy outside of their chain governance.

3.6 THE GLOBAL PRODUCTION NETWORK (GPN)

In the competition to describe a holistic view of the industry of global production with the paper of Fernandez-Stark and Gereffi (Gereffi & Fernandez-Stark, 2016), another framework appears. This framework also has root in the GCC and the Porter value chain analysis: it is called the **Global Production Network (GPN)**.

Sturgeon explained the difference between a chain and a network concept (T. J. Sturgeon, 2001). A chain is a vertical sequence of input-output, leading raw materials to delivery to end consumer. While a chain framework can be an aggregation of various linked and shared chains of actors, a network can extend the production framework by modelizing the interfirm relationships. Networks also associate economics connection with larger economic groupings. Network structures are not limited by a vertical linear structure; they are multi-dimensional. They represent multi-layered frames of economic activity. They map the relation, connectivity, scopes of influence, and power between the human and

non-human actor, for instance, technological elements (Dicken et al., 2001). It is, therefore, more relevant to describe policy impact.

In the article "Global Production Networks, theorizing Economic development in an interconnected world," Coe and Yeung (Neil Martin Coe & Yeung, 2015) describe the structure of the classic GPN. The network is an organizational and geographical structure (Dicken et al., 2001). GPN analysis does not consider the network in a static moment; it attempts to demonstrate the dynamic developmental impact on interconnected regions (H. W. C. Yeung & Coe, 2015).

The GPN is based on four previous concepts: the value chain of Porter, the social networks embeddedness theory, the actor-network theories, a framework that model social interaction as a network and finally the global commodity chain analysis (Hess & Wai-chung Yeung, 2006). We already defined the value chain of Porter and the GCC. In the meantime, actor-network theories defined the concept of actors and social networks modelized quantitively relationship between entities. An actor is an actant, an entity that acts or to which activity is granted by another actor. Its main characteristic is that it does not need direct motivations from an individual. An actor can be anything as far as it is the root of actions in the network (Latour, 1996). Alongside, Social networks theory is the process of studying social structures by using networks (Otte & Rousseau, 2002). A network is characterized by entities, called nodes and link, relationships between these entities, called edges (Newman, 2010). It is a graphical and mathematical way to represent the relationship between actors. Each actor is represented by a node and each relationship between them by edges. We will develop the mathematical representation of a network in Chapter V.

The following graphic in figure 4 represents the structure of GPN. (Neil M. Coe, Dicken, & Hess, 2008)

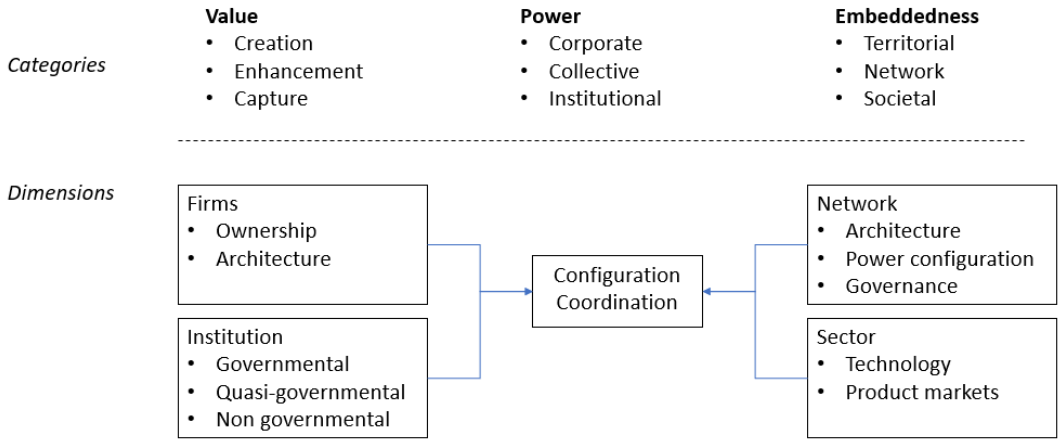

Figure 4 - Structure of a global production network (Neil M. Coe, Dicken, & Hess, 2008)

Foremost, the GPN analysis is multi-scalar: it takes into account actors interaction from local to global, it has multiple dimension. Secondly, the GPN is an extra-firm network. It highlights a broader range of extra-firm **institution**, divided into three categories that can shape firm activities: governmental, quasi-governmental, and non-governmental. Some example can be, for instance, trade unions, governmental agencies, NGO. The **firm** is an aggregation of discrete value-added activities. It has its architecture, specifics to its commodity, and have different levels of ownership over its value-added activities. Additionally, the production is a **network** and not a vertical chain. Finally, the governance dimension is more profound than the GCC as it shows how the regulatory systems and institutional contexts shape governance. Finally, **sector** specificity configured the production network – hence the required technologies and marketing strategies. (H. W. C. Yeung & Coe, 2015)

Furthermore, GPN is categorized by three interrelated variables: The **Value**, the **Power,** and the **Embeddedness**. Each of those variables has at least three other sub-variables defined in the previous graphic.

To start with, the **value** here is the value of the traditional definition of value-added activities of production moreover; it is also what the article of Coe and al calls "economic rent" (Neil M. Coe et al., 2008). Economic rent on the market is what enhances the firm value. It could be an asymmetric access to resource (*resource rent*), to technology (*technological rent*), the hiring of specific talent (*human resource rent*), organization skills (*organizational rents*), linkage inside

your network (*relational rent*), availability of infrastructure (*infrastructure rents*) or finally the financial rent (*financial rents*) as well as other the intangible asset. Those rents can generate a competitive advantage. These advantages allow or force companies to specialize in the rent they have access to. The value is timeless, represents the current but also the potential future rent. It can also be acquired without aggregation upward or downward in the output/input vertical structure of production. Value enhancement can be generated, for instance, through technology transfers, industrial upgrading, or access to regional assets.

Power is the ability of one actor to influence the comportment of another in a way conflicting to this actor interest. It is also the capacity to resist and counterattack to these influence. It could be coercive but also consensual (Parsons, 1963). Power can be generated by tangible asset but is an intangible relation. It is also dynamic and not absolute. Indeed power relationship in one dimension is influenced by and relative to power to other actors in another dimension of the network. All actors do not have an absolute identical quantity of powers in relation to all other actors. From the power variable, we could infer the level of mutual interest and dependency, and take into account the other source of power than the firm, for instance, the institutions.

The third variable, **embeddedness**, is "how [lead firm] constitute and are reconstituted by the economic, social and political arrangement of their geographic situation" (Neil M. Coe et al., 2008). It represents the importance of society, culture, institution culture, and history of economic actor. Network embeddedness is the degree of functional and social connectivity within a GPN. It measures, among other things, the stability of relation with intra and extra firm agent. Finally, the territorial embeddedness is how agents of the network are embedded in a specific location and how they impact and are impacted by the location. For example, access to labor skills network accesses to the supply of specific resources, accesses to local supplier network, relations to diverse institutions.

In conclusion, a global production network is a network of various actors with power relationship affecting their abilities to capture value in specific embeddedness.

3.7 CONCLUSION

In resume, different frameworks have been developed to conceptualize the global fragmentation of production. Production is subdivided into different adding value activities in a value-chain, from raw material to sales or disposal. The total value added corresponds to the final product sales. Besides, we can map relations and governances of this chain between a lead firm, suppliers, retailers, and consumers in a global commodities chain. It allows us to understand, among others, how distinct activities can be optimized by relocation abroad, as each value-added activities has its ownership-location-internalisation advantages. The GCC governance can be producer-driven, where complex production is controlled by a powerful lead firm producer or buyer-driven where standard production is handle by weak producer competing for cost, and where the GCC is controlled by powerful retailer or brand. Finally, global production can be mapped into networks, where different value chain interacts between them, value-added is exchanged, and actor exercises formal and informal influence on other actors, the Global Production Networks. The GPN has four dimensions, the firms, the sectors, the institution and the networks that configure a networks. Each actor is aiming to maximize its value, power, and embeddedness in the network.

CHAPTER 4: UPGRADING THE GLOBAL PRODUCTION NETWORK, COUPLING STRATEGIES

Now that we understand how the fragmentation of the supply chain created a global value chain and that this value chain is embedded in a larger production network. In this section, we will highlight how the GPN evolve and how actors such as local institution and MNE can take advantage of it. We need to understand the impact of the action of actors of the global production network.

4.1 GPN AND ECONOMIC DEVELOPMENT, THE STRATEGIC COUPLING

We will base our literature for GPN and economic development on the article of "global production network 2.0," previously cited (H. W. C. Yeung & Coe, 2015). GPN can be a useful tool to conceptualize global uneven economic development,

precisely focalizing on each geographic building block with distinctive institutional conditions. Regional development depends on the capacity to accumulate value, power, and embeddedness needed for a specific network in a specific region. GPN analyses the endogenous variable of growths, within the region and exogenous variable of growths, the actor that acts at a micro level, the lead firm.

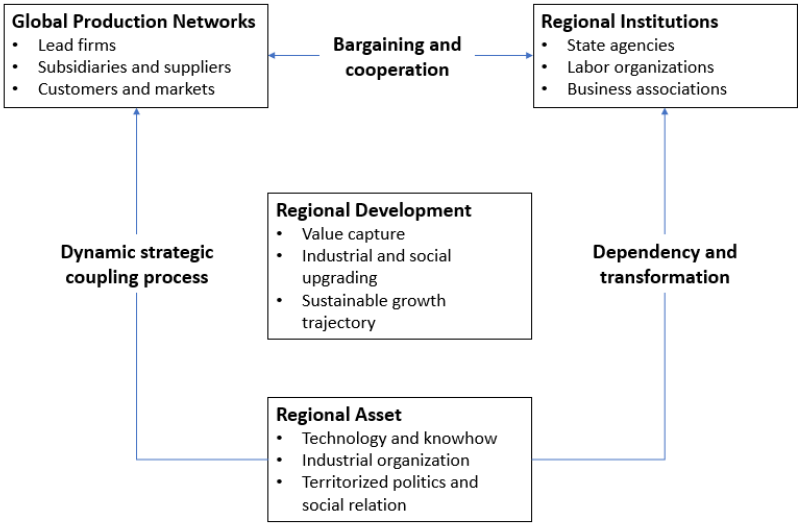

Figure 5 - Regional development in a global production network (Neil Martin Coe & Yeung, 2015)

The previous graphic describes the set of analyses of GPN development. Three frameworks interact at a regional level of a GPN,

First, there is the **global production network** with its three categories, the value, the power the embeddedness. It also has four dimensions hence – the institutions, the firms, the network, and the sector. **Regional assets** are the set of competitive advantages for developments of a region. They are embedded produce value and have power relationships with the rest of the global network. They can be divided into two types: scale and scope. First, the economy of scales come from a large concentration of specific knowledge, universities skills, and expertise in one localization in comparison to others. Secondly, the economy of scope is the result of intangible assets, for instance, long-term learning accumulation and cooperation between actors in the region. They are interdependent on **regional institutions**. Regional institutions can shape relation of power, shape cooperation between industries and society, and set up territorialized politics, for instance through FDI policies.

To develop a regional production network, an actor needs to find evolutive interaction between regional assets and the global production network: a **strategic coupling**. Strategic coupling is a process involving shared interests and cooperation between at least two actors who otherwise might not work together (H. W. Yeung, 2009). The more common tandem of actors is MNE and the regional institution. This coupling should allow value creation, enhancement, and/or capture. One crucial point of this theoretical framework is that, because the repartition of strategic coupling is imperfect between countries, entreprise need **Foreign Direct Investment to sustain competitive advantages** from this coupling. Strategic couplings have three essential characteristics (Mackinnon, 2012). First, it is Strategic: it demands deliberate and active intervention by global production networks actors (institution, firm, extra-firm organization, etc.). Furthermore, it is "time-space contingent" (H. W. Yeung, 2009): those strategies are temporary and continuously evolve with time and space (H. W. C. Yeung & Coe, 2015). Additionally, it transcends territorial boundaries: it is an interaction between actors of a different region as goods production is global. It implies that key decisions on the nature of strategic coupling can be taken outside of the region boundaries and will have a different result in the function of time and geography. There is a no predetermined, functional model. Moreover, regional assets are unevenly distributed, and therefore, the potential coupling is also unevenly distributed.

Using regional institution power to foster a specific global production network strategic coupling does not always result in development. Indeed, it depends on the strategic coupling between the regional asset and the need of the network. Developing regional assets, on another hand, can develop a global production network strategic coupling, especially if other existing regional assets are highly complementary to the strategic need of a lead MNE. Nevertheless, a non-strategic coupling enhancement result on resource and actors value, power, and embeddedness used for sub-optimal outcomes. Finally, as regional assets, GPN and regional institution capacities are temporary, strategic couplings are also temporary; therefore, we can have cases of strategic decoupling.

4.2 TYPE OF STRATEGIC COUPLING

Yeung develops strategic coupling in two categories: implicit coupling and explicit coupling. Henry Wai-Chung Yeung is a professor of the National University of Singapore and developed extensive literature on GPN, strategic coupling in East Asia and how strategic coupling arises. For Yeung, strategic coupling allows to position regions in GPNs through a relational perspective of actors (H. W. Yeung, 2009). He identified three facilitators of strategic coupling of two types. Their type could be implicit, foster by local firms networks, or explicit with direct state intervention. The facilitator could be transnational partnerships, modification of the regional industrial organization and regional institution initiative.

Foremost, **transnational partnerships** are informal knowledge networks of transnational actors. They can be characterized by mutual social identity, for instance, nationality. These international actors coordinate relationships between the network lead firms and suppliers and shape new relation (Saxenian, 2002). Secondly, the **modification of the regional industrial organization** come from MNE adoption of technological and structural innovations to adapt to competitive markets. These modifications provide opportunities for regional actors to upgrade their position into GPNs (Gereffi & Fernandez-Stark, 2016). There are numerous possible couplings as the modern production move from dominant product-driven chain governance to buyer-driven governance, MNEs go through vertical disintegration of their value chain activities, and vertical reintegration from the dispersion of the value-added in diverse locations. (Saxenian, 2002). The reintegration of the value-added in a new location can happen via the creation of national champion, local firms that became MNE by using dominant positions in evolving global production networks. Finally, **regional institutions** conduct a macro-economic policy via direct political **initiative** (Amin, 1999). The range of available initiative can be from enhancing human resources, physical infrastructure to public-private research consortiums (H. W. Yeung, 2009). It allows couplings between the interests of local firms and global MNE. Regional institutions have a critical role in promoting and regulating inward investment and by this means structuring the power relations in the GPN (Mackinnon, 2012)

These strategic coupling can be multiple. For instance, South Korean Chaebols as Samsung, were producers for global buyers that significantly invested in the region. They integrated progressively upward the value chain. The Chaebol power has been fostered by the industrial policy and direct state in the second part of the twenty century. (Neil Martin Coe & Yeung, 2015).

Another example is the Qindao economics zone studied by Jun Kim**.** (Kim, 2011)**.** The regional institution created a local cluster that receives explicit competitive advantage: the economics zone. The goal is the funnel the FDI in a specific localization, concentrate transnational partnerships and channels knowledge transfer between local firms and MNE**.**

Mackinnon, a professor at the University of Glasgow, widen the range of coupling process between a GPN and a region. Mackinnon uses an evolutionary view to develop a broader definition of strategic coupling. It introduces the coupling, recoupling and decoupling processes of regional GPN (Mackinnon, 2012) and fosters the idea that coupling can at the expense of other regions, in part due to MNE competition (Phelps & Fuller, 2000).

Foremost, the coupling is the process of creation of new regional asset via new investment. Besides, recoupling regional assets and lead firms is the process of enhancement of preexisting position within GPNs, for instance, through upgrading and value enhancement (Neil M Coe et al., 2004). Finally, decoupling is the process through which a region lose their regional asset or its strategic coupling with the global production network. Phelps and Mackinnon in their article " Devolution and the territorial politics of foreign direct investment" (Mackinnon & Phelps, 2001) conceptualized the principle the devolution that MacKinnon linked afterward to 'decoupling' following the development of strategic coupling literature (Neil M Coe et al., 2004). In this article, the authors compared the neoliberal politics of the United Kingdome with the socially restrictive politics of Germany and focused on their relationship to outward direct investment. The UK imposed imposes low entry and exit costs on firms. It makes it easier for MNE to start a process of decoupling when the structure of the GPN changed. Indeed it was easier for them to close or rationalize operations than in regulated Germany. The result was the progressive deindustrialization of the industrial area.

Mackinnon developed ten types of dimensions of coupling, recoupling, or decoupling and influence of the position of a region in GPNs. First, the **mode of entry** of GPNs lead firms into a region, it could be of three sorts.

Greenfield Investissement is an investment in a foreign country from scratch, without the purchase of an existing facility. (Chen, 2019). Secondly**,** a joint venture is a joint investment by two partners enterprise, of a new company with joint ownership. It can also be an automated export system, significant participation in the capital of a foreign company established in the export market concerned, by an exporting company(Wortman, 2016). Finally, an acquisition refers to the investment in the total ownership of a foreign affiliate.

Greenfield investment is considered coupling while repeat investment on existing infrastructure is recoupling. Merger and acquisition can be connected with reductions in productive capacities. Indeed, MNE focus on complementary coupling with their global strategy and might disinvest in parts where they have a superior competitive advantage. (Dawley, 2011) They could be recoupling or decoupling. The second is the status of an **affiliated company** within the mother company. The level of control and, therefore, relationship in a GPN can vary from autonomous to dependent and can evolve with time. Then, the **region position in the GPN** can either be host or source of FDI. It represents the upstream(source)/downstream(host) division of the Global Commodities Chain. **Regional assets** can be generic or distinctive. The bargaining power of a region varies if its asset is unique or not. Then, the **type of coupling** can be organic, strategic, or structural. Organic coupling is when regional assets and lead firms evolved together in the GPNs; the region was the source of the GPN. Strategic coupling comes from actor decision. Structural couplings have political-economic relations between Regional institution and the GPNs. For instance, GPN mostly controlled by an SOE. The **degree of coupling** can vary from full, with a complete coupling to none, with no coupling between asset and GPN. The **depth of recoupling** refers to the embeddedness of the existing asset that is enhanced. The eight, the **power relation** can be symmetric or asymmetric and represent the influence and alignment between different MNEs and regional institution. Finally, the **exposure to decoupling** represents the easiness to decouple from a region

for MNE of a GPN, for instance, the example of UK and Germany. (Dawley, 2011; Mackinnon, 2012; Mackinnon & Phelps, 2001; Phelps & Fuller, 2000)

CHAPTER 5: QUANTIFYING THE IMPACT, THE GLOBAL TRADE NETWORK

In the process of describing Chinese investment in the automotive industry in Germany, we analyzed multinational enterprises, their processes of internationalization and their investment policy, we described how Chinese enterprise invest. Afterward, we theorized the global development, and how MNE strategy depends on different production frameworks and what can be the incentive for the regional institution to promote or regulate international investment, we described why the company invests. Now we would like to quantify the impact of this foreign direct investment. Quantifying trade at countries level is complicate or even fool work. Indeed, trade is the intersection of multiple complex GPNs and GPN are, as we conceptualized, multi-dimensional, and not only value-added activities. However, we can approximate it and track change quantitatively. To do so, we will use the global trade network framework.

We start this section by defining the weighted international trade network. Based on these definitions, we will define the concept of network centrality.

5.1 DESCRIPTION OF THE GLOBAL TRADE NETWORK

In 1942, in a volume called 'The World Trade Network, the league of nation describe International trade as the following*: " International trade is much more than the exchange of goods between one country and another; it is an intricate network that cannot be rent without loss*. " (League of Nations, 1942)

A **network** is defined as a collection of points joined together in pairs by lines. The points are referred to as nodes, and the lines are referred to as edges. Many systems can be understood as networks in physics, biological, and social sciences. It is the mathematical object of relationships (Newman, 2010).

De Benedictis and Tajoli are two researchers from the Polytechnique School of Milan. In their paper, also called "The World Trade Network," they conceptualized the primary principles of **Global Trade Network (GTN)**. The natural way of describing trade between two countries is to create two nodes, the countries, and draw two edges with a direction between then: the import and export (De Benedictis & Tajoli, 2011). However, trade is not only about export and import between these two countries, as we described beforehand, trade is also about relationships and how this relationship compares to others. The relation between two country and can not be analyzed in isolation and is not independent to the trade of these countries to another country (Benedictis, Nenci, Santoni, Tajoli, & Vicarelli, 2013). Indeed, Trade is a directed network, a global trade network. The global trade network is not only a graphical visualization of trade. It is an interconnected system, and the best way to represent it quantitively is network analysis.

The effect of one country on trade between the two countries is not homogenous; After all, it does not correspond to the average effect of all countries. Social networks are characterized by various degree of heterogeneity and power distribution between its members, its nodes. We should aim to **quantify countries heterogeneity** in the trade network. To do so, we use various centrality measures. The impact of trade relation requires a structural analysis of relations in the network.

As we described, the world trade network is first composed of a **graph** with a set of nodes and edges between them. The edges are directed from the exporting country, i, to the importing country, j. Secondly, the set of nodes and edges each have additional critical information can underline relevant characteristics of the network relationship. The edge value function can be, for instance, the weight and nodes value function, the country-specific value. The weight of each edge is the monetary value of exports from country j to country i. These key elements describe the trade network a directed weighted network (De Benedictis & Tajoli, 2011). This graph is characterized by high dimensionality, corresponding to the number of countries trading, high connectivity but a substantial heterogeneity. (Benedictis et al., 2013)

In general, the density of a network increase with the number of its nodes relating to the same direct neighborhood. The density is the ratio between the number of actual edges and the number of maximum links between each node possible. (Clauset, Moore, & Newman, 2008). As we explained in the first to chapter, international trade have changed overtimes with a change in power, embeddedness, or value of global production networks. One trend of global trade is a constant increase in the density of the trade network. (Garlaschelli & Loffredo, 2005)

5.2 COUNTRIES' POSITIONS IN THE INTERNATIONAL GLOBAL TRADE NETWORKS: CENTRALITY AND ECONOMIC PERFORMANCE

The first basic notion of connectivity of a node to the network is the concept of degree centrality. Centrality measures are the method to describe the level of country heterogeneity in bilateral trade flows. (Benedictis et al., 2013)

Centrality measures in NA indicate the relative importance of a country in the network. Mainly if the country plays a significant role in the fragmentation of the global production. (Garlaschelli & Loffredo, 2005). In a directed network, there are two degrees of centrality. The in-degree centrality computes the number of edges pointing to a node, and out-degree centrality, measuring the number of edges departing from a node (Newman, 2010).

The in/out centrality degree of a directed weighted network, as the trade network is computed as follow (Newman, 2010):

$$C_{in}^{N} = \frac{\sum_{j \neq i}^{N} W_{ji}}{n-1} \qquad C_{out}^{N} = \frac{\sum_{j \neq i}^{N} W_{ij}}{n-1}$$

Where C_{out}^{N} represent the out-degree of centrality of N nodes. It is obtained by aggregating of the weights of export flows connected to the country and normalizing by (N−1), with N the number of countries (Benedictis et al., 2013)

However, centrality can be measured differently. There are four types of centrality (Jackson, 2010). First, degree centrality, that like we wrote measures how much a node is strongly connected to others node. Secondly, closeness centrality demonstrates how close a node is to every other node, with different ways to compute the distance between two nodes. Thirdly, the betweenness centrality describes how much a node is centrale in connection of all different nodes to each other. Finally, the eigenvector centrality measure how much node have a highly connected neighboorhood. This centrality explains how important and influential their connected are (Newman, 2006).

One of the critical relevancy points of this centrality is its reliance on collective evaluation, and not to expert evaluation (Franceschet, 2011). We are looking to evaluate embeddedness in a global production network, not how much a country trade at a specific time. Indeed, eigenvector centrality helped to predict a males probability of social rising in a school. (Spizzirri, 2011) We will then focus on the **eigenvector centrality** to represent the position of a country in the global production network concerning the leading traders of the production network in the case analysis. (Tajoli & De Benedictis, 2016).

By highly simplifying – we do not aim to develop the eigenvalue algorithm theory but to explain its impact - we begin by computing am adjacency matrix A of the graph, defined as $a_{ij} = w_{ij}$ if the node i is connected to j, 0 otherwise. We then compute the eigenvector of this matrice, with λ_i, the eigenvalue for the country *i* (Kaiser, 2017). this centrality is proportional to the sum of the centralities of its neighbors. This centrality can be large for two reason, first, if they have many neighbors, secondly, if its neighbors are powerful.

For example, Tajoli and De Benedictis said about the reduction of eigenvector in manufacturing in Italy: "*The reduction of this indicator suggests that the [Italy] GPN orientation did not adapt to the evolution of the world trading system, as a large part of its trade flows is connecting the country to relatively peripheral nodes*." (Tajoli & De Benedictis, 2016).

PART 2: CASE ANALYSIS, CHINESE ODI IN THE GERMAN AUTOMOTIVE INDUSTRY

In the previous part, we explored the literature on multinational enterprises, internationalization, Foreign Direct Investment (FDI), and lastly the chain and network structure of the global trade and production.Now, we aim to analyze the Chinese Outward Direct Investments (ODIs) in the German automotive sector. We will develop a conceptual framework, the global automotive production network, to map and analyze the economic globalization of the sector and its developmental consequences. We aim to answer the following question:

- What shifts can be observed in the Global Production Network (GPN) in the upstream and downstream value chain trade of the automotive sector in Germany?
- What was the impact of Chinese ODI on the upward value chain of the automotive industry from 2008 and 2017 in Germany?

In chapter 6, we will first make an overview of the current situation of the Chinese ODI in Europe and Germany. To do so, we will first analyze the literature and reports on the subject and then clean, transform, and analyze the data of the China "Global Investment Tracker" on China ODI to extract key automotive value for Germany.

Afterward, in chapter 7, we will map the four dimensions of the global production network: the firms, the sector, the local institution, and finally, the automotive network. During this GPN analysis, we will focus on Chinese and German actors in Germany and highlight where their power relationship, value creation, and network embedding comes from. During the 6.4 part, the network dimension, we will generate the global trade network of the automotive industry for finished and intermediate goods using a python tool that we developed. We will map the network, visualize, compute key figure, and calculate the eigenvalue centrality of each country for the last ten years.

In chapter 8 finally, we will compute the lag correlation between Chinese ODI in the automotive industry and the eigenvalue centrality of countries in the

automotive trade networks in the last ten year. Based on this data, we will analyze the risk of decoupling generated by the Chinese ODI in the German automotives sector, with the aim to track the impact of Chinese investment over three years.

CHAPTER 6: CHINESE OUTWARD DIRECT INVESTMENT IN EUROPE

6.1 CURRENT STATUS OF CHINESE ODI IN EUROPE

HISTORY OF CHINA OUTWARD DIRECT INVESTMENT IN EUROPE

In 2009, Françoise Nicolas, in "*Chinese Direct Investment in Europe: Facts and Fallacies*," in *International Economics*, compared Chinese investments in Europe with the ODIs of the other international powers. While Chinese ODIs in developing countries were increasing significantly, they were still very negligible compared to those of developed countries. Fifteen years ago, Chinese ODIs represented only 1.1% of global ODIs (Françoise Nicolas, 2009), which is derisory given the size of the Chinese economy.

In the first decade of the 21st century in Europe, Chinese ODI investments were mostly concentrated in services and the automotive sector supply (F. Nicolas, 2009). Europe is and was the global leader of the automotive sector and has the best in class expertise.

In his article, "China's Outward Investments: Challenge and opportunities for the EU, " Duncan Freeman, a researcher at the Brussels Institute of Contemporary China Studies (BICCS), demonstrates that Chinese investments in Europe underwent a radical change during the 2000s (Freeman, 2006). While ODIs had already been present since the 1980s, their number increased from $2 billion in 1990 to $6 billion in 2001, up to $19 billion in 2008 (Freeman, 2006) and 59.6 billion in 2017 (“European commission trade policy: China,” 2018). Before 2001, China imposed strict control over Chinese investment funds, firmly regulating outward foreign investment to keep Chinese capitals in China. (Nolan, 2001). This practice seems to come back in this last two years (Zhou, 2019).

Between 2001 and 2016, after the acceptation of China in the World Trade Organization, these protectionist policies have been radically replaced by the state" Go Global " policy. " Go Global " state policy advise Chinese firms to invest in global markets to get a dominant position in global markets (China-Policy, 2017). These expansionist policies are nevertheless limited to specific sectors. On the one hand, ODIs are found in sectors such as raw materials, high technology, logistics. On the other hand, investments in sectors that may pose national security problems are prohibited (Freeman, 2006). Go global program have a strategic aspect such as the policies “Made in China 2025” or “ the belt and road initiative,” but the Chinese government still want to limit capital outflow. “Made in China 2025” is an industrial strategy promoting high-end positions of China in the global industry while the “belt and road initiative “ promote infrastructure building around Chinese trade route, following the historic silk road (China-Policy, 2017). It seems no longer the time for protectionism, but for the combined use of resources of foreign and Chinese markets to obtain strategic interests. These strategic interests are raw materials, knowledge, technologies, and new markets for Chinese companies. (Freeman, 2006).

This last decade, the Chinese Outward Direct Investment experimented two different shift. First, there was a shift in FDI to ODI ratio. In 2015, Chinese ODIs increased by 16.8% (Lake, 2015), exceeding FDI for the first time with 145.7 billion-dollar investment, compared to 135.6 billion in FDI (KPMG, 2016). Secondly, there was a shift in State-Owned Entreprises (SOEs) to privately owned (POEs) Chinese company ODIs ratio. SOEs always have been powerful actors of the Chinese economy; however, in 2016, for the first time, 75.6% of ODI were private.(KPMG, 2016).

In 2016, despite the financial crisis and the Euro crisis of the last decade, Chinese investments did not decrease, quite the contrary. They increased from 1.1% in 2009 to 2.1% of global ODIs in 2015, doubling their total impact in almost six years (HSBC Global, 2015). They increased for the thirteenth consecutive year (KPMG, 2016). However, this figure is far from 12% of the world's gross national product of China.

Chinese ODI seems to spike in 2016 and 2017. However, in 2018, on the one hand, ODIs from China had been reduced by 18 % to 130 billion. While on the other hand, FDI inflow still increased by 4% in China. In Asia, FDI outflow stabilized or slightly decreased to around 400 billion. Asia FDI downfall was part of a larger trend. Indeed, Global foreign direct investment flows reduced in 2018, falling by 13 percent to $1.3 trillion (UNCTAD, world investment report 2019)

Finally, we should note that most of the figures on ODIs were and are sometimes questionable. Indeed, for tax optimization reasons, most Chinese ODIs, such as foreign investments in China, are made through Hong Kong and tax havens similarly to FDI in China (Françoise Nicolas, 2009).

MOTIVATION FOR CHINESE ODI IN EUROPE

As we developed in the four-fold categorization of motivation for ODI in chapter 2 (John H. Dunning & Lundan, 2008), There are four categories of ODI: First of all, the "resource seeking" with a search for raw materials not existing in the home market. These were the first type of Chinese foreign investments. The then rarer "market-seeking" ODI consists in seeking a market that is not directly accessible or in going through regulations. "efficiency seeking" aims to reduce costs, which is still very rare today. “Asset seeking” ODI’s are the concurrent acquisition of patents or technologies but also brand images. Finally, "strategic asset seeking" with the search for a Chinese world dominant position.

Françoise Nicolas notes that, in 2009, in Europe, the first goal of Chinese ODI’s was mainly market-seeking. Strategic asset seeking ODIs were then only the second (Françoise Nicolas, 2009). She stated that government intervention on Chinese company ODIs was then very exaggerated. The high proportion SOEs in the majority of foreign investments might have been proof of direct political intervention in European ODI. Indeed, in 2006, 82% of China's ODI was conducted by SOEs (H. W. Yeung & Liu, 2008). However, it would come from a Chinese internal reality rather than from an overall strategic will. SOEs are politically favored and are leaders in most of the Chinese sector (Nicolas 2009).

However, Strategic asset seeking are still part of reality. Chinese companies are looking to acquire know-how, brands, and a European distribution network (Lake, 2015). Despite the European potential, especially in times of crisis, the results of ODIs remain very unprofitable for Chinese MNEs and must be long-term to be economically viable. (Morck, Yeung, & Zhao, 2008; Francoise Nicolas, 2012)

In resume, In the four leading families of FDIs. First of all, the "resource seeking" ODI was the first of Chinese foreign investment to exist, and was mostly focus on other emerging countries. Then, the rarer "market-seeking" was the first type of Chinese ODIs to arise in Europe. Afterward, "efficiency seeking": to reduce costs, which is still very rare today. Asset seeking is the most relevant Chinese ODIs today. Finally, the "strategic asset seeking" ODI search for a Chinese dominant world position, these ODIs are growing and very present nowadays. Besides these ODIs, there are also many fictitious investments in tax havens linked to state corruption.

WHAT TYPE OF INVESTMENT?

Child and Rodriguez have identified three primary routes toward international investment by Chinese firms: 'inward' internationalization through partnerships and joint ventures, 'outward' internationalization through acquisition and organic expansion through greenfield project. (Child & Rodrigues, 2005)

I. International organic expansion by greenfield investment

Typically, this investment is developed with the company home country know-how. In the GPN theory, it is often referred to as a strategic coupling with the local market. It increases the position of the local market in the global production network by creating new regional assets.

The advantage is that Chinese MNEs can choose and optimize its localization. It helps the development of own recognized Chinese brand in the international market. MNE can introduce directly their management, which helps for global integration. However, it is a slow route to internationalization, as the position on the international market is built from scratch. Lastly, it is hard to manage and costly.

II. Joint venture in which the Chinese are in the majority.

Typically, this investment is developed with one or more local investor. In the GPN theory, it is often referred to as a strategic recoupling with the local market. It increases the position of the local market in the global production network by using enhancing existing regional asset

The advantages for China for joint ventures are the following: they can capitalize on their low-cost production in China. Comparatively, it is a low-risk investment and finally the opportunity to build a global reputation by coopering with actors of the GPN. The challenges are first to handle the power relationship with their partner and keep a certain control over their investment. Secondly, their partner might become hostile and turn competitor if they open their own brand on the market.

III. Merger and Acquisition

Typically, a Chinese investment either acquire a foreign competitor (horizontal acquisition) or integrate either a supplier or a retailer (vertical acquisition). In the GPN theory, Merger and acquisition can be connected with reductions in productive capacities. Indeed, Chinese MNE might focus only on complementary coupling with their global strategy, often only R&D and know-how, export it to their local market and might disinvest in parts where they have a superior competitive advantage, their downward supply chain. The advantage for Chinese MNE is to acquire new technology or internationally recognized brand rapidly. It denies access to the acquisition to competition and potentially can generate high growth by converging with their asset, for instance, their manufacture infrastructure and access to the Chinese market. However, the challenge is first to overpay for the asset. Secondly, the administration problem could arise while facing foreign management., indeed, most of international M&As end in failure, especially with cultural differences (Shenkar, 2009)

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6.2 DATA ANALYSIS OF CHINESE OUTWARD DIRECT INVESTMENT IN GERMANY AND COMPARISON TO EUROPE

To understand the impact of Chinese ODI in the automotive industry, we need to narrow down our analysis, from Europe to Germany, from all sector to the automotive industry, and finally from Chinese ODI to acquisition, joint venture, and greenfield projects.

DATASET SELECTION AND CLEANING.

The American Enterprise Institute publishes every year the "China Global Investment Tracker" dataset that covers China's global investment. It includes 3200 large transactions across energy, transportation, property, and other industries from 2005 to 2019 (American-Entreprise-Institute, 2019). The dataset links the Chinese parent company, the host country, the sector and the target company of the ODI, the value and company share of the transaction and finally if the FDI is a greenfield or part of the Belt and Road initiative.

Out of the 1571 ODIs for 1.1 trillion $ between 2005 and 2019, the German automotive sector counts 19 ODIs, for 16.67 billions $ invested. To make the dataset actionable, we first retrieved four missing value of acquisition share, via business news. As some company acquisitions were made via multiple transactions, we aggregated the shares acquired on each company by Chinese MNE. We then distinguished each of the Chinese ODI in function of the company share acquired for non-greenfield ODIs. If the share was smaller or equal to 50%, it was a joint venture, higher it was an acquisition. As the dataset provided data on Greenfield investment, we could then compare greenfield, joint venture, and acquisition FDI.

ANALYSIS OF CHINESE ODI IN EUROPE IN THE AUTOMOTIVE SECTOR

In annex I, we represent the Chinese ODI overtime per global region (Europe, South America, etc.). In this graph, we have confirmed put in perspective what has been developed by the literature. Indeed, the Chinese ODIs were supposed to be mostly concentrated in East Asia, Africa and South America, emerging countries, between 2005 and 2011. While this region position did spike up, developed marked still has a strong position. However, these numbers have to be put in

perspective of the total GDP of these regions. Indeed Africa receives as many ODIs, but represent a fraction of European GDP. Starting in 2013, the scale and number of Chinese ODI spiked up until 2016 and 2017. Europe and USA became the leading destination of ODI between 2012 and 2017. In 2018, Europe still stayed the first receiver with 39.5% of Chinese ODI for 50% in 2017. Yet, the US massively reduced its Chinese inflow, due hypothetically to the Trump effect.

Annex II represent the repartition of Chinese ODI in Europe overtime for all sector. The graph demonstrates that when Britain is a constant receiver of ODI this decade, Italy and Sweden ODI spiked up in 2014 and 2015, followed by a spike of german ODI from 2016 to 2018. 2017 was marked by the acquisition of Syngenta, a Swiss agriculture chemical company for 43 billion dollars, by far the highest Chinese acquisition in Europe ever recorded.

In figure 6 (larger in annex III), we will focus on the German market, and visualize the repartition of german Chinese ODI per sector over time. We revealed an apparent change in 2013. Prior to this date, Chinese ODIs were mostly focused on real estate and transport. Afterward, the automotive industry became ODI the main target by a long shot, varying from 50 % in 2013 to 82 % in 2018 of all sector target of Chinese ODI in Germany.

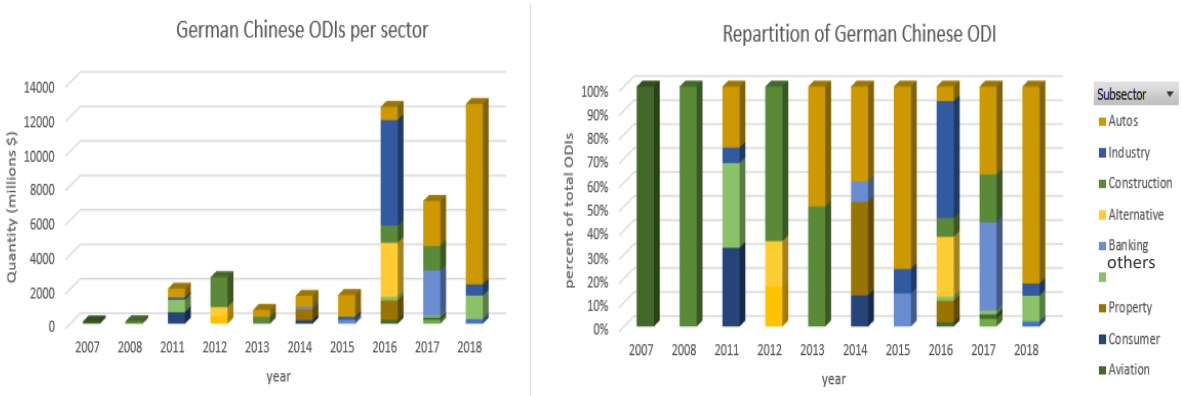

Figure 6 - German Chinese ODI per sector

In annex IV, we zoomed out of the European market and made a world overview of the Chinese automotive ODI. Germany became the leader of automotive Chinese ODI in 2018; we notice a wave of acquisitions in Italy and Sweden from 2015 to 2016, some smaller manufactured hub but with recognized brands such as Volvo

and Fiat. The rise of german ODI overlaps with a rise of Chinese Japan acquisition, another world brand leader of the automotive market.

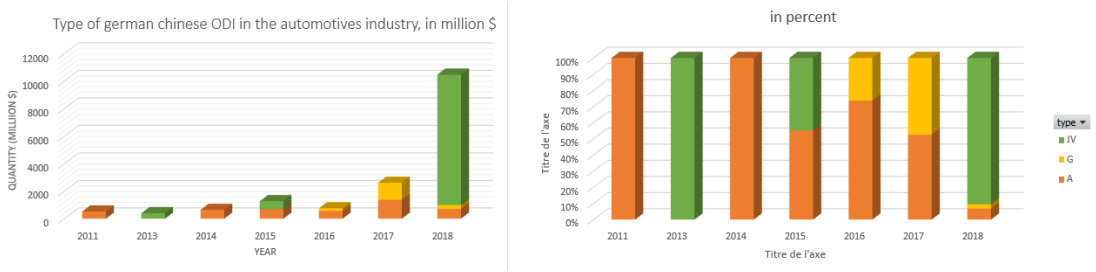

Figure 7 - Type of German Chinese ODI in the automotive industry

In figure 7 (larger in annex V), we highlighted the type of investment for the german Chinese ODI. The greenfield project is represented by a yellow bar, in orange, the Acquisition(A), and in green, joint ventures. In aggregate value, Joint Ventures (JV) represents 62 % percent of Chinese ODI in the automotive industry, Greenfield (G) roughly 10 % and acquisition 27 %. However, these results are strongly influenced by an outlier ODI and do not represent the whole picture over time, as seen in the graph. Indeed these investment values are influenced by a massive joint venture in 2018 between Daimler and Geely, two brands in the top 15 sales in the world. They settled a joint venture on the electric brand Smart for 9 billion $. Without this joint venture, acquisitions ODI represents 60 % of Chinese ODI in the automotive industry in Germany, while Greenfield and Joint Venture amount to 20 %.

In summary, around 2011, Chinese ODIs skyrocketed in Europe. German ODIs were only the second wave of European ODIs, spiking up in 2016 – 2018, after Sweden and Italy. Before 2012, Chinese ODIs in Germany were mostly real estate and transport and then switched on the automotive industry. Chinese ODIs in automotive in Germany were part of a significant wave touching Japan and the US, two other automotive leaders. Finally, automotive ODIs in Germany were predominantly from the acquisition type in the past. However, in 2018, a massive joint venture between a Chinese and german industry leader changed the investment landscape.

These numbers will be used in chapter III, to compare it to the variation of centrality level of finished goods.

CHAPTER 7: GLOBAL PRODUCTION NETWORK ANALYSIS OF THE CHINESE ODI IN THE GERMAN AUTOMOTIVE MARKET

Now that we acquired an overview of the state of Chinese ODI in the german automotive sector, we need to map the production network to understand the context and possible coupling or decoupling these ODI might influence. There are four dimensions in global production networks, namely the firms, the sector, the local institution, and the networks. The firms are characterized by value ownership and chain architecture. The Institution could be governmental, quasi-governmental on non-governmental. The sector represents the technology challenge and the product market, and finally, the network is defined by an architecture, and by actor power configuration. All these actors coordinate in a global production network with their own configuration for value creation, power, and embeddedness.

7.1 THE FIRMS

In this section, we try to describe the actor of the global production networks (GPN). We will focus on the German and Chinese actors to understand their motives and range of activities in the automotive GPN. First, we will explain the architecture and fragmentation of firms, what are their power relationship, how they generate value and how embedded they are in the global value chain. Afterward, we will focus more precisely on German and Chinese company, and use the transnationality index to compare them. Then we will explain the particularity of Chinese MNEs investing in Europe, what are the Chinese MNEs pull and push factors from the European industries. Finally, we will do a quick overview of specific MNE actor.

THE ARCHITECTURE: THE VALUE CHAIN

The automotive sector is a capital/knowledge-intensive industry. It requires a large amount of capital to set up production facilities and has a high level of complexity and innovation. This characteristic makes the automotive chain to be

a **producer-driven commodity chain**. In other words, it means that the automotive sector is controlled by large MNEs with strong brands recognition and manufacture capabilities. These MNEs centralize most of the value creation, and there is a limited quantity of the country involved in their Global Commodity Chain. As we developed in in the theoretical part of this paper, MNEs, in this case, often outsource labor-intensive component. The principal barriers to the entry of such sector for new firms are access to the complexity of the production (Humphrey & Schmitz, 2002).

Vincent Frigant and Martin Zumpe from the CNRS of the University of Bordeaux described the automotive industry value chain in their paper "Are automotive Global Production Networks becoming more global?" and represented it in the following graph (Vincent Frigant & Zumpe, 2014).

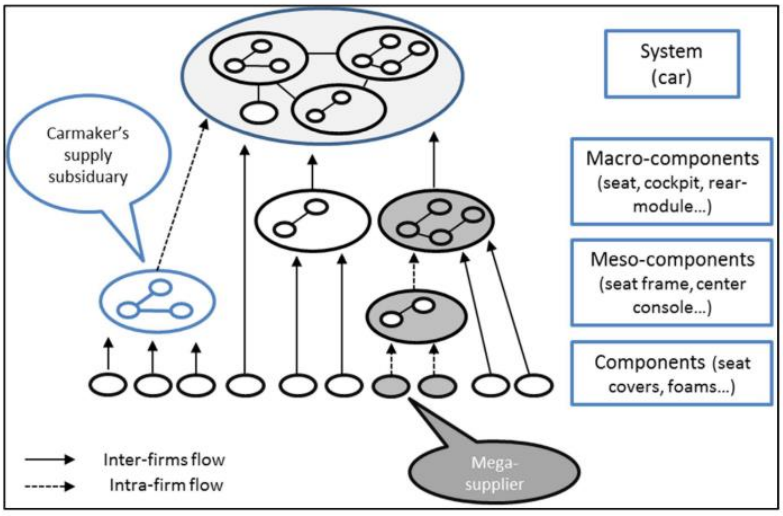

Figure 8 - Translating the concept of modularity to the automotive industry (Vincent Frigant & Zumpe, 2014)

This producer-driven car commodity chain is represented by relations of power and is more and more fragmented and modularized. (Murmann & Frenken, 2006). Indeed, while the production is highly complex as are other producer-driven commodity chains, the automotive components are highly standardized. Foremost, the carmakers acquire from large suppliers the first level of intermediate goods. This first type of intermediate products is called the macro-components; they are the majority of their procurement and could be, for instance, seat, cockpit, etc. They are the main parts of a vehicle. Secondly, car manufacturers sometimes acquire some meso-components, for example, in the case of high

vertical integration or for strategic reasons. Meso-components are intermediate goods of macro-components and could be seat frame, part of the cockpit, etc. Afterward, the macro-component suppliers themselves acquire intermediate meso-component from meso-component suppliers. Finally, meso-component supplier obtains component and raw material (Vincent Frigant & Zumpe, 2014). One crucial characteristic of the automotive sector is a still existing high level of vertical integration of suppliers. These highly integrated suppliers are called mega suppliers (V Frigant, 2011).

Finally, In addition to the mega supplier, the carmakers also inherited and still partially retain themselves a highly vertical integration of their supply chain, for some components, and centralize around them a local subsidiary network. It means that the automotive supply chain is not as highly fragmented and modularized than other supply chains with standardized components. Supplier clusters tend to be found on a narrow perimeter surrounding automakers' plants, whether units belonging to mega-suppliers or MNEs. (Vincent Frigant & Zumpe, 2014).

Nevertheless, the standardization of component created a blurry line between producer-driven GCC and buyer-driven GCC for intermediate goods. Therefore, following the Gerrefi theory of the GCC, MNE mega-suppliers aims to achieve economies of scale. To do so, many meso components supplies are moved from developed countries they historically are from (Bordenave & Lung, 1996), to labor-intensive countries such as China or East Europe. In the same times, we experience a changing relationship between automobile carmaker and their components suppliers and an increase of long-distance outsourcing. (Liu & Dicken, 2006)

Long-distance component traders, for instance, Chinese automotive mega-supplier, arose while developed country MNEs set up Joint-Ventures with Chinese partners. The Chinese state has a large negotiating power on access to his private market, the most important potential market in the world, and enforced strong relationships of automotive MNEs with local partner (Liu & Dicken, 2006).

As developed in chapter I of the literature reviews, UNCTAD established the Transnationality Index Report on leading MNE, a way to rank transnational companies. It is a ratio of international sales, labor, and asset in proportion to its activities. The report represents the Trans-Nationality Index (TNI) of the 100 biggest multinational companies worldwide in 2017, with their country of origin. We aggregated the TNI score at a country level the ranking to compute countries average and number of the firm. We also made a weighted average of the European union firm TNI, weighted by the number of firms per country.

In 2019, on the one hand, out of the 100 MNEs ranked in the World Investment Report, 51 were from Europe with 11 from Germany. Out of the 11 german MNE, 4 were in the motor vehicles industry, namely Volkswagen Group, Daimler AG, BMW AG, and Robert Bosch GmbH. The average TNI score of the European companies was around 72,4 %. Nevertheless, Germany has one of the lowest TNI in the European Union with 64%, after Italy. The prominence of the short-distance suppliers, and the embedding of german MNEs in industrial GPNs as the automotive sector, explained in Chapter 8, might be the leading cause of the lower result than, for instance, the United-Kingdom. For some perspective, the USA has 19 out of the 100 largest MNEs and has an average TNI ratio of 50%. The unified market of different countries might explain the high number of MNE as well as the average high TNI in Europe, allowing a cross border fragmentation of their value chain and the more natural insertion in specialized local production networks.

China, on the other hand, has the lowest TNI of any countries in the ranking, at 33%, at the exception of Norway that has only one MNE. China, the second biggest GDP in the world, has 6 differents top 100 MNEs in 2019, which is a significant improvement from the 2 of 2017. However, it is still, even with this improvement, less than the 10 Japoneses MNE.

This small amount of MNEs highlight that, if Chinese companies are currently internationalizing, the vast majority of their assets stay in their home country. We can link this finding to the OLI theory of Dunning and more specifically to the Eden and Dai extension on ownership in Chapter 2. Indeed while Chinese MNEs have already access to considerable asset advantage (Oa) in their home country, such

as low labor cost, vast retail market, allowing them to scale economies as well as a distribution network abroad, we can emit the hypothesis that it limits their needs for high transnationality. They lack transactional advantage (Ot), allowing coordination of value-added activities across countries; and a capacity to reduce environmental and financial risks via different markets. We will discuss if they have an institutional advantage (Oi) in part II, the local institution.

Overall, out of the 100 company, 12 were from the automotive sector, it had an average TNI of 64%, with the US market differentiating from the rest with lower MNEs TNI overall.

However, we should take care of extrapolating this ranking of only 6 larges Chineses companies to the private automotive industry of China, as the ranking shows another Chinese reality. Indeed, out of the six Chinese MNE in the top 100, five were state-owned. Therefore, the ranking is representative of the dominant SOE in China, but not to the growing privately-owned companies.

CHINESE FIRMS AND BECOMING MULTINATIONAL:

Since 1980, we observed an extraordinary rise in ODI and the same time, an increase in technological innovation from Emerging countries MNE. China became the most active internationalizing economy among them (Child & Rodrigues, 2005). The rise of FDI came in pair with its massive rise in exports to Europe. Based on the OLI reason of internationalization of Dunning, Chinese MNE internationalization is particular in the fact that they already had the Ownership asset advantage (Oa) as low cost of labor, infrastructure and distribution network (not always) and access to credit, especially for SOE at home. However, a Chinese scholar proposes that emerging economy MNEs internationalization are not only asset-exploiting but asset-augmenting (Zhang, 2009).

At first, internationalization in developed market arose as Chinese MNE began to face saturated internal home market and regional protectionism and went outside to find markets (Buckley, 2018). Afterward, Chinese MNEs started to use international expansion to overcome their latecomer disadvantage of late industrialization (Luo & Tung, 2007). Indeed, Chinese firms still lack technological assets like patents, trade secrets, and proprietary designs and often compensate

for those shortages via imitation of pioneers and innovators. However, copying is limited and creates Intellectual Property (IP) disputes if they want to compete in countries with strong IP regulation. Meanwhile, compete on cost is becoming more difficult (Shenkar, 2009). For Buckley, China is entering a middle-income economy, and cost of labor will continue to increase. Therefore Chinese MNEs needs to adapt their technological assets to compete (Buckley, 2018).

Oded Shekar in is paper, "Becoming multinational: challenges for Chinese firms", states that Chinese companies struggle to internalize international assets. He also notes that Chinese MNEs strive to use a globally dispersed value chain. It seems that they often don't succeed in the Internalization (I) of the OLI model. One of the reasons is foreign management difficulties. The ownership of Chinese companies is strongly hierarchical, and boards of directors that choose the management are rarely independent of the state. In part because of this, in 2009, Chinese firms were behind from global human resource management to organization design and control (Shenkar, 2009).

MANUFACTURER BRANDS IN THE AUTOMOTIVE INDUSTRY

In 2017, five home German MNEs and seven brands dominated the automotive industry in Germany: Volkswagen AG (that owns Audi and Porsche), BMW AG, Daimler AG, Adam Opel AG, and Ford-Werke GmbH. In annex VI, we can see an overview of the world ranking sales manufacturer gather by the "International Organization of Motor Vehicle Manufacturers" (International-Organization-of-Motor-Vehicle-Manufacturers, 2018). 96 million vehicles were sold in 2017. The ranking is dominated by Volkswagen, a German MNE and Toyota, a Japanese MNE, representing together a fifth of the total sales with 10 million each. In the top 20 of the biggest MNE sales of 2017, three were German brand, Volkswagen, Daimler and BMW for fives Chinese brands, namely in order SAIC, Geely, Changan, Dongfeng, and BAIC. In the ranking, the Chinese brands were all on the bottom of the top 20 and overall produced less car than German brands. The presence of strong German leader is a German regional asset. Out of the five leading Chinese brands, only one was a private owned MNE, Geely, for four SOE. Geely started a joint venture with Daimler to acquire 50 % of the brand Smart, an electric car

(American-Entreprise-Institute, 2019). If we broaden the ranking to the top 40, the SOE to privately owned Chinese automotive MNE ratio slightly change. In of the 16 Chinese out of 40 worldwide biggest MNEs, 9 are SOEs and 7 are privately owned. On the top 40, BYD, a Chinese Brand, was the only mainly electric car company, as Tesla was not a big actor yet in numbers of cars produced.

It is important to note that many of these Chinese brands were accused to copy developed countries model. While they are trying to enter the European market, they are still small players. Indeed their main market stays their Chinese home market (Brierley, 2009).

7.2 THE AUTOMOTIVE SECTOR

In the section, we explain the current status and challenges of the automotive sector. After understanding the firm actors and their value chain architecture, we will make an overview of the current product market, and the technical challenges the actors face.

The International Organization of Motor Vehicle Manufacturers publish the total global sales of commercial and passenger car every year (International-Organization-of-Motor-Vehicle-Manufacturers, 2018). Their number demonstrates that the automotive market is constantly growing, with the help of emerging markets. From 2007 to 2017, the market grew more than 50 %, moving from 66 million to 96 million vehicles. (International-Organization-of-Motor-Vehicle-Manufacturers, 2018). However, the growth is sustained by new market, as Europe and USA experience a stagnant demand and overcapacity.(Hunter, 2009) in 2018, the marketplace increased by 1 % to 98 million vehicles, slower than expected.

In their report "Global Automotive Supplier Study 2018," the consulting company Roland Berger mapped the current status, the future and the challenge of the automotive supply chain. Their critical findings are the following:

1. 2018 had record volume and profit in the automotive industry, but the sector growth is weakening.
2. Technology and structural disruption will change the industry

3. The current mega supplier chain structure, supplying macro, meso and normal components, will be transformed in the coming years. (Berret, Mogge, & Bodewig, 2018)

Foremost, the automotive supplier industry is expected to increase its revenues by 3% and stabilize its margin to 7 % of revenue. (Berret et al., 2018) However, while the margin stabilized for the whole supply market, macro-component suppliers improved their profits. For our paper, it is essential to note that Chinese and Nafta suppliers are currently more profitable than the European one. However, their profitability is reaching a tipping point and has been reduced in comparison to 2017.

Afterward, key technology changes are ongoing for the carmaker, and this change will disrupt the whole supply chain. First, new use models are arising in developed and emerging markets. New business concepts such as car sharing (for instance, Cambio), ride-hailing (Uber ..) will disrupt the way consumer move. Roland Berger forecast that, by 2025, this new solution will account for 15 % of car rides in Europe, and up to 35% of the Chinese market. This increase could reduce the number of car produce or create new necessary features of the existing product. Secondly, the autonomous car increased capabilities will most likely increase the new mobility business market share. It will also subsequently increase the knowledge and expertise required for the automotive industry, and significantly increase its digital dependency. Thirdly, we are in the middle of an artificial intelligence revolution with unknown consequence and possibility. Finally, there is a high momentum for a switch out from classical petroleum engine, where European is technologically leading to the OEM electric car, where China heavily invested. Roland Berger estimates that by 2025 20-30% of the European market will be electric, and with 30 to 50% for the Chinese market (Berret et al., 2018). Lastly, the mega supplier will struggle to find growth, and the technological change we spoke about will pressure them to innovate. The specialization in the value chain of suppliers focused on key standardized components, will help reduce the cost of big-buyers brand and competitively pressure mega supplier. They will have to find new partnerships for growth.

The following graph in figure 9 demonstrates the state of mega suppliers in the world.

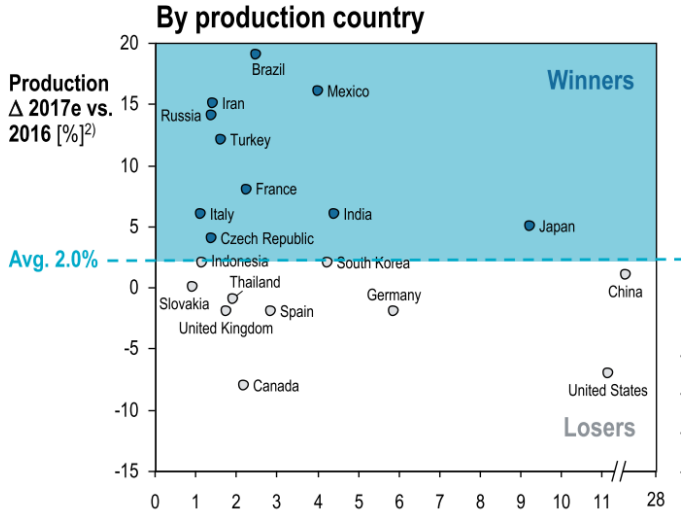

Figure 9 - OEM production per country of light vehicle vs. growth (Berret et al., 2018, p 8).

We can note that while China is the country with the highest production of intermediate goods, they struggle to find growth. In the mean times, the other BRICS nation and Mexico are experiencing the highest growth. Germany and other developed countries are themselves losing ground.

7.3 ROLE OF INSTITUTIONS

In this section, we will primarily focus on Chinese and German actors. We aim to understand their range of action, their power and embeddedness and how they create value in the networks.

INTERNATIONAL INVESTMENT POLICY OF CHINA

Foremost, China has a central government influencing Chinese MNE abroad and that has been promoting internationalization. (H. W. Yeung & Liu, 2008). In 2006 Freeman stated two main Chinese policies towards its multinationals (Freeman, 2006)

- Letting go of the small: Leave unprofitable companies without strategic aspects and focusing on the larger ones. There is a desire to create a hundred large Chinese firms, the global champion. (Freeman, 2006)
- Going global strategy: Buyout and implementation abroad by direct investment (China-Policy, 2017). The policy was later updated in to focus more on high-end products and added tighter access to investment

In the second decade, two new MNEs policies came into place:

- "Belt and Road" initiative: support of global trade infrastructure that centralizes China in global trade routes.
- "Made in China 2025": Moving up in the global value chain by promoting Chinese MNE champion (China-Policy, 2017).

To do so, the Chinese Communist Party can use different tools. Firstly, one of the main direct economic prerogatives of the Communist Chinese government is to name the management of Chinese SOE. Indeed, the Communist Party of China's Organizational Department name directly the CEOs of the largest 53 national SOEs (Morck et al., 2008). This nomination gives to the Communist Party a high control of the manufacturing sector and the banking system. It gives it extensively capacity to control, not only the SOE internationalization but also the access to loans for private firms if they internationalize. Secondly, by providing foreign investment subsidies to Chinese companies. These subsidies are either cash or the possibility of borrowing at low rates. (Freeman, 2006)

However, it is important to point out that Chinese authorities are not always supportive of internationalization. There have been many cases where Chinese authorities have fired managers of state-owned enterprises who demonstrated the envy for internationalization at the depends to local growth (Nolan, 2001.) Indeed, in these last two years, the government has cut many advantages that internationalization of MNEs could have brought and limited the ability for capital to flow out (Shen & Galbraith, 2018). They had had an opposite impact these last two years.

In China, the local government has applied large control over its internal automotive sector, promoting one state enterprise over others. They controlled the competition and reduced access to POE. (Neil M. Coe et al., 2008)

The Chinese government has clear MNE objectives. However, the European Union became China's largest trading partner, taking in 22 % of its total exports (Meunier et al., 2014). In a period of rises of protectionism, they need to cultivate a positive relationship with Europe, and it reduces their direct economical intervention.

THE EUROPEAN AND GERMAN INSTITUTION

After a peak of Chinese ODI in China in 2015-2016, the EU adopted a new strategy on China called "The EU-China 2020 Strategic Agenda for Cooperation". This plan maps the European Union's relationship with China for the next five years. The report's core point is to promote reciprocity and fair competition, a clear and regulated platform for investment.

The report states:

> "*China's policy of "going global" is accelerating. Its companies are being encouraged to trade, invest abroad, and find resources as never before. China's growing connection to global capital markets can generate benefits for all, provided that the right framework conditions are in place*."
> (European-Commission, 2016)

This report suggests, amongst others, that the EU should strengthen its relations with China, engage China to reform its economy and promote reciprocity and fair competition. It also plans to develop a Comprehensive Agreement on Investment to regulate Foreign Direct Investment or open new markets to investment and build infrastructures, trading, digital, and people-to-people connectivity between Europe and China. Finally, it states that the EU should maximize its cohesion in its dealings with China.

From this report, we can infer that Europe is still welcoming ODI and trades with China; however, more cautiously. It seems that they want to avoid unfair competitive advantages of Chinese MNE that can compete in multiple markets while the Chinese market is closed to European companies. This disadvantage strengthens Chinese MNE in GPN. Secondly, Europe agrees with the belt and road

initiative and want to develop infrastructure, promoting it. Finally, the last point highlights a key point for European institutions: while trade is a European competency, regulation on Chinese ODI is made by country-level law. Therefore, the EU aims for more unity (European-Commission, 2016).

One key example of a European country regulation of Chinese ODI is Germany. Germany's tightened its foreign trade law and demonstrates a wil to control MNEs taking over of its regional assets. In 2018, Germany agreed on new rules to lower the threshold for screening and blocking acquisition in German enterprise by non-Europeans (Hansen & Nienaber, 2018). Screening is the capacity that has a state to check if FDI actors in a global transaction comply with state safety standards and industrial security. For instance, in this law, they prohibited investments from non-European countries to invest in critical infrastructure from 25% to 10% (Sprich, 2019).

OTHER INSTITUTIONS

I. The Workers Union

Germany is the home of a highly qualified and well-organized workforce (Stefan Di Bitonto, 2019). In Germany, trade Unions are more powerful than their Chinese counterparts. Indeed, for instance, in Salzgitter, a VW plant, unionization is around 97 percent, and German Union has been keen to reach to others European labor union to regulate salary and reduce MNE management power of labor (Bernaciak, 2010).

Nevertheless, the standardization of automotive production across the company allows management to distributes its investment in the function of the international competitor. Purely production speaking, a part made outside of Europe often meets the same standard as the one in Germany. (Bernaciak, 2010) It gives power to the management to negotiate labor cost between unions of different sites (Hancké, 2000). The union is often limited at a sovereign state level. Indeed, because of language and cultural difference, there has been no will to set up labor transnationalism (Stirling & Tully, 2004). However, lately, it has been

signe of growing cooperation between European unionist (Bernaciak, 2010). Union starts to go transnational in GPN with a high degree of production internationalization and with the presence of multinational management in MNE, which is the case of the automotive industry (Arrowsmith & Marginson, 2006). Especially in the case of Europe, with the presence of transnational worker structure as European Works Councils (Bernaciak, 2010). The labor power on the automobiles MNEs reduce the fragmentation of production, it is therefore a German regional asset.

On the other hand, the Chinese union have limited power on production, and are often representative of the local institution. Their power is limited as the right to strike is actively monitored by Chinese authorities.

II. The German Universities

One key regional asset of Germany automotive production network is the existence of prestigious research universities with high connectivity with the industrial land space. The knowledge produced in the public sector has frequently been shown to be essential to GPN technology improvement (Siegel, D. S., & Phan, 2005). Recent studies from the United States and Germany show that publications of universities and university patenting innovation are positively linked (Agrawal & Henderson, 2002).

For German universities, there is an incentive to engage in informal technology transfer and acquire research money to support Universities. German scientists are more active in commercializing technology than, for instance, their U.S counterparts. In German universities, more than 20% of the scientists generate at least one joint publication with an employee of the private sector. Inside the university, around 17% of the researchers were also consultants for private firms (Grimpe & Fier, 2010). This potential of innovation, coupled with the incoming sector technology transformation is a German regional asset.

III. The Chinese Bank industry

Banks in China are state-controlled and are of the biggest SOE in the country. The four biggest banks, namely the Industrial and Commercial Bank of China, the Bank of China, the Agricultural Bank of China and the China Construction Bank account for about 75% of commercial loans and 50% of total banking assets in 2005 (Thomas & Ji, 2006). In 2018, the Global 2000, in the Forbes ranking of the biggest company in the whole world, the big four were at the 1st, 2nd, 4th and 8th place. Most of the loans go to either the state sector or to follow preferential policies set by the local government. In 2006, SOE accounted for three-quarters of the bank loan (Morck et al., 2008). Nowadays, with the slight growth/slow China is experimenting, entrepreneurs in China struggle to find investment for their enterprise and pay their debts due to low access to credit and the high rate of borrowing if possible (Lee, 2019).

7.5 THE AUTOMOTIVE NETWORKS

In this section, we attempt to describe the network structure of the automotive sector that we already approached in part I. We will begin with developing the work of Fringant and Zumpe on the distance between supplier and big buyer and the construction of local cluster. Afterward, we will develop the key analysis of this paper, the analysis and visualization of intermediate and finish good trade network, and the position of key countries on this network.

A LEAD FIRM NETWORK

We already touched the network structure of the automotive industry in point 7.1 on the firms. As a recap, at a multinational level, big brand buyer governs relationships with four types of supplier: the macro-component, the meso-component, and the component supplier, and lastly, the mega supplier incorporating all levels of component supply. Each of the supplier types also has various levels of connection with each other. Afterward, from point 7.2, the institution, we know that the GPN actors are dependant of the banking loan availability in China controlled by the government and that in Germany, the labor

union tries to limit the fragmentation of the networks. Finally, we know that the automotive is ongoing technological transformation and that German universities sector is highly embedded with the industrial sector, as a consultant or by creating patterns. Universities are then highly linked to the German manufacturer.

In the paper, "Are automotive Global Production Networks becoming more global ?" (Vincent Frigant & Zumpe, 2014), Frigant and Zumpe computed the average distance between auto part supplies. They found out that the automotive sector network is characterized by a low distance between suppliers and buyers in local clusters such as Europe, East Asia, and North America. However, another side of their research demonstrates a slight increase in far distance imports in Europe. Indeed, whereas imports of near-distance automotive commodities were still multiplied by 2.2, far distance ones were multiplied by 2.4 (Vincent Frigant & Zumpe, 2014). We can then infer that at MNE levels the network is characterized by tight clusters of supplier centered around of big buyers in local regions with influential MNE leaders such as Germany. It is a regional asset.

THE GLOBAL AUTOMOTIVE TRADE NETWORK

To describe Chinese ODI impact in the automotive industry in Germany, we should understand the network specificity at a macro level, the world trade, and understand the ongoing trade relationships between countries in the world. To do so, we will model the automotive trade network in python, compute the eigenvalue nodes centrality of each state, and analyze their variation across time.

Nevertheless, because of the specificities of the automotive firms architecture, we should not only analyze the trade of automotive commodities as a whole but split it between intermediate and finished goods and analyze key differences between supplier and big buyers. To arrive at this objective, we selected and cleaned a trade dataset and split it between intermediate and finished goods. We modeled and visualized it in networks and computed the centrality.

For the need of this master thesis, I created a python tool called 'gpn' available at https://github.com/hugovth/gpn.

I. Dataset selection and cleaning.

To model the world trade of the automotive industry, we need to gather world trade values and select only automotive-related trade. Bilateral trade flows are yearly gathered at a commodity granularity, by the United Nations Statistical Department, the ComTrade database ("UN Comtrade Database," 2019). This commodity level is called the "Harmonized System," an international classification of products. However, despite the fruitfulness and completeness of these datasets, it has been recognized to have missing flows and inconsistent data between export and import between countries. Therefore, the research center CEPII developed a mirror statistic strategy to improve missing data (Benedictis et al., 2013).

The dataset is available on the website of Massassuchet Institute of Technology oec.world (A Simoes & Hidalgo, 2011; Alexander Simoes, 2019). We select the HS2007 nomenclature, with data from 2008 to 2017. This dataset is rather large, for each six-digit levels commodities granularity (around 5000 commodities), 221 countries traded bilaterally with 220 others for nearly ten years. We selected only the HS code starting by 87, representing motor vehicles; other than railway or tramway rolling stock, and parts and accessories thereof (Foreign-trade-online, 2017). To distinguish between the finished goods and intermediate goods, we used the strategy suggested by Cingolani and al. (Cingolani, Panzarasa, & Tajoli, 2017), by applying to our dataset another commodities nomenclature called the Broad Economic Categories classification (BEC). The BEC distinguishes between intermediate goods, capital goods, and finished goods. A mapping between HS and BEC nomenclature is available on the Comtrade website. For the automotive sector, the BEC capital goods refer to equipment and do not distinguish with our definition of finished goods. We aggregate the data frame into trades value of finish and intermediary good in Python and create a third data set with the sum of both of them.

II. Modeling the network

To mode the network, we will use the python library API NetworkX. NetworkX is a useful tool that helps people create a network from Python datasets, compute centrality, and partially visualize it.

Following the trade network theory, each exporter and importer countries are set as nodes, and for each bilateral trade between the two countries, an edge is created with a weight equivalent to its trade value. The direction of the edge is from the exporter countries to the importer country. The operations is repeated for each type of goods.

The outgoing export from each country is then summed up to represent the total trade of each node. Afterward, we compute the eigenvalue centrality, developed in chapter 5, of each country and add it as another nodes feature. The python tool 'gpn' creates a dictionary with a generated trade network for each year as well as other features. The features are for instance the world export, the countries import and export, different nodes and edges centralities, a trade agency matrix and the possibility to add trade threshold to reduce the number of nodes (country) and edges (bilateral trade) that are irrelevant. Finally, it can generate a world trade map.

III. Visualizing the trade networks and critical findings

The visualization tools were the most complex part of the python tools. After we created a 'gpn' object for each type of goods, for each country nodes, we used the library API basemap to create a map and a set of country coordinates to visualize the network on the map. The county nodes size is representing the total export of the country, and the color of the node represents its eigenvalue centrality. In the section, when we refer to centrality, we will mainly refer to eigenvalue centrality, that represents the embedding of a country in the trade network, and how connected to crucial players a country is, as we developed in the theoretical part.

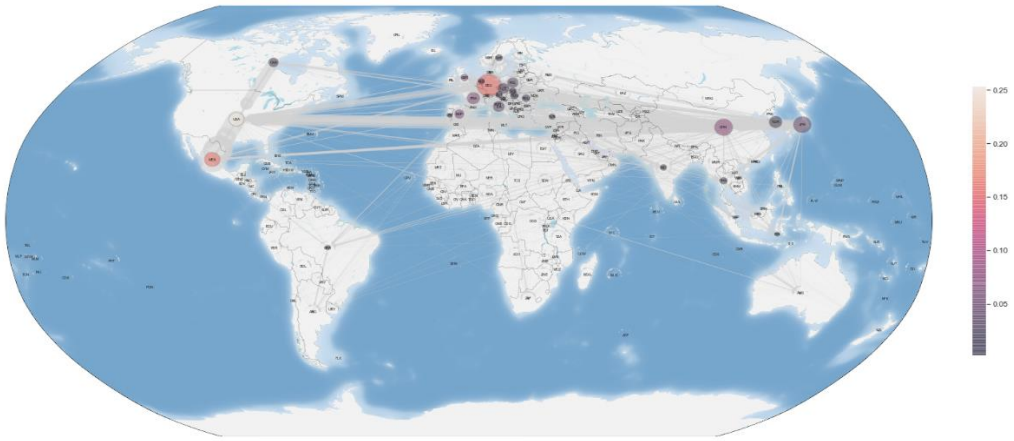

Figure 10 - Trade of automotive intermediate goods 2017

The trade of the whole automotive sector is in **annex VII**, the trade of finished goods in **annex VIII** and finally the trade of intermediate good in **annex IX.**

If we extract the total trades from the networks, the overall automotive industry trade is worth 1305 billion $ and is composed of 29% of intermediate goods and 71% finish goods. Ten years ago, in 2008, the sector was worth 1105 billion $ with a ratio of 26% of intermediate goods. Consequently, we can confirm that not only the sector growth a bit less than 20 % but the supply chain becomes slightly more fragmented.

From the three maps, of total goods, finished goods, and intermediate goods, we can infer and visualize some other discoveries.

From an aggregate automotive sector point of view, Germany is the leading exporter of the automotive industry with 244 billion exports in 2017, with ¾ of finished goods to intermediate goods. In the meantime, China is an upper average player, trading 64 billion dollars of automotive commodities, with a ratio of a bit less than two-thirds of intermediate goods. While trading less than Germany, the USA is by far the most central, Germany is only second. Indeed, the US has a stronger relationship with Mexico, and Canada, other principal traders and have its trade well dispersed in the world. Japan seems to be an anomaly, with high trade but a lower centrality than, for instance, China. Indeed, Japan is trading a lot to smaller or less central players in East-Asia and Pacific, and less to the numerous player in Europe.

One interesting result comes from comparing the intermediate goods world trade to the finished goods world trade. Although Germany stays the largest traders and the USA the most central player in both types of goods, the pictures change in the emergings countries and in Europe. Foremost, Europe is way more embedded in the finished goods network. Indeed, actors such as France are more central in the end market, and the UK is trading more finished goods massively, trading 45 billion of finished goods in comparison to 5 billion intermediate goods. As we analyzed before, the UK is also the center of automotive ODI from China.

In the emerging market, BRICS countries are nearly nonexistent actors at the exception of China. Mexico and China are the two emerging countries that are big players in the industry. China is trading vastly more intermediary good than finished goods, only 27 billion finish goods to 37.6 billion intermediate goods. However, it keeps a centrality level consistent with the world average taking into account its trade level. They also keep the same level of centrality across two types of goods, even though they trade massively more intermediate goods in comparison to other countries. In the meantime, Mexico retains the world ratio of 1 quarter intermediary goods to three-quarters of finished goods, but have a considerable change of centrality level between intermediary and finished goods. Mexico has the second-highest centrality in the trade network in intermediary goods but is average to mediocre for finish goods. Mexico centrality is in part due to the proximity to the most central player, the USA. However, the USA seems to be its only significant partner in finished goods, while Mexico also trades numerous intermediary goods to East Asia and less significantly with the European cluster.

IV. Centrality analysis overtimes

A GPN is always in movement and changes overtime. Understanding what is happening and the broader trend with a snapshot at a fixed moment in time is impossible. When we look at the centrality of a country in a network and its connection key partner, we should track it over time. The data of the CEPI allows to create networks from 2008 to 2017 and will enable us to track changes.

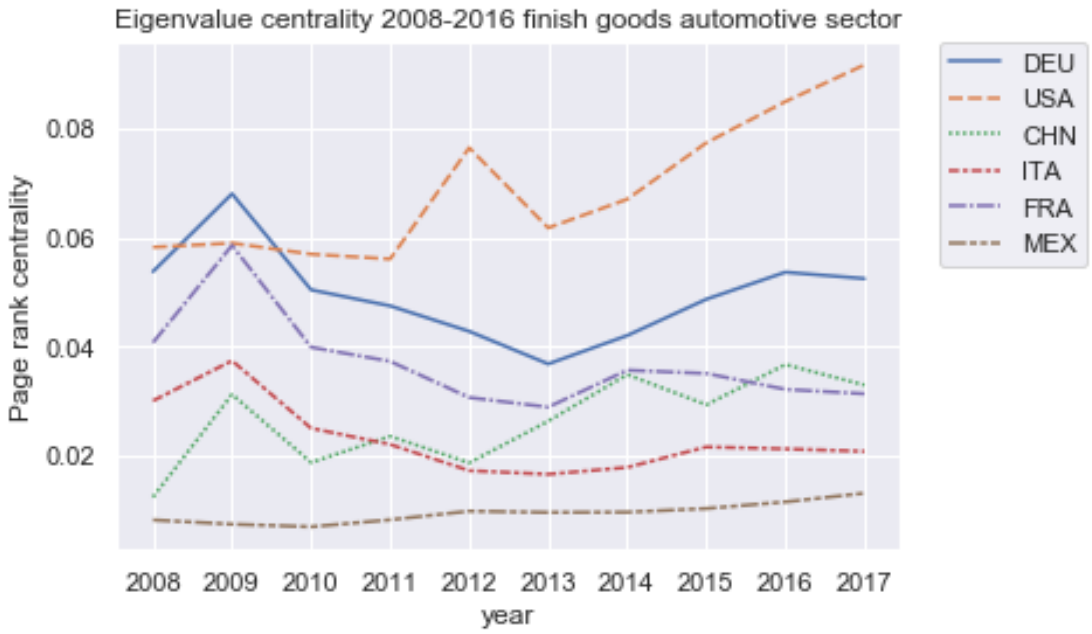

Figure 11 - Eigenvalue centrality of automotive finished goods 2008-2017

The line plot of centrality overtimes for the entire automotive sector can be found in **annex X**, for the finished goods in **annex XI** and the intermediary goods in **annex XII**. The graph represented above corresponds to annex XI.

One thing that is clear in this graph is that centrality level is correlated to the economic state. In 2008, the world had one of the biggest economic crisis since the 1930th, during this year the economy contracted and trade was reduced. Indeed, it is reflected in the automotive sector centrality variation. Secondly, during the first part of this decade, Europe suffers the euro crisis, and its trade impact was reduced during these five years.

The graphs of the entire trade centrality graph tells us three stories: the rise of Mexico and China, the downfall of Italy and France and lastly the leadership fight with Germany won by the US.

The rise of Mexico and China is unusual because they rise come from two different origins. Indeed, on the one hand, the centrality in the finished goods sector of Mexico stay quite steadily low this decade; nevertheless, its intermediate goods position spike up and nearly double. Mexico, a marginal central player in 2008, became as central as Germany in 2017 in intermediary goods. One hypothesis is that the reduction of centrality in 2015-2016 of the US might be linked to pike of

intermediate centrality goods in Mexico in 2016. Some power might have been transferred between the two players.

On the other hand, China spikes in centrality this decade came from both intermediary goods and finished goods. Whereas the increase of centrality in intermediate were steady, the finish goods centrality had more variation, going up and down every year. In 2017, China became as central as France, while France was four times more central in 2007. This is impressive, as China is still trading more intermediate goods than the rest of the market, and that Mexico did not improve his position in the same period. We can assume a "trade upgrade" for china.

Finally, it seems than Germany suffer more from the 2008 crisis than the US, in finished goods centrality. While in 2008, both had a centrality around 0.06, in 2017, the US was around 0.09 and Germany at a lower level than it was ten years ago. That being said, the Germany centrality story is brighter than for other European counterparts. Indeed, starting in 2013, Germany reverted the massive slope it experienced during the five previous years and started to increase its centrality at the same level than the US again, in contrary to the rest of Europe.

CHAPTER 8: CORRELATION BETWEEN INVESTMENT IN EUROPE AND POSITION IN THE UPWARD VALUE CHAIN, RISK OF DECOUPLING?.

8.1 STRATEGIC COUPLING IN GERMANY

As a reminder, strategic coupling allows to position regions in Global Production Networks through a relational perspective of actors. To develop a coupling, an actor, often an institution, needs to find evolutive interactions between its regional assets and the GPN.

Based on our chapter 7 analysis, we identified key regional assets of the German production networks:

1. The presence of strong manufacturer leaders with strong brand reputations, leading the automotive supply chain.

2. A strong network of macro, meso and general component suppliers with a short distance of transport between intermediary goods and final goods, the manufacturer leader.
3. Prestigious research universities with a high degree of embedding in the private sector.
4. An economy of scope: A highly qualified industrial workforce unified by a strong worker union
5. A high eigenvalue centrality in the global production network of both finished goods and intermediate goods, therefore a dominant position around the strong actors of the sector.
6. The access to the European market, the largest cluster of automotive production, without tariff.

From the GPN dimension analysis of chapter II, we infer the opportunities for regional actors to upgrade their position into GPNs.

First of all, we found that China and Germany MNEs already have a **transnational partnership** at some degree, an informal knowledge network of transnational actors between Chinese mega-supplier et German brands. This partnership is boosted by the go global strategy of the Chinese government and the sharp increase of ODI between the two countries. A global connection with the most central leader (Germany) and one of the biggest market (China) is a strong strategic coupling. Moreover, Europe is trying to regulate it.

However, Germany has its other local strategic coupling with a strong connection between German supplier and its big brands' which is coupled with the short distance of trade of intermediate goods. This strategic coupling is improved by strong trade union linked by a mutual social identity, reducing the global fragmentation of the trade network. There would be a risk of decoupling if the automotive sector became more globally fragmented, especially in the case of acquisition ODIs. Indeed, the majority of workers of Chinese MNE come from their home countries, German labor union will significantly lose negotiation power.

Secondly, the automotive sector is going through **modification of the regional industrial organization**, the sector is progressively moving to new electric

motors, and new types of end-uses of transportation. While Germany owns strong innovation capability pools, Chinese consumers are planned to use more and more quickly the new market technology. They already own established electric brand like BYD in their home market. Strategic coupling arises from MNE adoption of technological and structural innovations to adapt to competitive markets. Both China and Germany can find strategic coupling by cooperating. Indeed, Germany owns the capability to product innovation with their skilled force and universities embedding, while China have a competitive et central market of early users, with access currently protected by the Chinese institution SOE preference. The large joint venture between Geely and Daimler on the electric smart is a good example. However, the large number of acquisitions in the automotive sector might mean Germany lose key brand leaders and innovation competitive-advantages. We can deduce that the mode of entry of the Chinese ODIs has a high impact on this development aspect. Finally, mega-suppliers are losing power. On the one hand, there is a risk of decoupling for China, who was mostly a central player in the intermediate goods industry in the first decade and have strong mega supplier actors. On the other hand, this lose of power might mean a stronger fragmentation of intermediary goods, and the need for MNEs to seek for low labor cost asset outside of Germany, that labor union tries to regulate.

Chineses, on the other hand, try to make strategic coupling from the modifications of the regional industrial organization by developing news big Chinese brands and integrate upwards in the value chain. If they want to become a more central player in the global production network of finished goods, they not only need to increase their innovation capabilities for a highly complex industry but need to build up a transnational partnership and have better access to global central markets. As the centrality of an actor is directly correlated to the power of its partner. This justifies the “Made in China 2025”, aiming to go upward in the value chain as well as the “Belt and Road” initiative aiming at making China the most central market, at the cost of Germany centrality?

8.2 CORRELATION ANALYSIS BETWEEN CHINESE ODI AND AUTOMOTIVE MARKET DECOUPLING

We saw that Chinese ODIs in the automotive industry can help further transnational partnership and create strategic coupling, but can have a mixed coupling result coming from a modification of the regional industrial organization. To assess the impact, we should compare the Chinese ODI in the automotive sectors to the change of centrality overtimes in the German market.

We do not have at our disposal enough data to make significant hypothesis testing, as the massive inflow of Chinese ODI is a relatively new topic, and it is still relatively limited to key industries. Secondly, it is clear that both Chinese ODI and centrality are not stationary, and it is confirmed by Augmented Dickey-Fuller test with both pvalue > 0.05. Indeed their variance and average of this times series vary over times with politics cycles and GDP growth. However, comparatives and correlation analysis are still relevant to our analysis.

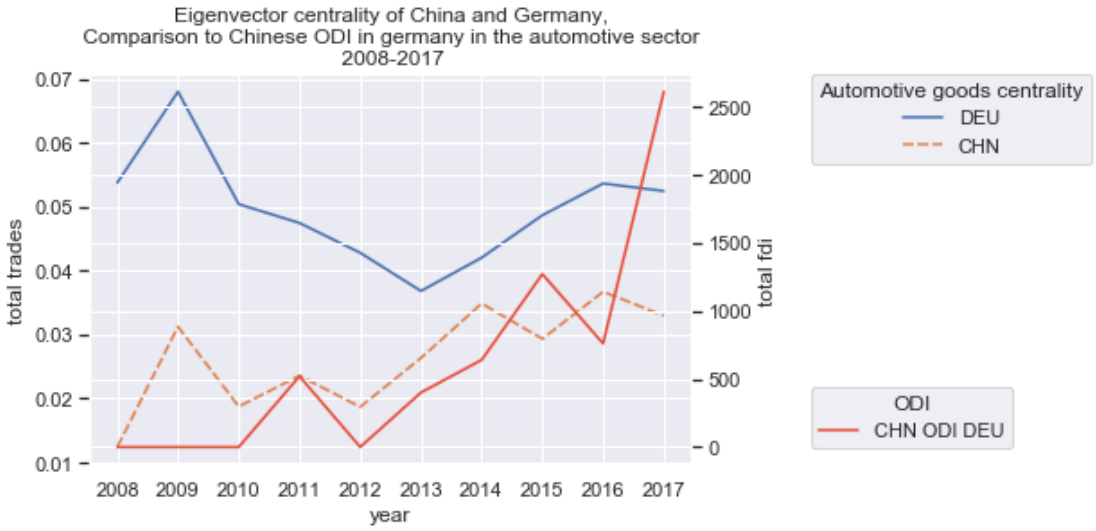

Figure 12 - Eigenvector centrality of China and Germany in the finished goods automotive sector, comparison to Chinese ODI in Germany. 2008-2017

In annex XIII and XIV, we represented the eigenvector centrality in automotive goods of China and Germany versus the Chinese ODI in the automotive finish goods sector in Germany; annex XIV represents this relation to Chinese acquisitions. There is a clear relation between Chinese ODI and Chinese centrality. However, correlation does not mean causation. Indeed, both of these variables are strongly correlated to the Chinese GDP and increase in their car market. Secondly, Chinese ODIs are not only focused on Germany but is part of a wider trend.

One of the interesting findings is that Germany centrality was sloping before the start of Chinese investments in 2011-2013, and then start to rise again. They are indeed positively correlated. The question remains that we can not evaluate at which degree Chinese investment impacted this slope change. Germany was then recovering from the Euro-crisis.

The Pearson correlation measures how two continuous variables co-variate over time. It indicates if a linear relationship exists: -1 means negatively correlated, 0 not correlated, and 1 correlated. However, as the impact of large ODI project takes time to come into effect, a single correlation is not enough to represent the synchrony between both. Therefore, we computed a time-lagged cross Pearson correlation with a time lag of a maximum of three years (Chenhua, 2015). As we have 9 years of data, a 3-year lag means a sample of only 6 years. Time lagged cross-correlation allow us to see if one time series is useful to predict another. It computes the lag in a correlation between a leader times series (Chinese ODI) followed by a follower time series (Finish goods automotive German centrality).

The correlation series are available in annex XIV and XV. Annex XIV represents the correlation between the Chinese ODIs and german centrality automotive sector while annex XV represents the correlation with only the Chinese acquisition ODI.

In annex XV, we notice nearly no correlation in the first two years between the ODIs and the centrality variation, with respectively -0.02 and 0.05 correlations. However, the correlation spike up after two years with 0.38 and 0.45 for 3-years lag. One limit of the analysis is that the automotive ODIs spiked up this last three years, and therefore is not represented in the three-year lag, as we do not have centrality measures after 2017. However, if this correlation is computed in a longer period of time, and corroborate our findings, we might deduce that the ODIs have a positive correlation after two years and peaking after three.

If we compare the Chinese acquisition ODI, however, this correlation is not clear anymore. Indeed, while lagged cross-correlation is also close to zero the first year, and we see a slight increase the first two years, the correlation after two years is only 0.24 and reach its maximum time lag. and actually goes down after three

years to nearly zero. The possibility of having a positive impact of acquisition ODIin the short term but transferring centrality in the long term can then be raised.

CONCLUSION

The mainstream perspective in international business assumes that foreign direct investments, if well-managed and fair, improve local market competition, bring valuable innovation from foreign markets, and often open new opportunities for local enterprise internally or abroad. The sudden growth of east-Asian four tigers followed by China was the most prominent example. However, this mainstream perspective created in the last century was based on the production of that time and has been questioned by the massive outflow of direct investment from China in complex production market such as automotive in a developing market.

Firstly, we investigate the motivations, repartition, and type of investment for Chinese Outward Investment in the German automotive sector. Around 2011, Chinese Outward Investment skyrocketed in Europe with a movement from market-seeking investment to asset-seeking Chinese investment. German ODIs were the second wave of European ODIs, spiking up in 2016 – 2018, after Sweden and Italy. Before 2012, Chinese ODIs in Germany were mostly in real estate and transport and afterward switched to predominantly the automotive industry. Chinese ODIs in automotive in Germany were part of a significant wave touching Japan and the US, two other automotive leaders. Finally, these ODIs in Germany were mostly from acquisitions in the past, with 60% acquisition, 20% joint venture, and 20 % greenfield. However, in 2018, a massive joint venture between a Chinese and a German industry leader shifted the investment landscape toward joint-ventures.

After analyzing the global fragmentation of the supply chain of Porter and Gerrefi, we highlighted that the automotive sector was a producer-driven global commodity chain. As we seek to understand its structural specificities and how it is embedded in the German market, we concluded that global production was better described by a network of actors, not only firms, competing for a certain

level of value-activities, power, and embeddedness: the global production networks.

The GPN of the automotive sector, from the German-Chinese relationship perspective, is composed of four dimensions: the firms, the sector, the institution, and the network.

From the firms' perspective, we investigate the differences between Chinese and European multinationals, the reason of their internationalization, and their supply chain structure. Because of the complexity of production, the automotive sector supply chain is a producer-driven commodity chain with strong producer multinationals leading the market and fragmentation of three layers of suppliers. The market is subdivided into two types: upstream to the supply chain, the final delivery to the finished goods to customers and downstream, the intermediate products of the finished goods. These suppliers often have an overall short transport distance between the lead producer and the supply. Nevertheless, the automotive sector is also characterized by q standardization of certain intermediary components. It, therefore, shares some buyer-driven commodity chain particularity in its downstream value chain. Some intermediary pieces are moved to producers in countries with the lowest cost-to-produce, and the MNEs act like big brand buyers delivering to consumers. 2017 Comtrade Data shows that the automotive industry trade was worth 1305 billion $ and was composed of 29% intermediate goods and 71% finish goods. Ten years ago, in 2008, the sector was worth 1105 billion $ with 26% intermediate goods. Consequently, we confirm that not only the sector grows around 20 %, but the supply chain also becomes slightly more fragmented. Moreover, Germany is the leading exporter of the automotive industry, with 75% of finished goods, while China is still an upper average player with slightly less than two-thirds of intermediate goods. Besides short-distance supplier, this fragmentation gave rise to influential mega-suppliers Chinese manufacturer. From 2017 to 2016, the slowdown of Chinese intermediate goods corresponds to the increase of labor cost in Chinese inner market. Furthermore, by reviewing the Trans-Nationality Index of 2017 of the 100 largest MNEs, we conclude that European MNEs had a higher level of transnationality than those in USA and in China. However, Germany has the second-lowest average

TNI in the EU. The embedding of German MNEs in industrial GPNs with the prominence of short-distance suppliers, such as the automotive sector, might be the leading cause of this result. The small TNI of Chinese MNEs highlights that if Chinese companies are currently internationalizing, the vast majority of their assets stay in their home country. A hypothesis is that China production system already has access to low labor cost and vast retail market, ownership of assets that leads other developed countries to internationalize in the past, as explained in the Dunning OLI theory developed in Chapter two.

For the sector dimension, carmakers face and will face new customer use models such as car-sharing and ride-hailing, and a shift to electric. These technology changes will be more prominent in China than in Europe.

From an institution perspective, on the one hand, the Chinese institutions are pushing Chinese MNEs champions to become global leaders, with global trade infrastructure that centralizes China in global trade routes such as Belt and Road initiative. Chinese institutions also promote innovation following the "made in China 2025" and give access to substantial financing via large SOE bank. On the other hand, European institutions are lately trying to unify European actors on their relations with China. Germany, in 2018, increased screening of international investment and limited investment in key security sectors. Finally, we identify two non-governmental institution actives in the german automotive GPN: Germany universities and the labor union.

To analyze the network dimension, we modelized the data from 2007 to 2017 of the Comtrade from the United Nation Conference on Trade and Development, cleaned by the CEPII. We selected trade data related to the automotive industry, and we split the trade from finish goods and intermediate goods using the Broad Economic Categories commodities. To discover the impact of key actors of the network, we developed a python tool to create, visualize, and compute the eigenvalue centrality of the Global Trades Networks of the automotive sector, the intermediate goods automotive sector, and finished goods automotive sector. This eigenvalue centrality corresponds the importance of a country's trade activities in the networks, and the importance to its trade partners.

The eigenvalue centrality in the automotive trade between 2008 and 2017 tells us three stories: the rise of Mexico and China, the downfall of Italy and France, and lastly the leadership fight between Germany and the US. Although Germany is still the largest trader and the USA is the most central player in both types of goods, emergings countries are more central in intermediate goods and Europe is more central in finished goods. On the one hand, while finished goods centrality of Mexico remained steady, its centrality of intermediate goods centrality spiked up, in line with the intermediate goods fragmentation and buyer-driven GCC. On the other hand, China's spikes in the centrality of automotive goods came from both intermediary goods and finished goods, becoming as central as France in finished products. We can, therefore, assume a "trade upgrade" of China. While in 2008, both Germany and the US had a centrality around 0.06, in 2017, the US was around 0.09 and Germany at a lower level than ten years ago. In 2013, Germany reverted the massive slope it had experienced the last five years, corresponding to the massive increase of Chinese ODI as well as the recovery from the Euro crisis and 2009 crisis.

Then, what key factors explain Europe and China's position in the automotive Global Production Network, and how might Chinese multinationals influence German multinational embedding in it? What are the risk for Germany? From the GPN dimension analysis of the automotive sector, we identified six German automotive GPN regional assets: the presence of strong manufacturer leaders with strong brand reputations leading the automotive supply chain, prestigious research universities with highly embedded in the private sector, a highly qualified industrial workforce unified by a strong worker union, a powerful position in eigenvalue centrality in both GPN intermediate goods and finish goods, the access to the European market, the largest cluster of automotive production, without tariff. We identified two types of coupling of the Chinese-German relation that will change the GPN position: transnational partnership and modification of the regional industrial organization. For the transnational partnership, we made the hypothesis that centrality in trades is linked to the centrality of the trades partner. A partnership between mega-supplier and brands can improve both Chinese and German local networks embedment, as centrality improves in both markets.

Strategic coupling arises from MNE adoption of technological and structural innovations in response to market competition. The automotive sector is going through modifications of the regional industrial organization with a change in the end-use and technology of vehicle ongoing. While Germany has dominant innovation capability, Chinese consumers will the new market technologies use more and more quickly. This development is possible and mutually beneficial if it goes through joint ventures but would be less significant through acquisition. Finally, the fragmentation of the intermediate supply chain puts Chinese mega-manufacturer at risk, leadoing to the need to upgrade their capabilities to maintain a strong position. The acquisition of keys technologies and German brands creates a risk of decoupling. Indeed, it is unlikely that worker union will have power on Chinese management to reduce global fragmentation, and Germany is at risk to lose a key regional asset, the large brands. Europe might have to adopt a posture similar to China and promote joint venture with a local partner instead of pure acquisition.

Finally, we conducted a correlation analysis between Chinese ODI and automotive market to investigate potential decoupling correlation. First of all, while the analysis shows interesting current trends, both Chinese ODI and centrality are not stationary, and we dispose of a limited set of data as the spike of Chinese ODI in Germany only happened in the last decade. We should be careful before building a hypothesis. As we investigate the risk of decoupling between Chinese investment and German GPN, our findings deduced the opposite. Indeed, the ODIs have a positive correlation between Eigen-centrality and Chinese ODI (acquisition, joint venture, and greenfield investment) after two years and peak after three. If we compare the Chinese acquisition ODI, however, this correlation is smaller, peak after two years, and is close to zero after three. There, it can be an increasing possibility of having a positive impact of acquisition ODI in the short term while transferring centrality in the long run. This analysis is limited by a ten years period. Chinese ODIs are often 100 million USD per project, the impact might arise only after 10 years, going beyond our dataset. To increase our sample size, we could possibly analyze the impact of emerging countries ODIs in a producer-driven commodities chain of developed countries by analyzing one large Asian-tiger country such as Korea. We could review its investment in a dominant country in a

specific technology, for instance, electronic, over a more extended period of times as it emerged before China. However, the size of China will always make a unique case.

As the network analysis is one of the four dimensions of the automotive global production network, and the trade network is one portion of the network structure, therefore not the sole focus of this master thesis, we limited the scope of the analysis to key figures explaining the networks. However, further research might be required to analyze this network. First, the time periods and the unique commodity are too limited for hypothesis testing with a significant p-value. If we want to infer significant correlations between investment and centrality variation, larger datasets will be required. Secondly, the eigenvalue centrality is the most representative aspect of trade power out of the four classic centralities developed in chapter5, but other types of centralities such as Katz and PageRank centrality allow adding constant therm representing extra-network dimension (Kandiah, Escaith, & Shepelyansky, 2015) while keeping the importance of neighbor of the eigenvalue centrality. The centrality network structure could be then extended by using other GPN dimensions such as the GDP allocated to a specific commodity of a country, the number of patterns granted in the country industry, the localization of critical worldwide regulation institution of the sector, or even number of brands.

Another further possible research is to break up the sovereign state network in region network, as the localization dimension does not always refer to a state. For instance, the USA is significantly more central than a European country in the current networks, but will it be the case on a state level? However, it is unlikely that such dataset exists with the same level of commodity granularity as the one we currently use.

Global trade is as the Banyan figs tree, a giant Indian tree with thousands of distinct trunks. It looks like a forest but is bound to shared roots and the same DNA. Each new trunk adapts to its environment, grows up subject to the vagaries of time, in competition with its neighbors for each ray of sunshine, but remains all linked to each other. Judging global trade only by its canopy and the size of a tree leaf might lose track of the nutriment going through the connected root, as each trunk seems unique but are in reality one tree. However, an analogy of peacefull

unified three has a limit. If a more massive tree produces nutriment for a smaller tree next to him, without sparing the sun, the two neighbor trees will be replaced by a larger one, covering a smaller surface than a vast hectare than the interconnected Banyan tree can cover.

TABLE OF ABREVIATIONS

Name	Abreviation
Broad Economic Categories	BEC
Brazil, Russia, India, China and South Africa	BRICS
European Union	EU
Foreign Direct Investment	FDI
Global Commodities Chain	GCC
Gross domestic product	GDP
Global Production Network	GPN
Global Trade Network	GTN
Global Value Chain	GVC
Harmonized System	HS
Intellectual Property	IP
Multinational Enterprises	MNE
North American Free Trade Agreement	NAFTA
Non-Governmental Organization	NGO
Outward Direct Investment	ODI
Organisation for Economic Co-operation and Development	OECD
Ownership-Location-Internationalisation	OLI
Privatly Owned Entreprise	POE
State-Owned Entreprise	SOE
Trans-Nationality Index	TNI
United Kingdom	UK
United Nation Conference on Trade and Development	UNCTAD
United States of America	USA
World Trade Organization	WTO

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ANNEXES

Annex I:

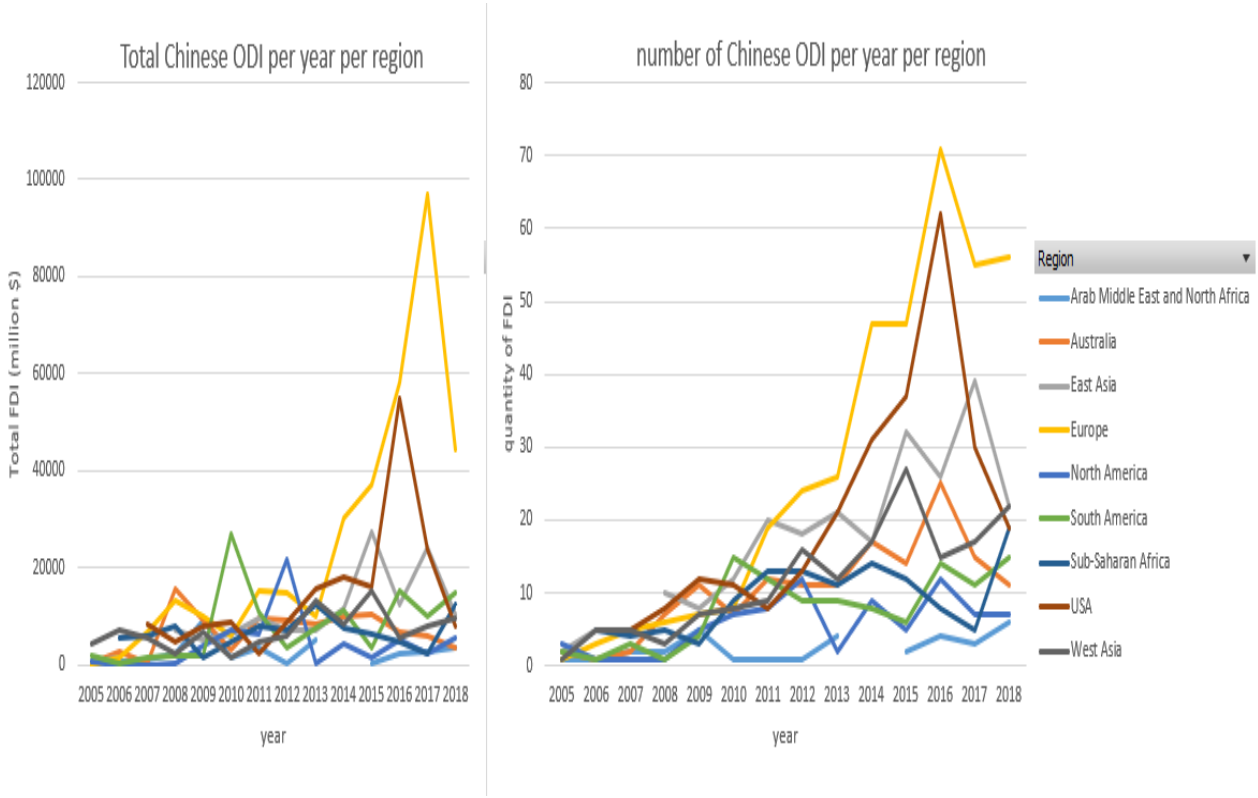


Figure 13 - Total Chinese ODI per year per region

Annex II:

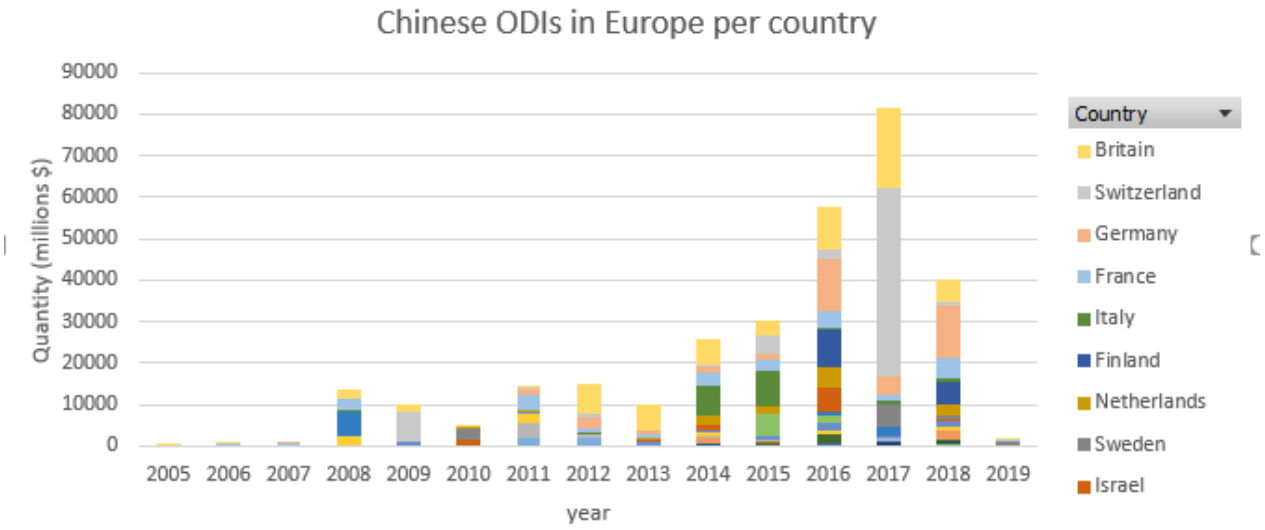


Figure 14 - Chinese ODI in Europe per country

Annex III: German Chinese ODIs per sector

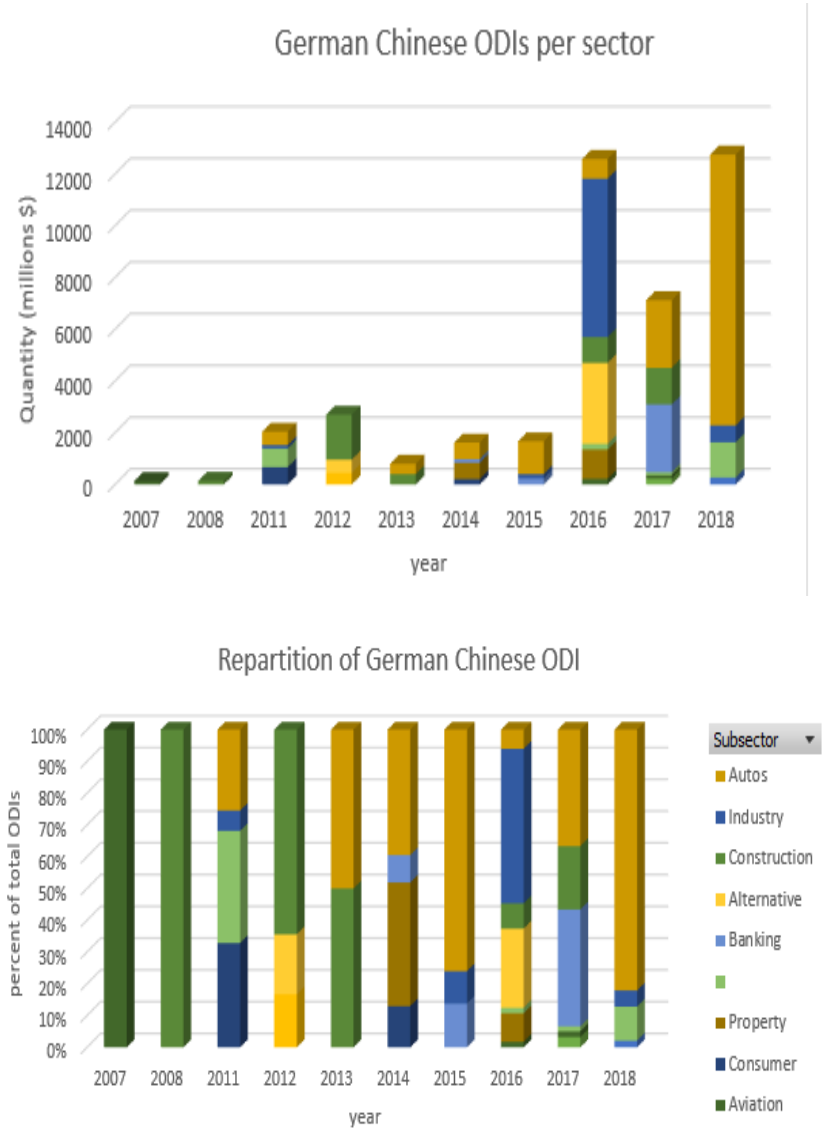


Figure 15 - German Chinese ODIs per sector

Annex IV:

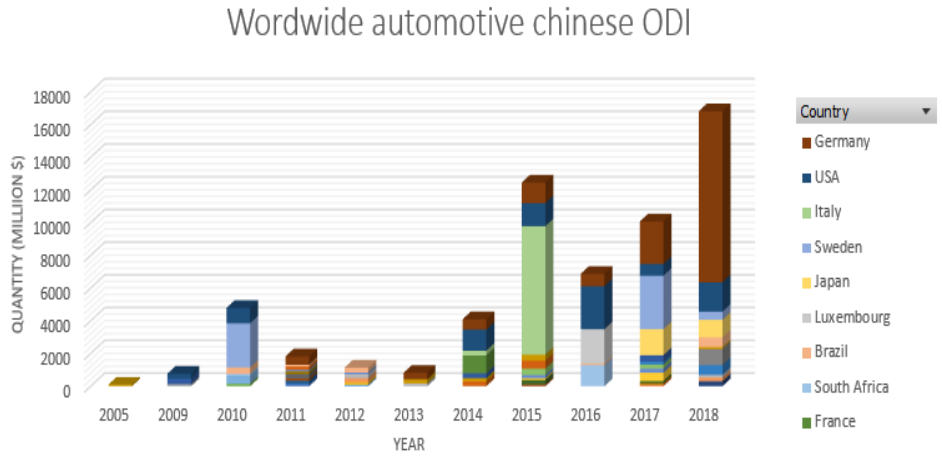


Figure 16 - Worldwide automotive Chinese ODIs

Annex V:

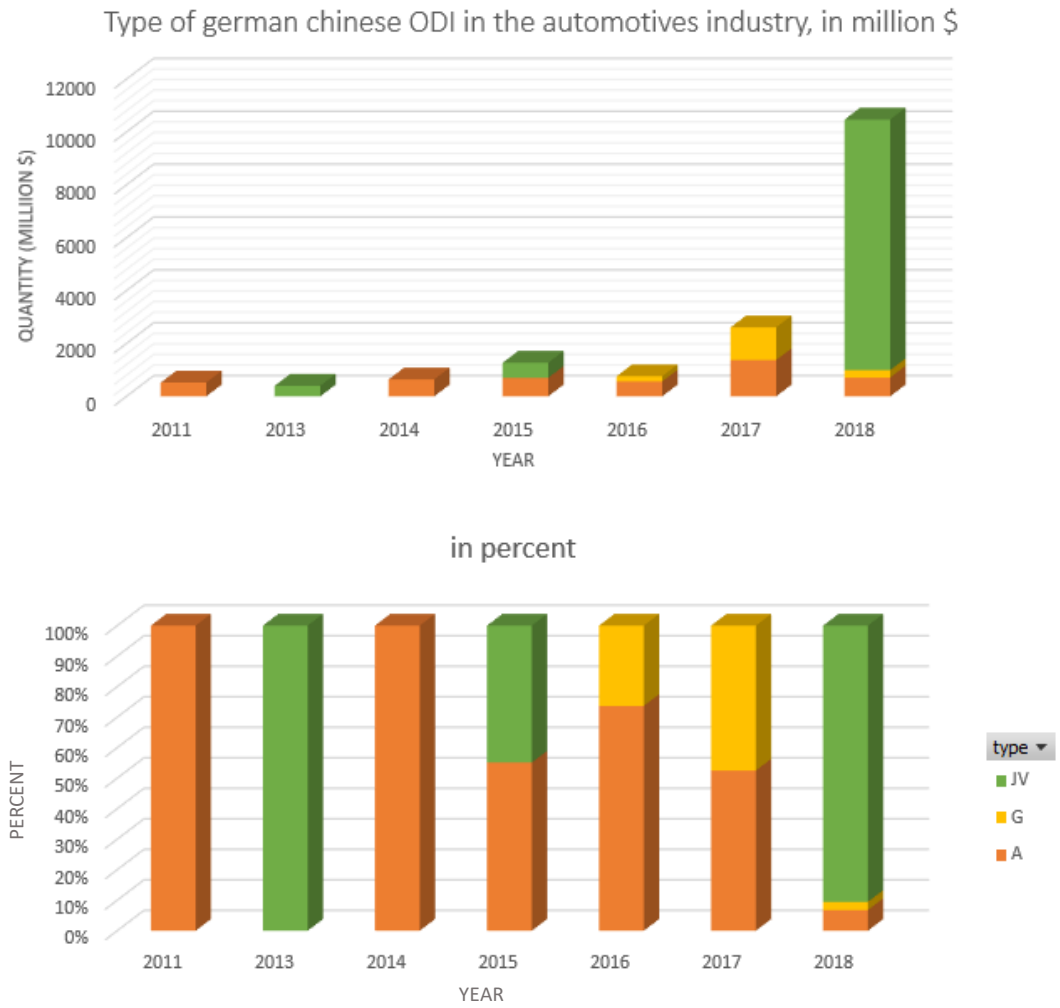


Figure 17 - German ODI in the automotive industry, type of investment

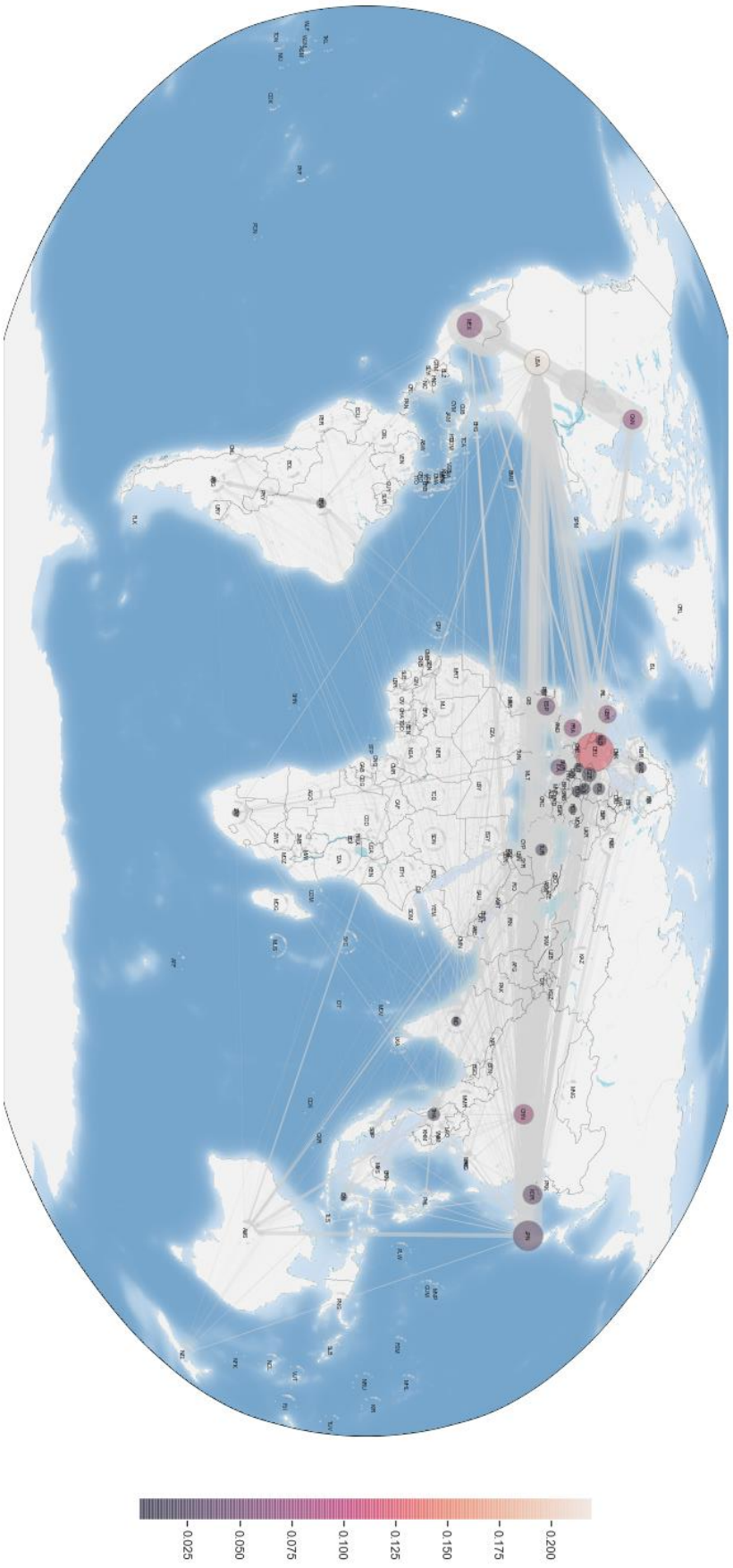
Annex VI:

WORLD RANKING OF MANUFACTURERS

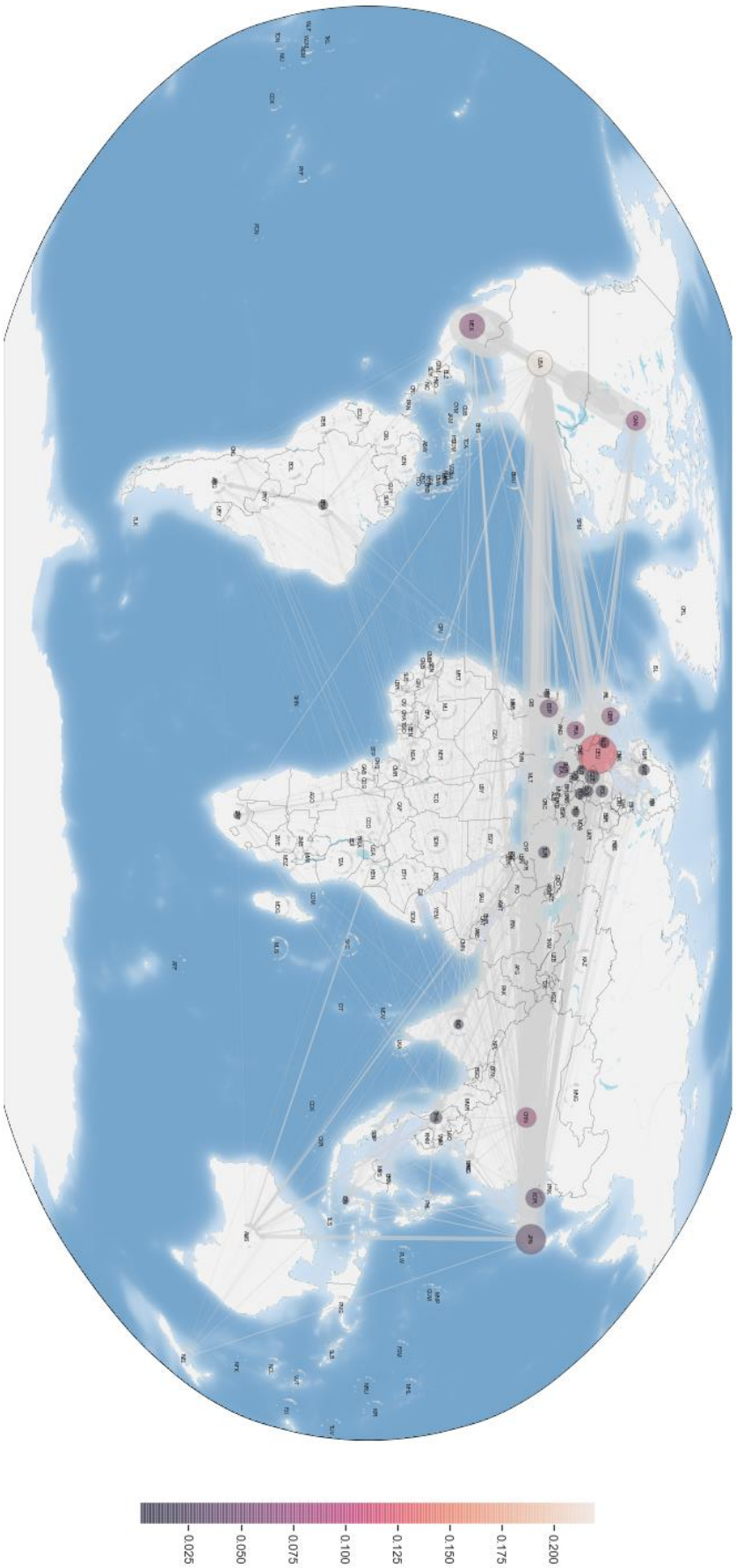
Rang	GROUP	Year 2016 SUM	Year 2017 SUM
	Total	**94 020 883**	**96 922 080**
1	TOYOTA	10 213 486	10 466 051
2	VOLKSWAGEN	10 126 281	10 382 334
3	HYUNDAI	7 889 538	7 218 391
4	G.M.	6 971 710	6 856 880
5	FORD	6 457 773	6 386 818
6	NISSAN	5 556 241	5 769 277
7	HONDA	4 999 266	5 236 842
8	FIAT	4 681 457	4 600 847
9	RENAULT	3 373 278	4 153 589
10	PSA	3 152 787	3 649 742
11	SUZUKI	2 945 295	3 302 336
12	SAIC	2 564 786	2 866 913
13	DAIMLER AG	2 526 450	2 549 142
14	B.M.W.	2 359 756	2 505 741
15	GEELY	1 266 456	1 950 382
16	CHANGAN	1 715 871	1 616 457
17	MAZDA	1 586 013	1 607 602
18	DONGFENG MOTOR	1 315 490	1 450 999
19	BAIC	1 343 682	1 254 483
20	MITSUBISHI	1 091 500	1 210 263
21	SUBARU	1 024 604	1 073 057
22	GREAT WALL	1 094 360	1 041 025
23	TATA	925 205	932 387
24	IRAN KHODRO	636 000	710 869
25	SAIPA	531 000	648 324
26	MAHINDRA	605 376	612 595
27	ISUZU	654 480	612 421
28	CHERY	631 454	605 331
29	FAW	557 174	592 688
30	GAC	384 937	513 870
31	ANHUI JAC AUTOMOTIVE	651 291	493 199
32	BYD	510 572	421 590
33	BRILLIANCE	464 210	362 166
34	HUNAN JIANGNAN	335 585	315 363
35	CHINA NATIONAL HEAVY DUTY TRUCK	199 941	296 594
36	CHONGQING LIFAN MOTOR CO.	278 389	214 145
37	SHANNXI	116 034	189 066
38	ASHOK LEYLAND	145 434	160 208
39	SOUTH EAST (FUJIAN)	114 515	159 473
40	PACCAR	139 605	153 405

Figure 18 - World ranking of manufacturers (International-Organization-of-Motor-Vehicle-Manufacturers, 2018)

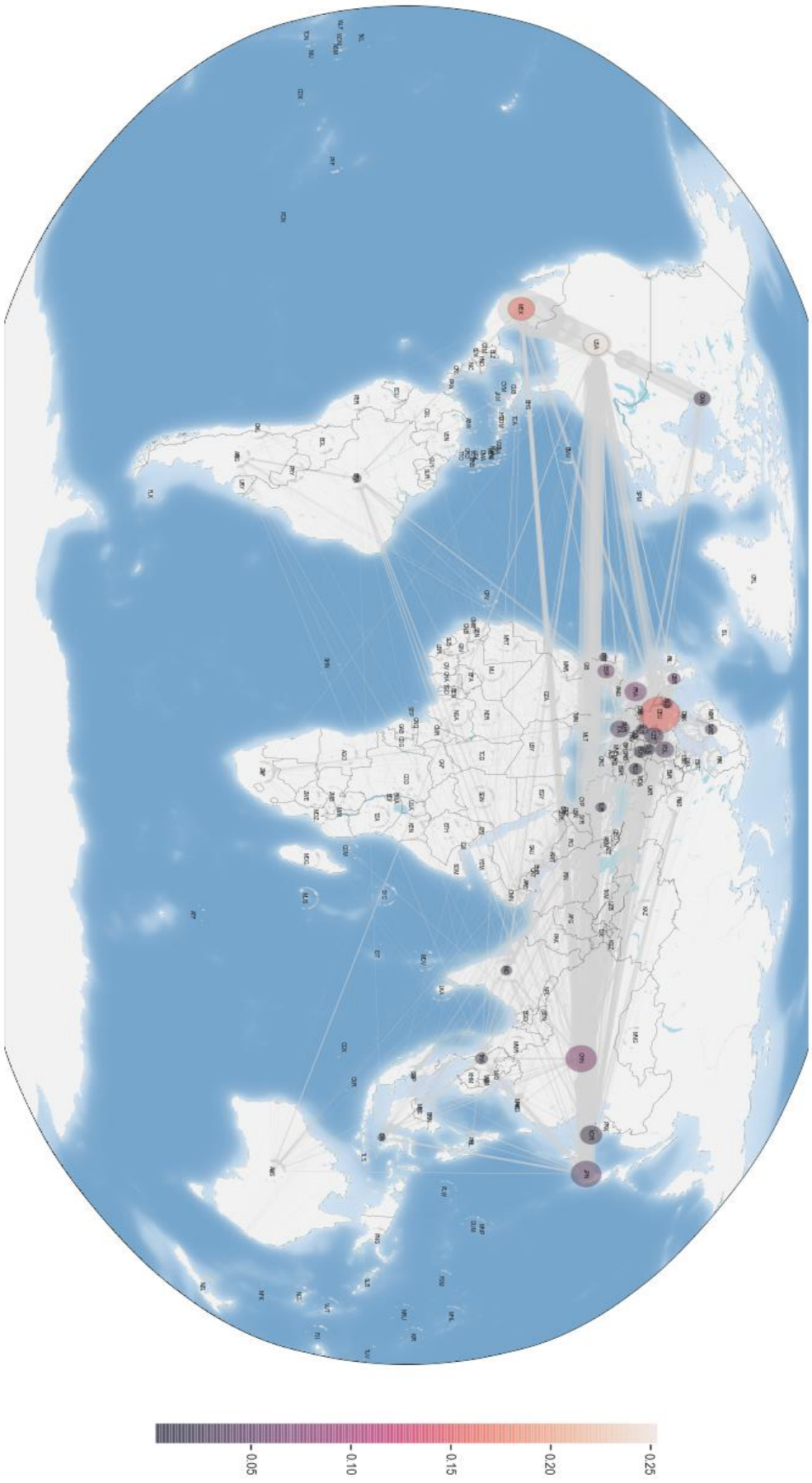
Annex VII: Automotive trades, total goods



Annex VIII: automotive sector world trades, finished goods.



Annex IX: automotive sector world trades, intermediate goods. `



Annex X:

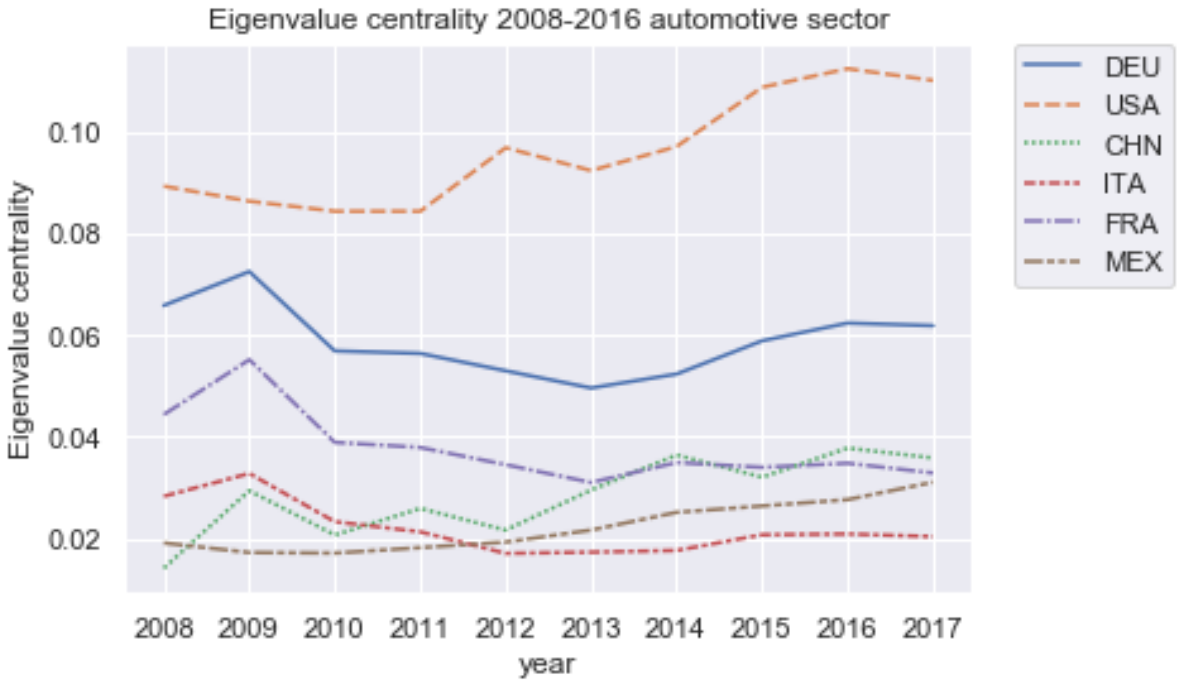


Figure 19 - centrality over times in the automotive sector

Annex XI:

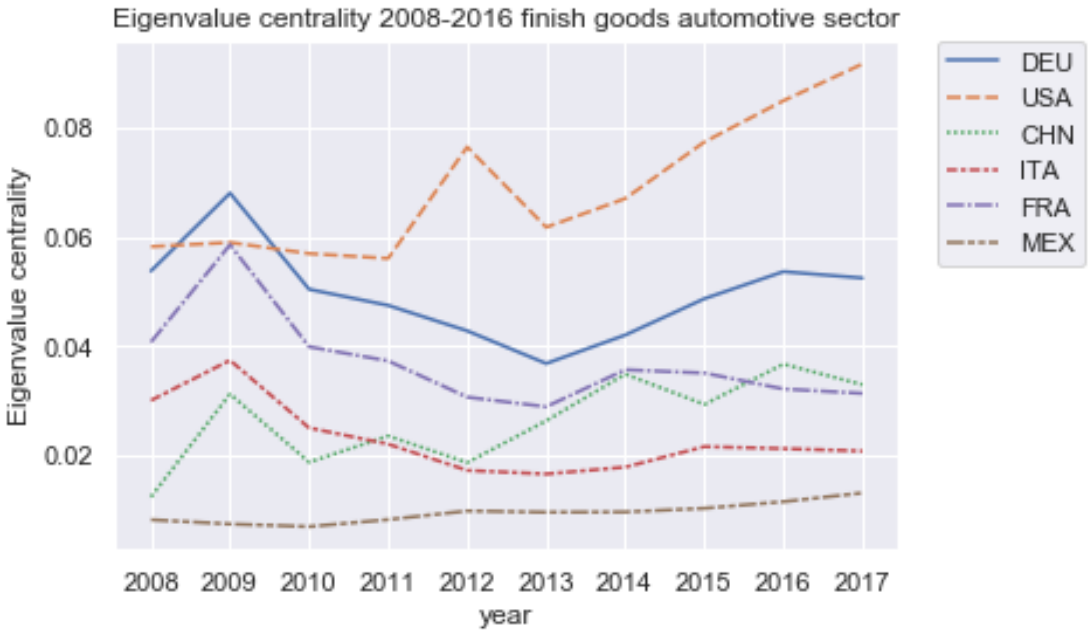


Figure 20 - centrality overtime of the finish goods in the automotive sector

Annex XII:

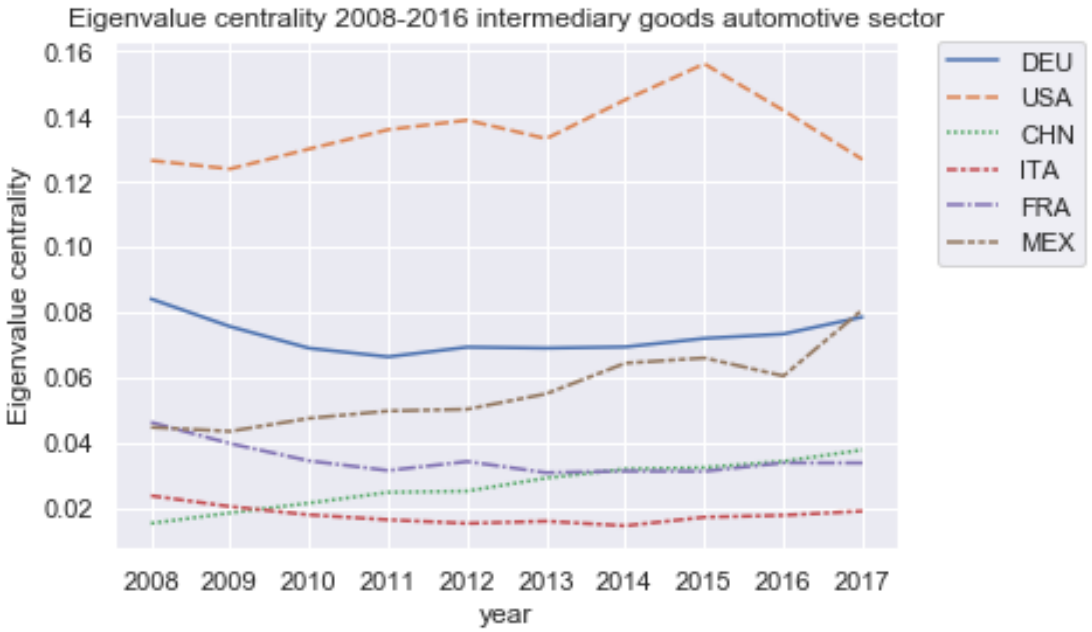


Figure 21 - centrality overtime of the intermediate goods in the automotive sector

Annex XIII:

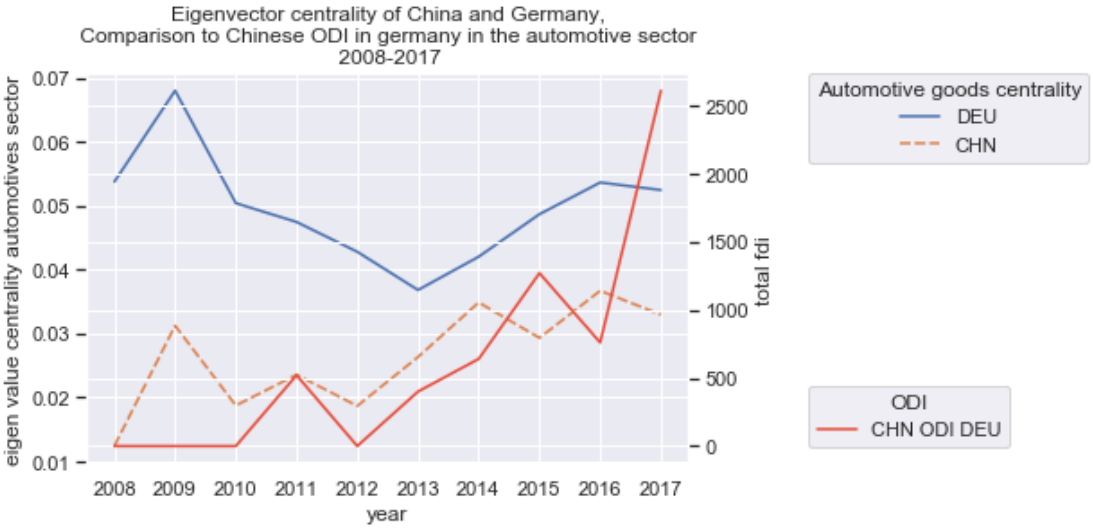


Figure 22 - Eigenvector centrality of China and Germany, Comparison to Chinese ODI in Germany in the automotive sector 2008-2017

XIV:

Figure 23 - Eigenvector centrality of China and Germany, Comparison to Chinese odi aquisition in germany in the automotive sector

Annex XV:

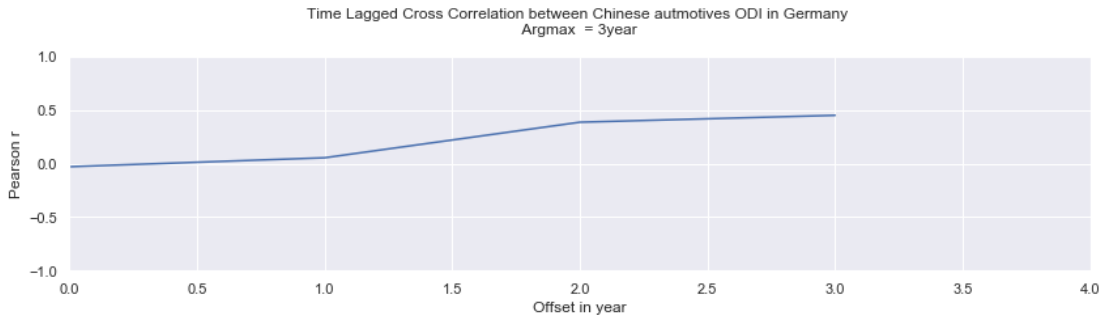


Figure 24 - Time lagged cross-correlation between Chinese automotive ODI in Germany and eigenvalue centrality in the GTN

Annex XVI:

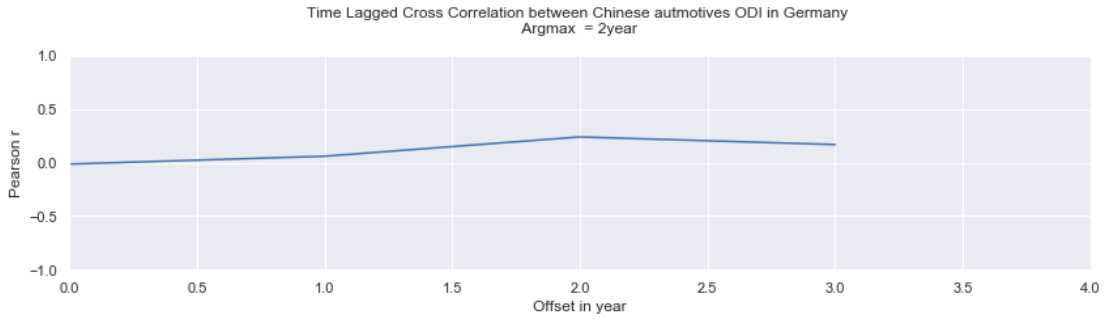


Figure 25 - Time lagged cross-correlation between Chinese automotive aquisition in Germany and eigenvalue centrality in the GTN

Annex XVII:

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
USA	0.089262	0.086312	0.084334	0.084328	0.096815	0.092316	0.097056	0.108696	0.112351	0.110042
DEU	0.065810	0.072479	0.056882	0.056391	0.052974	0.049597	0.052338	0.058875	0.062359	0.061849
CAN	0.039204	0.038137	0.037917	0.034853	0.036508	0.036417	0.038400	0.042695	0.045925	0.036665
CHN	0.014187	0.029410	0.020702	0.025927	0.021668	0.029549	0.036426	0.032064	0.037793	0.035844
FRA	0.044379	0.055162	0.038914	0.037908	0.034527	0.031025	0.034942	0.034005	0.034810	0.032899
MEX	0.019148	0.017260	0.017145	0.018220	0.019314	0.021676	0.025159	0.026412	0.027658	0.031089
GBR	0.032995	0.033499	0.028242	0.027597	0.024185	0.027919	0.028316	0.033440	0.036580	0.029788
ITA	0.028316	0.032799	0.023322	0.021335	0.017090	0.017333	0.017666	0.020756	0.020911	0.020394
ESP	0.023347	0.024961	0.022074	0.015564	0.011932	0.011799	0.015062	0.017797	0.019069	0.019838
GHA	0.001290	0.001547	0.013905	0.007738	0.009134	0.006558	0.002324	0.001868	0.009661	0.017129
AUS	0.012429	0.011427	0.011591	0.012485	0.016824	0.017916	0.014415	0.016957	0.015814	0.016951
KOR	0.004127	0.005240	0.004599	0.005983	0.009423	0.006839	0.006411	0.007799	0.010140	0.016253
JPN	0.015480	0.012615	0.013885	0.012732	0.012909	0.011079	0.012059	0.012192	0.013944	0.015233
RUS	0.052255	0.015008	0.020928	0.027772	0.037164	0.035381	0.025644	0.012226	0.013875	0.015198
CMR	0.001257	0.001258	0.002800	0.001500	0.001987	0.001482	0.003489	0.005918	0.001780	0.015053
NLD	0.011901	0.011670	0.011332	0.010367	0.010415	0.009341	0.010504	0.011976	0.016330	0.012607
BRA	0.008422	0.012131	0.015532	0.017632	0.016118	0.022996	0.014585	0.013605	0.011502	0.012434
POL	0.011070	0.010828	0.009691	0.008417	0.009212	0.008124	0.008306	0.008630	0.010855	0.010705
SDN	0.009184	0.010291	0.012027	0.010122	0.008602	0.001907	0.003774	0.009308	0.003244	0.010583
CHL	0.004027	0.005528	0.005257	0.006891	0.007288	0.007532	0.005235	0.010859	0.008690	0.010513

Figure 26 - Eigenvalue centrality in the total automotive sector 2008-2017

Annex XVIII:

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
USA	0.126535	0.123934	0.130064	0.135997	0.138911	0.133235	0.145176	0.156209	0.141908	0.126853
MEX	0.044592	0.043357	0.047339	0.049606	0.050131	0.054880	0.064280	0.065882	0.060348	0.080698
DEU	0.084030	0.075538	0.068880	0.066229	0.069205	0.068905	0.069270	0.071888	0.073247	0.078466
CHN	0.015074	0.018297	0.021314	0.024605	0.024994	0.028998	0.031750	0.032223	0.034121	0.037630
FRA	0.046110	0.039601	0.034292	0.031311	0.034073	0.030638	0.031123	0.031072	0.033663	0.033634
GBR	0.035652	0.031586	0.027014	0.025001	0.026294	0.023652	0.027768	0.029967	0.034663	0.030878
ESP	0.026679	0.025080	0.022783	0.019649	0.018553	0.018821	0.021917	0.022608	0.024731	0.029376
RUS	0.027873	0.017750	0.022402	0.033844	0.030883	0.033580	0.022267	0.014790	0.019466	0.025895
JPN	0.018686	0.013977	0.014175	0.014427	0.014546	0.013389	0.013754	0.012904	0.013954	0.020610
BRA	0.014700	0.017382	0.021526	0.022681	0.023683	0.031374	0.022841	0.017953	0.017364	0.018874
ITA	0.023571	0.020248	0.017706	0.016184	0.015073	0.015750	0.014338	0.016981	0.017565	0.018848
NLD	0.014488	0.009841	0.010080	0.009940	0.012218	0.011175	0.012285	0.014137	0.015744	0.016274
POL	0.014391	0.013139	0.012314	0.011744	0.011427	0.010933	0.011080	0.011896	0.014091	0.014988
CZE	0.011058	0.012553	0.011430	0.011644	0.010884	0.012605	0.011209	0.011573	0.014405	0.014642
ARG	0.007953	0.010307	0.014366	0.015228	0.015395	0.020172	0.014016	0.011638	0.010560	0.012356
ZAF	0.008604	0.008843	0.007511	0.007774	0.007882	0.008675	0.010687	0.006734	0.008006	0.012274
SWE	0.016610	0.011833	0.013319	0.014495	0.012084	0.010813	0.010230	0.011396	0.012289	0.012212
TUR	0.015960	0.011751	0.010659	0.012047	0.012149	0.009406	0.011299	0.010555	0.011183	0.011265
AUS	0.008196	0.009706	0.009994	0.009462	0.012364	0.011496	0.011403	0.012938	0.012652	0.010693
SVK	0.009404	0.009080	0.009647	0.008102	0.008359	0.009248	0.007804	0.010851	0.010686	0.010609

Figure 27 - Eigenvalue centrality in the intermediate goods automotive sector 2008-2017

Annex XIX:

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
USA	0.058172	0.058929	0.056901	0.056015	0.076388	0.061711	0.066977	0.077314	0.084859	0.091589
DEU	0.053720	0.067967	0.050367	0.047427	0.042765	0.036787	0.041999	0.048643	0.053600	0.052425
CAN	0.024348	0.025967	0.025142	0.022477	0.028245	0.023983	0.026187	0.030871	0.034367	0.038299
CHN	0.012384	0.031206	0.018721	0.023534	0.018656	0.026310	0.034843	0.029299	0.036673	0.032925
FRA	0.040704	0.058507	0.039854	0.037266	0.030636	0.028880	0.035645	0.035043	0.032130	0.031321
GBR	0.032117	0.033032	0.030039	0.028734	0.024875	0.029341	0.028645	0.034447	0.037326	0.031057
GHA	0.001403	0.001737	0.025015	0.010557	0.008880	0.008247	0.002817	0.002039	0.012657	0.023501
KOR	0.003093	0.004766	0.003696	0.003998	0.012580	0.005779	0.005760	0.007537	0.010588	0.022225
CMR	0.001389	0.001460	0.004281	0.002031	0.002365	0.001931	0.004259	0.008426	0.002461	0.021943
ITA	0.030033	0.037374	0.025005	0.022044	0.017237	0.016573	0.017829	0.021579	0.021220	0.020772
AUS	0.014215	0.011737	0.013005	0.014338	0.017957	0.018528	0.014835	0.015318	0.013803	0.017231
ESP	0.022996	0.024622	0.021918	0.012756	0.009905	0.009393	0.012576	0.016521	0.015634	0.015627
SDN	0.011010	0.011464	0.010857	0.010187	0.008771	0.002261	0.004456	0.011706	0.003766	0.014714
SEN	0.002326	0.003331	0.003915	0.012879	0.005406	0.006603	0.004801	0.007018	0.006168	0.014418
NLD	0.011671	0.012836	0.012422	0.011246	0.010599	0.009635	0.011371	0.011953	0.020453	0.013288
CHL	0.003975	0.007928	0.005457	0.007492	0.007780	0.009638	0.005495	0.018357	0.012527	0.013250
MEX	0.008201	0.007423	0.006949	0.008233	0.009816	0.009585	0.009630	0.010295	0.011508	0.013105
RUS	0.058384	0.014751	0.019706	0.025531	0.039027	0.033079	0.023613	0.010275	0.012103	0.012445
MMR	0.000876	0.001363	0.002036	0.001875	0.001535	0.001846	0.002245	0.002060	0.005993	0.011276
SAU	0.019787	0.016593	0.014906	0.017040	0.019182	0.018100	0.022314	0.029080	0.019834	0.010752

Figure 28 - Eigenvalue centrality in the finished goods automotive sector 2008-2017

Annex XX:

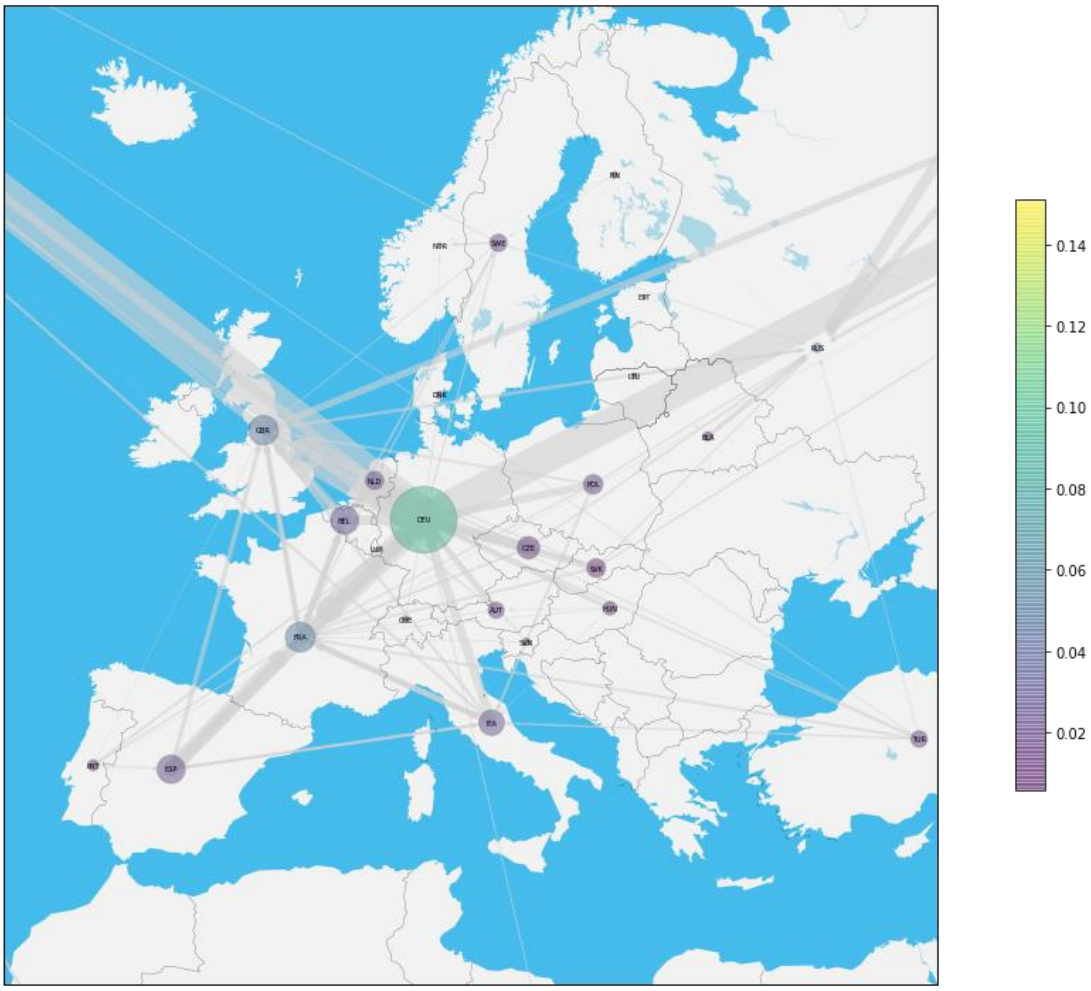


Figure 29 - 2012 GTN automotive sector with a thresholds on countries representin a least 0.05% of global trade and threshold on bilateral trade, representing at least 5% of country export, zoom in Europe