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# INDUSTRY 4.0 AND THE CHANGING TOPOGRAPHY OF GLOBAL VALUE CHAINS

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# Industry 4.0 and the changing topography of global value chains

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## Abstract

The paper explores how new digital production technologies, also known as Industrial Internet, or Industry 4.0 (I4.0), could shape global value chains (GVCs). We argue that Industry 4.0 is one of the drivers of backshoring, i.e. the movement of production back to home countries. I4.0 offers firms some of the flexibility that was lost in complex production chains, and higher productivity and quality to neutralize the labour cost advantages of offshoring locations. We test this hypothesis using firm-level data and find corroborating evidence for it. Moreover, evidence from case studies of firms in the Basque Country indicates a positive relationship between investments in digital production technologies and backshoring.

**Keywords**

Backshoring, global value chains, digitalization.

# 1 Introduction

The paper aims to explore the intersection of two topics that have garnered some attention in industrial policy over the last years: first, the diffusion of new production technologies, also known as Industrial Internet, or Industry 4.0 (I4.0). The goal of I4.0 is to achieve a highly productive and at the same time, highly flexible manufacturing process. Second, we focus on the stagnation of global value chains (GVCs) and the backshoring of production. An increasing number of case studies from various countries document that firms are moving production from Asia and other emerging economies back to the U.S. and Europe.

We argue that I4.0 is one of the drivers of backshoring. It offers firms some of the flexibility that was lost in complex production chains, and higher productivity and product quality to neutralize the labour cost advantages of offshoring locations. We test this hypothesis using data from the European Manufacturing Survey, a large-scale study of manufacturing firms, and find evidence corroborating it in case studies of firms in the Basque Country.

# 2 Recent literature

In the following section, we develop the paper's main line of reasoning based on recent literature. In particular, we look at GVCs, off- and backshoring, and what explains the various motives and drivers for backshoring. We also review the literature on the relationship between I4.0, GVCs and backshoring.

## 2.1 The growth of global value chains

One of the most important developments in world trade over the last 40 years has been the fragmentation of once purely national value chains and the development of GVCs (Timmer et al., 2014; Baldwin, 2016). Firms offshored various stages of production to locations abroad to benefit from differences in factor cost, most important in labour costs, and other locational advantages. This development led to the emergence of GVCs. International expansion first took place in Europe and in the U.S.; after 2000, the attention of multinational firms began to turn to Asian markets. In 2017, inflows of foreign direct investment (FDI) to Asia were already higher than FDI inflows to the U.S. and the European Union (EU) (UNCTAD, 2018).

International business theory explains why firms expand their operations to foreign markets. Dunning's eclectic paradigm (Dunning, 1981, 1988, 2001) describes the international expansion as the result of ownership, location and internalization advantages (OLI advantages). Enterprises will prefer foreign own production over other modes of international exploitation of firm-specific assets such as exporting or licensing when three conditions are met:

- Ownership advantage: The asset must provide the MNE with some advantages over incumbent competitors in foreign markets allowing the firm to enter the market.
- Location advantage: Foreign production must offer advantages over a concentration of production in the home country, in particular factor cost differences between various locations, which open an opportunity for labour arbitrage.
- Internalization advantage: Enterprises must gain an advantage from exploiting the asset internally as compared to exporting or licensing another firm. This may reflect the transferability and some public good characteristics of their assets, principal-agent problems or other forms of asymmetric information that can be avoided by internalization.

GVCs grew fast between 1990 and the onset of the global financial crisis of 2008/09; their growth has recently come to a halt (Timmer et al., 2016; UNCTAD, 2018). Market saturation and a lack of promising opportunities have played their part in this development; however, some studies also indicate that firms are actively moving back production and other activities to their home countries, a strategy known as 'backshoring' or 'reshoring' (Ellram et al., 2013; Gray et al., 2013; Fratocchi et al., 2016).

## 2.2 Backshoring

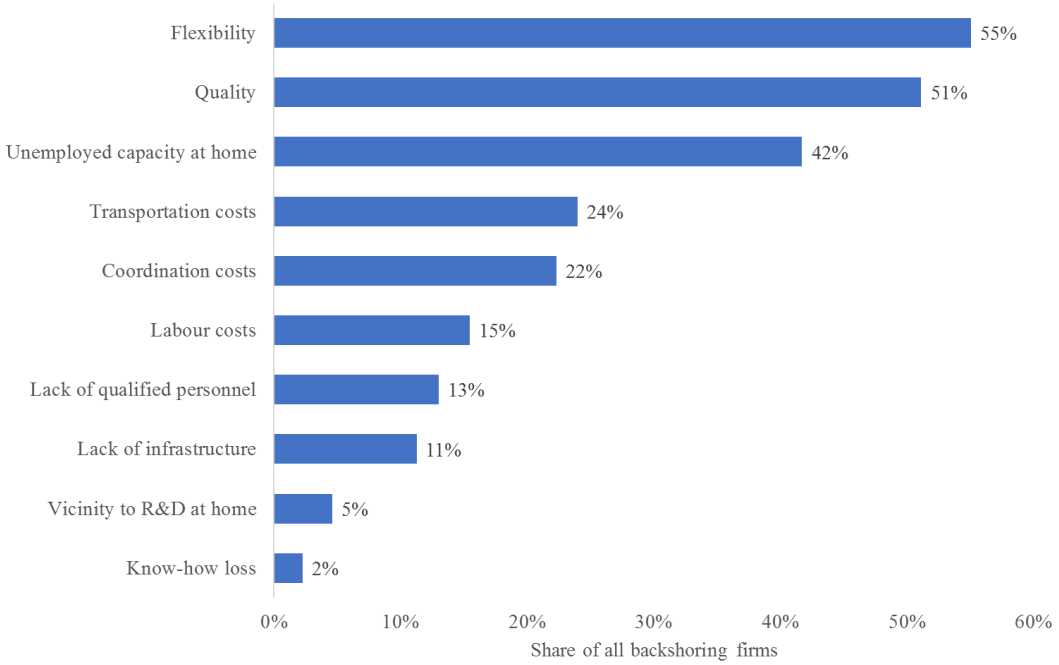
Backshoring grabbed the attention of practitioners and policymakers first; in the last 10 years, it has also become a topic of interest for academic research in international business (Stentoft et al., 2016; Barbieri et al., 2018) and international economics. There is no explicit theory on backshoring; within the framework of Dunning's eclectic paradigm, backshoring can be interpreted as the revision of a previous offshoring and internationalization decision (Ellram et al., 2013; Gray et al., 2013; Förstl et al., 2016). Thus, backshoring decisions are the result of changes in the ownership, internalization or location factors described above, or the result of an incorrect assessment of these factors in the internationalization process. Baldwin and Venables (2013) point out that offshoring is a discontinuous process, and produces a systematic tendency to 'overshoot', followed by subsequent reshoring. In their aim to cut costs, firms have built supplier networks that are too complex and decreasingly tolerant of delays. Backshoring can be seen as a correction of overshooting offshoring decisions, which may be an explanation for the stagnation of the growth of GVCs. A low quality of goods produced abroad, for example, is one frequent motive for backshoring (see below).

In the OLI framework, this means that the firm was not able to utilize its ownership and internalization advantages – how its products and technologies compare with those of other firms and how well the firm is able to turn this advantage into economic benefits at the foreign location. It may also be that the firm did not correctly assess the full costs of production at the given location. For example, excessively high coordination costs as the reason for backshoring indicates that the firm underestimated the transaction, holdup and monitoring costs of a wholly-owned subsidiary against other entry modes such as exports, licensing or a joint venture.

The issue has been raised in the literature whether backshoring should be considered as the correction of a failure in the preceding offshoring decision, or as a managerial adjustment to changing external and internal conditions. The literature seems to endorse the latter view (Di Mauro et al., 2018). Baldwin and Venables (2013) speak of 'snakes', value chains in which the sequence of production steps is determined by technological constraints and the costs associated with a fragmentation of these production steps. They see an 'overshooting' of offshoring, which is followed by corrections of offshoring decisions.

The literature also addresses the motives for backshoring (Foerstl et al., 2016; Wiesmann et al., 2017; Di Mauro et al., 2018). In a recent survey of the literature, Di Mauro et al. (2018) find a diverse mix of motives (42 in total!), relating to the internal as well as external environment of the firm, and to cost efficiency as well as to consumer orientation, but with no information about what the most frequent reasons are. The European Manufacturing Survey (EMS) provides a ranking of these motives (see Figure 1). Accordingly, the lack of flexibility and product quality are the most frequent reasons, both of which are the cause of about half of all backshoring decisions. Within the OLI framework, flexibility and quality can be explained as erroneous assessments of internalization and ownership advantages and the costs of putting these advantages into practice in foreign locations. Unused capacity utilization at home, by contrast, only plays a minor role with regard to location advantages and can mainly be explained by the sluggish recovery from the crisis of 2008/09 and 2011 in Europe.

**Figure 1: Reasons for the backshoring of production activities, 2013 – mid-2015**




*Source*: EMS, 2015. Note: Multiple answers allowed;

It is also surprising that a loss of know-how and weak linkages between foreign production and R&D at home are only relevant for a minority of backshoring firms. The separation of production and R&D—identified by Pisano and Shih (2012) and others as one of the reasons for long-term losses of innovative capacity in offshoring firms—is only considered a relevant problem by a small minority of backshoring firms surveyed in the EMS.

Based on the survey of Di Mauro et al. (2018), we can add three more important reasons for backshoring to this ranking. The first is the 'Made-in' effect: customers value the production of various goods in a particular European country as a sign of quality. Examples are Italy and France for fashion, Germany for machinery, etc. Another factor are trade barriers such as customs for re-imports and exchange rate fluctuations, which become more important with rising complexity and an increasing number of countries involved in GVCs. Third, Di Mauro et al. also identify closing gaps in labour costs and increased productivity at home as reasons for backshoring, which are not directly addressed in the EMS.

When considering motives for backshoring, we also have to look at the basic distinction between market-seeking and efficiency-seeking offshoring. The models of Baldwin and Venables (2013) or Hums et al. (2012) only implicitly refer to efficiency-seeking offshoring. In practice, however, many decisions on international expansion may be driven by a mix of the two motives. For

market-seeking offshoring, which serves clients in the host country, changes in factor cost differences may be a less important motive for backshoring than for efficiency-seeking offshoring.

## 2.3 Information and communication technologies

Another main driver of growth of GVCs, besides market opening and factor cost differences, are new technologies. New technologies and multinational firms have an intimate relationship: multinational firms are responsible for a large amount of business R&D activities worldwide and shape countries' competitive advantages to a considerable degree; ownership advantages from innovation are often the reason why firms become multinational. In the past, the telegraph, the steamboat, railways or container shipping accelerated communications, radically reduced transport costs and resulted in a multiplication of world trade (Baldwin and Martin, 1999). Today, the technological basis for the growth of GVCs are information and communication technologies (ICTs).

ICTs allow the coordination of production and flows of goods within companies and between suppliers and customers in real time. This makes it easier for management to monitor, control and coordinate the activities of subsidiaries and suppliers abroad (Alcácer et al., 2016). The ability to "orchestrate" and link knowledge and production globally becomes crucial for the competitiveness of MNEs (Dunning and Lundan, 2008). Thus, ICTs can increase the geographical scope of firms and reduce their transaction costs – the costs of entering, fulfilling and enforcing contracts. Transaction costs explain why some transactions are organized within firms, while others are performed at markets, and low transaction costs can boost economic growth.

Hence, the international division of labour increases at different stages of the value chain (Timmer et al., 2014). Today, it seems that a new step in the evolution of ICTs is taking place, based on a variety of digital production technologies (e.g. sensors, actuators, horizontally and vertically integrated production, robots, additive manufacturing), and new tools for production management (e.g. real-time enterprise resource planning and production control, data analytics, applications of artificial intelligence). In the manufacturing context, this development is often labelled as the Fourth Industrial Revolution—following mechanization, electrification and automation—or Industry 4.0. A thorough discussion on I4.0 can be found in the IDR 2020.

## 3 Questions of the paper

This background paper investigates the linkages between I4.0, backshoring, and GVCs in general. As laid out above, the literature generally assumes that ICTs foster fragmentation by reducing the costs of unbundling of production and improving coordination in GVCs. However, I4.0 may have the opposite effect; we assume that I4.0 aims to attain a highly flexible and at the same time highly efficient manufacturing process, which allows for the production of individualized goods under the economic conditions of a mass producer (Lichtblau et al., 2015). This has two implications for GVCs:

- First, increases in productivity and capacity utilization associated with I4.0 make labour arbitrage between high-income countries and offshoring locations less appealing, and thus create an incentive for backshoring. Regaining economies of scale in production in Europe and more proximity to R&D and innovation may offer additional incentives.

- Second, a higher flexibility and quality of the production process enables customized production in small batches at very low marginal cost. This may open new market segments to firms, particularly in developed countries. These new opportunities can only be successfully approached if the customized goods can also be delivered quickly, calling for minimal time between order and delivery. In times of Amazon, no customer is willing to wait for a product order longer than a couple of days.

Both factors may contribute to more backshoring. Thus, this paper explores whether a positive relationship exists between I4.0 and backshoring in manufacturing firms. Moreover, we try to substantiate the existence of such a relationship and to gain further insights into it from a number of case studies involving manufacturing firms in the Basque Country.

The assumption that technology is related to increased backshoring is new to the international business and international economics literature, and only very recent contributions consider this relationship: Laplume et al. (2016) and Strange and Zucchella (2017) discuss how additive manufacturing may lead to more GVCs; De Backer et al. (2018) investigate the impact of robotics on GVCs. There is, however, a lack of empirical evidence. The only exception is a study by the McKinsey Global Institute (2019), which estimates that global goods trade will drop by 10 per cent by 2030 due to artificial intelligence, automation and additive manufacturing.

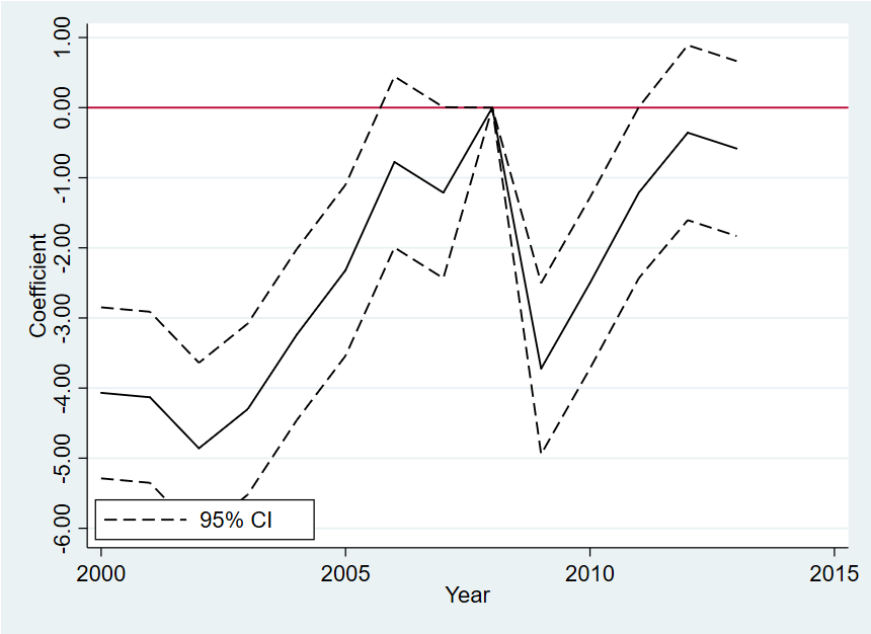
## 4 The development of global value chains: macroeconomic evidence

Backshoring may reduce the imports and exports of goods used as production inputs, if these inputs are moved across borders. Hence, if backshoring has become more widespread, we should find at least some evidence for this development in international trade statistics.

We use data from the OECD Trade in Value-Added (TiVA) database for our analysis. TiVA includes data for 64 economies and 36 industries. Data from national input-output figures is linked to imports and exports at industry level to allow an analysis of change in demand, production structure, etc. across countries. We calculate an indicator of vertical specialization that measures the foreign value-added share in the production of exports, expressed as a share of gross exports. The higher this indicator is, the more foreign value added is needed for the production of exports and, thus, the higher the degree of product fragmentation in GVCs.

To depict the trend of vertical specialization over time, we regress the foreign value-added content as a share of gross exports in manufacturing on time and country dummies. We omit the dummy for the year 2008, so the dummies show the statistical deviation from that base category 2008. Figure 2 depicts the coefficients for the years 2000 to 2014.

**Figure 2: Foreign value-added content in manufacturing exports, regression coefficients and confidence intervals, 2000–2014**

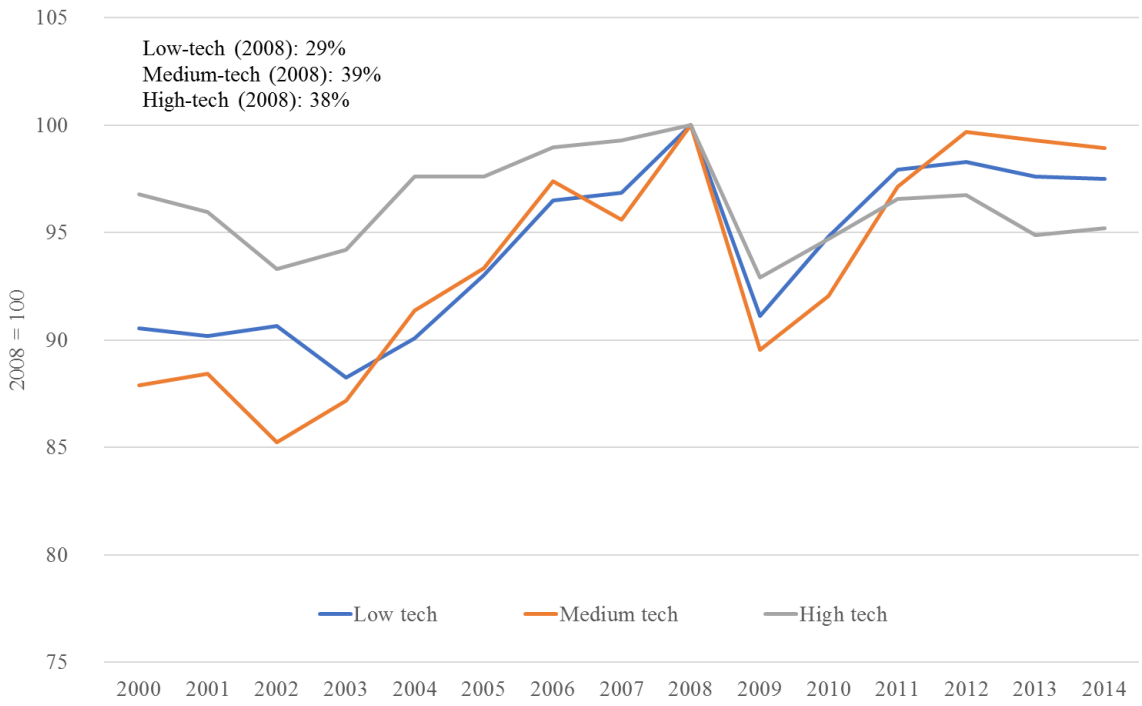



*Source*: Calculated as described above based on the OECD TiVA database and attached nowcasting estimates by the OECD.

The foreign value-added content in exports dropped sharply in 2008/09 and rebounded thereafter. Six years after the crisis, the average foreign value-added content in exports was still below the level of 2008. The confidence interval indicates that we cannot be certain that the level for 2014 is different from the 2008 level.

From a sectoral perspective, fragmentation rebounded more slowly in high-technology industries such as machinery or automotive since the crisis than in medium- and low-technology industries. In Figure 3 we calculate the average foreign value-added content in exports from high-technology, medium-technology and low-technology industries. Medium-technology industries comprise around 58 per cent of total exports, followed by low-technology (27 per cent) and high-technology industries (15 per cent). The values are unweighted averages for 64 countries. For a better comparison, the values have been normalized with 2008=100.

**Figure 3: Foreign value-added content in manufacturing exports for high-technology, medium-technology and low-technology industries, 2000–2014**




Note: Values are unweighted averages across 64 countries in the OECD-TiVA database.
*Source*: OECD TiVA database.

Differences in fragmentation between high-technology, medium-technology and low-technology industries decreased in the years after 2008, because fragmentation decreased in high-technology industries, while low-technology industries were less affected by decreases in fragmentation compared to the other two industries. Differences in foreign value-added content were lower in 2014 than they were in 2000.

One factor that might explain this development is sluggish demand for investment goods relative to non-tradeable services, which has been identified as a main reason for the stagnating imports of goods and services relative to world GDP since the crisis (IMF, 2016). The share of high-technology goods in total exports dropped by 1.5 percentage points between 2008 and 2014. Sluggish demand and unused capacity utilization in the home countries may have detained further fragmentation of value chains. Figure 1 provides some support for this assumption, because unused capacity utilization at home are an important reason for backshoring.

A second important factor is a lower level of fragmentation in Chinese manufacturing (Timmer et al., 2016). China's share in global demand has been growing rapidly; however, the country today requires fewer imports since more and more products are being produced domestically. This is not necessarily a sign for backshoring, because it may also be that foreign firms are substituting exports by producing in China.

The IMF (2016) finds in an analysis of international trade after 2008/09 that the fragmentation of GVCs indeed stopped after 2011. However, this halt was not the decisive factor for the trade slowdown. Timmer et al. (2016) confirm that the fragmentation of international production has stalled since 2011 but claim that this halt plays a larger role for the trade slowdown than asserted by the IMF.

The assumption that I4.0 is related to a stagnation of GVCs implies an increasing use of technology in GVCs, and we therefore looked at the labour share in GVCs for additional evidence. A shrinking labour share may point to a substitution of labour by capital and an increased use of technology. Chen et al. (2018) look at factor incomes in GVCs and find a decreasing labour share for the period 1997–2008, but no change between 2010 and 2014. That is, capital intensity remained stable in the period we are interested in.

For additional evidence, we also looked at foreign affiliates statistics (FATS) administered by Eurostat and data on the activities of multinational enterprises published by the US Bureau of Economic Analysis (BEA). Both data sources collect information on the economic activities of affiliates of domestically owned (EU and U.S.) firms abroad.

The BEA data clearly show no sign of de-globalization (see Table 2); employment in U.S. affiliates abroad has increased overall and in all world regions between 2009 and 2016, as well as between 2011 and 2016. The trend for manufacturing and for all industries is similar. If there was a stagnation in GVCs, it did not affect employment in U.S. affiliates outside the U.S. One explanation might be that the activities that contributed to this growth operated in foreign markets for those particular markets and were only loosely integrated in GVCs.

**Table 1: Employment in U.S. affiliates abroad, 2009–2016, business sector, 1,000 persons**

| Country/ Region | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|
| Canada | 1,099 | 1,102 | 1,135 | 1,193 | 1,176 | 1,290 | 1,267 | 1,321 |
| Europe | 4,747 | 4,598 | 4,726 | 4,701 | 4,684 | 5,212 | 5,249 | 5,312 |
| Latin America, other Western Hemisphere | 2,602 | 2,751 | 2,818 | 2,887 | 2,951 | 3,384 | 3,414 | 3,370 |
| Africa | 228 | 248 | 254 | 287 | 323 | 320 | 329 | 339 |
| Middle East | 129 | 139 | 140 | 144 | 148 | 186 | 178 | 184 |
| Asia and Pacific | 4,224 | 4,657 | 4,681 | 4,871 | 5,026 | 6,010 | 6,202 | 6,215 |
| Total manufacturing, all countries | 5,424 | 5,548 | 5,735 | 5,724 | 5,792 | 6,445 | 6,495 | 6,383 |
| All countries total | 13,029 | 13,496 | 13,753 | 14,084 | 14,308 | 16,401 | 16,639 | 16,739 |

*Source*: Bureau of Economic Analysis

**Table 2: Employment in EU affiliates abroad, 2010–2016, business sector, 1,000 persons**

| Country/Region | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|
| Africa | 1,244 | 1,223 | 1,323 | 1,441 | 1,276 | 1,304 | 1,334 |
| Total America | c | 6,223 | c | 6,738 | 6,477 | 6,180 | 6,232 |
| Canada | c | 376 | 389 | 379 | 339 | 329 | 345 |
| United States | 3,328 | 3,255 | 3,322 | 3,534 | 3,300 | 3,060 | 3,133 |
| Total Asia | 4,187 | 4,187 | c | 4,923 | 4,930 | 4,825 | 4,988 |
| China | 1,244 | 1,616 | 1,770 | 1,755 | 1,806 | 1,734 | 1,798 |
| Japan | c | 187 | 179 | 177 | 177 | 176 | 192 |
| Rep. of Korea | 110 | 111 | c | 91 | 90 | 85 | 85 |
| India | 995 | 886 | 1,081 | 1,139 | 1,136 | 1,180 | 1,258 |
| Total manufacturing, all countries | 5,017 | 5,424 | 5,630 | 5,693 | 5,580 | 5,341 | 5,515 |
| All countries | 13,638 | 13,963 | 15,024 | 15,703 | 14,794 | 14,376 | 14,629 |

Note: Data only includes activities of firms from EU member states outside the European Union. Data for 2010–2012 only; does not include Croatia as an EU member state; c: confidential

*Source*: EUROSTAT FATS Database

Empirical evidence from EUROSTAT for the activities of EU firms outside the European Union is mixed; for the period 2010–2015, we see employment growth in EU affiliates in the U.S. and in North America in general. The development in Asia is divided between growth in China and India, and stagnation or even employment decline in Japan and the Republic of Korea. Overall, EU overseas employment rose between 2010 and 2016, but decreased slight decrease was evident between 2012 and 2016, which would support the assumption of de-globalization. However, we have to be careful with conclusions here, because the decrease may also be the result of disinvestment. For example, the sale of an EU-owned firm in Japan to a U.S. multinational is a financial transaction that does not necessarily lead to lower GVC integration of Japan.

Finally, digitalization also leads to dematerialization, when flows of physical goods are substituted by flows of data. It may be that we do not observe de-globalization, but the trend shows that inputs are becoming increasingly intangible due to digitalization. They are partly visible in the form of services, and partly vanish from trade statistics because they are given away for free such as in the case of many digital services. It is difficult to test this hypothesis with our

data, but nevertheless, it is a feasible assumption given the intangible zero marginal cost-character of many digital goods.

## 5 Firm-level evidence on offshoring and backshoring

We will now move from the macroeconomic level to the firm level. The analysis in this chapter is based on the European Manufacturing Survey (EMS), a cross-European survey of manufacturing firms. EMS focusses on factors such as technical modernization, the introduction of new organizational concepts, international offshoring and backshoring of production and R&D activities, new business models and service innovation. In addition, EMS includes detailed information on innovation input and output, the qualifications of employees, and a number of control variables, such as firm size, exports, the position of the firm in the value chain, or characteristics of the main product and of the production process.

This section uses the 2015 edition of EMS, which covers the years 2013–2015. This data has already been used in another paper on offshoring (Dachs et al., 2017), while EMS data from previous editions has been included in the studies of (Kinkel et al., 2010; Dachs and Zenker, 2014).

The data set includes 2,926 manufacturing firms with at least 20 employees from Germany, Austria, Switzerland, the Netherlands, Spain, Slovenia, Croatia and Serbia. We assume that backshoring requires previous offshoring, so we set all observations with no imports of intermediate goods or no foreign production as missing. This reduces the number of observations to 2,450. Germany and Switzerland account for the largest number of firms in the sample. The results are unweighted.

The data covers two forms of backshoring; first, backshoring of own production activities from abroad; second, backshoring from foreign suppliers. Firms with no imports or no foreign production have been removed from the data. Backshoring from foreign suppliers fits with the de-fragmentation trend we observed in the macroeconomic data, while backshoring of own production activities abroad does not necessarily indicate lower imports of inputs, because foreign production may serve foreign markets as well.

## 5.1 Descriptive statistics of the sample

The data reveals that backshoring is still a rare phenomenon; only 4.3 per cent of all firms in the sample have backshored (105 firms in total). 2.2 per cent of all firms backshored their own production activities, while 1.6 per cent brought back activities from foreign suppliers to the home country.

Offshoring is more frequent: 12.2 per cent of all firms have offshored production activities, 7.6 per cent of all firms have offshored to own firms abroad, while 5.5 per cent of all firms have chosen to offshore to foreign suppliers. Only three firms engaged in both modes of backshoring. For every backshoring firm in the sample, we find three offshoring firms. Surprisingly, a large proportion of backshoring is done by firms that also offshored production activities in the same period (see Table 3 and also Table 4). Thus, backshoring does not mean that firms completely withdraw from abroad; it is rather a strategy that withdraws activities from a particular location, while expanding in another country.

Preliminary data from the Austrian EMS 2018 suggest an upward trend for backshoring and a downward trend for offshoring: 7.1 per cent of all firms have backshored (EMS, 2015: 5.9 per cent), while 10.2 per cent have offshored (EMS, 2015: 16.9 per cent).

**Table 3: Combinations of backshoring and offshoring, 2013-15**

| Group | Total | Share on valid answers |
|---|---|---|
| Total backshoring | 105 | 4.3% |
| Total offshoring | 334 | 12.2% |
| Backshoring and offshoring | 42 | 1.7% |
| Only backshoring | 63 | 2.6% |
| Only offshoring | 283 | 11.6% |
| No backshoring or offshoring | 2,060 | 84.1% |
| Total | 2,448 | 100% |

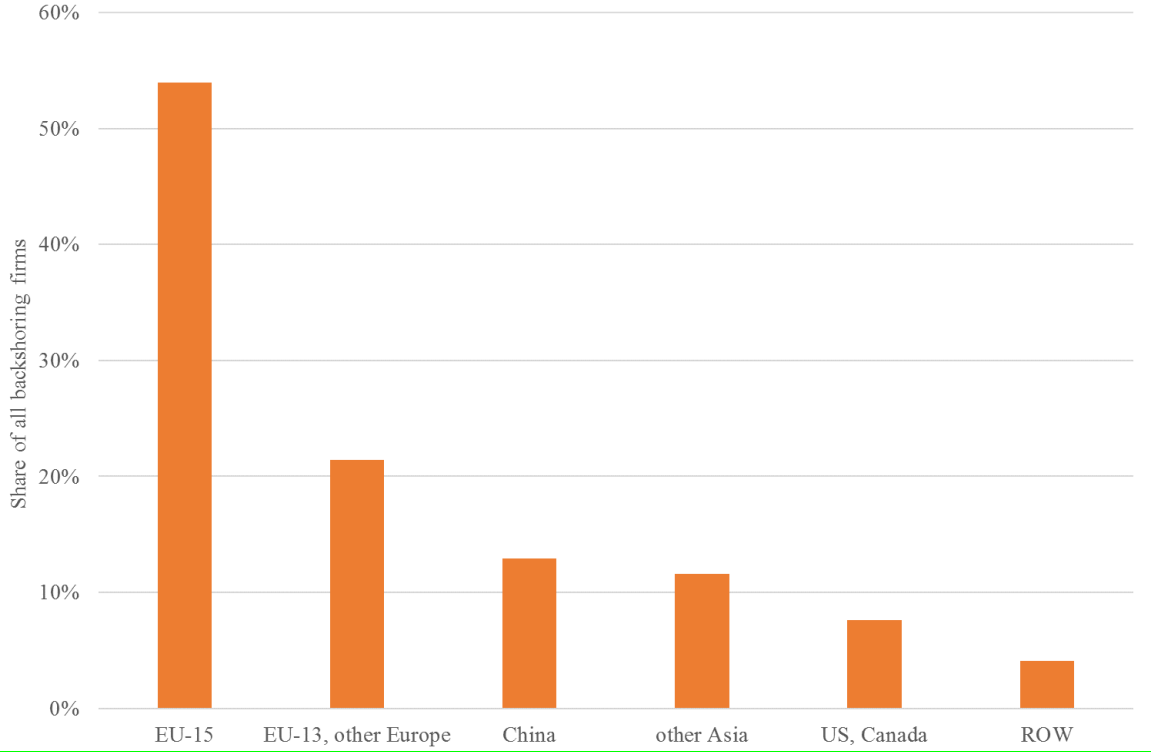
*Source*: EMS, 2015

The share of backshoring and offshoring firms is quite homogenous across countries. We find the highest share of backshoring firms in Austria (5.9 per cent), and the lowest share in Germany (3.5 per cent). The highest shares of offshoring firms are found among Swiss and Dutch firms (18 per cent), while 4 per cent of firms in Slovenia, Croatia and Serbia offshored. More than half of the

backshoring firms have moved back production activities from the EU-15 countries (Figure 4). One quarter of the backshoring activities originate from China and other Asian countries, and around 20 per cent from the EU-13 countries and the rest of Europe. In the last decade, China and other Asian countries as well as the EU-13 countries were the main target countries for production offshoring of European firms. Backshoring from China and other Asian countries has gained momentum compared to the findings of the 2012 EMS survey (Dachs and Zenker, 2014). However, backshoring by European firms still takes place primarily between high-income countries and within Europe. Taken together, emerging economies in Asia, South America and Africa account for about one-fourth of all backshoring.

The question for partner countries in backshoring consists of multiple answers, which also provides some information on multiple backshoring. Seventy-nine firms or around three-quarters of the sample of backshoring companies provided information on partner countries. Sixty-nine firms—the vast majority—have offshored from one country only, six firms from two, and one firm from three countries. Thus, we assume that multiple backshoring is not frequent.

**Figure 4: Share of backshoring firms by various partner countries, 2013–2015**




Note: Multiple answers allowed.

*Source*: EMS, 2015

The data also allow separating the motives for backshoring from emerging economies and comparing them with the motives of firms that backshored from Europe or North America (Figure 5). Sample sizes for this comparison, however, are very small, since only one-fourth of all backshoring firms moved production back from emerging economies to the countries represented in the sample.

The most striking result is that no firms that backshored from an emerging economy reported excessively high labour costs as the reason for this move. However, one-fourth of all firms that backshored from high-income countries did complain about labour costs. This result is a strong indication that the labour cost advantages of emerging economies are still intact.

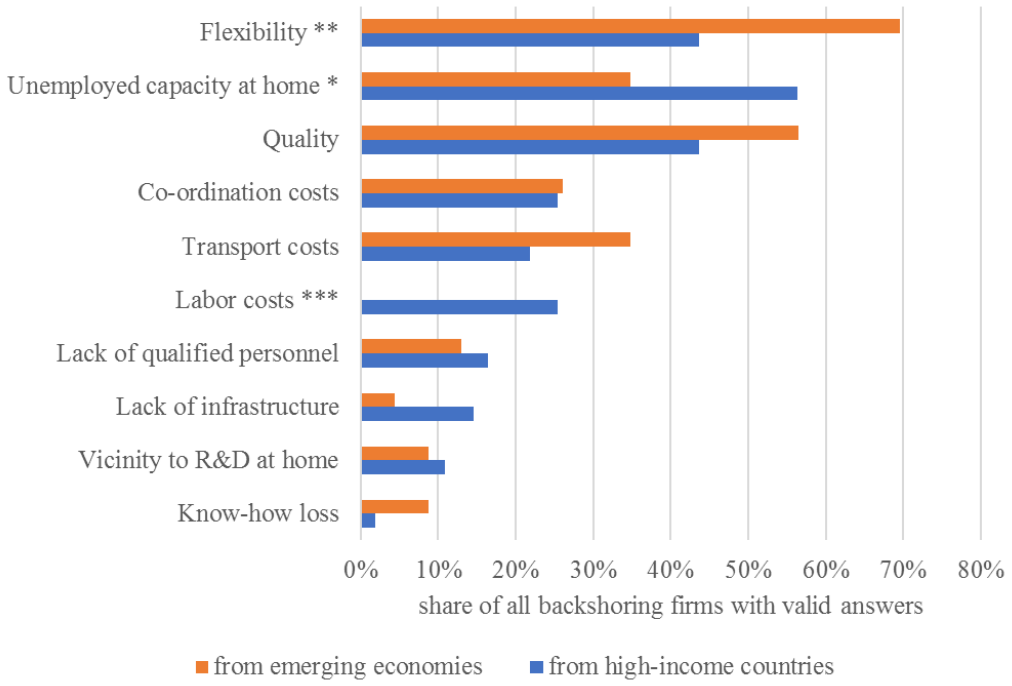
The big challenge for foreign production in emerging economies is the lack of flexibility. A significantly higher share of 70 per cent of all backshoring firms with valid answers report this obstacle in connection with emerging economies, compared to only 44 per cent related to high-income countries and 51 per cent for the entire sample. This confirms an observation from case studies (Di Mauro et al., 2018) that backshoring from geographically distant countries is driven by issues such as lead times, costs and the flexibility of transport and logistics.

Another significant difference is the way backshoring firms perceive unused capacity utilization. This is an issue related primarily to high-income countries, most likely because firms expect higher growth in emerging economies. Transport costs are also more important for backshoring decisions from emerging economies.

Surprisingly, backshoring firms have a better perception of the infrastructure in emerging economies compared to high-income countries. This could be explained by a selection effect. Greenfield investments in emerging economies often take place in locations with well-developed infrastructure as part of a larger package of locational advantages. It could also be that firms that invest in emerging economies have a higher tolerance level because they already ex-ante expect a lower level of service from infrastructure.

There is no significant difference in factors related to knowledge. This is also true for know-how loss, which seems to be a minor problem in both sub-samples despite a higher share among firms that backshored from emerging economies.

**Figure 5: Motives for backshoring from emerging economies and high-income countries, 2013–2015**




Note: Multiple answers allowed. *** p<0.01, ** p<0.05, * p<0.1
*Source*: EMS, 2015.

## 5.2 Firm characteristics of offshoring and backshoring firms

Offshoring and backshoring firms reveal some characteristics that distinguish them from other firms. Table 4 documents some of these characteristics. First, there is strong relationship between off- and backshoring and firm size. Large firms are more likely to offshore and backshore, as the average number of employees in back- and offshoring firms indicates. The propensity to offshore and backshore is highest in firms with over 1,000 employees. Thirty-six per cent of these firms offshored and 10 per cent backshored production activities in the period 2013–2015.

Second, the share of high-technology firms is significantly higher among both backshoring and offshoring firms. The lowest share of offshoring and backshoring firms, by contrast, are found in low-technology industries. The share of low-technology firms among backshoring firms is 15 per cent, compared with 28.4 per cent for non-backshoring firms. This is in line with international business theory, which asserts that firms with valuable intangible assets will try to exploit them in foreign markets. However, innovation activities are one way to develop these assets. Accordingly, we also find a higher share of innovative firms among backshoring and offshoring firms compared to all other firms.

In Table 4 we also used an alternative sectoral classification, namely the technological regime suggested by Marsili and Verspagen (2002). Technological regimes represent an aggregation of industries according to knowledge base and the prevailing mode of production in the industry. The taxonomy distinguishes between five technological regimes: continuous process (food, beverages, textiles, paper, wood, printing, mineral products, basic metals), fundamental process (petrol, chemicals), complex systems (automotive), science-based (pharmaceuticals, electronics) and product-engineering (metal products, machinery, electrical products). In the context of this paper, technological regimes are an interesting alternative to the classification according to technology intensity since we are interested in the relationship of production technologies and economic outcomes.

Table 4 presents T-tests for differences between backshoring and offshoring firms and their counterfactuals for the science-based and the continuous process regime. The share of firms in the science-based regime is significantly higher among offshoring and backshoring firms, which reflects the innovativeness of these industries and the existence of internally transferrable assets in the form of scientific knowledge and innovation practices. The high share of science-based firms among backshoring firms could be explained by the ties lost to the science base of their home countries, which leads to backshoring. Continuous process firms, by contrast, are capital-intensive and produce standardized goods, so offshoring may only offer minor labour cost advantages, which could also explain the lower share among backshoring firms.

**Table 4: Firm characteristics of backshoring and offshoring firms, 2013–15**

| **Firm characteristics** | **Backshoring** | | | **Offshoring** | | |
|---|---|---|---|---|---|---|
| | **No** | **Yes** | **Sig** | **No** | **Yes** | **Sig.** |
| Average number of employees | 180 | 426 | *** | 156 | 371 | *** |
| High-technology industry | 8.6% | 16.2% | *** | 8.2% | 12.3% | ** |
| Low-technology industry | 28.4% | 15.2% | *** | 30.5% | 17.4% | *** |
| Science-based regime | 14.2% | 24.8% | *** | 13.% | 21.6% | *** |
| Continuous process regime | 33.6% | 16.2% | *** | 36.3% | 17.9% | *** |
| Supplier | 29.5% | 19.2% | ** | 26.8% | 35.5% | ** |
| Innovator | 62.2% | 74.3% | ** | 58.7% | 74.7% | *** |
| Exporter | 42.5% | 61.5% | *** | 37.8% | 58.1% | *** |
| Offshoring in the same period | 12.1% | 40% | *** | | | |

*** p<0.01, ** p<0.05, * p<0.1

*Source*: EMS, 2015

Firms that are suppliers to other companies have a higher propensity to offshore, but a lower propensity to backshore. Suppliers have strong incentives to locate close to key customers, so they might follow their customers to locations abroad, which explains the higher propensity to offshore. A lower backshoring propensity, by contrast, can be explained by close ties with customer firms at the foreign location, which often have to be supplied flexibly from a short distance, so that proximity to these foreign customers is advantageous, and provides an additional 'glue' to stay abroad.

Finally, offshoring and backshoring firms also have a higher share of exports in total turnover than other firms. This is another sign of their international orientation, which is related to intangible assets. Exports are an alternative way to exploit these assets, hence it is not surprising that offshoring and backshoring firms also use this form of international expansion. The last line of the table includes the share of backshoring firms that also offshored in the same period. As already mentioned above, there is a considerable share of backshoring firms (40 per cent) that also offshored in the same period, which points to the fact that backshoring is not necessarily a sign of de-globalization and a retraction from all foreign activities, but rather part of a selective locational strategy.

EMS also provides some evidence on firms' main competitive strategies. The questionnaire asks respondents about the importance of six competitive factors (price, quality, innovation, customization, on-time delivery and service offerings) on a six-item scale with a value of 1 for the most important and a value of 6 for the least important factor.

Quality is considered to be the most important competitive factor by both backshoring and non-backshoring firms. The main differences between the two groups lie in customization, which is more important for backshoring firms, and in servitization and innovation, which is regarded as being less important by backshoring firms. However, both factors have low overall assessments compared to price or quality.

**Table 5: Valuation of strategic factors of backshoring and offshoring firms, 2013–15**

| Competitive factor | No backshoring | Backshoring | Sig. |
|---|---|---|---|
| Price | 3.17 | 3.37 | |
| Quality | 1.90 | 2.03 | |
| Innovation | 4.12 | 3.71 | ** |
| Customization | 3.13 | 3.42 | * |
| On-time delivery | 3.28 | 3.38 | |
| Services | 4.58 | 4.25 | ** |

Note: Mean values for answers on a six-item scale, 1 = most important
*Source*: EMS, 2015.

We used the information on competitive factors to extract three competitive strategies of firms following Porter (1985):

- *Cost leadership*, which is strongly correlated (>0.5) with a high importance for price and on-time delivery;
- *Service focus* (or differentiation focus in Porter's terminology), which is strongly correlated with service offerings and on-time delivery;
- *Flexible quality* (or differentiation in Porter's terminology), which is strongly correlated with a high focus on product quality and customization.

We could not identify the fourth strategy described by Porter in the data, namely cost focus.

Table 4 presents the means of the factor loading for each strategy for backshoring and non-backshoring firms, on the one hand, and the offshoring and non-offshoring firms, on the other. A higher factor loading reflects a stronger orientation towards this strategy.

We find that there is no significant difference between backshoring and non-backshoring firms in the price and service focus strategy, only in the flexible quality strategy; this indicates that high product quality and customization are considered to be the most important competitive factors by backshoring firms, more so than price or service offerings. This confirms the finding of Di Mauro et al. (2018, p. 120) that "backshoring reflects a shift from a cost focus to a differentiation focus in the competitive strategy of the firm". This also supports the assumption that I4.0 with its promise of high-quality customized production in small batches at very low marginal costs appeals to backshoring firms because these factors are more important for their competitiveness than the price of servitization.

The strategies are more diverse for offshoring firms. They also employ the flexible quality strategy, but also have a significantly higher service focus and price leadership strategy. This indicates that a broader set of strategic factors drives offshoring, including market-seeking and cost efficiency.

**Table 6: Firm strategies of backshoring and offshoring firms, 2013–15**

| | Backshoring | | | Offshoring | | |
|---|---|---|---|---|---|---|
| **Strategy** | **No** | **Yes** | **Sig** | **No** | **Yes** | **Sig.** |
| Price | 0.010 | 0.111 | | -0.008 | 0.071 | * |
| Service focus | 0.003 | -0.011 | | -0.017 | 0.109 | *** |
| Flexible quality | 0.001 | 0.137 | *** | -0.014 | 0.104 | *** |

*Source*: EMS, 2015.

## 5.3 Measuring Industry 4.0

The main argument of this paper is that backshoring is related to investment decisions in I4.0 technologies. I4.0 does not consist of a single technology, but of a group of technologies united by their aim to increase productivity and flexibility in manufacturing. This group includes software as well as sensors, robotics, logistics and some also include additive manufacturing.

Accordingly, I4.0 is measured using an index that captures the usage of various I4.0 technologies by individual firms. The basis for the calculation of the index is an array of questions in the EMS 2015 which inquire whether the firm has implemented a specific technology. The reference year for implementation is 2014 or earlier. We focus on seven I4.0 technologies that are already available on the market and can thus also be adopted by SMEs (Table 7).

**Table 7: Technologies used to construct an index of I4.0 technologies**

| Technologies |
|---|
| Product-lifecycle-management systems |
| Additive manufacturing |
| Digital exchange of data with suppliers / customers |
| Systems for automation of internal logistics |
| Near real-time production control systems |
| Technologies for safe human-machine interaction |
| Mobile/wireless devices for providing services |

*Source*: EMS, 2015

The use of several I4.0 technologies should result in a higher index value compared to firms that only use one of these technologies. Moreover, a more intensive use of individual technologies should also yield a higher index value.

We created three versions of the index of I4.0 technologies usage (i4index):

- the number of technologies in use;
- the number of technologies in use weighted by the inverse of the relative frequency of firms in the sample that use the technology;
- the number of technologies in use weighted by the intensity the individual firms use the technology. This intensity is measured on a three items scale (low, frequent, intense use).

The three versions of the index revealed a high correlation of 0.92 and 0.95, respectively, so we decided to use the second version of the index which has the advantage of a large number of different values, while there are markedly fewer missing values than in version three.

The computation of the index is illustrated in Table 8. Consider a firm that initially only uses systems for the automation of internal logistics and technologies for safe human-machine interactions. Automated internal logistics is used by 34 per cent of all firms in the sample, while technologies for safe human-machine interaction are only used by 5 per cent of firms. The resulting index value is 1.61. Stronger involvement indicated by a higher index value reveals more intensive use of I4.0 technologies, as more production technologies have been implemented.

**Table 8: Example for the calculation of the I4.0 index**

| **Technology** | **Value** |
|---|---|
| Systems for automation of internal logistics | 1*(1-0.34) |
| Technologies for safe human-machine interaction | +1*(1-0.05) |
| All other technologies not employed | +0*(1-…) |
| Index value | 1.61 |

*Source*: EMS, 2015

Table 9 reports the values of the index for different sectors and firm size classes along with the corresponding shares of offshoring and backshoring firms.

All three variables point into the same direction; the I4.0 index increases with firm size and technology intensity, i.e. the firms in the largest size group and in the most R&D-intensive group also have the highest average I4.0 values. However, the correlation between all three variables is

only modest, between 0.11 and 0.167, which indicates a considerable amount of heterogeneity in the actual use of I4.0 technologies within the size classes and technology groups.

**Table 9: Descriptive statistics for backshoring, offshoring and the Industry 4.0 index**

| Category | Frequency | Mean backshoring | Mean offshoring | Mean i4.0 Index |
|---|---|---|---|---|
| < 50 employees | 1,138 | 2% | 8% | 0.60 |
| 50-249 employees | 1,296 | 5% | 13% | 1.09 |
| 250-999 employees | 338 | 8% | 21% | 1.69 |
| + 1,000 employees | 58 | 10% | 38% | 2.48 |
| High-technology | 252 | 8% | 17% | 1.27 |
| Medium high-technology | 811 | 6% | 20% | 1.09 |
| Medium low-technology | 999 | 3% | 9% | 0.97 |
| Low-technology | 864 | 2% | 7% | 0.76 |

*Source*: EMS, 2015

## 6 Multivariate analysis

To explore this heterogeneity in more detail, we apply a multivariate analysis with a probit model. Table 10 provides an overview of the dependent and independent variables used in the analysis. The dependent variables are offshoring (*off*) in Models (1) and (2), and backshoring (*back*) in Models 3 and 4. *Off* and *back* are dummy variables which are 1 if the firm has offshored/backshored production activities in 2013 or 2014, and 0 otherwise. These can be own production activities or production that has been sub-contracted to an independent supplier.

Independent variables include firm size measured by the logarithm of the number of employees (*lemp*) and logarithm squared (*lemp2*) in two specifications of the regression to account for the non-linear relationship between firm size and off- and backshoring. The I4.0 index (*i4index*) described above is our measure of investments in I4.0 technologies.

We employ two variables to control for international orientation, the share of exports on turnover (*exp*), a dummy that is 1 if the firm has own production activities abroad (*aprod*) and 0 otherwise. Since we also consider backshoring from foreign suppliers, *aprod* is not necessarily 1 for all backshoring firms.

To control for sectoral affiliation, we use the classification of sectors according to their R&D intensity proposed by the OECD. The taxonomy distinguishes between high-technology, medium high-technology, medium low-technology and low-technology. The technology classification also to some degree captures differences in innovation intensity between firms, so we do not include a variable for innovative efforts at firm level.

In addition, we include a dummy variable that is 1 if the firm is a supplier to other firms (*supply*). Many suppliers have followed their industrial customers to offshoring locations and may thus have fewer incentives to return than producers of final products that (also) serve the European market. One dummy variable identifies the firm's home country. The base case are firms from Germany. Finally, we include the three strategic variables from Table 6.

We calculate four different versions of a probit model with marginal effects. In Models 1 and 2, offshoring is the dependent variable, while we use backshoring as the dependent variable in Models 3 and 4.

**Table 10: Definition of variables**

| Variable Label | Definition | Type |
|---|---|---|
| off | Offshoring: the variable is 1 if the firm offshored production activities in 2013 or 2014. and 0 otherwise. | Dummy |
| back | Backshoring: the variable is 1 if the firm backshored production activities in 2013 or 2014, and 0 otherwise. | Dummy |
| Lemp, lemp2 | Logarithm and logarithm squared of the number of employees in 2014 | Metric |
| i4index | I4.0 technologies index described in Section 5.3 | Ordinal |
| exp | Share of exports on turnover of the firm | Metric |
| aprod | Production activities abroad; the variable is 1 if the firm has own production abroad, and 0 otherwise. | Dummy |
| Hitech, mhitech, mlowtech, lowtech | Sectoral variables that describe the industry's R&D intensity. The base case is the low-technology industry (lowtech). | Dummy |
| supp | Position in the value chain; the variable is 1 if the firm is a supplier to other firms, and 0 if the firm produces final products. | Dummy |
| de | Country dummy for Germany (DE) | Dummy |
| Cost, service, flex | Factor loadings for the three strategies introduced in Table 6 | Ordinal |

*Source*: EMS, 2015

The results characterize backshoring firms in one sentence: they are firms in high-technology and medium high-technology industries of different sizes, which are often suppliers to industrial clients, exporters and produce abroad and use I4.0 technologies.

We first look at the coefficient for the I4.0 indicator (*i4index*), which is highly significant and positive. This points to a meaningful relationship between backshoring and the index, and supports our assumption. However, the index is also significant for offshoring, which means that I4.0 does not hold firms back from offshoring. This reflects the market-seeking character of offshoring.

Next, we look at the role of firm size. The close relationship between the I4.0 index and firm size in the descriptive statistics (Table 9) may point to collinearity and biased coefficients. Variance inflation factors do not, however, give any indication of multicollinearity. The regression model reveals that firm size is insignificant for offshoring as well as for backshoring. Hence, other factors explain the relationship we observed in descriptive statistics, including I4.0 usage and the sectoral affiliation. We also ran a specification of the model without the *I4.0 index*, and *lemp* was not significant, so the index does not capture size information. There is also no support for a non-linear relationship between firm size and offshoring or backshoring.

Sectors are relevant in different ways; offshoring is significantly more frequent in medium high-technology industries such as the chemical industry, machinery, electronics industry or transport equipment than in low-technology industries, while high-technology industries only reveal a higher propensity in Model 2). Backshoring, by contrast, indicates a clear association with high-technology industries after controlling for all other factors. This is in line with the finding from input-output data that high-technology industries have been a driver of the stagnation of GVCs since 2011.

**Table 11: Regression results**

| VARIABLES | off (1) | off (2) | back (3) | back (4) |
|---|---|---|---|---|
| i4index | 0.092*** | 0.138*** | 0.119*** | 0.137*** |
| | (0.033) | (0.028) | (0.043) | (0.039) |
| lemp | 0.010 | 0.255 | 0.008 | 0.401 |
| | (0.043) | (0.202) | (0.056) | (0.288) |
| lemp2 | | -0.012 | | -0.032 |
| | | (0.019) | | (0.027) |
| hitech | 0.233 | 0.341** | 0.473** | 0.581*** |
| | (0.155) | (0.136) | (0.203) | (0.193) |
| mhitech | 0.424*** | 0.507*** | 0.256 | 0.333** |
| | (0.117) | (0.101) | (0.171) | (0.160) |
| mlowtech | 0.006 | 0.065 | 0.210 | 0.240 |
| | (0.120) | (0.104) | (0.171) | (0.161) |
| supp | 0.126 | 0.110 | -0.429*** | -0.492*** |
| | (0.090) | (0.078) | (0.139) | (0.133) |
| off | | | 0.377*** | 0.635*** |
| | | | (0.133) | (0.118) |
| aprod | 1.235*** | | 0.626*** | |
| | (0.092) | | (0.130) | |
| exp | 0.002 | 0.005*** | 0.004* | 0.005*** |
| | (0.001) | (0.001) | (0.002) | (0.002) |
| de | -0.159* | -0.150* | -0.045 | 0.004 |
| | (0.087) | (0.077) | (0.124) | (0.117) |
| cost | -0.034 | -0.056 | 0.051 | -0.006 |
| | (0.058) | (0.050) | (0.078) | (0.073) |
| service | 0.096 | 0.084 | -0.190* | -0.236** |
| | (0.077) | (0.068) | (0.106) | (0.100) |
| flex | -0.274*** | -0.333*** | -0.264* | -0.250* |
| | (0.103) | (0.089) | (0.140) | (0.129) |
| Constant | -1.956*** | -2.644*** | -2.477*** | -3.586*** |
| | (0.196) | (0.510) | (0.272) | (0.750) |
| Observations | 2,121 | 2,338 | 1,884 | 2,101 |

*** p<0.01, ** p<0.05, * p<0.1

*Source*: EMS, 2015

Being a supplier significantly reduces the odds for backshoring, but not for offshoring. We explain this by the fact that suppliers to foreign customers may be stuck at the location of their foreign clients abroad; however, we cannot explain why suppliers do not have a higher propensity for offshoring, given that they may have an incentive to follow their clients. Maybe the 'offshoring bandwagon' of industrial producers and their suppliers has slowed down.

The results also show that other internationalization indicators such as foreign production (*aprod*) and exports (*exp*) are highly relevant in explaining offshoring and backshoring. Moreover, we included *off* as an independent variable in Models 3 and 4 to account for the observation that firms often do both, off- and backshoring, in the same period.

Finally, we find a significant negative association between offshoring and the flexible/quality strategy, which means that firms that consider high product quality together with customization to be their competitive strategy have a lower offshoring propensity. There is also a negative association with backshoring (in contrast to the descriptive statistics), but only at the 10 per cent confidence level.

Overall, the differences between offshoring and backshoring firms are small. We only find significant differences in their sectoral affiliation and in their position in the value chain as suppliers to industrial clients. Every second backshoring firm also offshored during the same period. This supports the interpretation of backshoring as a correction of previous offshoring decisions.

## 7 Case studies

Section 7 of the paper presents additional evidence on backshoring from case studies. The aim of the case studies is to better understand the interplay between the competitive advantages of firms, their activities in the offshoring locations and the diffusion of I4.0 technologies. The case studies will substantiate the validity of the results of the empirical analysis, but may also shed light on new aspects of backshoring, for example, the importance of co-location between R&D and production for backshoring.

The case studies are based on face-to-face interviews with firm representatives in the Basque Country between 27 February and 1 March 2019. The interviews included seven firms and three cluster associations. We report on four cases here, but lessons from the other cases will also be part of the cross-case conclusions.

## 7.1 NBI Bearings Europe

***Description of the company***

NBI Bearing Europe is a manufacturer of bearings used in various products of the machinery industry, for example, cranes, pumps, etc. The firm was founded in 2002. Currently, the company employs around 300 workers each in China and in the Basque Country. The firm's strategy for Europe is to produce high-quality products in small batches with a high degree of flexibility and automation. Large multinationals are often not willing to deliver small batches. This customization strategy also includes assistance to clients to select the best bearing for their needs. Ninety per cent of these products are sold in Europe. The market is moving in the direction of faster deliveries. China, by contrast, mostly mass produces.

***Internationalization strategy***

The owner started producing in China in 2006, but moved back home in 2010 due to the crisis. Part of the business was handed over to the Chinese partner. Today, the firm invests more in the Basque Country because the owner does not want to invest without actually being present. The company's long-term goal is to produce in markets where the goods are also sold. Recently, the firm also set up an engineering centre in Bucharest, Romania, and will start mass production in Romania in the near future, because the company has found a strong industrial base there and production may actually be even cheaper than in China. R&D and design will remain in the Basque Country to protect the firm's secrets.

***Location advantages***

The biggest location advantage of Europe is the proximity to customers. Another important factor are the close linkages with universities in the Basque Country. NBI sees three huge advantages for China over Europe; first, the quality of the supply chain – there are thousands of good suppliers, but you 'get what you pay for'. The company had to build up a supply chain in the Basque Country. Second, public decision processes are much faster in China than in Europe; it took only eight months from the initial set-up to production in China. Third, a system of industrial standards for bearings is in place in China, which is more sophisticated than that in Europe, triggering demand for high-quality bearings.

The company expects that the cost differences between China and the EU will level out over the next few years due to automation and advances in production technology, but also due to rising costs in China. This process already started around 2012. Automation has also markedly improved the company's productivity.

***Case study conclusions***

Firms are experiencing shrinking cost differences between the EU and China. Although this was not the reason for NBI Bearings Europe to bring production back from China, the reduction in cost differences might nevertheless be a strong push towards backshoring, if production close to the customer is a prerequisite for providing individual solutions and a large degree of flexibility. This case study provides evidence that automation can lead to backshoring.

## 7.2 Orbea

***Description of the company***

Orbea is the largest bicycle manufacturer in Spain and one of the oldest companies in the country. The firm is located in Mallabia, Basque Country. It is part of the Mondragón Cooperative. The company focusses on higher-value segments of the market and follows a pronounced customization strategy. Around 60 per cent of all bikes are produced (painted and assembled) in accordance with customer specifications, and customization is supported by an online configuration tool. Electric bicycles are a fast-growing product category. Overall, the company offers around 250 models.

Most bicycles are produced in Mallabia with some of the more expensive bikes being made in Portugal. This is an exception in the bicycle business where the majority of brands are marketing brands and have their bikes produced in Asia. Every 4-5 years, Orbea develops a new frame as a platform for various models. Product development is carried out in-house.

***Internationalization strategy***

Internationalization began in 2003/04. The company benefited from increased popularity of professional cycling in the U.S. where Orbea garnered attention with its sponsorship of the pro Team Euskatel. In 2007, Orbea started production in China because of the growth expectations in this market. In 2012, production in China was closed and moved back to Europe. The frames are still sourced from Asia, and the firm also has a logistics base in Hong Kong SAR, China.

The reasons for the backshoring were disappointing demand growth, exchange rate fluctuations and, most importantly, the start of the customization strategy which requires proximity to main markets, which are Europe and the U.S. Moreover, producing in Europe is also a selling point for the company, distinguishing it from competitors.

***Location advantages***

Orbea's customization strategy requires proximity to customers but also to retail trade, since Orbea does not require retailers to hold large inventories and orders far in advance. Orbea's biggest location advantage of Europe is proximity to clients as well as proximity to its retailers. Retailers are important because they provide experiences to customers. Bypassing retailers and selling directly over the internet is not an option for Orbea.

Automation or I4.0 was not relevant for the backshoring decision and is generally not very relevant for the firm, because Orbea mostly produces by hand and the batch sizes are too small for automation. The main application areas for digitalization is in logistics, smart warehousing and marketing, for example, applications of virtual reality.

***Case study conclusions***

The case of Orbea demonstrates that a strategy of flexibility and customization in a market of standardized products requires proximity to customers and retailers. Backshoring helped the firm regain some of the flexibility necessary to manufacture customized products.

## 7.3 Gestamp

***Description of the company***

Gestamp is a manufacturer of car bodies and other metal parts for the automotive industry headquartered in the Basque Country. The company was founded in 1997 and employs 41,000 workers worldwide. Its customers are large car producers all over the world, so the firm serves the same companies in a number of different national markets. The firm's technological core competence is the forming of steel and aluminium parts using different techniques. I4.0 for improving productivity and logistics represents an important technology trend for the company.

***Internationalization strategy***

Globalization is one of the pillars of the company's strategy. Production takes place in the target markets, because the products are large and do not travel easy. Hence, producing in China for Europe is not feasible due to logistics. To compete in the industry, the company has to follow its customers to locations abroad. This is a general feature of the automotive industry: when Tier 1 suppliers move abroad, they often have an invitation and commitment from the client, so the risks of internationalization are lower.

Moreover, it is also important to develop and design close to customers; the company owns 13 engineering and R&D centres worldwide. These centres develop local variants of the global platforms for customers, and test and use local knowledge in these key markets.

***Location advantages***

The most important location advantage abroad is proximity to clients, which is indispensable for the industry the company operates in due to the need for close interaction and short lead-time. The firm's core competences, however, are still being developed in the Basque Country and are rooted in the regional innovation system. This also includes own production facilities for tools and stamping machinery. However, it is becoming increasingly difficult to find skilled staff. Expanding engineering and R&D in the Basque Country and abroad is not a contradiction.

***Case study conclusions***

The interview reveals the dominant role of the customer as a driver of internationalization in the automotive sector. Large automotive producers require their Tier 1 suppliers to be present at their sites abroad, which leads to a domino effect that also forces Tier 2 suppliers to move abroad. This also explains why suppliers have a significantly lower propensity to backshore as our regression analysis demonstrates. The 'glue' is their strong commitment and relationship with industrial clients, which makes backshoring futile to some degree.

## 7.4 Bahco

***Description of the company***

Bahco is a producer of hand tools and part of SNA Europe, which in turn is the affiliate of the U.S. multinational Snap-on Tools. SNA Europe coordinates the European activities of the Snap-on Tools group from the Basque Country. The principal distribution channel are retail distributors, and the company's customers are industrial firms in Europe, excluding the UK. The U.S. parent company has a completely different distribution channel and key markets, and sells directly to garage owners and contractors in the U.S, the UK and Japan.

The key factors for success are innovation and automation, together with lean production. The most important source for new products is the observation of and interaction with end users. Automation of repetitive motions, polishing, etc. to increase productivity and safety in production has been an important strategy at Bahco for the last five years. Flexibility is not a goal of automation at Bahco; flexibility comes from better skilled workers. I4.0 beyond automation is considered an important issue, for example, data caption from machines or the use of marketing data, but so far, the firm has not generated any value from it. Automation and lean production have not reduced the firm's labour force in the Basque Country; on the contrary, it helped increase volumes of production.

***Internationalization strategy***

The company's internationalization is a result of mergers and acquisitions of tool manufacturers across Europe. Today, the group owns a portfolio of tool brands across Europe and produces these in several countries.

Automation has also helped backshore some of the production activities the Snap-on group moved to China ten years ago. Argentina is another example of backshoring. Today, production in the Basque Country can compete with factories of the group located in China in terms of production volume. This is due to automation, lean production and know-how. In addition, automation has also contributed to a much shorter lead-time and helped reduce inventories and consequently, costs.

The interview partner sees a trend for backshoring in other sectors as well. China is becoming more cost-intensive, while manufacturing in Europe is becoming more productive, and the reliability of production in the EU is higher.

***Location advantages***

The interview partner considers the company's production in the Basque Country as cost-efficient as it is in low-cost countries due to automation, experience and lean production. He admits that manufacturing today has only very little in common with what it was ten years ago. However, one bottleneck is the availability of skilled workers, and the company is trying to generate interest in schools, etc. A network of close suppliers is another advantage of their location in the Basque Country, something they cannot find in China. In the opinion of the interview partner, it is generally difficult to find reliable suppliers in China.

***Case study conclusions***

Bahco exemplifies the relationship between backshoring and increases in productivity and flexibility by modern production technologies. Contrary to fears that automation reduces the number of jobs, the firm managed to increase volumes by becoming more cost-efficient. The challenge for the firm is to find new workers, and skills shortage seems to be the most pressing problem. It underpins the observation from other cases that the playing field for European manufacturing seems to more balanced today than it was several years ago.

## 7.5 Lessons across the cases

The interviews revealed some common features across most of the firms. First, the Basque Country's **local economic ecosystem** is an important source of competitiveness for all firms. The firms benefit from this environment by receiving inputs from customers for new product development, intermediate goods from their suppliers, technology developed together with research institutes and universities and skilled personnel trained in the region. Both skilled workers and the local supply chain contribute to a high flexibility of the firms in terms of timely delivery and product customization.

**Internationalization is a must** for all interview partners for several reasons. First, the regional and national market is not large enough to generate sufficient revenues from new products to allow the scale of activities. Hence, as international business theory predicts, firms with valuable intangible assets seek to exploit these assets in international markets, leading to market-seeking internationalization. Second, most of the firms view proximity to key customers as a prerequisite for success. Proximity allows them to respond quickly to new requirements from clients and help them identify technology and market trends. For example, OEMs in the automotive industry expect their suppliers to follow them to foreign markets and support the internationalization of their suppliers. The interviews reveal that information gathered from clients and competitors is an essential input for innovation, even for R&D-intensive firms.

The firms are divided over the **cost advantages** of foreign production (in particular, China) compared with production in the Basque Country. Some of them see a level playing field in terms of production costs between Europe and China or at least a trend in this direction. Costs in China have increased disproportionately while productivity in Europe increased. We got the impression that cost advantages are not the prime reason for foreign production in the majority of cases. The main driver is production in the market of the firm's main clients.

Knowledge-seeking (as opposed to market- and efficiency-seeking) does not seem to be an important motive for internationalization, except knowledge from clients. Some firms have R&D and engineering facilities abroad, but no firm mentioned that the need for proximity to foreign universities or corporate R&D abroad drives internationalization.

We observe some cases of **backshoring**. The reasons for backshoring were market-related, specifically weaker than expected demand growth and unexpectedly strong competition from domestic firms. In all cases, backshoring was a local reaction to changing market conditions and not a general withdrawal from international markets. This is in line with the observation from the EMS data that offshoring and backshoring takes place in the same period in a number of firms.

The interviews also shed more light on the finding from the empirical analysis that suppliers to industrial clients have a significantly lower propensity for backshoring. The fact that large clients request the presence of key suppliers at foreign locations explains these firms' lower backshoring intensity.

The **role of automation and I 4.0** as a driver for backshoring could be observed in two cases. Here, productivity increases due to automation allowed the firm to bring back volume production from China, because automation and lean production level out the cost differences. However, we also find evidence in two cases that a lack of flexibility when producing in China was an important driver for backshoring. In one case, customization required proximity to customers and retailers in Europe, while in another case, it was proximity to industrial clients that drove backshoring.

Opinions about the future direction of backshoring were mixed. Some firms were not familiar with the idea, while others saw their backshoring as a one-time episode. By contrast, some firms also see potential for backshoring of other firms in their sector or in other industries because the cost differences between Europe and China are levelling out, and location decisions are increasingly being influenced by target markets rather than labour costs.

## 8 Implications

This paper investigated backshoring – moving production activities from foreign locations back to the home country. Backshoring can be a defining trend for GVCs, if more firms decide to bring production back home. Empirical results from a large-scale survey show that backshoring is not yet very common; only around 4 per cent of all manufacturing firms in Europe moved production back to their home countries between 2013 and 2015.

The qualitative analysis and case studies reveal some drivers of backshoring. First, backshoring firms are mostly large, high-technology and medium high-technology firms with strong exports and production abroad. Hence, backshoring is certainly not a strategy of failing firms in outdated industries. Second, backshoring is often triggered by the need for more flexibility. Firms cannot provide short lead-times and high degrees of customization if production is located in China and products have to be shipped around the world to their European customers. Third, the case studies show that firms are strongly embedded in their local ecosystems, including their supplier networks, local universities and technology centres and clients. These ecosystems provide firms with benefits that go beyond cost advantages; skilled personnel, ideas for new products and flexibility in the supply of production inputs. However, local ecosystems can also prevent backshoring if firms need to develop and produce in proximity to key clients abroad, for example, in the automotive industry.

The analysis also uncovers a positive relationship between I4.0 and backshoring. This is a surprising result, given that new technologies are regarded as being drivers of globalization. Modern production technologies can, however, favour a re-concentration of production in the home countries, when they increase productivity and flexibility, and level out the cost advantages of Asian locations which to a considerably degree drive offshoring. If a firm can produce its goods at similar costs in Europe and enjoy higher flexibility because of the local ecosystem and proximity to clients, backshoring becomes a feasible option. Consequently, the expansion of I4.0 may lead to more backshoring in the future.

There are already some signs of stagnation in the expansion of GVCs, one of the defining trends in the world economy since the 1970s. Empirical evidence from input-output data suggests that the growth of GVCs stopped around 2010, and backshoring is one of the reasons for this halt. The next few years will show whether the stagnation of GVCs we observe in the data is just a temporary correction of disappointing internationalization projects or a permanent change. Trade liberalization in emerging economies and reduced transportation and communication costs, the drivers of the growth of GVCs in the past, may have run out of steam, which would point to a permanent stagnation. Over the last few years, greenfield FDI in manufacturing in Asia and Latin America has been markedly below the levels of 2011 and in preceding years, which may be a first indication that the attractiveness of these countries is diminishing permanently (UNCTAD, 2018). This interpretation corresponds to the sluggish negotiations over trade and investment liberalization, and growing resistance against free trade by civil society groups as well as governments. Examples of such de-globalization tendencies are Brexit or the trade dispute between the U.S. and China.

If GVC stagnation is indeed permanent, backshoring may lead to more industrial production in Europe and the U.S. The further adoption of I4.0 technologies, including additive manufacturing, may favour local value chains (LVCs) and a co-location of production and consumption (Laplume et al., 2016). In LVCs, firms benefit from proximity to customers with diversified demands and needs, thus increasingly competing with the—to date—dominant GVCs and their separation between production and consumption. More LVCs are certainly desirable from an ecological point of view. However, they will disappoint those who hope that industrial jobs will also return with production activities. I4.0 requires very specific skills, and not a lot of new employees. It is unlikely that low-skilled jobs will ever return, and the number of jobs brought back by reshoring will certainly be lower than those that were initially offshored.

For emerging economies, the effects of backshoring and de-globalization are less desirable. FDI has been an engine of development for emerging economies in Asia, albeit less so in Latin America or Africa. GVCs help firms in emerging economies enter global markets, even if inputs and equipment have to be imported. In addition, technological learning in GVCs and spillovers from foreign-owned to domestic firms has provided inputs from the development of these countries (Blomström and Kokko, 1998; Keller, 2010). From the data, it appears that the threat that foreign investors will leave emerging economies is still low. Backshoring by European firms is primarily taking place within Europe, and only a minor part of manufacturing returns to Europe from emerging economies.

I4.0 may pose a bigger challenge for emerging economies, because it increases the capital and skills intensity of production and may take away the biggest advantage of low-income countries – cheap labour (Rodrik, 2018). Low-income countries that are not yet part of GVCs may find it increasingly difficult to enter global markets and value chains in the future. Our results also indicate that the labour cost advantages of emerging economies are still intact, and backshoring is not a retreat from international markets.

New production technologies may weaken the comparative advantages in low-income countries; however, the attractiveness of some of these countries is no longer based on low labour costs alone, but also on sophisticated consumers and industrial clients, an increasingly skilled workforce, specialized suppliers and world-class research at universities. China, India, and other Asian countries are representing a growing share of worldwide demand, and domestic markets in these countries are still growing faster than in Europe or North America. Moreover, there is no reason to believe that the diffusion of I4.0 is limited to Europe and North America. China, India, and other countries have ambitious plans in this technological domain, and the productivity advantage of high-income countries may be transitory only.

## References


Alcácer, J., Cantwell, J., Piscitello, L., 2016. Internationalization in the information age: A new era for places, firms, and international business networks? Journal of International Business Studies 47, 499-512.

Baldwin, R., Venables, A.J., 2013. Spiders and snakes: Offshoring and agglomeration in the global economy. Journal of International Economics 90, 245-254.

Baldwin, R.E., 2016. The Great Convergence: Information Technology and the New Globalization. Belknap Press, Cambridge [Mass.].

Baldwin, R.E., Martin, P., 1999. Two Waves of Globalisation: Superficial Similarities, Fundamental Differences, NBER Working Paper.

Barbieri, P., Ciabuschi, F., Fratocchi, L., Vignoli, M., 2018. What do we know about manufacturing reshoring? Journal of Global Operations and Strategic Sourcing 11, 79-122.

Blomström, M., Kokko, A., 1998. Multinational Corporations and Spillovers. Journal of Economic Surveys 12, 247-277.

Chen, W., Los, B., Timmer, M.P., 2018. Factor Incomes in Global Value Chains: The Role of Intangibles. NBER Working Paper No. 25242, Cambridge, MA.

Dachs, B., Kinkel, S., Jäger, A., 2017. Bringing it all back home? Backshoring of manufacturing activities and the diffusion of Industry 4.0. Paper presented at the 2017 DRUID conference, New York.

Dachs, B., Zenker, C., 2014. Backshoring of Production Activities in European Manufacturing, Vienna.

De Backer, K., DeStefano, T., Menon, C., Suh, R.J., 2018. Industrial robotics and the global organisation of production. OECD Science, Technology and Industry Working Papers 2018/03, Paris.

Dunning, J.H., 1981. International Production and the Multinational Enterprise. Allen and Unwin, London.

Dunning, J.H., 1988. Explaining International Production. Harper Collins, London.

Dunning, J.H., 2001. The Eclectic (OLI) Paradigm of International Production: Past, Present and Future. International Journal of the Economics of Business 8, 173-190.

Dunning, J.H., Lundan, S.M., 2008. Multinational Enterprises and the Global Economy, 2nd ed. Edward Elgar, Cheltenham.

Ellram, L.M., Tate, W.L., Petersen, K.J., 2013. Offshoring and Reshoring: An Update on the Manufacturing Location Decision. Journal of Supply Chain Management 49, 14-22.

Förstl, K., Kirchoff, J.F., Bals, L., 2016. Reshoring and insourcing: drivers and future research directions. International Journal of Physical Distribution & Logistics Management 46, 492-515.

Fratocchi, L., Ancarani, A., Barbieri, P., Di Mauro, C., Nassimbeni, G., Sartor, M., Vignoli, M., Zanoni, A., 2016. Motivations of manufacturing reshoring: an interpretative framework. International Journal of Physical Distribution & Logistics Management 46, 98-127.

Gray, J.V., Skowronski, K., Esenduran, G., Johnny Rungtusanatham, M., 2013. The Reshoring Phenomenon: What Supply Chain Academics Ought to know and Should Do. Journal of Supply Chain Management 49, 27-33.

IMF, 2016. Global trade: What's behind the slowdown?, World Economic Outlook. International Monetary Fund, Washington, pp. 63-119.

Keller, W., 2010. International Trade, Foreign Direct Investment, and Technology Spillovers, in: Hall, B.A., Rosenberg, N. (Eds.), Handbook of the Economics of Innovation. Elsevier, Amsterdam, pp. 794-829.

Kinkel, S., Maloca, S., Dachs, B., 2010. Produktionsverlagerungen und Rückverlagerungen der deutschen Industrie in Zeiten der Krise. Wirtschaft und Management 12, 9-27.

Laplume, A.O., Petersen, B., Pearce, J.M., 2016. Global value chains from a 3D printing perspective. Journal of International Business Studies 47, 595-609.

Marsili, O., Verspagen, B., 2002. Technology and the Dynamics of Industrial Structures: An Empirical Mapping of Dutch Manufacturing. Industrial and Corporate Change 11, 791-815.

McKinsey & Company, 2019. Globalization in transition: The Future of Trade and Value Chains. McKinsey Global Institute, Washington DC.

Pisano, G., Shih, W.C., 2012. Does America Really Need Manufacturing? Harvard Business Review 90, 94-102.

Porter, M.E., 1985. Competitive Advantage. The Free Press, New York.

Rodrik, D., 2018. New Technologies, Global Value Chains, and Developing Economies. Background Paper, Pathways for Prosperity Commission, Oxford.

Stentoft, J., Olhager, J., Heikkilä, J., Thoms, L., 2016. Manufacturing backshoring: a systematic literature review. Operations Management Research 9, 53-61.

Strange, R., Zucchella, A., 2017. Industry 4.0, global value chains and international business. Multinational Business Review 25, 174-184.

Timmer, M.P., Erumban, A.A., Los, B., Stehrer, R., de Vries, G.J., 2014. Slicing Up Global Value Chains. Journal of Economic Perspectives 28, 99-118.

Timmer, M.P., Los, B., Stehrer, R., De Vries, G.J., 2016. An Anatomy of the Global Trade Slowdown based on the WIOD 2016 Release. GGDC Research Memorandum 162, Groningen.

UNCTAD, 2018. World Investment Report 2018: Investment and New Industrial Policies. United Nations, New York and Geneva.

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