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The domestication of value chains through local content requirements: Can interconnected economies benefit from the Chinese experience?

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ABSTRACT

Objective: The objective of the article is to reflect on the effectiveness and conditions of economic policy based on local content requirements (LCRs) by testing the hypothesis that the application of LCRs in China between 2004 and 2014 was instrumental in increasing the volume of value added created in its economy.

Research Design & Methods: By using inter-country input-output tables, we attempt to assess the effectiveness of LCRs in increasing the volume of value added induced in a country where, as is the case in China, they are used to enhance domestic technological capabilities. Our analysis focused on high-tech and medium-high-tech (HT&MHT) sectors. In order to test the hypothesis, data from 2004 and 2014 were analysed for Austria, China, Germany, and the Visegrád countries (V4). This approach makes it possible to compare the effects of the domestication of value chains in China with the processes that accompanied the internationalisation of value chains in the group of four emerging economies.

Findings: The findings of our study justify the conclusion that the application of LCRs in China's HT&MHT industries in 2004-2014 effectively increased the volume of value added created in its domestic economy. The negative consequences of LCRs predicted by the theory indeed occurred in China's HT&MHT industries. The prices of intermediate inputs increased more than proportionally relative to the prices of outputs; likewise, the value added of suppliers to these industries increased more than proportionally. The gross value-added coefficient in HT&MHT industries decreased. Nevertheless, the induced value added by HT&MHT industries in the Chinese economy significantly outweighed the value-added loss resulting from the reduction in the direct gross value added coefficient in these industries. The reduction in margins resulted from the imposition of LCRs, which forced final producers to scale up sourcing from local suppliers. Local content requirements in China may have contributed to a rapid increase in technological capabilities. Technological catching up by Chinese HT&MHT producers and their suppliers accelerated in the context of increasing scale of production achieved by intensifying participation in world trade and by increasing the purchasing power of local consumers.

Implications & Recommendations: Although some elements of technological self-reliance present in the Chinese model may serve as an inspiration for the Visegrád countries to reflect on the international division of labour that emerged in the 1990s in Europe, the space for its renegotiation seems to be constrained not only by their population size but also by their limited ability to mobilise innovative inputs.

Contribution & Value Added: The novelty of our approach consists in estimating the positive and negative effects of LCRs as predicted by theory, expressing them in monetary terms, and comparing them with the effects achieved by economies where value chains are internationalized.

Article type:	research article
Keywords:	economic policy; global value chains; industrial upgrading; interconnected economies; local content requirements
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INTRODUCTION

Catching-up mechanisms are a central issue in research on developing economies. In this area, numerous analysts consider high technology sectors to be the most promising, since it is where developing countries have the greatest potential to boost productivity through knowledge development (Stehrer & Wörz, 2001; Fagerberg & Godinho, 2004). However, in order to upgrade, business actors in developing countries need to gain access to leading technologies and markets in developed countries to achieve an appropriate scale of production as well as the ability to meet their demand for state-of-the-art products (Hobday, 1995; Amsden, 2001). In the globalisation era, such an opportunity is provided by the insertion of selected segments of the national economy in international value chains, where industrial upgrading is achieved through cooperation with global leaders (Baldwin & Lopez-Gonzalez, 2015).

However, firms in the Global South are faced with the dilemma of how to promote cooperation with foreign lead firms within the latter's global value chains and, at the same time, to maintain their capacity to capture value added given the fact that, in the long run, they want to avoid getting stuck in low value added activities without viable prospects for functional upgrading. An alternative is to create their local value chains (Lee *et al.*, 2018) by, among other things, inducing lead international firms to scale up cooperation with local business actors and to transfer knowledge to them. One of the instruments used for this purpose is local content requirements (LCRs), *i.e.* administrative requirements to purchase a certain proportion of intermediate inputs from local suppliers.

There are good reasons to believe that LCRs provided an important tool for implementing China's industrial policy after its accession to the WTO in 2001. Efforts to promote technological self-sufficiency and domestication of value chains were further strengthened by the Made in China 2025 strategy (MIC, 2025) which seeks to modernize China into an advanced manufacturing leader. At the other extreme of internationalisation are medium-sized and small open economies of the four Visegrád countries (the V4), *i.e.* the Czech Republic, Hungary, Poland, and Slovakia, whose industries constitute part of global value chains organised mainly by TNCs headquartered in Western European countries. As they actively strive to chart their paths of economic development, it is reasonable to inquire whether China can indeed provide an appropriate model in this respect.

This article aims to reflect on the effectiveness and conditions of LCR-based economic policy by testing the hypothesis that the application of LCRs in China between 2004 and 2014 was instrumental in increasing the volume of value added created in its economy.

The relevance of this study is supported by two arguments. Firstly, by using inter-country input-output tables the authors attempted to assess the effectiveness of LCRs in increasing the volume of value added created in a country where, as is the case in China, they were used to enhance domestic technological capabilities.

The novelty of our approach consists in estimating the positive and negative effects of LCRs as predicted by theory, expressing them in monetary terms, and comparing them with the effects achieved by economies where value chains are internationalized. Moreover, we examined whether the effectiveness conditions for LCRs as identified in the literature have been met, namely whether the coordination problem was overcome and production was rapidly scaled up in industries with a high potential for learning by doing (Tomsik & Kubicek, 2006; Veloso, 2001; 2006). If so, the rapid value-added growth in China's high-tech and medium-high-tech industries may indeed have resulted from the application of LCRs.

The rest of the paper is organised as follows: after Introduction in Section 2. we review the literature regarding goals of LCRs, implementing it as an instrument of innovation policy and barriers to its use. At the end of this section we formulate hypotheses. Section 3 presents research methodology. Section 4 provides results of the research on the consequences of LCRs implementation in the Chinese economy, compare and discuss the accompanying effects in the fields of overcoming coordination problem, indigenizing R&D and the role of domestic demand. Section 5 concludes.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The Origin and Goals of LCRs

Local content requirements are policies enacted by governments that require foreign firms to use domestically manufactured goods or domestically supplied services to operate in a given host economy. They take a variety of forms. They may focus on input markets and trade or be related to discriminatory government procurement and localisation requirements associated with data protection and security (OECD, 2016). Moreover, LCRs are defined as a specific type of localization barriers to trade that seek to force foreign companies to manufacture locally what they would otherwise produce outside a nation's borders and export to a recipient economy.

Countries define 'local content' in a variety of ways, such as the percentage of local components used in the assembly of a final product; the share of locally developed intellectual property embodied in the development of a product or service; or the share of locally produced or local content in the broadcasting and audio/visual sectors. Local content requirements impact both private and public sector procurement.

According to estimates, since the financial crisis of 2008 until 2016, more than 140 new local content measures were put in place by governments largely to improve domestic employment and industrial performance. Local content requirements were introduced by dozens of countries, including Argentina, Brazil, Canada, China, India, Indonesia, Malaysia, Mexico, Nigeria, Russia, Turkey, and Vietnam. Brazil even 'made LCRs a centrepiece of its industrial policy' (Ezell *et al.*, 2013).

Nonetheless, LCRs tend to cause welfare losses. The benefits gained by upstream producers may not offset the negative effects of making goods manufactured by final producers more expensive, such as reduced consumer surplus and loss of competitiveness of downstream producers vis-à-vis their foreign rivals (Stone *et al.,* 2015; Grossman, 1981). Davidson *et al.* (1985) conclude that LCRs increase domestic producers' rents and reduce consumer welfare. Richardson (1991) adds that domestic producers of final goods also pay for this by losing their market shares to less expensive foreign producers, whereas domestic welfare depends on whether the suppliers' gain compensates for the producers' loss. The effect on domestic welfare as a whole is contingent on the magnitude of these changes, but when combined with the negative effect on foreign producers, both global production and global welfare are reduced. Stone *et al.* (2015) note that this research current focuses on the effects of LCRs dependent on the market power of upstream producers. If this power is substantial, LCRs amplify inefficiencies in a given sector (Belderbos & Sleuwaegen, 1997), but if it is small, LCRs may increase them, which is desirable when a monopolistic foreign subsidiary forces low prices on numerous domestic suppliers (Moran, 1992). Even so, the rationales behind introducing LCRs may involve more complex factors than just the desire to affect respective market powers or domestic prices.

In their formal analysis of the mechanisms of LCRs' impacts, Tomsik and Kubicek (2006) highlight that they are not as clear as they would appear from the competitive equilibrium model. Indeed, the invalidation of the assumption of constant returns to scale is insufficient to justify the use of LCRs in developing countries, as they increase the benefits of suppliers at the expense of profits of final producers, raising the GNP rather than the GDP. The coordination problem, *i.e*. a situation where a final good cannot be manufactured in the absence of a domestically produced intermediate good is an argument in favour of LCRs. This problem arises in the context of a certain minimum level of transport costs and specificity of an intermediate good, otherwise, it would be easy to acquire inexpensively abroad. Again, these conditions may not be sufficient, as the natural comparative advantage may favour the production of some goods in a developed country. Only when the coordination problem is aggravated by the inadequate scale of production does it lead to the conclusion that too small a demand for a particular good may limit manufacturers' profits and thus prevent them from setting up production in a developing country. Local content requirements may be more effective if a given industry in the host country is characterised by a large technology gap but has a large learning potential. The rapid increase in the scale of production accelerates learning by doing and, when combined with low labour costs, the host economy may become more competitive in manufacturing this good than

the developed one despite its less efficient technology. In this way, LCRs enable the developing country to overcome the initial technological backwardness in a given industry (Tomsik & Kubicek, 2006). Therefore, LCRs are often imposed on industries where higher value-added stages can be located in the local developing economy. This instrument was also used by developed countries in the past (Stone *et al.*, 2015; Chang, 2007), although restrictions on their application have been agreed upon by World Trade Organisation's (WTO) members. However, they can still be put forward as a precondition for receiving public support (Tomsik & Kubicek, 2006).

Veloso (2001, 2006) concludes that this policy instrument is intended to enhance technological capability, especially in developing countries. By attracting foreign investment, domestic producers have a unique opportunity to improve their competences, but on condition that the foreign manufacturer is willing to cooperate and transfer the requisite knowledge to domestic producers. Moreover, the learning-by-doing effect associated with the increased scale of operations of domestic suppliers and the rapidly falling learning curve in the high-tech and medium-high-tech (HT&MHT) sectors mean that LCRs should be considered as an instrument of innovation policy as well (Veloso, 2001). Thus, in countries characterised by a large technology gap, the positive effect of industrial upgrading resulting from inducing producers to cooperate with local suppliers can significantly outweigh the increase in costs of intermediate inputs and raise welfare (Tomsik & Kubicek, 2006; Veloso, 2006). This rarely occurs in advanced economies (Veloso, 2001) due to the already high level of technology and the lower relative benefit of raising it still further.

The subsidies that accompany LCRs can also be more than offset by an increase in value added thus freed up – which is critical is the ability of local producers to achieve economies of scale. In an analysis conducted for the Brazilian automotive market, increasing production from 35 000 to 200 000 units boosted optimal local content from 45% to 90% (Veloso, 2006). At low production levels, however, virtually all the benefits associated with LCR-based policies disappear. This observation may confirm the effect of scale on increasing factor productivity noted by Verdoorn (1949), which is likely because the Keynesian increase in aggregate demand is important for inducing investment in new technologies (the so-called Kaldor-Verdoorn effect; see Kaldor, 1966).

To sum up, there are two research currents on LCR effects: the older one focuses on changes in the market power of firms (*e.g.,* Grossman, 1981; Davidson *et al.,* 1985; Richardson, 1991), whereas the more recent one expands the analysis to include technological aspects (Tomsik & Kubicek, 2006; Veloso, 2001; 2006). Below, they shall be called 'market power' and 'innovation' currents, respectively.

LCRs in China's Technological Self-reliance Strategy

Albeit unofficially and covertly, LCRs are at the heart of China's contemporary economic policy. The catalyst for the current wave of industrialization in China was its accession to the WTO in 2001, which marked a period when the country's manufacturing industry marched into the international market. 'Foreign investments flooded into China to capitalize on opening the Chinese market to foreign competitors. Year by year, China becomes the production outsourcing base of the international manufacturing industry' (Huimin *et al.,* 2018). At the same time, China kept accumulating a trade surplus. These developments led to increasing China's share of HT&MHT exports (Figure 1), which were originally identified as priority areas.[1]

The objectives of China's current economic policy resemble those pursued in the 1990s by the four dragons of East Asia (South Korea, Taiwan, Hong Kong, and Singapore) in electronics. To overcome market barriers to entry and then to assimilate process and product technologies, those firms engaged in subcontracting which consisted in supplying Western companies with semi-finished and finished products under their brand – thus enabling East Asian producers to enter markets previously controlled by Western ones (Hobday, 1995). By adopting similar objectives, contrary to WTO rules, China did not abandon its policy of preferences for local producers. The opening of China's automotive market to foreign

[1] Specifically, these strategic sectors include: information technology, numerical control machinery and robotics, aerospace and aviation equipment, maritime engineering equipment and high tech maritime vessel manufacturing, advanced rail equipment, energy-saving and new energy vehicles, electrical equipment, new materials, biomedicine and medical devices and agricultural machinery and equipment (Chamber, 2017).

investment in the early 1990s constitutes an instructive case in point (see *e.g.,* Tabata, 2014). Accession to the WTO raised concerns among domestic producers that TNCs with economies of scale and extensive supply networks would drive local producers out of the market (Ali *et al.*, 2004). However, the state urged investors to co-opt domestic players by requiring them to enter into joint ventures and offset programs as a precondition for access to its emerging huge automotive market (Gallagher, 2003; Thun, 2004).

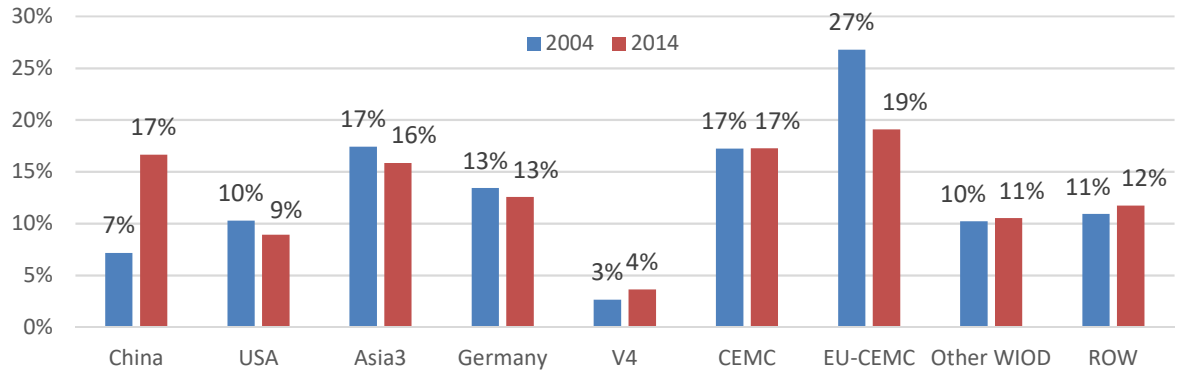

Figure 1. Share of HT&MHT products in world trade
Source: own elaboration based on WIOD.

Preferences for local manufacturers also existed in other areas, such as nuclear and renewable energy equipment. For example, in 2010, Clean Development Mechanism funds were made available only to Chinese majority-owned entities (Stone *et al.*, 2015). The success story of the country's wind power sector is also well documented (Qiu & Anadon, 2012; Liu *et al.*, 2015). The government's development programme for this sector, localization rate, R&D, and intellectual property support successfully promoted domestic technology development and international technology transfer. The increasing scale of production subsequently reduced costs by more than 4% with each doubling of capacity (Qiu & Anadon, 2012), ultimately enabling China to become a leader in wind energy production in 2010 and a major exporter. It is worth noting that, apart from market access, China's authorities were able to defend their policy of supporting domestic producers by citing the examples of other countries using LCRs to a much greater extent (Stone *et al.*, 2015; Deringer *et al.*, 2018).

Industrial upgrading, technological progress, and an unprecedented rise to global prominence in the first dozen years or so since joining the WTO emboldened the Chinese authorities to take even bolder steps towards technological independence. In May 2015, Prime Minister Li Keqiang launched the initiative Made in China 2025 (MIC 2025) which sets out to turn China into an advanced manufacturing leader. This 10-year comprehensive strategy focuses heavily on intelligent manufacturing in 10 strategic sectors and 'has the aim of securing China's position as a global powerhouse in high-tech industries which constitutes nearly 40 per cent of China's entire industrial value-added manufacturing' (ISDP, 2018; Chamber, 2017).

Policies implemented under MIC 2025 are designed to achieve three main objectives (Chamber, 2017, p. 13):

1. localize and indigenize;
2. substitute;
3. capture global market share.

Local content requirements provide a common ground for achieving each of the MIC 2025 objectives, as its success is critically determined by the scale and scope of LCR implementation in the sectors of interest as stipulated by the strategy.

As a result, more and more analysts are expressing reservations about China's economic policy. Chinese government subsidies skew markets, and undercut the American and other foreign manufacturers, leading to overcapacity and the dumping of cheap products on the global market. There are also widespread concerns about China's goal of achieving 70% self-sufficiency in core components and

critical materials by 2025. According to analysts, China applies implicit detailed quotas on the use of local resources for domestic companies in violation of WTO rules. In response to the emerging Chinese 'techno-nationalism' (Wübbeke *et al.*, 2016), technologically leading countries have begun to take measures to restrict Chinese exports and investment. China's ability to build its production on the rapidly growing demand of the world's largest population is becoming an important resource in this regard. Therefore, in view of the expected retreat from globalisation, in recent years, Chinese authorities have taken measures to strengthen internal circulation (Blanchette & Polk, 2020).

Domestication vs Internationalization of Value Chains

China's retreat from increasing economic openness, noted since the mid-2000s, has not been experienced by developed countries so far. In the era of production fragmentation, production sharing and offshoring became a way for leading global firms to reduce manufacturing costs and increase profits as they morphed into transnational corporations (TNCs). Advances in long-distance communication and the removal of barriers to investment and trade enabled them to exploit international wage differentials (Baldwin, 2012). Thus, reduced manufacturing costs are an important factor in sustaining the export competitiveness of certain segments of Western economies (Milberg & Winkler, 2013; Grodzicki & Skrzypek, 2020).

The 'trade-in tasks' brought about a second unbundling, *i.e.* the separation of factories from offices (Baldwin, 2006) leading to a 'functional specialization' of economies within global value chains (Stöllinger, 2021). The so-called factory economies specialise in manufacturing stages that yield relatively less value added per unit of output than the headquarter economies (Baldwin & Lopez Gonzalez, 2015; Stöllinger, 2021). From the perspective of developing countries, unlikely to become technological leaders, foreign investment provides an opportunity for at least 'spot' industrialisation and the development of technological competence in individual production stages.

The so-called Factory Europe has become one of the most important centres where low-cost economies cooperate with technological leaders. Thanks to their insertion into global value chains, the Visegrád countries became important producers and exporters of complex manufacturing goods (Bruszt & Greskovits, 2009). The still significant role of the manufacturing sector in these economies appears to be associated with production for leading firms from the global core countries, especially Germany. Due to the strong cooperation ties in industry, economists (*e.g.,* Augustyniak *et al.*, 2013) often use such shorthand terms as the German-Central European Supply Chain (GCESC) or the Central European Manufacturing Core (CEMC), which includes Austria (Stehrer & Stöllinger, 2015). Interdependence may be the source of growth for this cluster's export-oriented industry (Augustyniak *et al.,* 2013) thus maintaining the cost competitiveness of the German economy (Simonazzi *et al.,* 2013; Grodzicki & Skrzypek, 2020) thanks to which producers from the V4 countries gain access to global markets. However, Nölke and Vliegenthart (2009) warn that the dependent nature of V4 economies may hinder development opportunities owing to the dominant role of TNCs in industry (Table 1). For the most part, foreign corporations neither contribute to the development of local research systems nor show much interest in training the workforce of their affiliates. Instead, they prefer to import new technologies from their parent companies (Nölke & Vliegenthart, 2009; Bruszt & Greskovits, 2009). Although some elements of technological self-reliance present in the Chinese model may serve as an inspiration for the Visegrád countries to reflect on the international division of labour that emerged in the 1990s in Europe, the space for its renegotiation seems to be constrained not only by their population size (64 million), but also by their limited ability to mobilise innovative inputs.

The size of the Chinese economy and its associated capabilities are too large to be confined to the standards set by competitors from developed countries. Admittedly, in 2004–2014 Chinese companies in general were not global lead firms not least because of a lack of access to technology and markets. However, practice reveals that China's decision to join the WTO should be considered not so much as a token of recognition of free trade rules but as an attempt to build domestic firms capable of competing not only on costs. Hence its acquisition of the capacity to manufacture technologically advanced goods led to a natural consequence, namely an attempt to become technologically independent.

Table 1. Investment positions of China vs CEMC

Country / Country group	Inward FDI stock (% of GDP)		Outward FDI stock (% of GDP)	
	2004	2014	2004	2014
CHN	12.6	10.4	2.3	8.5
CZE	48.0	58.5	3.2	8.8
HUN	59.2	71.4	7.6	28.9
POL	33.0	38.8	0.3	5.1
SVK	65.4	49.2	2.5	2.7
V4	44.3	48.4	2.6	8.8
AUT	23.5	39.8	23.2	49.3
DEU	25.9	22.1	28.3	36.0
CEMC	28.3	28.4	24.3	32.1
World	24.3	33.1	25.2	33.5

Source: own elaboration based on UNCTAD database.

The trajectory of China's policy of domestication of value chains – and its dissimilarity from the common experience of growing interconnectedness in the age of globalization (OECD, 2013) – can be portrayed by comparing a sample value chain in the HT&MHT sectors in China with its counterparts in the Central European Manufacturing Core. This sample (Figure 2; for details, see Grodzicki and Geodecki, 2016) illustrates China's growing control over its global supply by analysing the extent to which backward and forward linkages are controlled by domestic business actors and the extent to which a given sector of the economy studied relies on final demand driven by domestic consumers.

China's policy of domestication of value chains through LCRs can be viewed as an attempt to build technological capabilities by overcoming the coordination problem, *i.e.* strengthening incentives for firms to invest in technological development. By combining cost advantages with building technological capabilities of suppliers to HT&MHT industries, Chinese authorities were trying to build comparative advantages in this sector. However, this meant that before rising wages could act as a comparative disadvantage, they needed to significantly strengthen domestic demand to achieve economies of scale. These elements distinguish it from the policies pursued by developed countries, such as Germany, which generated comparative advantages in HT&MHT exports much earlier, but were too expensive to rely solely on local intermediates (Figure 2.A.) and not large enough to rely on domestic final demand (Figure 2.D).

Unlike other developing economies, including the V4, China tried to overcome the constraints inherent in the dependent nature of its economy by making itself independent of headquarter economies in technology imports. This was particularly important in HT&MHT, which increasingly relied on local content (Figure 2.A). Likewise, the huge market size made it possible to treat domestic consumers as the main buyers of HT&MHT products and the main source of value added created (Figure 2.D). As the world's largest population is still far from meeting its aspirations, this market has strong growth prospects and makes China resilient to possible restrictions on access to other markets.

Hypotheses Development

Based on the goals of LCRs raised in the literature review, the practice of developing countries, the expected effects of LCR raised by representatives of 'market power' and 'innovation' currents, and the goals and activities for localization of value chains in China, we aimed to test the following hypothesis:

H: The application of LCRs in China in 2004-2014 effectively increased the volume of value added created in its economy.

Additionally, based on the data on Chinese HT&MHT sectors, in which LCRs were actively applied between 2004 and 2014, three auxiliary hypotheses were formulated:

H1: The consequences of LCRs predicted by theory occur in China's HT&MHT sectors.

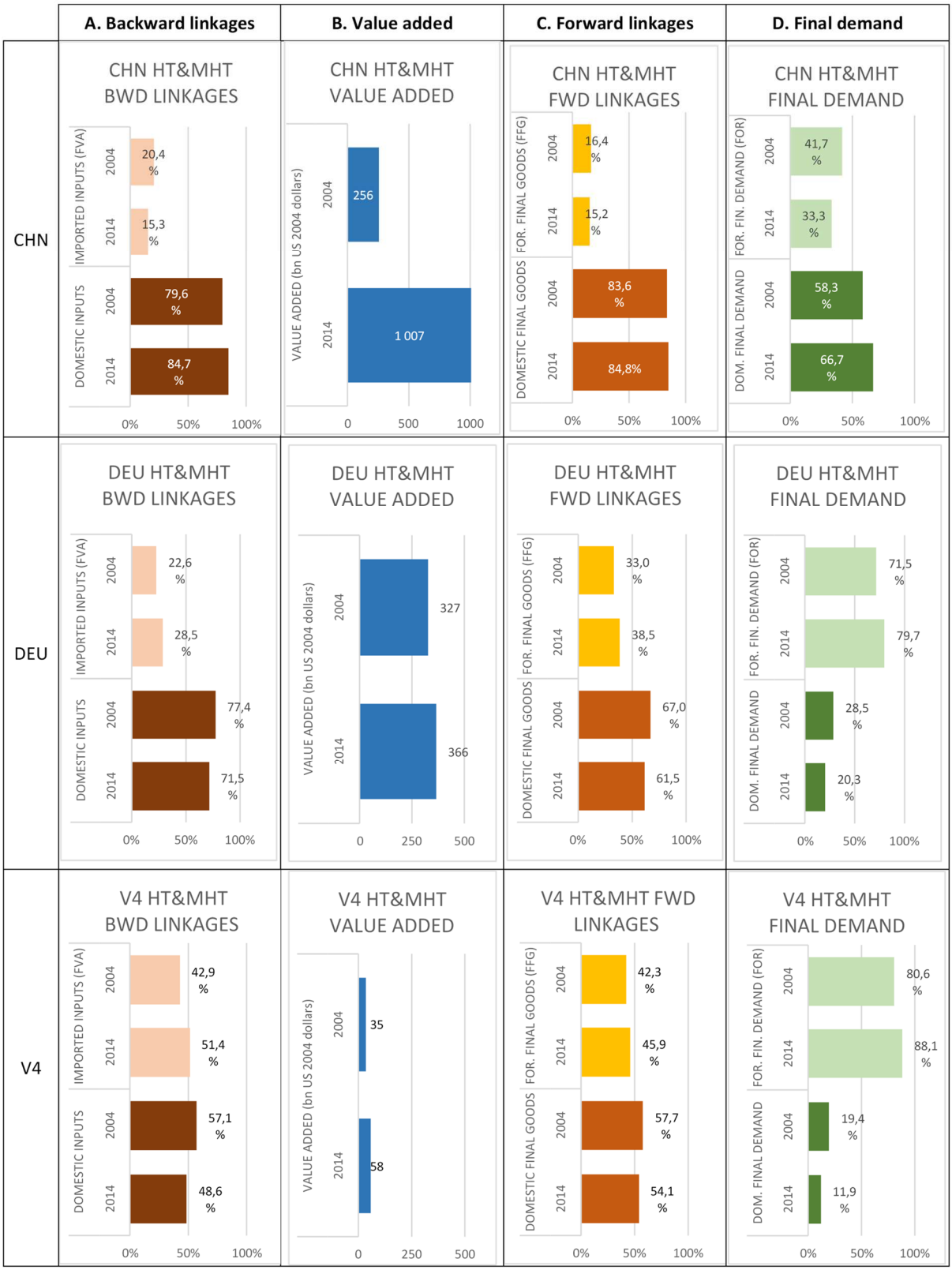

Figure 2. Position of HT&MHT sectors of the analysed economies in global value chains in 2004 and 2014
Source: own elaboration based on WIOD.

H2: The induced value added in the Chinese economy by its HT&MHT sectors outweigh the expected decline in the value-added ratio in these industries.

H3: The impact of LCRs on technological capabilities and value creation occurs as anticipated by the representatives of the innovation current.

It would be the case if the following three processes were observed:

1. The non-market methods of coordinating economic processes that favour the suppliers of the HT&MHT sector increased.
2. Technical change in the economy clearly accelerated.
3. The scale of production in sectors subject to LCR increased above average.

We shall therefore rely on circumstantial inferencing. We assume that LCRs in the Chinese economy were quite likely effective provided that two conditions were met:

- the application of LCRs brought about a positive net effect in the form of increased value added in the domestic economy, which would be consistent with the theory and findings of the representatives of the market power current;
- a range of mechanisms emerged to increase the volume of value added in the sector affected by the instrument, as predicted by the representatives of the innovation current.

RESEARCH METHODOLOGY

The Object of Study and Research Technique

To test the hypothesis, data from 2004 and 2014 were analysed for Austria, China, Czech Republic, Germany, Hungary, Poland, Slovakia, the Visegrád countries (V4), and the Central European Manufacturing Core (CEMC), which includes the V4 as well as Austria and Germany. The period studied covers the decade before the announcement of the Made in China 2025 strategy (MIC 2025), during which China consolidated its position as a modern and globally significant producer of high-tech goods. It also marks a ten-year period since the Visegrád countries joined the European Union during which the CEMC emerged. This approach makes it possible to compare the effects of the domestication of value chains in China with the processes that accompanied the internationalisation of value chains in the group of four emerging economies and, at the same time, to weigh the rationale of the industrial policy of a catching-up country against the conditions existing in developed countries – technology providers to the CEMC (Stehrer & Stöllinger, 2015).

Our analysis focuses on the HT&MHT sectors. By comparing Eurostat's high-tech classification of manufacturing industries with the strategic sectors listed in MIC 2025, we shall explore the changes in value added in the following seven two-digit divisions of NACE Rev. 2:

- C20 Manufacture of chemicals and chemical products;
- C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations;
- C26 Manufacture of computer, electronic and optical products;
- C27 Manufacture of electrical equipment;
- C28 Manufacture of machinery and equipment n.e.c.;
- C29 Manufacture of motor vehicles, trailers and semi-trailers;
- C30 Manufacture of other transport equipment.

As business actors in these industries have a disproportionately high share of R&D inputs in their turnover, we assumed that technological knowledge constitutes a significant proportion of intermediate inputs acquired by them.

Using a catalogue of HT&MHT broken down by sector, we relied on input-output tables (Timmer *et al.,* 2015) to demonstrate how the value-added processes that policymakers, including the authors of MIC 2025, strive to affect using industrial policy tools, proceed in individual countries and sectors. We referred to the WIOD database (Timmer *et al.,* 2015), the latest edition of which (November 2016) covers the years 2000-2014 and 56 industries in 44 countries worldwide.

RESEARCH STAGES

Direct Input and Direct Value-Added Ratios

Verifying the main hypothesis and, subsequently, auxiliary hypotheses H1-H3 required estimating direct material intensity and direct value-added content using the national input-output table (NIOT) taken from the WIOT (Timmer *et al.,* 2015), in which the global output (X) of each jth sector (number of sectors S = 56) consists of intermediate inputs purchased by industry j from 56 domestic suppliers (x), imported input costs (imp), and value added (VA) according to formula 1 below.

$$X_j = \sum_{i=1}^{n} x_{ij} + imp_j + VA_j \quad (1)$$

Analysing the subsequent components of global output, we obtained the following coefficients for sector *j*:

– domestic input (DI):

$$DI_j = \sum_{i=1}^{n} x_{ij} \,/\, X_j \quad (2)$$

– imported input (II):

$$II_j = imp_j / X_j \quad (3)$$

– and gross value added (GVA):

$$GVA_j = VA_j / X_j \quad (4)$$

Inverse Matrix Coefficients

Next, we estimated the well-known Leontief inverse matrix, which analyses the direct and indirect effects of certain final demands in one industrial sector on other industrial sectors. Inverse matrix coefficient tables are compiled to estimate how much production is ultimately being induced in all sectors of the economy by a final demand increase of one unit in a specific sector. In this way, we can estimate the full – direct and indirect – influence of an increase in final demand on the product of a particular sector.

By performing appropriate transformations on the input-output matrix, we obtained the Leontief inverse matrix L^{-1}:

$$L^{-1} = (I - A)^{-1} \quad (5)$$

in which *I* is the unit matrix and *A* is the material intensity matrix in which the individual elements $a_{ij}=x_{ij}/X_j$. The elements of matrix L^{-1}, l^{-1}_{ij} represent full material intensity coefficients. They show how many units of output in sector *i* have been used, both directly and indirectly, to increase the final demand of sector *j* by one unit, while leaving the final demand of the other sectors unchanged.

Using the technical coefficients table, which presents the relationship between national inputs from sector *i* and the value of the global output of sector *j* (e.g., Ministry, 2016; Alvares, & Bravo, 2012), we estimated domestic inputs, imported inputs, and gross value-added inducement coefficients:

– domestic input inducement coefficients (DII) – reflect the value of domestic materials from individual sectors consumed directly and indirectly in the whole economy when final demand in a given sector (and thus intended only for final purposes, *i.e.* consumption, investment or export) increases by a unit value:

$$DII = DI * L^{-1} \quad (6)$$

For a given sector *j*, this coefficient is an element of dii_j row vector *DII*:

– imported inputs inducement coefficients (III) – report the value of foreign-sourced materials consumed directly and indirectly throughout the whole economy to achieve an increase in final demand in a given sector by a unit value:

$$III = II * L^{-1} \quad (7)$$

For a given sector *j*, this coefficient is element iii_j of row vector *III*:

– gross value-added inducement coefficients (GVAI) – report the gross value added generated directly and indirectly in the whole economy by increasing final demand in a given sector by a unit value:

$$GVAI = GVA * L^{-1} \quad (8)$$

For a given sector *j*, this coefficient is $gvai_j$ row vector GVAI.

RESULTS AND DISCUSSION

In an attempt to verify H1, we referred to the effects of performance requirements identified in the literature to determine whether any of the following effects predicted by market power analysts actually occurred:

– prices of intermediate inputs purchased by producers from the Chinese HT&MHT sectors increased;
– market power (as measured by the increase in value added) increased to a greater extent in sectors which supplied more intermediate inputs to Chinese HT&MHT sectors than in those which supplied less to these sectors;
– the profit margin of final producers decreased.

As expected by theorists (Grossman, 1981; Davidson *et al.*, 1985; Richardson, 1991), import substitution strengthened upstream suppliers. Chinese HT&MHT sectors saw a stronger rise in the prices of intermediate inputs relative to the increase in the price of gross outputs (Table 2, col. a) than the other countries studied. Local content requirements introduced in a specific sector clearly favoured domestic suppliers. In China, the association between the increased share of HT&MHT as recipients of the manufacturing sector's intermediate inputs and the increase in the sector's value added between 2004 and 2014 was stronger than in other countries, which implies that local content policies may indeed have enhanced the market power of intermediate goods suppliers (Table 2, col. b).

Table 2. Growth of input and output prices in HT&MHT (a) and value-added growth of HT&MHT suppliers in relation to growth in the share of HT&MHT sectors in their sales of intermediate inputs in 2004-2014 (b)

Country / Country group	Input prices minus output prices (a)	Correlation coefficients between the growth of the share of supplies for HT&MHT and value added growth (b)
CHN	14.1	0.59***
CZE	7.6	0.25
HUN	-4.2	-0.13
POL	0	0.26
SVK	5.1	0.48*
V4	2.3	–
AUT	3.8	0.34
DEU	-0.6	0.1
CEMC	0.2	–

Note: (a) Differences in price level growth rates of intermediate inputs and gross output of HT&MHT industries between 2004 and 2014 (in percentage points). Weighted averages reflect the share of individual sectors and countries in gross output. (b) Linear correlation coefficients of the change in the share of HT&MHT sectors as recipients of intermediate inputs of manufacturing sectors (percentage points) and the growth rate of value added percentage points in these sectors between 2004 and 2014; significant at the level ***<0.01; **<0.05; *<0.1; N=19; NCHN=18 (n/a for C33).
Source: own elaboration based on WIOD and SEA WIOD (Timmer *et al.*, 2015).

Neither cost increases in HT&MHT nor the correlation between increased profitability and being a supplier to HT&MHT were necessarily due to the enactment of LCRs. After all, in the CEMC countries, which did not apply LCRs, increased co-operation with the HT&MHT sectors was also generally accompanied by a faster increase in value added, moreover, input prices seemed to be proportional to supplier profitability. Therefore, there must have been other factors besides LCRs that affected the profitability of scaling up co-operation with high-tech sectors. Nevertheless, the fact that once the LCR policy was applied in China, its domestic suppliers to HT&MHT imposed higher prices and increased profits to a

greater extent in proportion to their degree of co-operation with HT&MHT, is consistent with the models proposed by Grossman (1981), Davidson *et al.* (1985), and Richardson (1991), which emphasise the correlation between LCRs and supplier market power. The key question posed in this approach is whether, once LCRs have been applied, the gains to input producers outweigh the losses to final producers (Richardson, 1991). To estimate the net effect on domestic welfare, we assumed that the above-mentioned changes in the Chinese economy occurred as a result of LCRs and that it was the LCR that acted to reduce the profitability rate of final producers as a result of strengthening their suppliers. On the other hand, we assumed that none of the CEMC countries pursued an LCR policy. This assumption simplifies the interpretation of the observation (Figure 3) that between 2004 and 2014, the Chinese economy became more independent from the global economy, whereas the CEMC economies grew more interdependent. Contrary to global integration trends, China reduced the values of import intensity coefficients in the HT&MHT sectors from 0.13 to 0.07 (see Figure 3, coefficient of imported inputs – II). This means that in 2014, a one yuan increase in output increased the demand for intermediate inputs from abroad by seven fen as compared to 13 fen in 2004. This was achieved amidst an increase in the share of local content: domestic direct material intensity (DI) coefficients increased from 0.63 to 0.74. Since domestic intermediate goods may not have been perfect substitutes for foreign goods, direct value-added (GVA) coefficients decreased from 23 to 18 fen per one yuan of global output.[2]

As regards H1, there are reasons to believe that the negative consequences of LCRs predicted by the theory indeed occurred in China's HT&MHT industries. The prices of intermediate inputs increased more than proportionally relative to the prices of outputs. Likewise, the value added of suppliers to these industries increased more than proportionally.

Conversely, the CEMC countries became even more interconnected, as evidenced by their increased mutual trade flows. In Germany, direct import intensity (II) increased from 0.17 to 0.23, in Austria from 0.34 to 0.38, and in the V4 countries from 0.36 to 0.44. While in Germany and Austria, this was accompanied by increased value-added content (GVA) – by ca. 0.33–0.36 in relation to output – cooperation with Western economies kept it at a lower level in the V4 countries (0.23-0.24, though still lower values were noted in Slovakia).

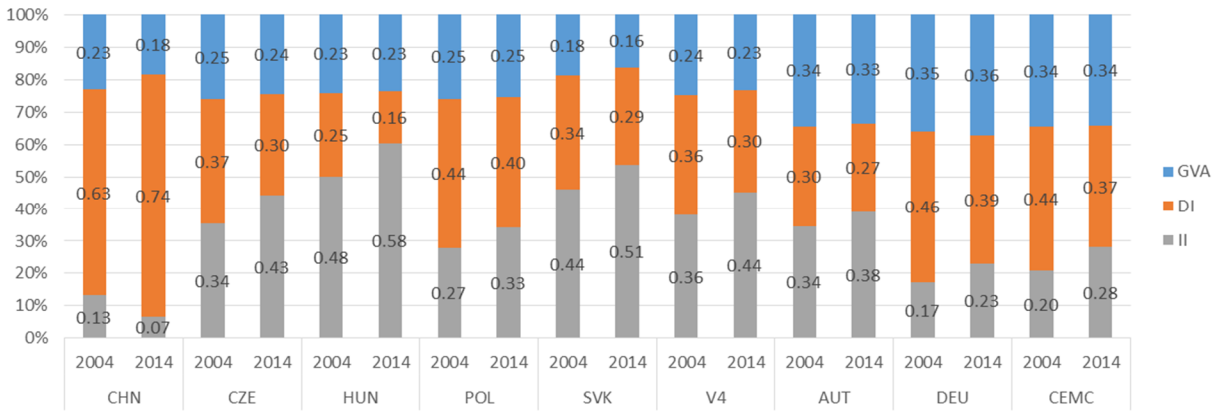

Figure 3. Direct material intensity and value-added content coefficients

Source: own elaboration based on WIOD. For V4 and CEMC, the estimated values are the weighted average shares of individual countries in the global output of HT&MHT sectors.

In verifying H2, we wanted to assess whether the potential negative consequences of LCRs were compensated for by increases in value added across the Chinese economy and in welfare. To this end, we examined whether the induced value added in the Chinese economy by Chinese HT&MHT actually outweighed the expected decline in the value-added ratio in these sectors.

[2] Note that this reduction is relative as it expresses the ratio of value added to global output. Yet even though the global output in Chinese HT&MHT sectors increased fivefold in monetary terms, the slower-growing value added still increased fourfold.

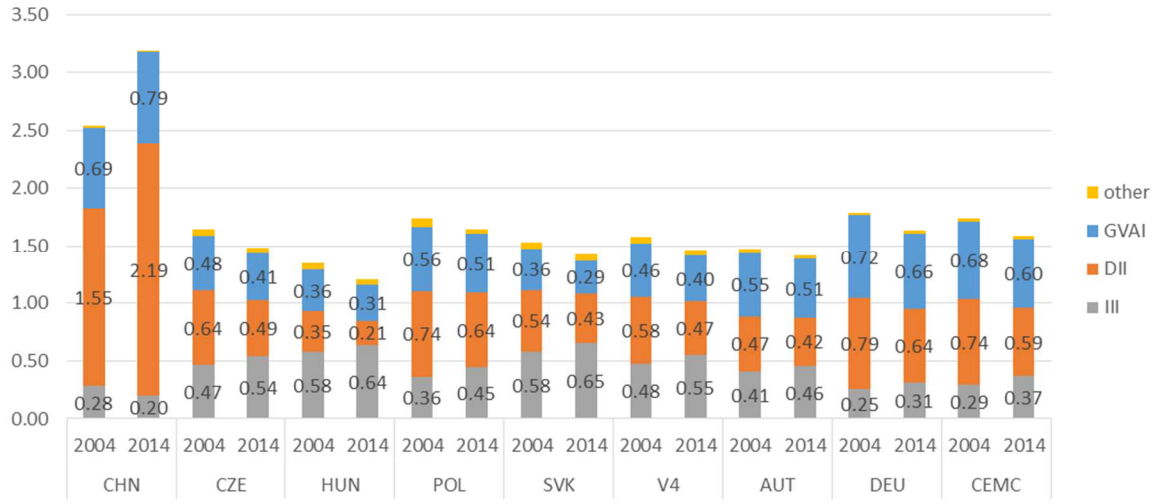

Figure 4. Coefficients of induced gross value added, domestic and imported input use in HT&MHT sectors
Source: own elaboration based on WIOD. Weighted averages of shares of individual sectors and countries in final demand.

To estimate the effects of a decade of domestication of value chains in China and their internationalization in the CEMC, we referred to the model of offshoring effects proposed by Milberg and Winkler (2013, p. 153) to estimate the impact on the labour market. Firms based in headquarter economies engage in offshoring to reduce their costs by moving production to lower-wage countries. The model in question identifies four effects of the latter: (1) a reduction in product prices boosts sales (scale effect); 2. the mark-up effect includes an increase in margins of offshoring companies; (3) the investments made and lead to higher productivity; at the same time, however, (4) a substitution effect occurs, which means that domestic production factors are replaced by foreign ones. Part of the value added is thus produced abroad instead of domestically as before, but this is a precondition for increasing the proportion of value added created by investors. In the case of the domestication of value chains, the substitution effect is reversed: foreign suppliers are replaced, and more value added is created domestically. However, final goods producers face increased costs in the form of higher prices of intermediate goods, which reduces demand, the scale of production, and profit margins.

To estimate the consequences of the analysed changes for domestic welfare, we looked at a counterfactual scenario (CS) in which the values of the direct and induced coefficients remained at 2004 levels (*e.g.,* we assumed that for China these coefficients in 2014 were identical to those in 2004, or 0.23 instead of 0.18 for GVA and 0.69 instead of 0.79 for GVAI; see Table 3). Thus, we were able to determine whether the reduction in the direct gross value added ratio (GVA) of China's HT&MHT sectors that occurred until 2014 was compensated for by an increase in the value added induced by these sectors throughout the national economic system (GVAI) in the period studied, or in both these sectors and cooperating industries.

To estimate the magnitude of these effects and compare the results across countries, we converted the changes in GVA and GVAI into monetary units. The estimation revealed that changes in these values between 2004 and 2014 were dramatically different for China and the CEMC countries, as suggested by Figures 3 and 4.

China's HT&MHT sectors experienced a several-fold increase in GVA – from USD 256 bn. to USD 1007 bn. (an increase of USD 751 bn.; see Table 3, col. 1), but at the cost of reducing GVA from 0.23 to 0.18, which, compared to the counterfactual scenario, meant a reduction of potential GVA in HT&MHT by USD 240 bn. in 2014 (see Table 3, col. 2a). This means that increasing global output in 2004–2014 while keeping the GVA coefficient at 0.23 would have added USD 240 bn. more value to HT&MHT in 2014 alone. To be able to compare this figure with the effect of a change in GVAI, which allows us to estimate the effect of increasing final demand on the national economy as a whole, we need to translate the effect of a change in global output into the effect of a change in final demand. By dividing final

demand by global output,[3] we can obtain an approximate answer to the question of how much lower was the monetary value of GVA in HT&MHT in 2014 due to the reduction in GVA from 0.23 to 0.18 relative to final demand. This allows us to compare col. 2b with col. 3 showing the change in GVAI. This means that the change of -240 bn. dollars is approx. -86 bn. dollars if the reduction in question is taken to refer to the effect of the change in final demand alone.

The substitution effect for the whole economy (GVAI) was positive and amounted to an additional USD 186 bn. (Table 3, col. 3,). This was due to increased final demand in HT&MHT and the diversion of a significant proportion of it to domestic suppliers. In other words, the reduction in the percentage share of value added in the global output of these sectors resulting from the supply of domestic instead of foreign intermediate goods was overcompensated by an increase in value added in the whole economy (+186 bn. dollars in 2014 alone). If the increase in local content results, among other things, from LCRs, it must be concluded that the latter contributed to the domestication of value chains and effectively raised welfare in China. The total GVAI in the entire Chinese economy expressed as the effect of boosting final demand in China's HT&MHT sectors increased by USD 1.2 trillion compared to 2004.

In contrast, in the CEMC countries where value chains are internationalised, the increase in GVA was not so spectacular, but still distinct (USD 66 bn., see Table 3, col. 1) given the dynamics of industrial production in other EU countries. The GVA of HT&MHT increased by an extra USD 16 bn. compared to the counterfactual scenario (see col. 2), which was due to increased global output of the HT&MHT sectors and a slight increase in the share of value added, especially in Germany (Table 3, col. 2a). This was accompanied by a reduction in the scale of co-operation with domestic suppliers. The combined effect, including the gains of the HT&MHT sectors and the losses to domestic suppliers from the diversion of HT&MHT's final demand to foreign suppliers in 2014, was –68 bn. dollars (Table 3, col. 3). This is how much higher the gains to the CEMC economies would have been if the increase in final demand had not been swallowed up by a reduction in the value of induced GVA, well below the 2004 level. However, in the case of the CEMC, the reduction in GVAI shown in the table (Table 3, col. 3) is due to the unrealised potential of cooperation with domestic entities, which would not necessarily have materialised.

On the one hand, the German and Austrian economies have to deal with the substitution effect by offshoring production to low-cost locations. On the other hand, however, according to the aforementioned model by Milberg and Winkler (2013), offshoring in Western countries is accompanied by cost reductions and increased competitiveness, sustained demand for HT&MHT products, a mark-up effect increasing investment and productivity, and a resultant scale effect. Indeed, both the GVA of the HT&MHT sectors and their impact in the form of GVAI increased between 2004 and 2014 (by USD 50 bn. or 10% in Germany and USD 5 bn. or 17% in Austria, respectively). The precondition for such expansion was the considerable increase in the scale of co-operation with foreign players largely located in the low-cost V4 economies. Likewise, in the latter, the substitution of local sourcing of intermediates measured by the loss of GVAI did not entail a reduction in GVAI in real terms. On the contrary, it increased from USD 55 bn. to USD 88 bn., *i.e.* by USD 33 bn. (Table 3, col. 4) or 56%, which is significant. Cooperation in the CEMC is mutually beneficial in terms of increased productivity and scale of production. This additional effect in Germany translated into a significant increase in added value and profits in HT&MHT (the mark-up effect), whereas in the V4 it led to a substantially expanded scale of production and added value created (Table 3, col. 1 and 4) thanks to access to Western European and non-European markets offered by cooperation in the CEMC.

Our findings show that in China, between 2004 and 2014, *i.e.* immediately after WTO accession, when the utility and feasibility of using LCRs were being tested, the negative as well as positive effects of LCRs predicted in the literature occurred and the latter probably prevailed. As regards H2, the induced value added by HT&MHT industries in the Chinese economy significantly outweighed the value-added loss resulting from the reduction in the direct gross value added coefficient in these industries. If this was the outcome of LCRs, then their cost-benefit balance in HT was positive. In the following

[3] The assumption that the effect of the change in final output is proportional to the change in global output may not be met, but for the purpose of the discussion we only need a rough comparison of changes in GVA and GVAI in monetary units. The figures in col. 2b should therefore be treated as approximations.

section, we will discuss these findings by referring to the LCR effectiveness conditions as identified by Tomsik and Kubicek (2006), and Veloso (2001, 2006), among others, which serves verifying H3.

Table 3. Value added in HT&MHT sectors in 2014 compared to 2004 and to the counterfactual scenario (CS) in which the direct and induced gross value-added ratios remain at 2004 levels (US 2004 million dollars)

Country / Country group	1.GVA change (GVA2014-GVA2004)	2. Actual GVA 2014 minus CS as the effect of		3. Actual GVAI 2014 minus CS	4. GVAI change (GVAI2014-GVAI2004)
		2a. global output change*	2b. final demand change	as the effect of final demand change	as the effect of final demand change
CHN	751.254	-239.385	-85.615	185.905	1 205.384
CZE	8.010	-571	–513	-4.896	11.440
HUN	2.550	324	317	-2.576	2.736
POL	9.521	529	428	-3.375	13.532
SVK	3.300	-615	-544	-2.145	5.125
V4	23.382	-333	-712	-12.992	32.832
AUT	3.970	-13	-12	-2.954	5.030
DEU	39.546	16.248	13.549	-52.179	49.739
CEMC	66.898	15.902	13.480	-68.125	87.601

Note: *Actual CHN GVA2014 = 1 007 356 = 0.18 * 5 494 236, counterfactual scenario (CS) = 1 246 740; = 0.23 * 5 494 236; Actual CHN GVA2014 – CS as the effect of global output change = -239 384.
Source: own elaboration based on WIOD and SEA WIOD (Timmer *et al*., 2015).

Overcoming the Coordination Problem

The difference in the coordination mechanisms applied seems to be clear. In a planned economy such as China's, authorities force the HT&MHT sectors to redirect their demand for intermediate inputs to domestic players. The gains for the cooperating sectors together with the gains for Chinese HT&MHT producers compensated for the loss of value added due to the substitution effect of the domestication of value chains (see Table 3). This happened even though increases in the prices of intermediate inputs and decreases in GVA confirmed the predictions of theorists as to the negative effects of LCRs (Tomsik & Kubicek, 2006; Stone, 2015; Grossman, 1981; Richardson, 1991). These and other administrative instruments seem to be effective where there is a high potential for technological catching up and at the same time a high potential for scaling up (Veloso, 2001; 2006). In technology frontier countries, redirecting demand to domestic sectors does not have much potential for productivity gains from technology learning.

In neoclassical economics, there is no need for ex-ante coordination, because participants hold small shares of the market, cannot influence prices, and there is no room for economies of scale given the decreasing marginal productivity of technology (Chang, 2003). On the other hand, state coordination permits reduced consumption of scarce resources, which cannot be achieved under market competition. Especially in technologically backward economies which invest in specific knowledge-based resources, the loss of investment effects (*e.g.,* in research and technological capabilities) due to lack of coordination can be extremely costly as shown by transaction cost economics (*e.g.,* Willimson, 1985). In the absence or imperfect protection of intellectual property, a steadily growing supply of technological knowledge can suspend the law of diminishing returns to scale, as improved technologies rapidly diffuse throughout the economic system (*e.g.,* Romer, 1990). This process is driven by the public factor, since positive externalities resulting from increasing technological capabilities are not usually factored in by entrepreneurs in their calculations. It would therefore appear that in developing countries, sometimes the market copes with the coordination problem less successfully than in the presence of a public agent implementing central planning or industrial policy measures (Chang, 2003; Auerbach & Sotiropoulos 2012).

Indeed, it seems unlikely that under market conditions, final goods producers in the HT&MHT sectors would voluntarily agree to lower their profit margins and thereby enable suppliers to increase their benefits and promote the technological advancement of the entire economy, as was the case in China (see Table 3, col. 2b and 3). Without LCRs, Chinese HT&MHT producers and foreign investors in these sectors might not have chosen to scale up sourcing from Chinese suppliers, as the latter, at least initially, offered less efficient technological solutions at a higher price (Table 2). On the other hand, in

the CEMC, cost-cutting measures through offshoring were observed, which fits in with the logic of the market mechanism (see Figure 3 and Table 3, col. 2b and 3).

However, the coordination problem occurs only if the following two conditions are met: (1) the good in question is sufficiently specific, and (2) transport costs are sufficiently high (Tomsik & Kubicek, 2006). Since technological knowledge 'turns out not to be 'information' that is generally applicable and easily reproducible, but specific to firms and applications' (Pavitt, 1984, p. 343), whereas goods supplied in the R&D stage rank among the most specific and tacit assets (Winter, 1987; Dosi, 1988). Likewise, transport costs are important for technological industries; higher technological intensity implies a higher propensity of TNCs to move production to foreign subsidiaries due to the high cost of technology transfer (Keller & Yeaple, 2013). Moreover, technology as an intermediate input in high-tech industries can be particularly expensive due to the monopolistic nature of any new business solution further reinforced by the use of the patent system, as was originally observed by Schumpeter (1934). The importance of the R&D indigenization policy can be interpreted in the light of an analysis conducted by Linden *et al.* (2009) which focuses on value flows within global value chains and points to the low share of value added by the Chinese iPod manufacturer. Less than half of the retail price (USD 144 out of USD 299) was accounted for by inputs of which the 10 most expensive ones were produced by high-tech suppliers from the Asian tigers and the U.S., which received a total of USD 125 (or 85% of the cost of all inputs). The value of locally produced inputs was limited to the remaining USD 19, which underscores the crucial importance of technology ownership for the capacity to create high value added.

Thus, despite official assertions by Chinese policymakers that China does not pursue a local content policy, practice suggests otherwise (Wübbeke *et al.*, 2016). In April 2018, President Xi Jinping reiterated the importance of indigenous innovation, saying that 'the core technologies are the pillars of a great power' and 'the core technologies can only come from self-reliance' (Liu, 2018). Therefore, the cooperation of Chinese business actors with outside investors should be seen as a way of building their technological capabilities, whereas increasing the scale of sourcing of domestic intermediate inputs in the decade of 2004-2014 was intended to help indigenous suppliers to master core technologies.

Indigenizing R&D and Escaping the Middle-Income Trap

The positive effects of innovation policies thus understood are highlighted by studies on spillovers from foreign investment in Chinese manufacturing industries (Abraham *et al.,* 2010; Lu *et al.,* 2017), including high-tech manufacturing (Liefner *et al.*, 2006; Fu & Gong, 2011). However, the findings of research on high-tech sectors suggest that the most important source of technological knowledge is China's R&D effort (in the ICT sector: Wang *et al.*, 2010) and that FDI is of limited importance for productivity growth (Hale & Long, 2011). Table 4 presents data on R&D spending and its effects such as patents. They illustrate the varying capacities of individual economies to independently develop technology and set trends in this area. Particularly noteworthy in this respect is the Chinese economy, in which research efforts multiplied between 2004 and 2014 (with a fourfold nominal increase in GDP, business R&D expenditure in relation to GDP increased by a factor of 2, thus the total business R&D spending increased by a factor of 8), resulting in an unprecedented increase in intellectual property stocks.

Coordination failure alone may not provide a sufficient incentive to locate production in a particular country. Even if inputs are specific and trade costs are sufficient, it may still be less profitable to carry out certain activities in developed countries (Tomsik & Kubicek, 2006; Veloso, 2006). This happens, among other things, in the absence of an appropriate scale of production in a developing country due to its small population or low purchasing power. This was the reason behind the failure of import-substituting industrialization in Latin America and the pursuit of export-oriented industrialization by Southeast Asian countries (Low & Tijaja, 2013). China, too, largely focused on strengthening its export capacity immediately after WTO accession, especially in HT&MHT products.

It is important to note that the above-mentioned complementarities between scale and efficiency gains arise not only from technological progress but also from learning-by-doing, thereby illustrating growing experience with each additional unit of a good produced. This effect can be obtained through the application of LCRs if a technological gap exists and the good in question is locally produced. In such a situation, LCRs artificially accelerate learning. With increased productivity and lower labour

costs, the manufacturing of a given intermediate good can become more competitive than in a developed country. However, to shorten the period during which the application of LCRs forces manufacturers to use less efficient local technology, the sectors subject to intervention must have a high learning potential (Veloso, 2005; Tomsik & Kubicek, 2006). In high-tech industries, latecomers may create high value added per unit thanks not only to access to monopoly profits but also to the great potential for market growth (Stehrer & Wörz, 2001; Fageberg & Godinho, 2004).

Table 4. Technological input (R&D expenditure as a percentage of GDP) and output (number of patent applications and patents granted) in 2004 and 2014

Country / Country group	R&D (% of GDP)				Patents (number)			
	GERD		BERD		Patent applications filed under PCT		Triadic Patent families	
	2004	2014	2004	2014	2004	2014	2004	2014
CHN	1.22	2.02	0.81	1.56	1.783	24.036	296	2.431
CZE	1.14	1.96	0.71	1.10	118	191	22	22
HUN	0.86	1.35	0.35	0.96	156	134	49	14
POL	0.55	0.94	0.16	0.44	98	345	21	41
SVK	0.50	0.88	0.25	0.32	26	35	1	6
V4	0.74	1.21	0.33	0.64	398	704	93	84
AUT	2.17	3.08	1.47	2.2	896	1.386	272	332
DEU	2.44	2.88	1.70	1.95	15.480	17.527	6.376	4.260
CEMC	2.13	2.57	1.45	1.72	16.774	19.617	6.742	4.676

Source: own elaboration based on OECD (2021a) and OECD (2021b).

An early discussion of localization policy (Richardson, 1991) suggests that it may lead to the loss of markets to less expensive foreign competitors. Understandably, Chinese buyers had no alternative, since their domestic market was protected by tariffs. However, given the rising labour cost (Table 5), it is difficult to explain why foreign buyers were sourcing ever more expensive Chinese products citing exclusively market power arguments (Grossman, 1981; Richardson, 1991; Stone *et al.,* 2015). Despite the symptoms of local content policies, Chinese HT&MHT exports in the decade studied increased spectacularly from 7% to almost 17% of world exports (see Figure 1) and did so much faster than the share of total goods exports. Even though OECD research (2016) shows the generally negative impact of LCRs on trade volumes, it confirms that among the countries that have applied this particular policy instrument, China experienced hardly any negative consequences. The Kaldor paradox (1978) appears to have been at work in this case. The paradox is that contrary to intuition, in countries experiencing rapid technological development, an increase in unit labour cost (Table 5) is accompanied by an increase in export competitiveness as measured by the share in world exports. These findings were confirmed by Fagerberg (1996), who pointed to the role of R&D in increasing the competitive capacity of East Asian tigers in the 1980s and the complementarity of technological efforts with economies of scale in some high-tech industries. Avoiding the so-called middle-income trap means finding an answer to the question of how to permit wages to rise without losing markets and compete on quality and unique solutions rather than on costs. Doubts as to whether the Chinese economy could manage such a transition were expressed by Gill and Kharas (2007) who coined the term 'middle-income trap.' A decade later, Wei *et al.,* (2017) were quite certain that data on Chinese patents appeared encouraging enough that there was no room for doubt any longer.

Thus, the Chinese initiatives mentioned in the literature review aimed at increasing scale and gaining competitive advantages in HT&MHT industries were intended to increase technological capabilities, which is not only the *raison d'être* for applying LCRs but also a precondition for their effectiveness. Indeed, the initial reduction in the technological gap made it possible to induce producers to co-operate with indigenous suppliers without excessively reducing economic efficiency (Veloso, 2006).

The Role of Domestic Demand

The fast-growing domestic demand driven by high wage dynamics (Table 5) may also have been a factor in China's industrial production dynamics. Recalling the observations made by Verdoorn (1949), the aforementioned Kaldor (1966) argued that productivity growth is not only due to increases in scientific and technological knowledge, but that factor productivity increases with an increase in the scale of production. In his reasoning, Kaldor indicated that in different markets dominated by the same American investors, despite having access to the same knowledge and know-how, business actors increased labour productivity faster in larger markets. Particularly important for the capital goods sector was the increase in workers' wages generating demand for industrial goods (Kaldor, 1966) and thus stimulating entrepreneurs' interest in wage increases. In accordance with Myrdal's cumulative causation principle, increasing demand, in turn, accelerates production, leads to productivity increases, and a further reduction in prices, which again stimulates demand, but this time it also enhances the cost competitiveness of a given economy. If it occurs in technologically advanced industries, non-price competitiveness also increases due to innovations driven by learning by doing (Amable, 1992). This Verdoorn-Kaldor effect has a clear Keynesian angle and may explain how, despite increasing unit labour costs, the potential for learning by doing and the competitiveness of Chinese HT&MHT producers continued to increase.

Analysts note that in transforming its hitherto low-wage economy, 'China's economic planning apparatus through its economic transition utilised aspects of Kaleckian and Keynesian aggregate demand economic theory' (Kenderdine, 2017), the objective being to limit overexposure to global markets by unleashing the potential of a domestic market composed of 1.3 billion consumers (Valverde, 2020). With a shrinking working-age population and wages rising due to the achieved technological level, the previous model of low-cost exports could not be maintained, especially in the context of a general retreat from globalisation among Western democracies. The dual circulation strategy and measures taken by the Chinese authorities to strengthen internal circulation should be seen as a strategy to move away from an export-led development model on their terms (Blanchette & Polk, 2020). The strengthening internal circulation may also result from a natural confrontation between latecomers and incumbent leaders. Examining the development trajectories of Brazilian, Korean and Chinese industries, Lee *et al.* (2018) noticed a process called by them in-out-in-again, which means that after joining GVCs and gaining initial competence in the production of technologically advanced goods, further self-development efforts require a temporary reduction in dependence on foreign contractors to return as global market actors having built their brands. In these circumstances, having a large domestic market may present a considerable advantage.

This process is illustrated by the data on labour productivity, wages and labour compensation, and their relationship to value added presented in Table 6. In the decade preceding MIC 2025, China already saw a significant increase in wages: fourfold in the whole economy and almost threefold in the comparatively better-paid HT&MHT sectors. Apart from the rapid growth in value added, an extra wage growth driver was the increase in their share of value added to 55% in the economy as a whole and 48% in HT&MHT sectors subject to greater international competition. These readings are similar to those of developed countries (AUT and DEU) rather than to the catching-up ones (V4).

For China, the negative consequences of LCRs predicted by theory were not particularly severe. The reduction in consumer surplus due to the increase in the cost of final goods, even if it did occur, was overcompensated by wage increases. On the other hand, the reduced cost competitiveness of domestic enterprises vis-à-vis foreign ones hardly affected Chinese producers as they were becoming increasingly focused on the domestic market (as much as 67% of final demand; cf. Figure 2D) protected by high trade barriers.[4] Growing consumer demand was therefore being met by domestic producers, which promoted value-added retention and contributes to productivity growth through economies of scale as well as a rapidly falling learning curve. At the same time, the comparison of labour productivity and wages explains why high-tech sectors were becoming an area that catching-up countries were

[4] In 2013, China had one of the highest explicit barriers to trade and investment indicators (OECD Entrepreneurship at a Glance 2015, p. 109).

keen to enter – it is not so much the pace as the gap between labour productivity and wages that is highest there.[5] Focusing on them not only increases the potential to shift from competing on the cost to competing on product quality and technological sophistication (Kaldor, 1978; Fagerberg, 1996; Lee *et al.*, 2018) – which, as was pointed out above, Chinese high-tech manufacturers have largely succeeded in doing – but is also simply the most profitable solution (Stehrer & Wörz, 2001).

Table 5. Labour productivity, labour compensation, and labour share in the economies studied in 2004 and 2014

Country / Country group	Productivity (global output thousand USD2004) / employee)			Wages (labour compensation thousand USD2004 / employee)			Labour compensation / value added		
	Whole economy								
	2004	2014	Change	2004	2014	Change	2004	2014	Change (p.p.)
CHN	7.2	28.6	298%	1.2	5.1	325%	48%	55%	+7
CZE	55.4	72.9	32%	11.5	14.5	26%	51%	51%	0
HUN	47.2	50.3	7%	12.2	11.5	–6%	57%	54%	–3
POL	35.6	53.7	51%	8.2	12.0	46%	50%	50%	0
SVK	45.0	77.8	73%	8.7	15.5	78%	47%	49%	+2
V4	43.7	60.3	38%	10.6	12.7	20%	52%	51%	–1
AUT	135	144	7%	41.2	43.1	5%	59%	61%	+2
DEU	125.6	125.9	0%	40.2	39.5	–2%	62%	62%	0
CEMC	113.2	113.6	0%	23.3	23.7	2%	60%	60%	0
HT&MHT									
CHN	34.3	91.8	168%	3.0	8.0	167%	39%	48%	+9
CZE	97.8	149.3	53%	12.2	16.0	31%	48%	44%	–4
HUN	111.9	147.9	32%	11.4	13.0	14%	42%	37%	–5
POL	64.1	105.1	64%	8.3	12.3	48%	50%	46%	–4
SVK	97.9	218.3	123%	8.9	17.9	101%	49%	51%	+2
V4	90.6	144.0	59%	9.7	14.0	44%	47%	44%	–3
AUT	296	341	16%	54.8	59.7	9%	54%	52%	–2
DEU	276.3	286.7	4%	61.7	63.9	4%	62%	60%	–2
CEMC	253.9	262.6	3%	28.9	38.6	34%	60%	57%	–3

Source: own elaboration based on WIOD and WIOD's Socio-Economic Accounts.

CONCLUSIONS

The findings of our study justify the conclusion that the application of local content requirements in China's HT&MHT industries in 2004-2014 effectively increased the volume of value added created in its domestic economy.

As regards H1, there are reasons to believe that the negative consequences of LCRs predicted by the theory indeed occurred in China's HT&MHT industries. The prices of intermediate inputs increased more than proportionally relative to the prices of outputs; likewise, the value added of suppliers to these industries increased more than proportionally, Moreover, the gross value-added coefficient in HT&MHT industries decreased. These phenomena occurred with greater intensity in China than in benchmark countries where LCRs were not applied.

As regards H2, the induced value added by HT&MHT industries in the Chinese economy significantly outweighed the value-added loss resulting from the reduction in the direct gross value added coefficient in these industries. If this was the outcome of LCRs, then their cost-benefit balance in HT was positive. Another argument in support of the research hypothesis was the occurrence of mediating mechanisms, which are identified in the literature as motivations for the use of LCRs (Tomsik & Kubicek, 2006; Veloso, 2006).

[5] Although labour costs are higher in HT&MHT than in the economy as a whole, the former's much higher productivity provides entrepreneurs with a more favourable difference between output and compensation per worker.

The reduction in margins in China's HT&MHT sectors appears to have resulted from the imposition of LCRs, which forced final producers to scale up sourcing from local suppliers. By definition, they are less productive in a developing country, hence LCRs are applied to increase their productivity. This contrasts with the absence of such instruments in the CEMC countries, where market logic dictates that leading players in headquarter economies should cooperate with low-cost suppliers from abroad.

As regards H3, LCRs in China may have contributed to a rapid increase in technological capabilities expressed in terms of R&D intensity and the number of patents. As such, LCRs underpinned considerable investment in the development of local technological capabilities. Although rising wages reduced export competitiveness, technical progress overcompensated for this effect. In consequence, non-price competitiveness (exemplified by the growing share of Chinese sectors in the global HT&MHT products market) and productivity increased, which resulted in a fourfold increase in value added in these sectors over the period in question. In technological frontier countries, there is no potential for such an artificial acceleration of technology transfer, learning, and increasing technological capabilities by increasing the scale of production.

Technological catching up by Chinese HT&MHT producers and their suppliers accelerated precisely in the context of significantly increasing scale of production achieved by intensifying participation in world trade and by increasing the purchasing power of local consumers. Developed countries have no extra potential for such scaling up, whereas, in developing countries, the domestication of value chains would entail a temporary loss of major markets. Moreover, in the latter, the vast majority of final customers are foreign ones accessed thanks to collaboration with headquarter economies. In such a situation, domestication efforts would be counterproductive in terms of increasing the scale of production. This suggests that catching-up countries have limited room for manoeuvre as regards the application of LCRs in pursuit of technological development, unless they have the demographic potential to exploit domestic demand should their foreign partners decide to retaliate.

Therefore, we relied on circumstantial inferencing: we did not seek unequivocal evidence of impacts, *i.e.* whether and to what extent LCRs were actually instrumental in the occurrence of these phenomena. However, since the application of this policy instrument brought about positive net effects in the form of increased value added in the domestic economy, and a range of mechanisms emerged to increase the volume of value added in the sector affected by it, we have sufficient evidence to conclude that China's application of LCRs in 2004–2014 indeed induced technical progress and increased the volume of value added in its economy. However, it appears that other developing countries are unlikely to benefit from this experience. China's policy proved to be successful thanks to the existence of a technological gap, the prospects for economies of scale resulting from the size of its internal market, which significantly strengthened the effects of export expansion, and a sufficiently strong state capable of resisting not only the pressure from final goods manufacturers but also from previous global incumbents on technologically advanced products markets. The experience gained by China in the period immediately following its accession to the WTO (until 2014) provided a good starting point for the announcement in 2015 of the Made in China 2025 strategy, which seems to emphasise the country's desire to substitute foreign technologies with its own.

Having said that, our research approach has some limitations. Firstly, we assumed that China applied LCRs, whereas no such measures were adopted by the EU member states. However, in reality, various other more or less hidden barriers protect the European market against competition from outside (tariffs) and from technologically catching-up economies (*e.g.,* product standards). The already high level of technological sophistication of the German and Austrian economies may be the effect of institutions created decades ago to strengthen internal economic circulation. This implies that certain negative effects of such hidden LCRs should also be visible in the developed CEMC countries. We did not address the potential industrial policy impacts such as the loss of cost competitiveness and the struggle to regain it through offshoring. Secondly, our findings may lead to the conclusion that subjecting economic actors to an industrial policy regime requires a strong political control of economic life. China officially denied violating WTO rules, which was met with widespread disbelief (cf. Wübbeke *et al.*, 2016), but analyses of LCRs applied by other countries suggest that other large economies, such as the United States, Brazil, and India, use similar instruments to an even greater extent than China (Stone

et al., 2015; OECD, 2016; Deringer *et al.,* 2018). This strongly implies that behind the façade of free trade, powerful players pursue protectionist policies anyway (Chang, 2003; Wallerstein, 2004), whereas China was put on the spot, because its very size threatens the incumbent leaders. In this situation, more useful lessons for developing countries may be drawn from case studies of medium-sized countries and sectoral policies. The consequences of the Made in China 2025 Strategy also promise to be an informative object of study, as they may already manifest themselves in the subsequent editions of international input-output tables.

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Conflict of Interest

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