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ΥΠΟΥΡΓΕΙΟ ΑΝΑΠΤΥΞΗΣ ΚΑΙ ΕΠΕΝΔΥΣΕΩΝ

ΓΕΝΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΕΡΕΥΝΑΣ ΚΑΙ ΤΕΧΝΟΛΟΓΙΑΣ

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Summary

This study explores the basic trends in the production and use of intangibles in Germany and Greece in the 2000-2014 period. To this end, we use the novel Globalinto Input-Output Intangibles Database (GIOID) (Dimas et al., 2021; 2022a, b), which provides data regarding the use of four different types of intangible inputs for 56 2-digit NACE Rev.2 sectors in the two economies. This database adopts a novel conceptual framework, where intangibles are considered as intermediate production inputs produced by specific intangibles' producing service sectors in each economy. By treating intangibles as producer's services, this framework embeds them in domestic and global value chains and unlocks the origin dimension in intangibles' production, as the user can distinguish, and measure domestically produced and imported intangibles (all types). We make use of this extensive dataset to document trends regarding intangible flows for the two economies, and identify the major sectors engaged in the use of intangibles in their production. The analysis focuses on the production and use trends of different types of intangibles, with emphasis in the intangible inputs consumption trends of the manufacturing sectors in the two economies.

Keywords: intangible inputs; intangible flows; Germany; Greece; manufacturing; R&D

Empirical investigation on the patterns of production and use of intangible assets in Germany and Greece

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1. Introduction

Intangible assets have recently been in the foreground of economic research with several studies trying to capture their true effect on production values and productivity growth in a rapidly changing economic environment. Empirical research on the matter has to tackle two major issues: definition and quantification of intangible assets. Since the seminal works of Nakamura (2001) and Corrado et al. (2005, 2009), the scientific community has established a specific approach in the measurement of investments in intangible assets by classifying them into various categories. Relevant information and concepts to measure business intangible investments by industry in the EU have been proposed by several databases, namely INNODRIVE (Jona-Lasinio et al., 2011), INDICSER (O'Mahony et al., 2012), INTAN-Invest (Corrado et al., 2016), the 2019 release of the EUKLEMS (Stehrer et al., 2019), and the INTANProd dataset (Bontadini et al., 2021). But critical issues derive from intangible investments data such as: where are those investments used? Who produces the intangible assets and who capitalizes on them?

According to Corrado et al. (2005, 2009), intangible assets comprise computer software, ICT activities, research and development activities output, organizational capital, innovative property and economic competencies, entertainment, and design, branding and marketing. The fact that these assets are intangibles, does not imply either that access to them is free, or that some of them are provided by nature. On the contrary, intangible assets are mainly provided by certain economic sectors, which are continuously developing their production methods, as well as the characteristics and the merits of these assets. As a result, intangibles can certainly be treated as intermediate products and services in the inter-industry trade. Moreover, in the globally fragmented economy, intangibles as well as other intermediates, are constantly traded between industries in different economies around the world. This sector dimension of intangible assets usage as inputs in the production process and the corresponding trade of intangibles between industries, is yet to be explored by the scientific community.

Using the aforementioned concept of treating intangibles as intermediates, we contribute to the emerging field of quantifying the impact of intangible assets in an industry's production cycle by introducing a higher level, 2-digit NACE Rev.2 sector

inputs approach based on the inter-sector (and inter-country) trade of utilities. The study of intangible inputs in combination with various statistics regarding investment in research and development (R&D), allows us to successfully quantify the true impact of intangibles on a sector's activity and furthermore, using trade statistics and further studying of inter-industry relationships, to map the intangibles trade between countries.

The construction of the GLOBALINTO Input-Output Intangibles Database (GIOID) (Dimas et al., 2021; 2022a, b; Tsakanikas et al., 2022) was implemented in the context of the Horizon 2020 project: GLOBALINTO: Capturing the value of intangible assets in micro data to promote the EU's Growth and Competitiveness. The construction methodology is based in an input-output (I-O) breakdown of several figures and indicators related with sector activity. The database also focuses at sector investment on R&D.

By adopting the concept of intangibles as inputs, we formulate an industry-level database of intangibles based on production input data from all over the world, for 56 2-digit NACE Rev.2 sectors in the EU-27 economies and the United Kingdom (UK) using the World Input- Output Database (Timmer et al., 2015). Output data of these sectors were also processed. WIOD was constructed based by a consortium of 12 research institutes, headed by the University of Groningen and its construction was funded by the Research Directorate General of the European Commission as part of the 7th Framework Program. GIOID draws data from the 2016 release of WIOD which consists of a series of intercountry I-O tables and covers 43 countries (27 EU countries, UK and 15 other major countries in the world) and a proxy economy for the rest of the world, for the period 2000-2014. Data for 56 sectors are classified according to the International Standard Industrial Classification revision 4 (ISIC Rev. 4) that is also consistent with the NACE Rev.2 industry classification. The tables adhere to the 2008 version of the System of National Accounts (SNA). Furthermore, the I-O data are complemented with several statistics related to R&D investment from Eurostat Structural Business Statistics and National Accounts. By treating intangibles as producer's services, this framework embeds them in domestic and global value chains and unlocks the origin dimension in intangibles' production, as the user can distinguish, and measure domestically produced and imported intangibles (all types).

The current chapter utilizes this novel dataset to provide a preliminary empirical investigation on the major trends regarding the production and use of intangibles in Germany and Greece. We specifically analyze the evolution of intangibles production and use in the two countries and monitor patterns that correspond to specific sectors and types of assets, with an emphasis on the origin of intangibles and use patterns that correspond to each country's manufacturing sectors.

2. The database

The methodological approach for the construction of the database is based on the relevant literature and consists of three main phases:

- Extraction of the raw data from WIOD's intercountry I-O tables based on the principles of I-O analysis (Miller and Blair, 2009).
- Calculation of the respective variables and measures included in the database.
- Consolidation of the calculated variables and measures with additional complementary data from Eurostat Structural Business Statistics and National Accounts.

This means that there is significant value added to the source WIOD, since all these new measures that have been created, emanate from the relevant literature, and represent a methodological and conceptual new approach to measuring intangibles at the national and sectoral level.

GIOID is divided into two separate categories of data and indicators: data related with sector input (Inputs side) and data related with sector output (outputs side).

2.1. Intangible sector inputs (at current prices)

Based on the I-O concept of WIOD and on the categories of intangibles from the INTAN-Invest database, we approximate intangible assets as production inputs that are produced from four two-digit NACE Rev.2 industry sectors¹ (or groups). Specifically, the sectors producing intangibles are:

- J62-J63 sectors: Computer programming, consultancy, and related activities; Information service activities
- M72 sector: Scientific research and development
- M73 sector: Advertising and market research
- N sector: Administrative and support service activities

The intangible inputs are produced from these sectors in 43 countries (all EU members and Great Britain included) and the rest of the world (RoW) and used by 56 2-digit NACE Rev.2 sectors in each EU country and Great Britain, during the period 2000-2014. Overall country inputs, per category of intangibles, are also estimated, in each year. The database also includes aggregates of intangible inputs imported from BRIC economies (Brazil, Russia, India and China), the Euro Area and EU-27 together with Great Britain.

2.2. R&D sector inputs

Using the available Eurostat Structural Business Statistics data, we include in the database two indicators regarding R&D inputs:

- R&D spending to output ratio (current prices): data cover 37 2-digit NACE Rev.2 sectors from all EU members and Great Britain for the period 2007-2013

¹ Intangible assets from these sectors cover software, R&D input, organizational capital and branding.

- R&D personnel to total employment ratio: data cover 37 2-digit NACE Rev.2 sectors for the period 2008-2014

2.3. Sector outputs (at current prices)

The database includes data about the part of production absorbed from exports for 56 2-digit NACE Rev. 2 sectors, in each EU country. Exports are divided into five categories, with respect to usage purpose, following the classification in the I-O tables of WIOD:

- Exports used as intermediate inputs;
- Exports used for household consumption;
- Exports to non-profit organizations serving households consumption;
- Exports used for government consumption;
- Exports pertaining to gross fixed capital formation;

These exported goods are produced in the EU-28² countries and exported into 42 countries (all EU members except from the country of origin included) and the rest of the world (RoW), for the period 2000-2014. The database also includes aggregates for sector intra and extra EU exports per usage, with emphasis on the exports of intermediate inputs. Especially regarding exports of intermediate inputs, the database includes data to sectors producing intangibles. This fact enables the tracing of value chains of intangibles.

In addition, we provide data regarding sector productivity, approximated by the ratio of value added to total output (at current prices) and an all sectors (total economy) estimate. The database also includes an indicator about each sector's performance relative to the average sector productivity globally.

2.4. R&D output

Using the available Eurostat Structural Business Statistics data, we include an indicator to approximate the R&D output derived by each sector's R&D activity:

- Patent applications to the European Patent Office: data cover 19 2-digit NACE Rev.2 sectors from all EU-28 members for the period 2000 – 2013

The detailed list of all variables included in the database is presented below:

2.5. Input variables

- Imports of intangibles, per type of intangible;
- Domestically purchased intangibles, per type of intangible;
- Share of imported intangibles to global imports of intangibles, per type of intangible;
- Share of Euro Area imported intangibles to total intangible inputs, per type of intangible;

² Henceforth, EU-28 refers to all 27 EU members and the UK.

- Share of EU-28 imported intangibles to total intangible inputs, per type of intangible;
- Share of BRIC economies imported intangibles to total intangible inputs, per type of intangible;
- Share of RoW imported intangibles to total intangible inputs, per type of intangible;
- Share of domestic intangible inputs to global domestic intangible inputs, per type of intangible;
- Share of domestic intangible inputs to total intermediate consumption;
- Share of imported intangible inputs to total intermediate consumption;
- Share of domestic intangible inputs to total output;
- Share of imported intangible inputs to total output;
- Share of R&D expenditure to total output;
- Share of R&D personnel to total employment;

2.6. Output variables

- Exports, per use and per destination (intra-EU and extra-EU);
- Share of exports to global exports, per use and per destination (intra-EU and extra-EU);
- Share of exports to total output, per use;
- Share of exports to total output, performance relative to the world, per use;
- Exports to sectors producing intangibles, per destination (intra-EU and extra-EU);
- Exports to sectors producing intangibles, performance relative to the world, per destination (intra-EU and extra-EU);
- Share of exports to sectors producing intangibles to total output;
- Share of exports to sectors producing intangibles to total output, performance relative to the world;
- Share of value added to total output (efficiency or value-added coefficients);
- Share of value added to total output (efficiency or value-added coefficients), performance relative to the world;
- Patent applications to the European Patent Office;

3. Results and discussion

3.1. Investigation of intangible inputs in the period 2000-2014

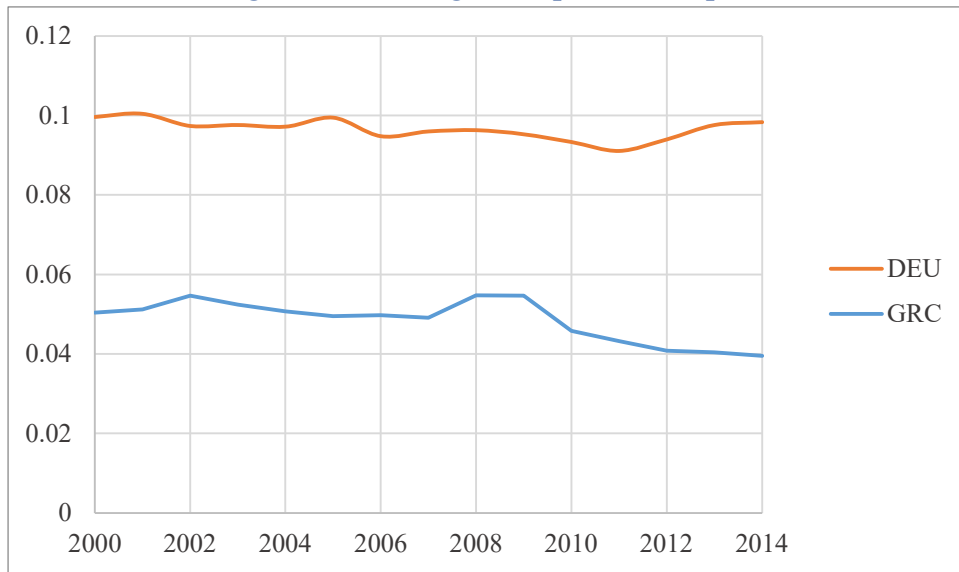


Figure 1: Share of German and Greek domestic intangibles to total intermediate consumption over time.

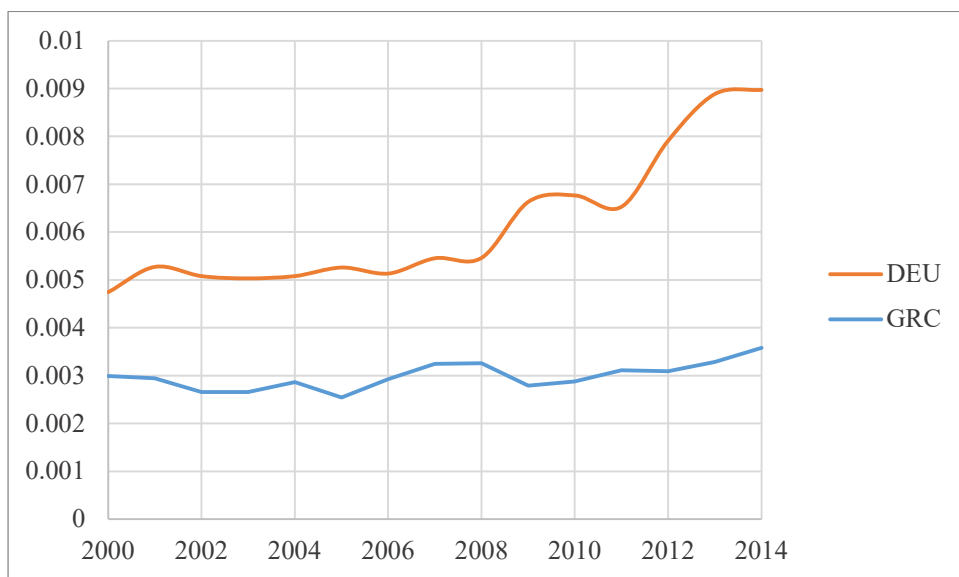


Figure 2: Share of German and Greek imported intangibles to total intermediate consumption over time.

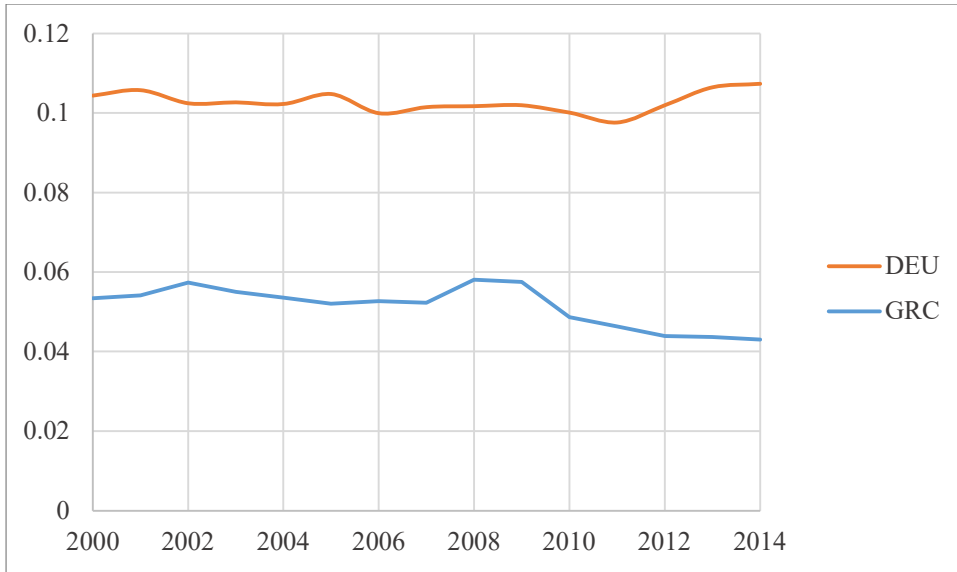


Figure 3: Share of German and Greek total intangibles to total intermediate consumption over time.

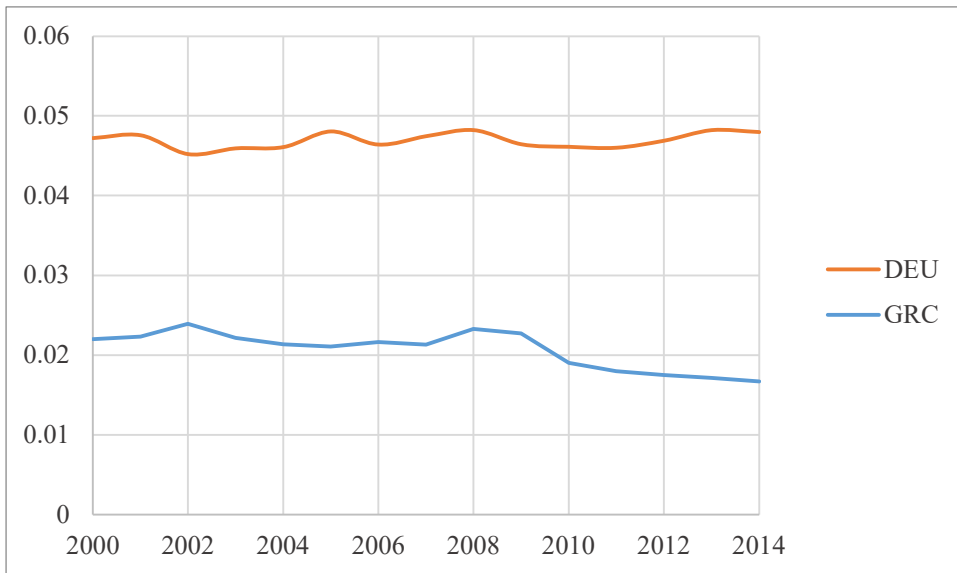


Figure 4: Share of German and Greek domestic intangibles to total output over time.

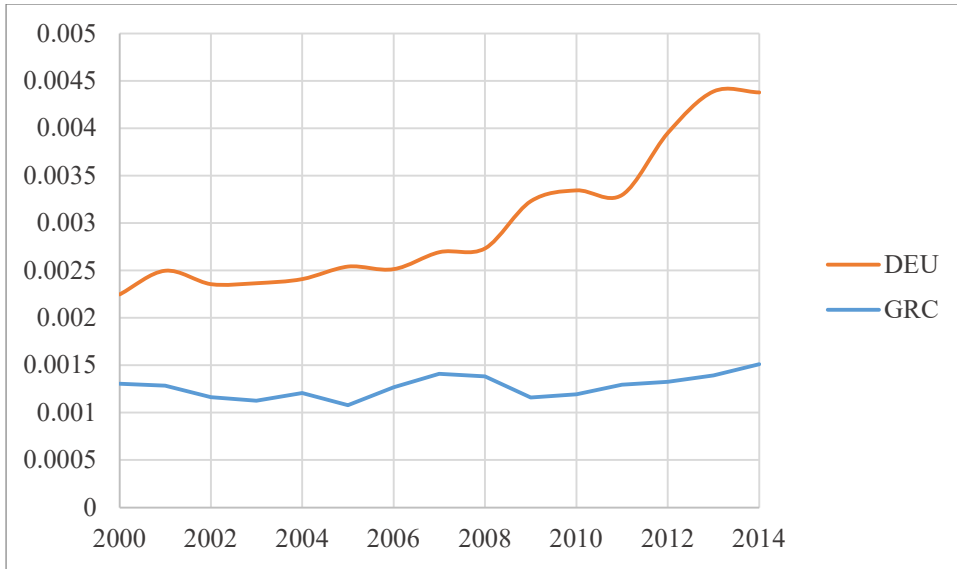


Figure 5: Share of German and Greek imported intangibles to total output over time.

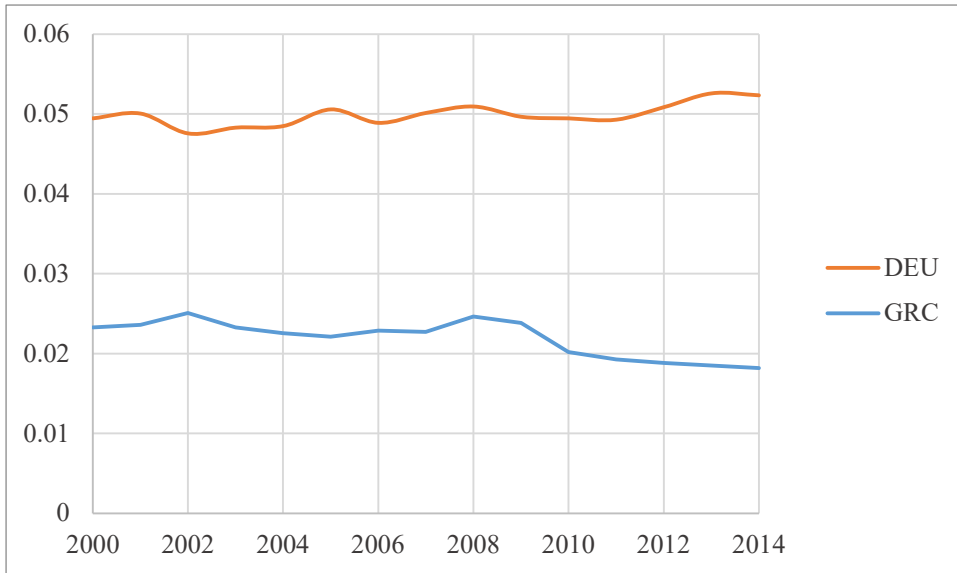


Figure 6: Share of German and Greek total intangibles to total output over time.

3.2. Investigation of asset type shares in aggregate intangible inputs

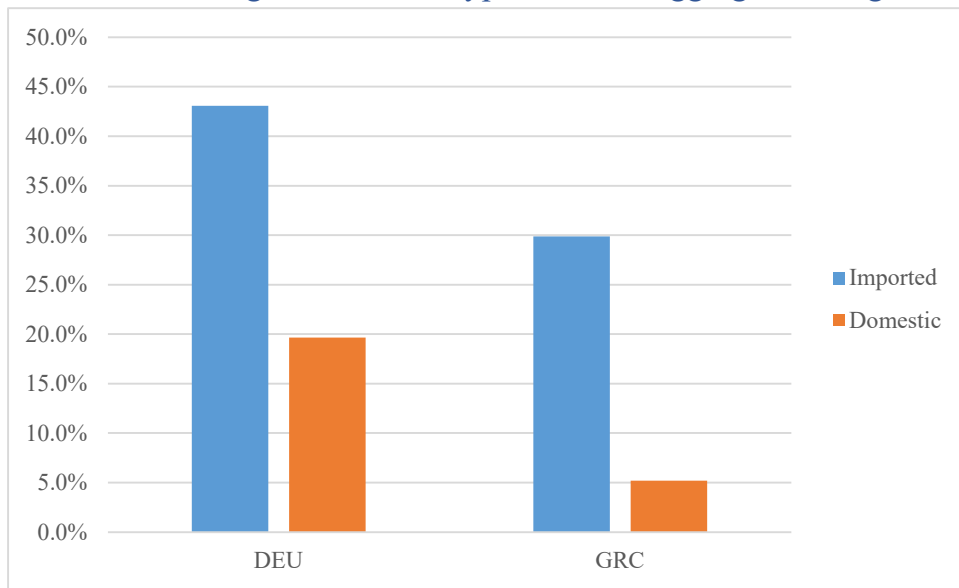


Figure 7: Share of J62-J63 asset type in German and Greek intangibles per origin. Average of 2000-2014.

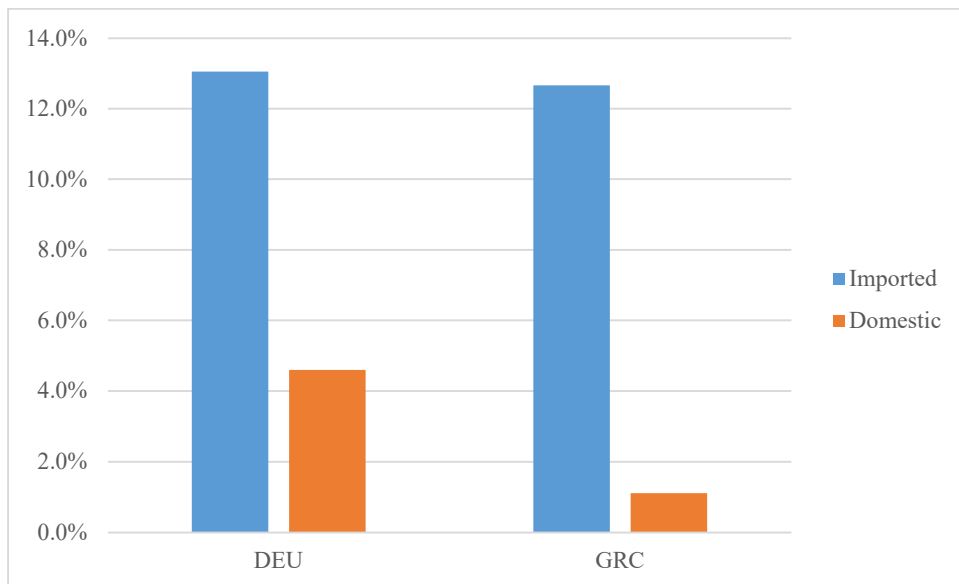


Figure 8: Share of M72 asset type in German and Greek intangibles per origin. Average of 2000-2014.

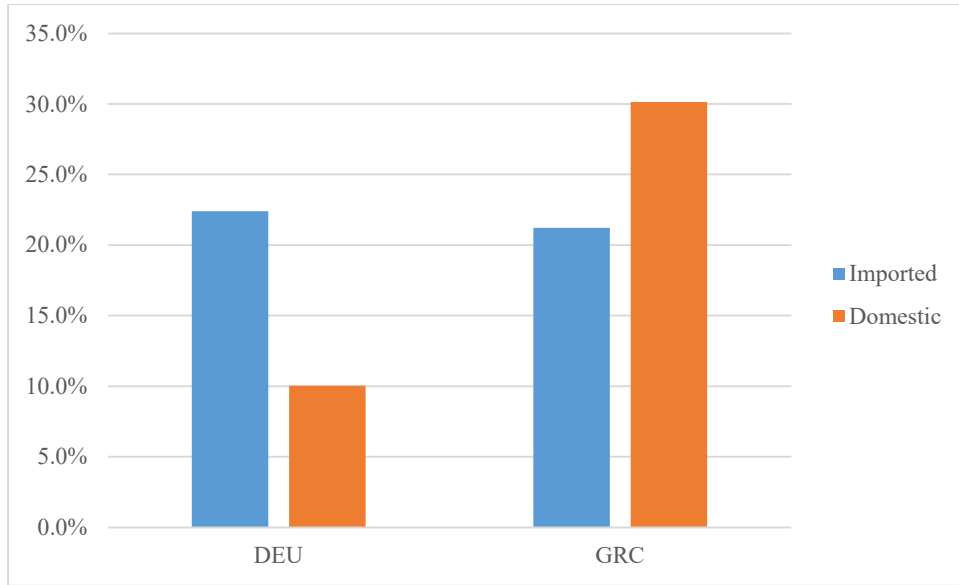


Figure 9: Share of M73 asset type in German and Greek intangibles per origin. Average of 2000-2014.

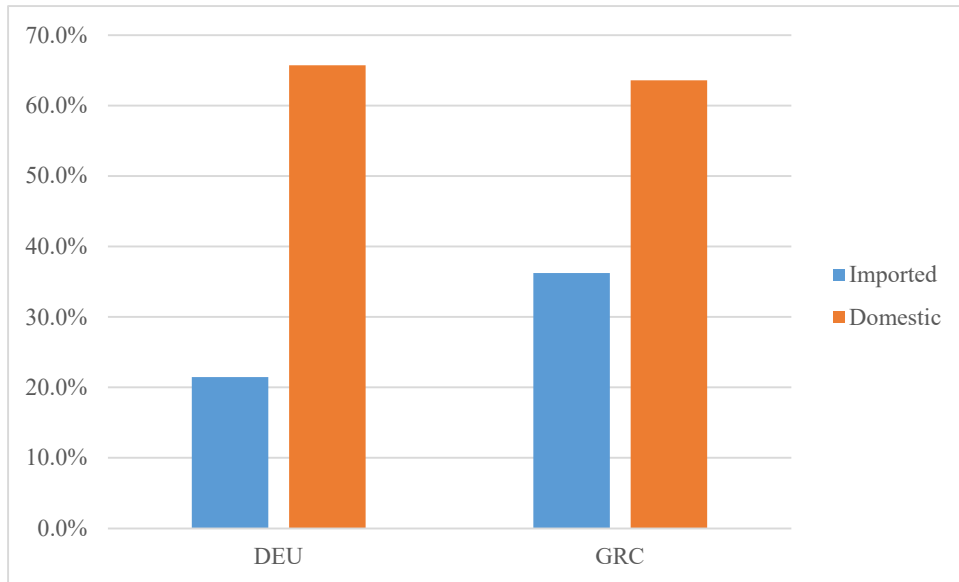


Figure 10: Share of N asset type in German and Greek intangibles per origin. Average of 2000-2014.

3.3. Inputs origin for the top-10 intangible-intensive sectors in each country

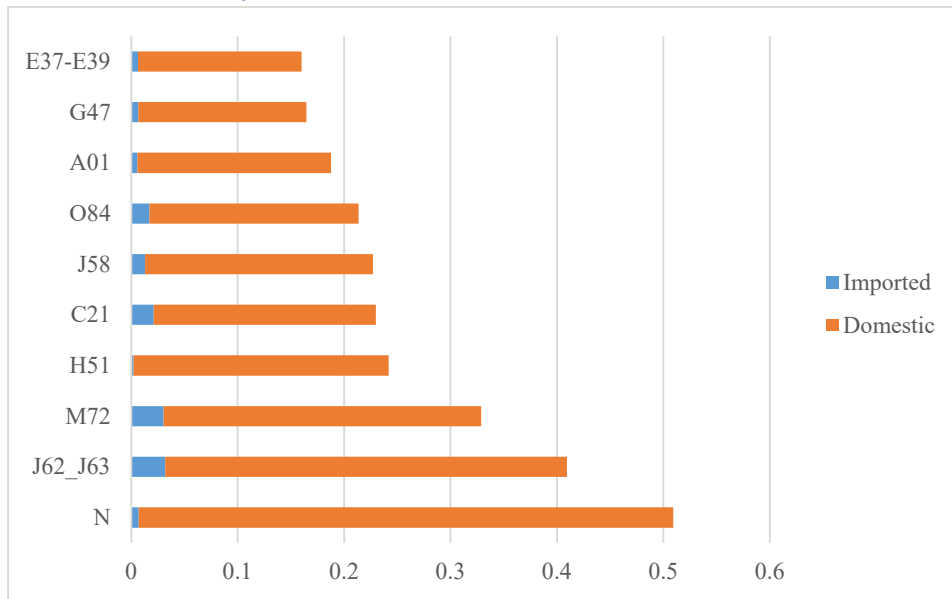


Figure 11: Most intensive sectors with regard to intermediate consumption. Germany, 2000.

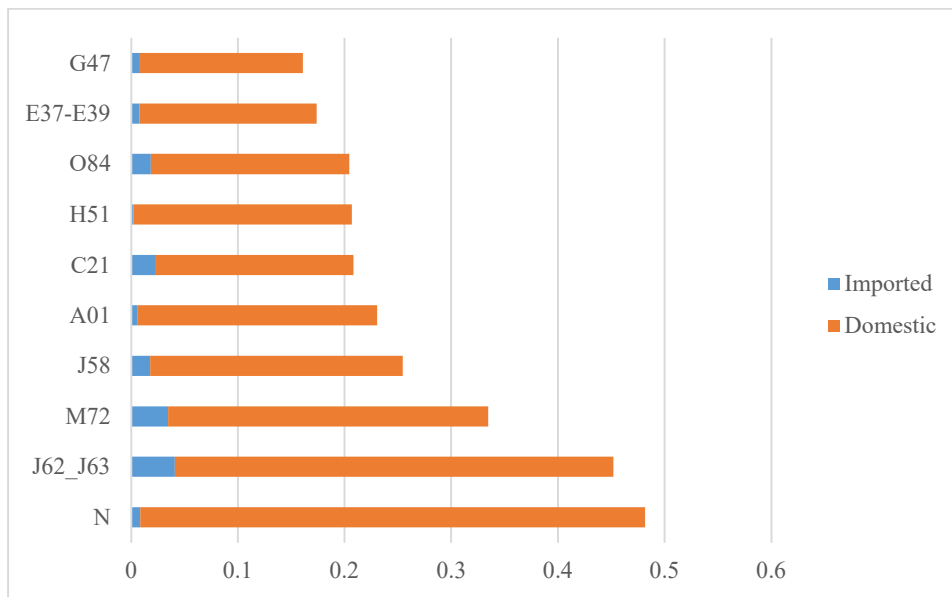


Figure 12: Most intensive sectors with regard to intermediate consumption. Germany, 2007.

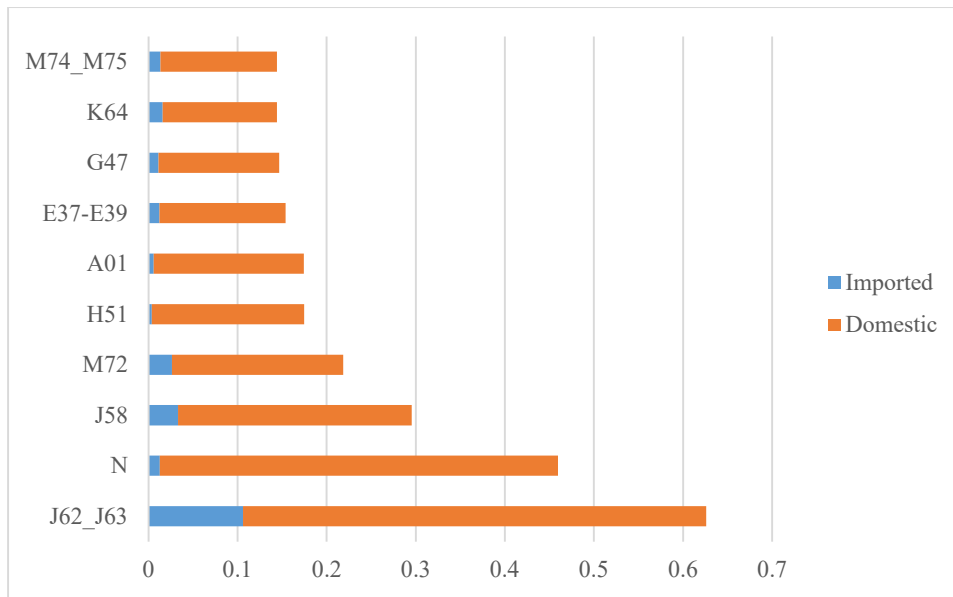


Figure 13: Most intensive sectors with regard to intermediate consumption. Germany, 2014.

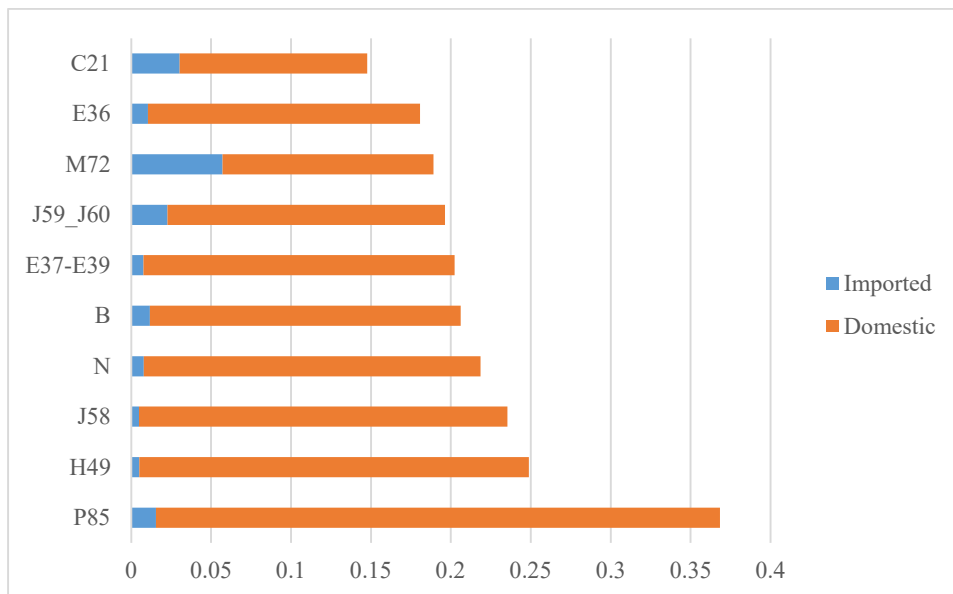


Figure 14: Most intensive sectors with regard to intermediate consumption. Greece, 2000.

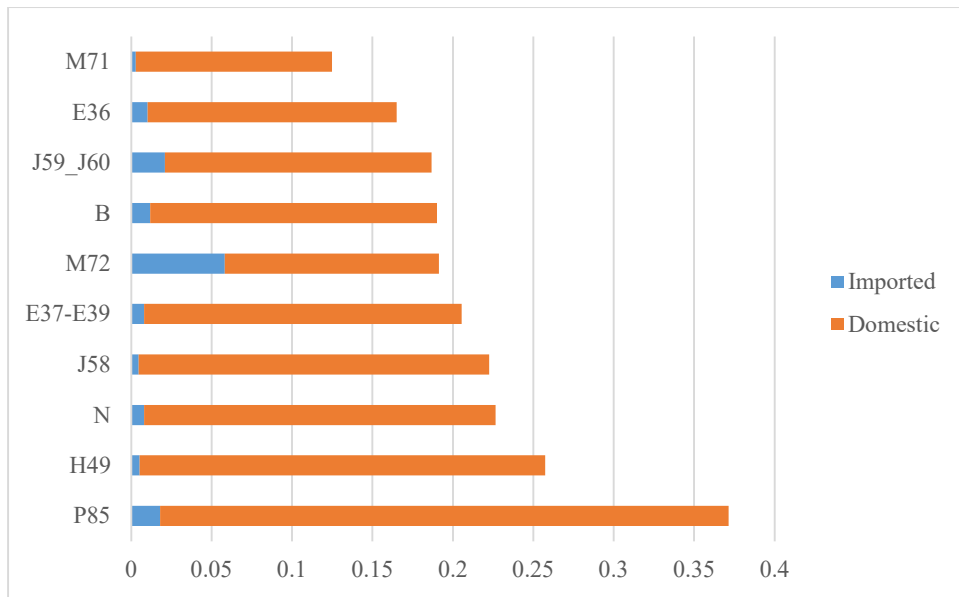


Figure 15: Most intensive sectors with regard to intermediate consumption. Greece, 2007.

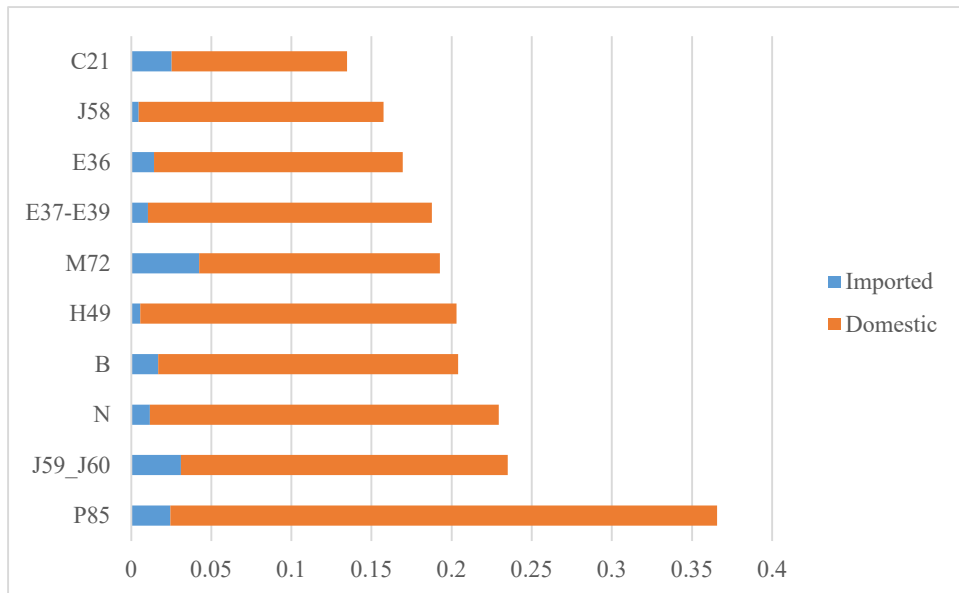


Figure 16: Most intensive sectors with regard to intermediate consumption. Greece, 2014.

3.4. Identification of the most intangible intensive manufacturing sectors

The manufacturing sector rankings per asset type (domestic, imported and total intangible inputs) were extracted.

As shown in Tables Table 1 to Table 6, a relative stability between 2000 and 2014 is observed in Greece. More specifically, the prime manufacturing sectors in computer programming, consulting & information (J62-J63) are wood (C16), printing & reproduction (C18) and computer & electronics (C26). In research & development (M72), the prime sectors are printing & reproduction (C18), pharmaceuticals (C21) and other transport (C30). Advertisement & market research (M73) asset type is dominated by food, beverages & tobacco (C10-C12), paper (C17), petroleum (C19) and chemicals (C20). Within administration & support (N), the leading role is played by machinery &

equipment (C28), other transport (C30) and furniture & other manufacturing (C31-C32).

Table 1: Sector rankings (manufacturing) per asset type, domestic intangible inputs, Greece, 2000.

RANK	J62-J63	M72	M73	N
1	C16	C21	C10-C12	C31-C32
2	C18	C18	C19	C28
3	C26	C23	C20	C30
4	C25	C16	C17	C16
5	C33	C33	C33	C22

Table 2: Sector rankings (manufacturing) per asset type, imported intangible inputs, Greece, 2000.

RANK	J62-J63	M72	M73	N
1	C26	C21	C10-C12	C22
2	C16	C30	C17	C31-C32
3	C18	C22	C20	C28
4	C30	C24	C19	C19
5	C33	C19	C13-C15	C29

Table 3: Sector rankings (manufacturing) per asset type, total intangible inputs, Greece, 2000.

RANK	J62-J63	M72	M73	N
1	C26	C21	C10-C12	C31-C32
2	C16	C18	C19	C28
3	C18	C30	C20	C30
4	C25	C16	C17	C22
5	C33	C23	C33	C16

Table 4: Sector rankings (manufacturing) per asset type, domestic intangible inputs, Greece, 2014.

RANK	J62-J63	M72	M73	N
1	C16	C21	C10-C12	C31-C32
2	C18	C18	C19	C28
3	C26	C23	C17	C30
4	C25	C33	C20	C22
5	C33	C16	C33	C29

Table 5: Sector rankings (manufacturing) per asset type, imported intangible inputs, Greece, 2014.

RANK	J62-J63	M72	M73	N
1	C26	C21	C10-C12	C19
2	C16	C30	C20	C31-C32
3	C30	C22	C17	C28

4	C18	C26	C13-C15	C22
5	C29	C24	C33	C18

Table 6: Sector rankings (manufacturing) per asset type, total intangible inputs, Greece, 2014.

RANK	J62-J63	M72	M73	N
1	C16	C21	C10-C12	C31-C32
2	C18	C30	C20	C28
3	C26	C18	C17	C30
4	C25	C23	C19	C22
5	C33	C22	C33	C29

According to Tables Table 7 to Table 12, the situation in Germany between 2000 and 2014 is stable as well. Namely, fabricated metal (C25), computer & electronics (C26), electricals (C27) and machinery & equipment (C28) outperform computer programming, consulting & information (J62-J63), food, beverages & tobacco (C10-C12), petroleum (C19) and furniture & other manufacturing (C31-C32) outperform advertisement & market research (M73) and wood (C16), printing & reproduction (C18) and repair & installation (C33) outperform administration & support. As for research & development (M72), pharmaceuticals (C21) and other transport equipment (C30) play timelessly a leading role, but a slight change can be observed. More specifically, intensities of repair & installation (C33) diminished over the years and computer & electronics (C26) and electricals (C27) emerged in recent years.

Table 7: Sector rankings (manufacturing) per asset type, domestic intangible inputs, Germany, 2000.

RANK	J62-J63	M72	M73	N
1	C25	C21	C10-C12	C16
2	C26	C30	C31-C32	C18
3	C28	C33	C19	C17
4	C27	C29	C13-C15	C24
5	C33	C20	C20	C25

Table 8: Sector rankings (manufacturing) per asset type, imported intangible inputs, Germany, 2000.

RANK	J62-J63	M72	M73	N
1	C25	C30	C10-C12	C16
2	C28	C21	C31-C32	C18
3	C18	C33	C19	C24
4	C26	C23	C13-C15	C17
5	C27	C29	C20	C25

Table 9: Sector rankings (manufacturing) per asset type, total intangible inputs, Germany, 2000.

RANK	J62-J63	M72	M73	N
1	C25	C21	C10-C12	C16
2	C26	C30	C31-C32	C18
3	C28	C33	C19	C17
4	C27	C29	C13-C15	C24
5	C33	C20	C20	C25

Table 10: Sector rankings (manufacturing) per asset type, domestic intangible inputs, Germany, 2014.

RANK	J62-J63	M72	M73	N
1	C26	C26	C10-C12	C16
2	C27	C21	C21	C18
3	C28	C27	C19	C33
4	C24	C18	C20	C30
5	C21	C30	C31-C32	C23

Table 11: Sector rankings (manufacturing) per asset type, imported intangible inputs, Germany, 2014.

RANK	J62-J63	M72	M73	N
1	C24	C21	C10-C12	C16
2	C28	C13-C15	C21	C18
3	C25	C22	C31-C32	C33
4	C27	C20	C20	C30
5	C26	C28	C19	C17

Table 12: Sector rankings (manufacturing) per asset type, total intangible inputs, Germany, 2014.

RANK	J62-J63	M72	M73	N
1	C26	C21	C10-C12	C16
2	C27	C26	C21	C18
3	C28	C27	C19	C33
4	C24	C30	C20	C30
5	C21	C18	C31-C32	C23

By cross-referencing the leading sectors between Greece and Germany, there are some similarities. In particular, computer & electronics (C26) is common within computer programming, consulting & information, pharmaceuticals (C21) and other transport equipment (C30) are common within research & development and food, beverages & tobacco (C10-C12) and petroleum (C19) are common within advertisement & market research (M73). There are no interfaces within administration & support (N).

3.5. Shares of intangible inputs in manufacturing sectors per asset type: comparison between Germany and Greece

Based on the technology of each manufacturing (C) sector, the shares of intangible inputs per type are calculated. More particularly, there is a stable behavior between 2000 and 2007 (Figures Figure 17 to Figure 22), where, in both LTC-MLTC and MHTC sectors, advertisement & market research (M73) heads by a great difference with 80-90%, administration & support (N) and computer programming, consulting & information (J62-J63) follow with 5-15% and 2-5% respectively and presence of research & development (M72) is negligible (under 0.5%). In HTC sectors the intangibles are more evenly distributed. Namely, advertisement & market research (M73) barely overcomes 50% research & development (M72) is noticeable with 20% and administration & support (N) also reaches 20%, while the share of computer programming, consulting & information (J62-J63) remains in the order of 5%. As for the recent data of 2014 (Figures Figure 23 to Figure 25), the gap between advertisement & market research (M73) and administration & support (N) and computer programming, consulting & information (J62-J63) is slightly smaller. Remarkable is, that in HTC sectors, both research & development (M72), advertisement & market research (M73) and administration & support (N) share about 30% of the intangible inputs and computer programming, consulting & information (J62-J63) follow in the order of 10%.

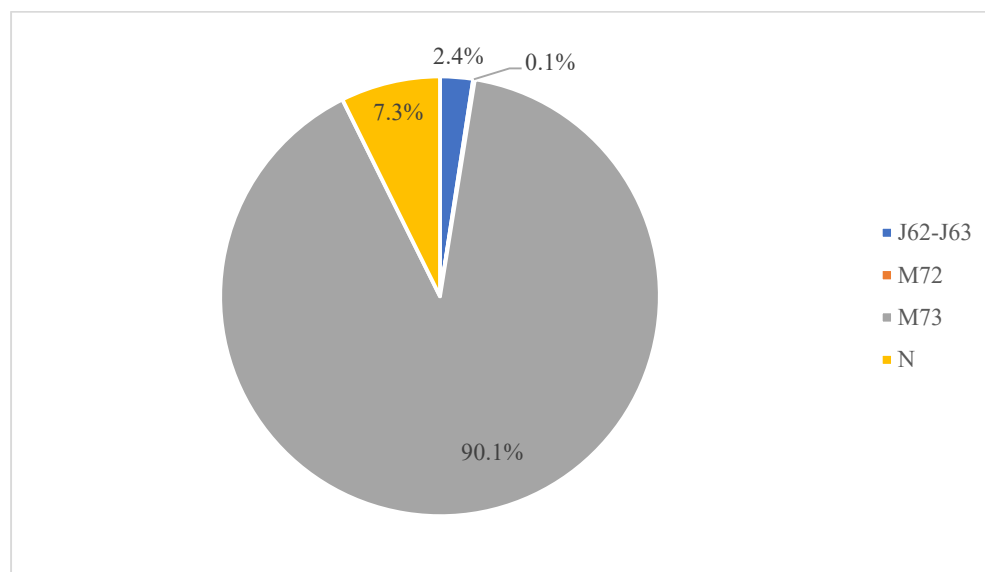


Figure 17: Intensity shares for LTC-MLTC Greek manufacturing sectors, total intangibles, Greece, 2000.

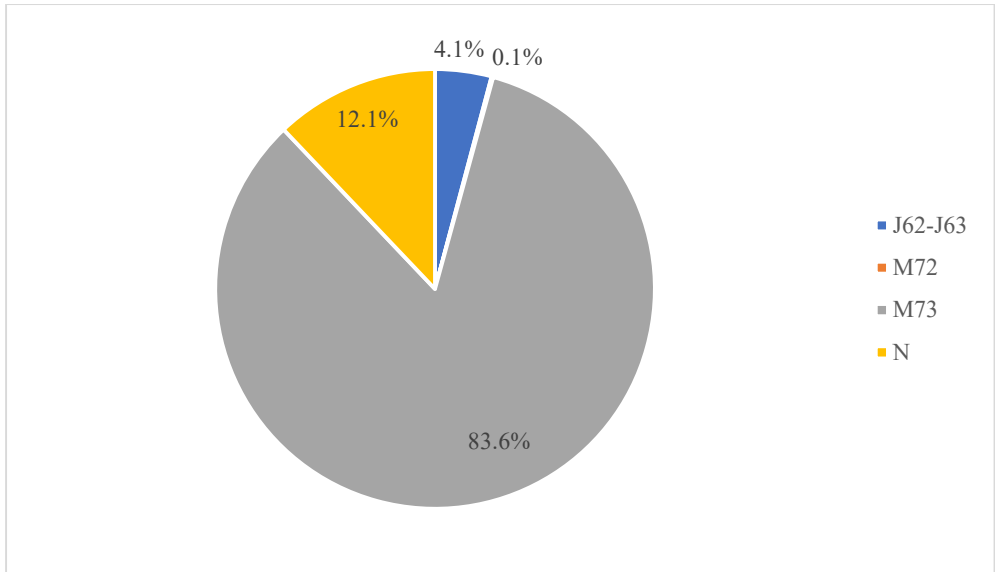


Figure 18: Intensity shares for MHTC Greek manufacturing sectors, total intangibles, Greece, 2000.

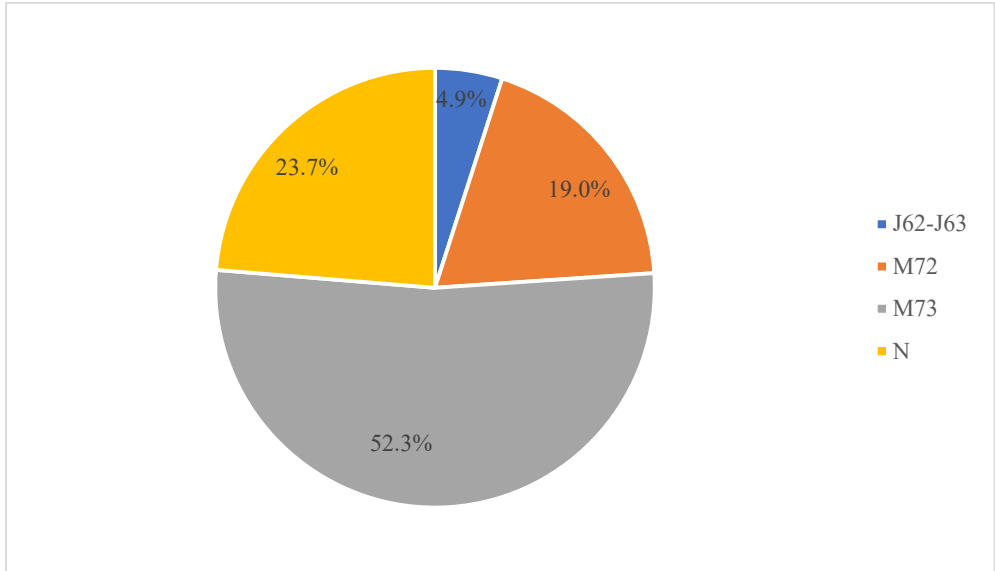


Figure 19: Intensity shares for HTC Greek manufacturing sectors, total intangibles, Greece, 2000.

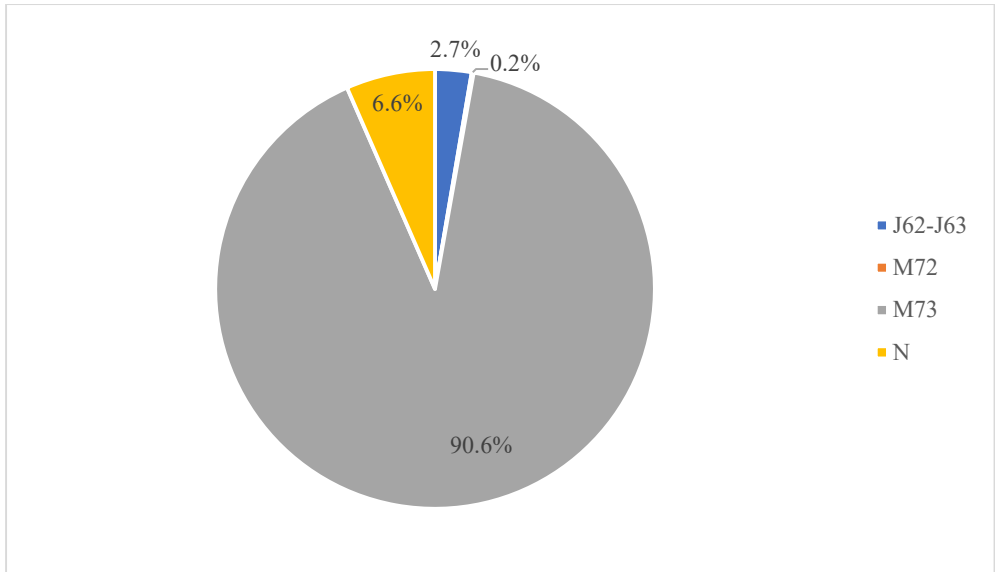


Figure 20: Intensity shares for LTC-MLTC Greek manufacturing sectors, total intangibles, Greece, 2007.

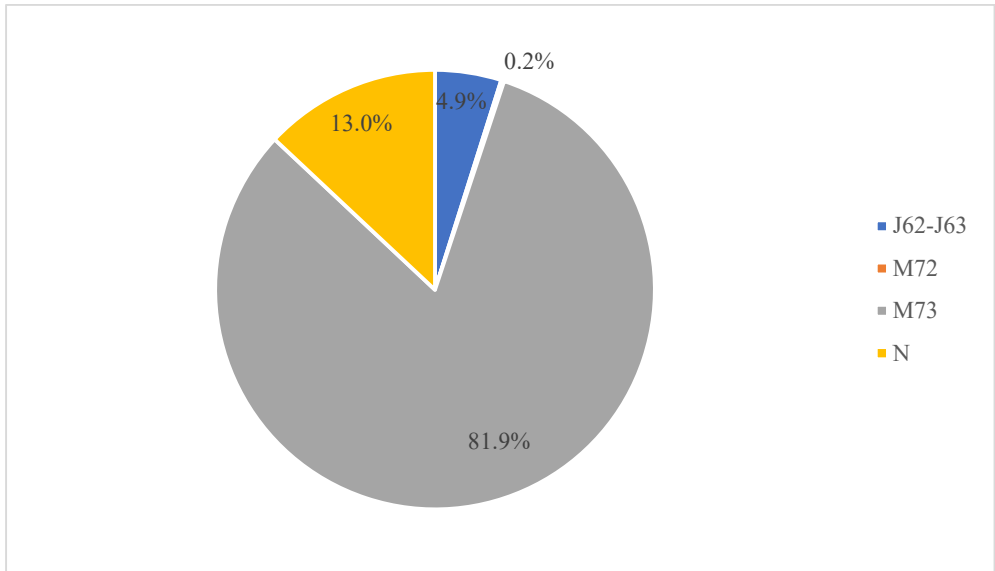


Figure 21: Intensity shares for MHTC Greek manufacturing sectors, total intangibles, Greece, 2007.

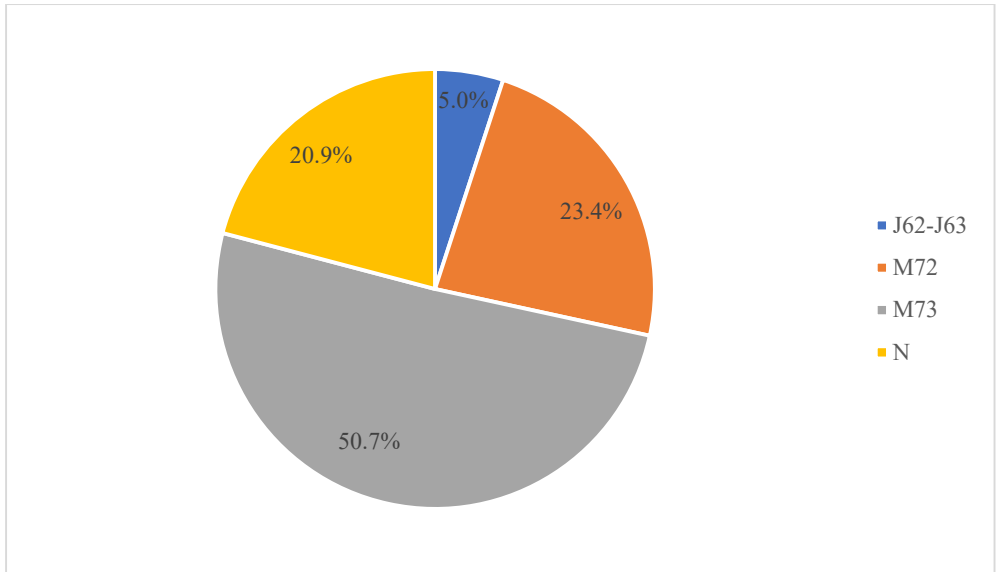


Figure 22: Intensity shares for HTC Greek manufacturing sectors, total intangibles, Greece, 2007.

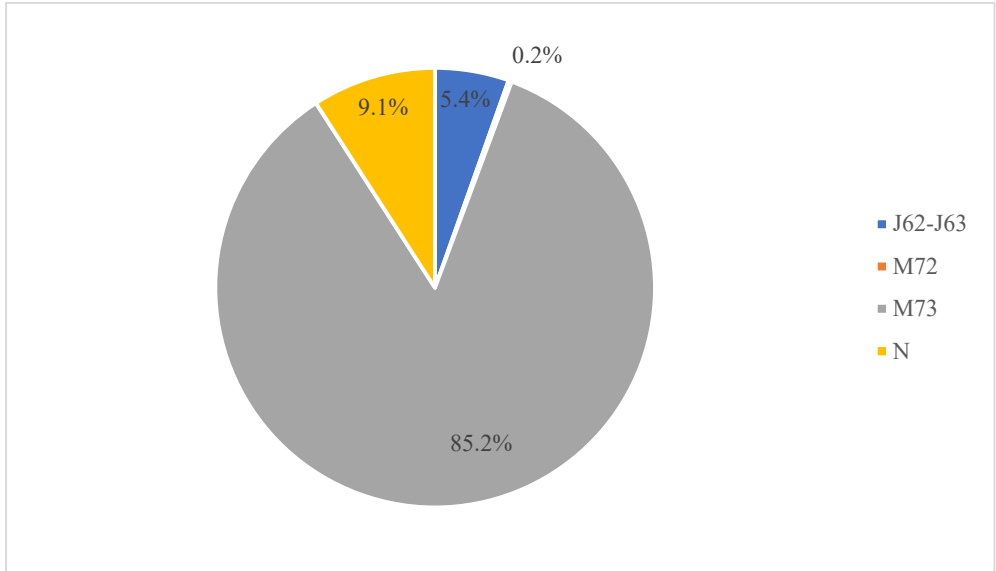


Figure 23: Intensity shares for LTC-MLTC Greek manufacturing sectors, total intangibles, Greece, 2014.

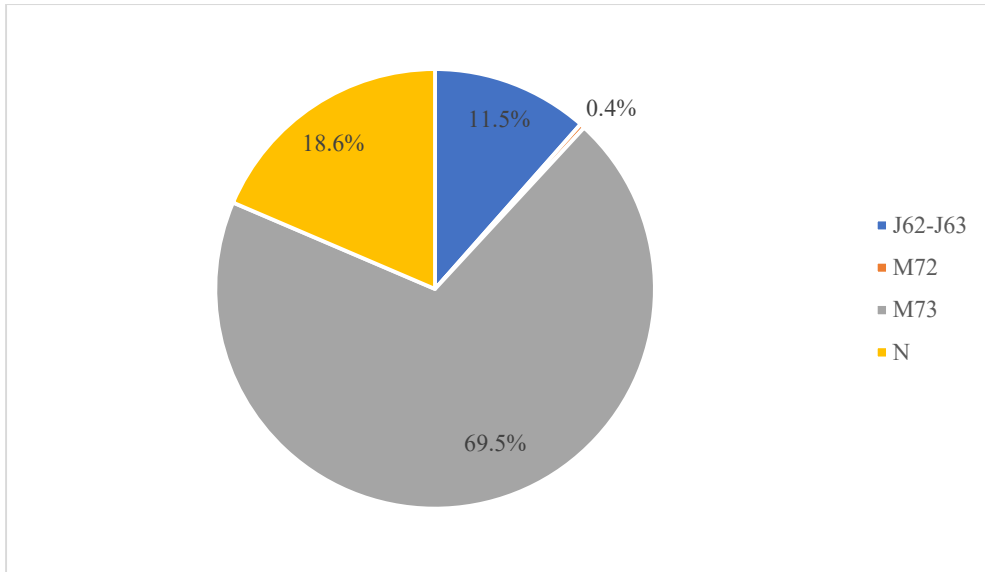


Figure 24: Intensity shares for MHTC Greek manufacturing sectors, total intangibles, Greece, 2014.

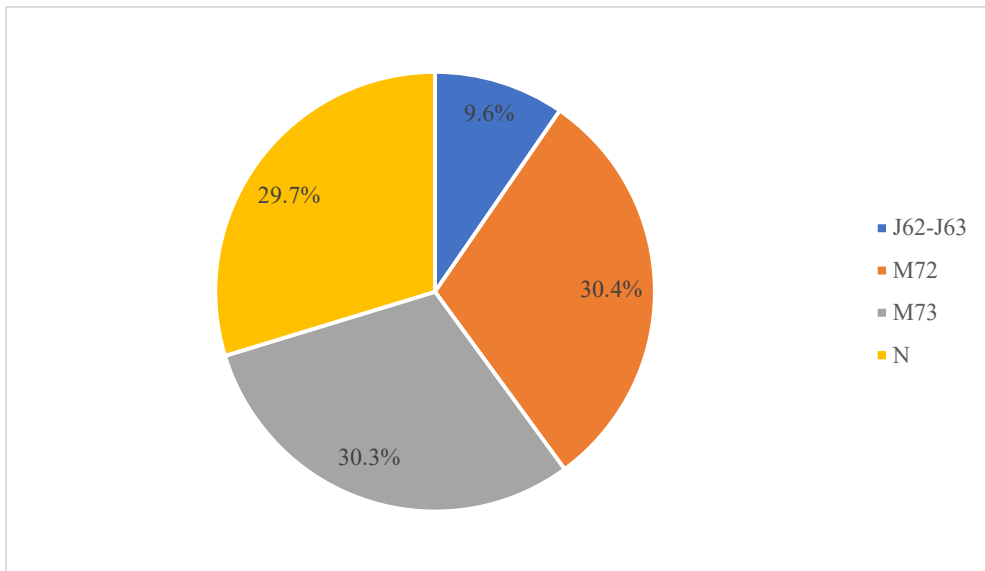


Figure 25: Intensity shares for HTC Greek manufacturing sectors, total intangibles, Greece, 2014.

In Germany (Figures Figure 26 to Figure 34), the main remarks are the following. Administration & support (N) is dominant over the intangible assets with share that can reach 65%. In any case, the gap from other asset types is lower in HT sectors. Research & development (M72) is especially higher in HT sectors, but reaches in 2014 extremely low levels (about 1-2%). The behavior is similar between 2000 and 2007.

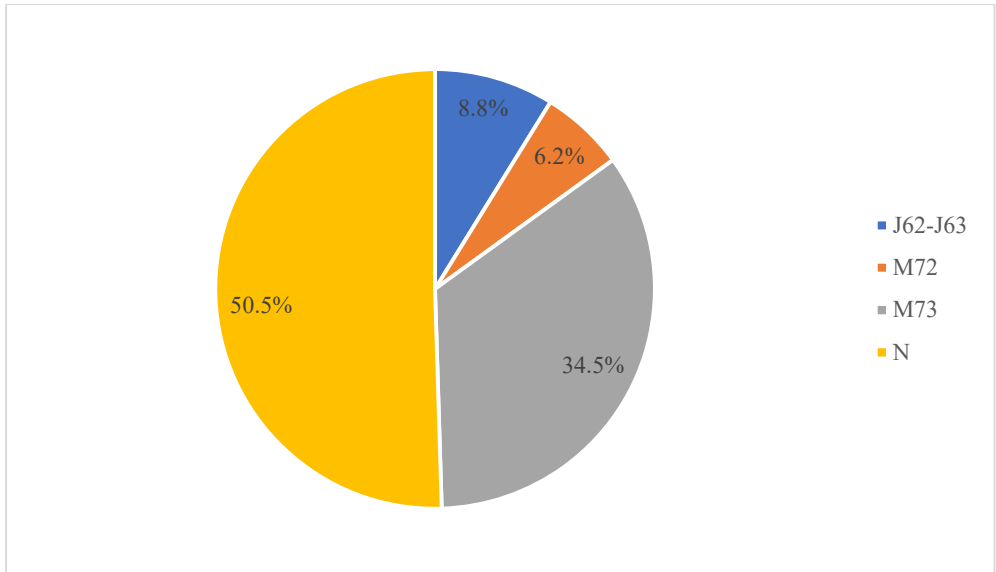


Figure 26: Intensity shares for LTC-MLTC German manufacturing sectors, total intangibles, Germany, 2000.

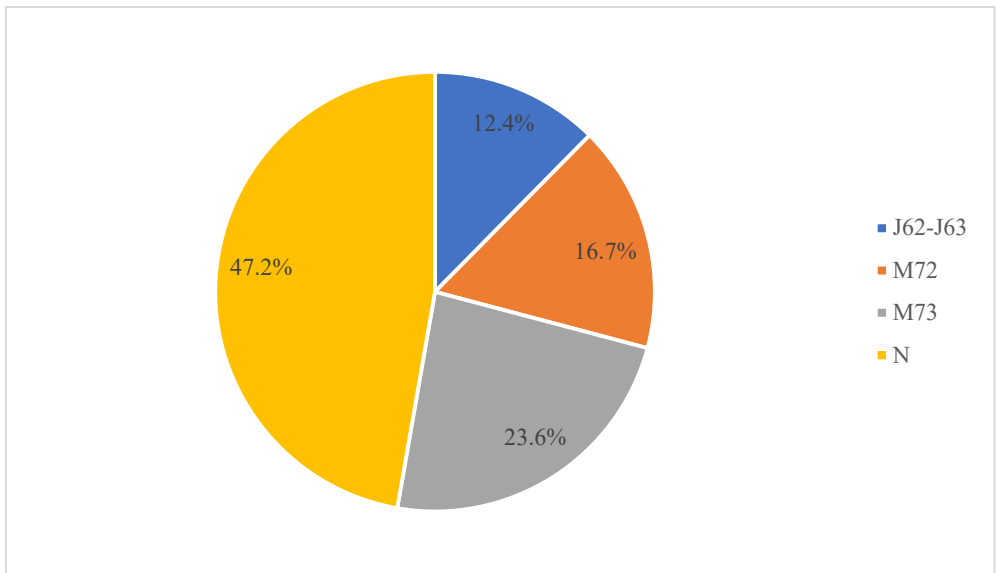


Figure 27: Intensity shares for MHTC German manufacturing sectors, total intangibles, Germany, 2000.

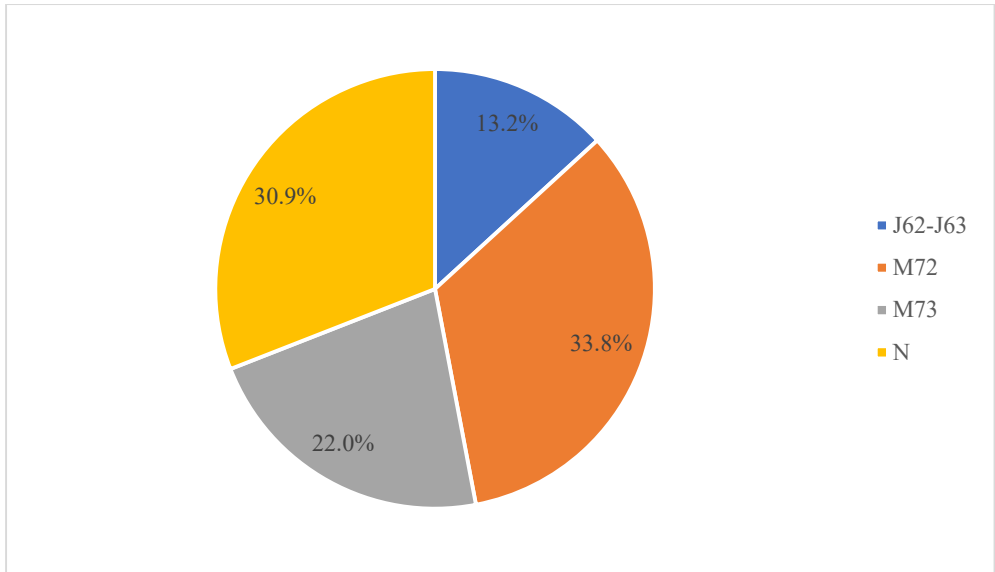


Figure 28: Intensity shares for HTC German manufacturing sectors, total intangibles, Germany, 2000.

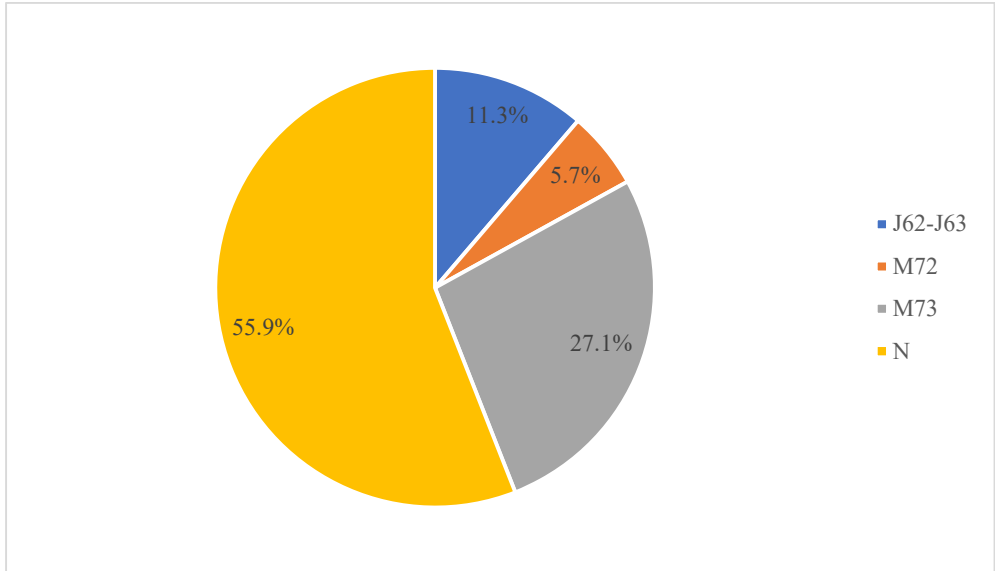


Figure 29: Intensity shares for LTC-MLTC German manufacturing sectors, total intangibles, Germany, 2007.

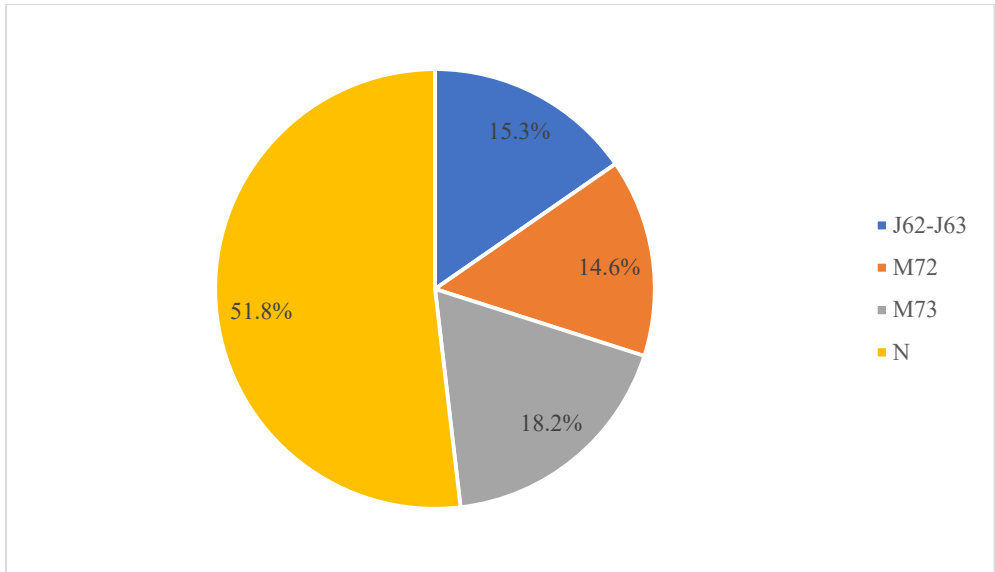


Figure 30: Intensity shares for MHTC German manufacturing sectors, total intangibles, Germany, 2007.

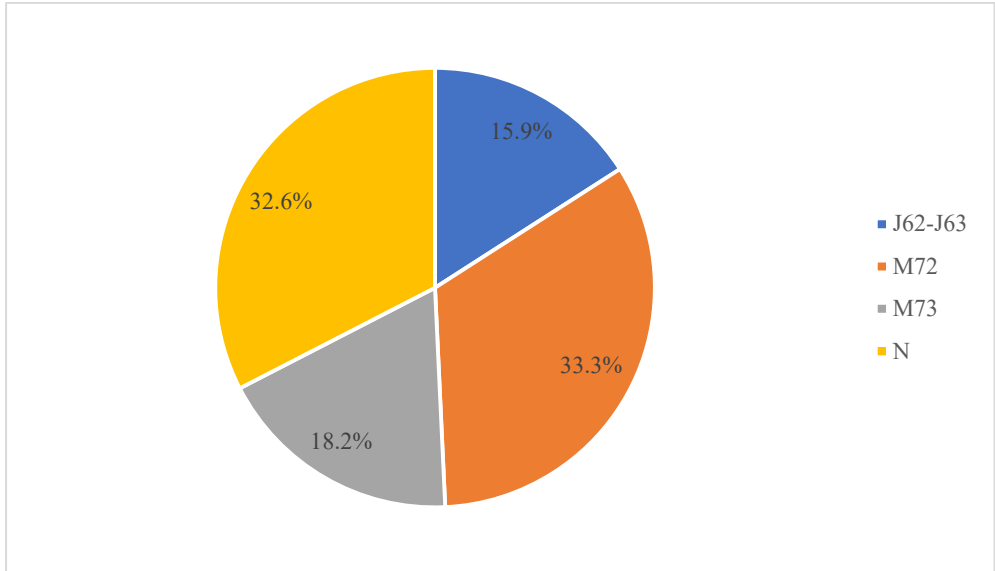


Figure 31: Intensity shares for HTC German manufacturing sectors, total intangibles, Germany, 2007.

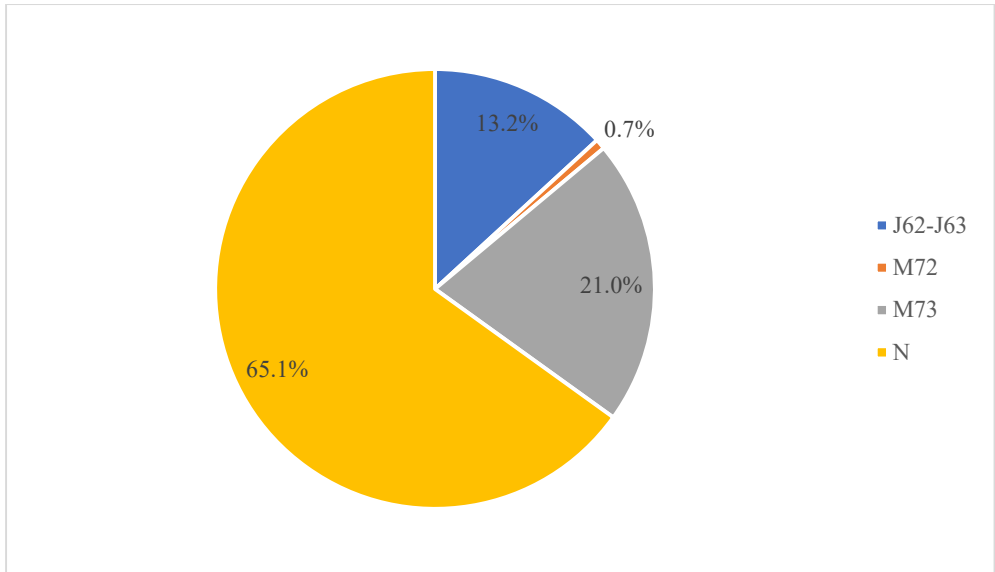


Figure 32: Intensity shares for LTC-MLTC German manufacturing sectors, total intangibles, Germany, 2014.

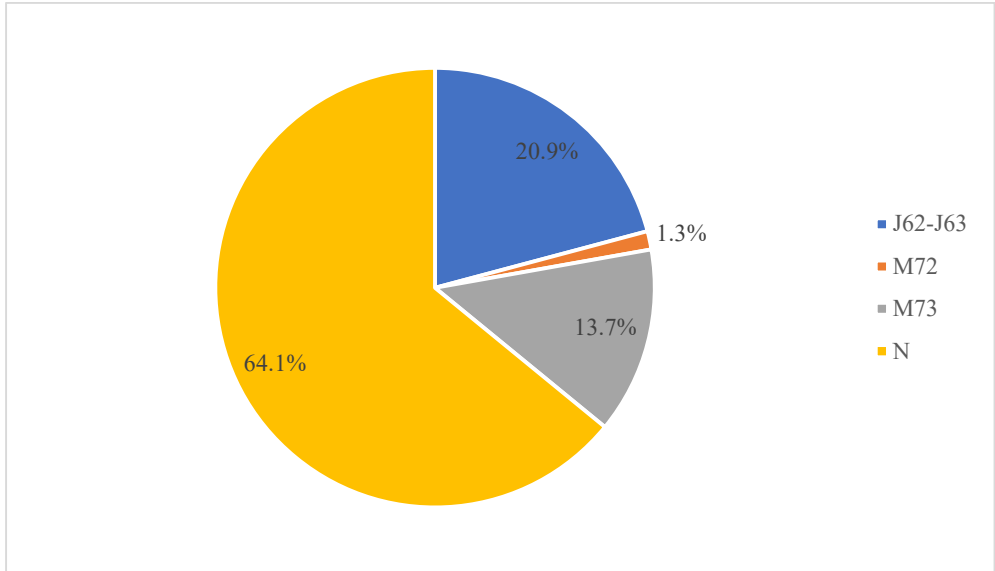


Figure 33: Intensity shares for MHTC German manufacturing sectors, total intangibles, Germany, 2014.

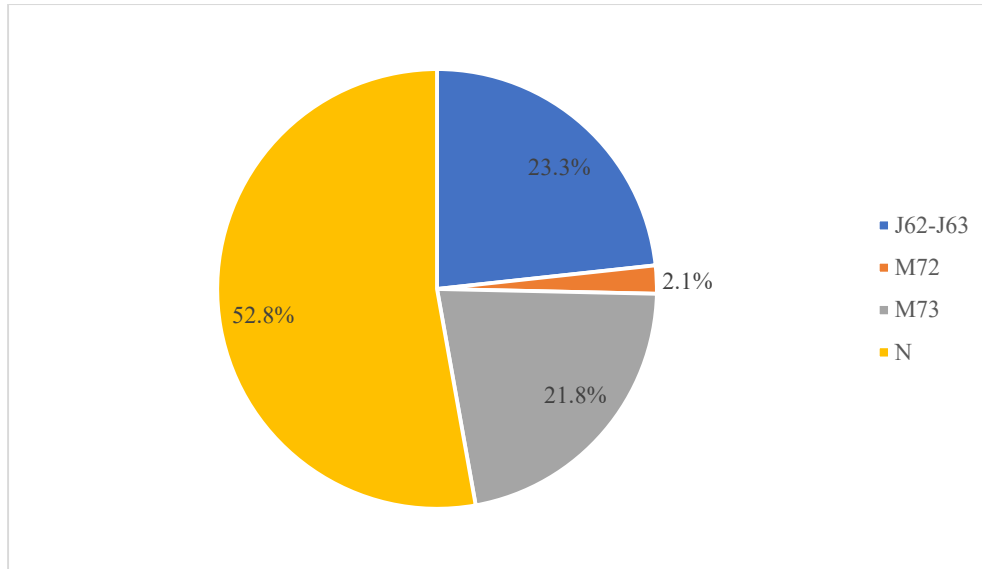


Figure 34: Intensity shares for HTC German manufacturing sectors, total intangibles, Germany, 2014.

At sector technology level, there is a similarity between Greece and Germany. More specifically, the lower the level of technology is, the more highlighted is a particular asset type. It is about advertisement & market research (M73) in Greece and administration and support (N) in Germany. Also, research & development (M72) is more noticeable in HT sectors. Generally speaking, both countries' intangible shares distribution seem influenced by the economic crisis in 2008, while the behavior before seems stable. Noticeable is, that research & development (M72) after the crisis is empowered in Greece and weakened in Germany on the contrary.

3.6. Trends of intangibles' utilization over time, per asset type and origin in manufacturing sectors

The average annual growth rate of intangibles over time is calculated. The time horizon is divided to the following periods: 2000-2007 (pre-crisis), 2008-2010 (crisis) and 2011-2014 (post-crisis).

The situation during pre-crisis period in Greece (Figures Figure 35 to Figure 39) is satisfactory. In any case the growth rate is positive and the MHTC sectors play a leading role. In research & development (M72) HTC sectors outperform too. Domestic and imported intangibles have similar growth rate in computer programming, consulting & information (J62-J63), domestic intangibles have greater growth rate in research & development (M72) and imported intangibles have greater growth rate in advertisement & market research (M73) and administration & support (N). Averagely none of the origins stands out.

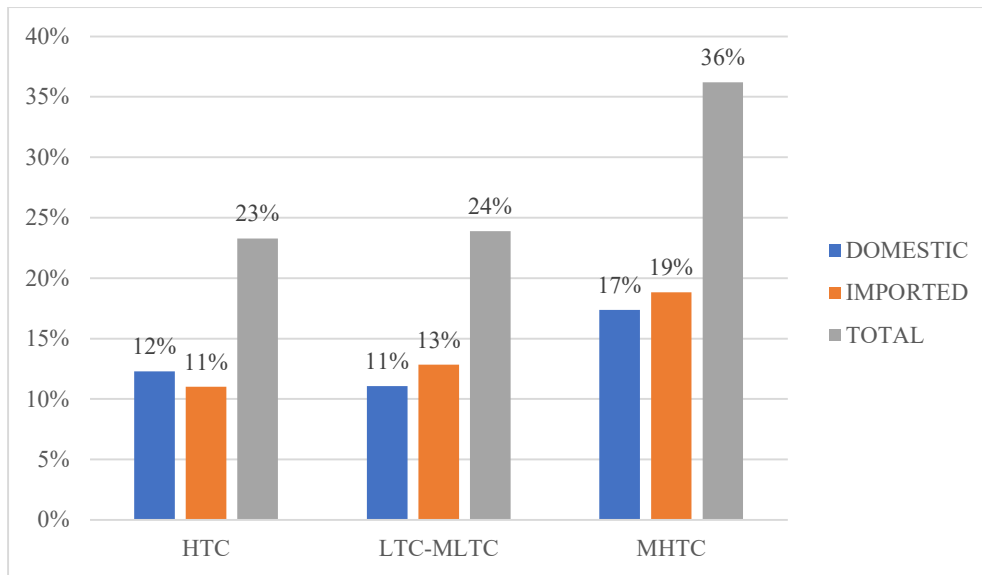


Figure 35: Growth rate (average annual) of J62-J63 inputs per origin, Greece, 2000-2007.

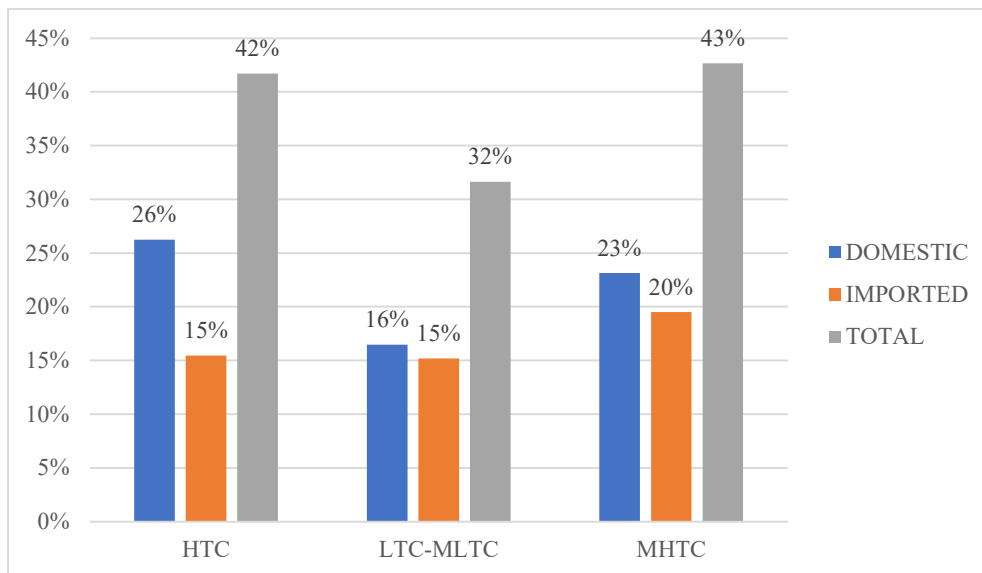


Figure 36: Growth rate (average annual) of M72 inputs per origin, Greece, 2000-2007.

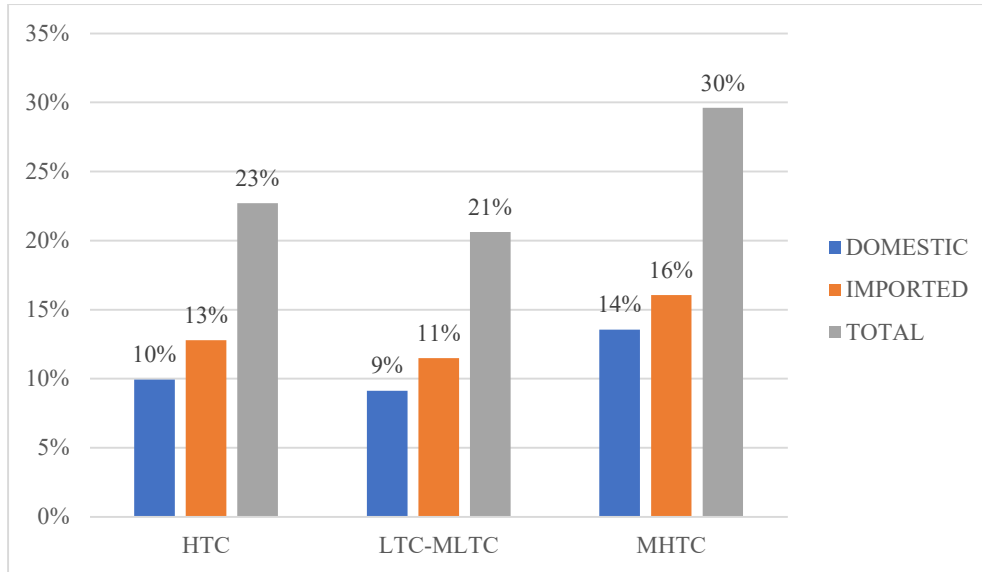


Figure 37: Growth rate (average annual) of M73 inputs per origin, Greece, 2000-2007.

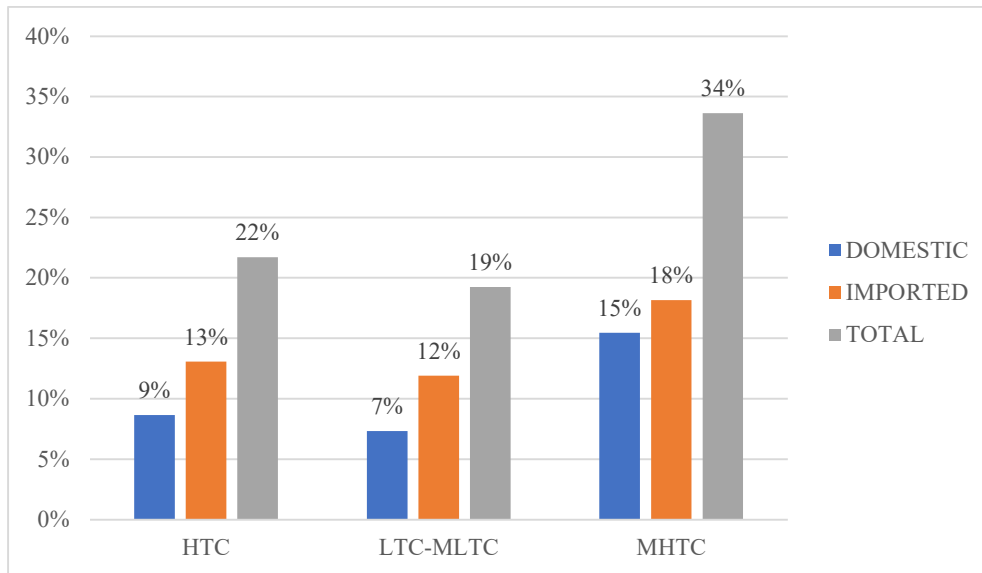


Figure 38: Growth rate (average annual) of N inputs per origin, Greece, 2000-2007.

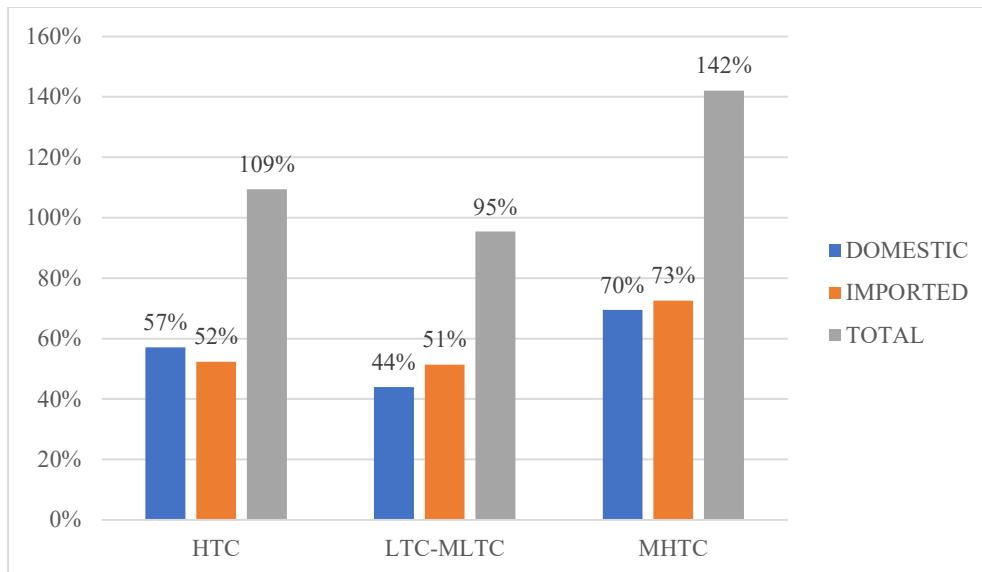


Figure 39: Growth rate (average annual) of total inputs per origin, Greece, 2000-2007.

During crisis in Greece (Figures Figure 40 to Figure 44) the situation indicates mainly recession. The only case that positive growth rate is preserved is HTC sectors, domestic origin, with 24% growth. But in aggregate the growth rate is negative. The worst case is MHTC, where the recession reaches 46%.

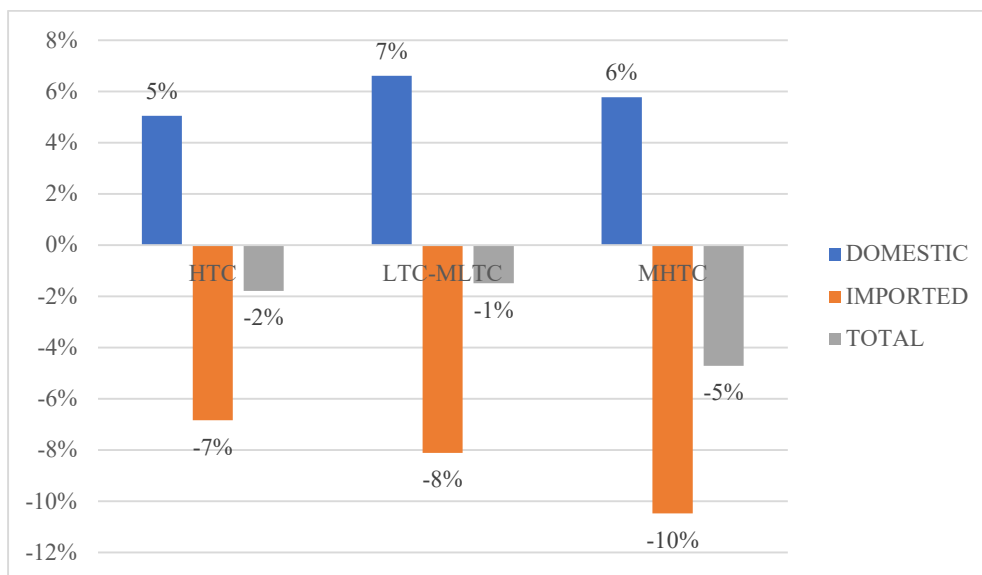


Figure 40: Growth rate (average annual) of J62-J63 inputs per origin, Greece, 2008-2010.

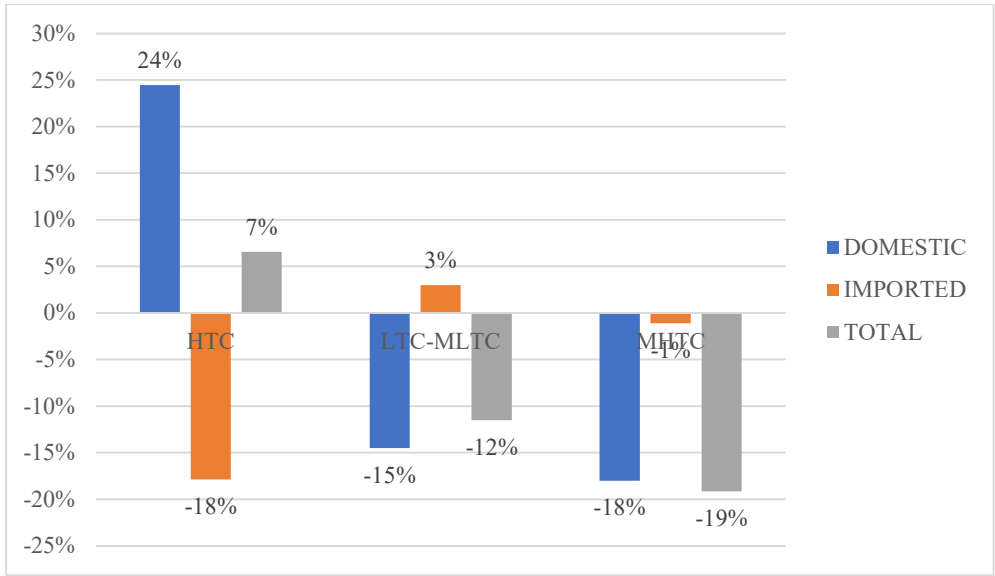


Figure 41: Growth rate (average annual) of M72 inputs per origin, Greece, 2008-2010.

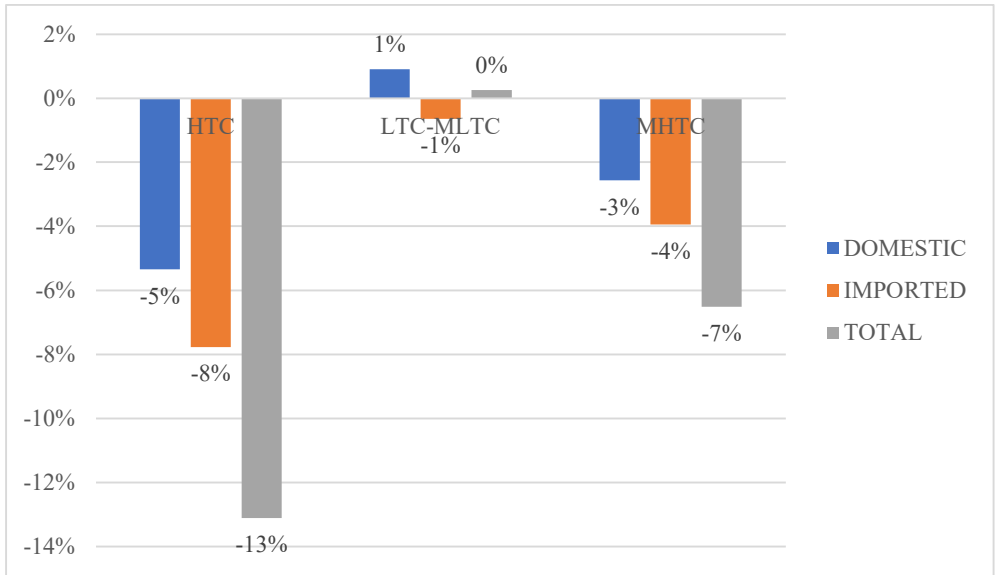


Figure 42: Growth rate (average annual) of M73 inputs per origin, Greece, 2008-2010.

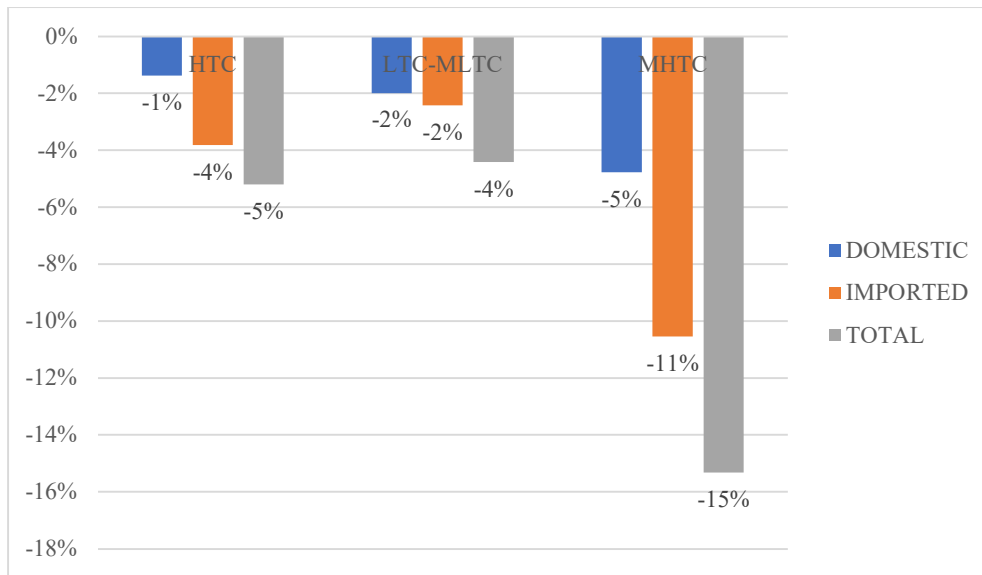


Figure 43: Growth rate (average annual) of N inputs per origin, Greece, 2008-2010.

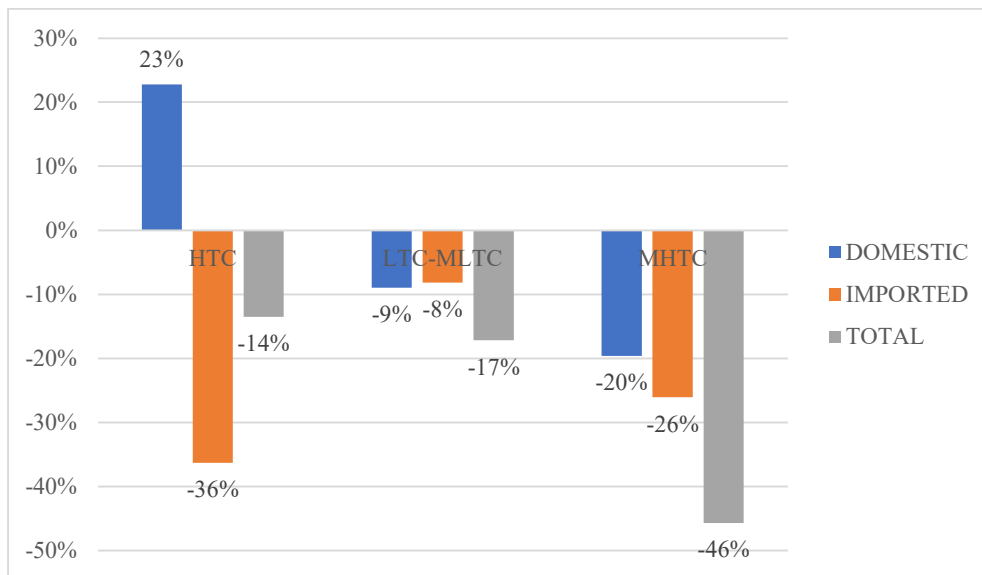


Figure 44: Growth rate (average annual) of total inputs per origin, Greece, 2008-2010.

During post-crisis period (Figures Figure 45 to Figure 49) the situation is slightly improved. In computer programming, consulting & information (J62-J63) the growth rate of HTC sectors is 18% and the manufacturing sector growth rate is positive. In research & development (M72) the growth rate of HTC sectors reaches 30%, but exclusively as for domestic intangibles. The growth rate of C sector is also positive. In advertisement & market research the imported intangibles' growth is stagnated, while the domestic intangibles show recession that reaches 15%. In administration & support (N) the imported intangibles' growth rate waves between 6-13%, while domestic intangibles' growth rate is negative. Generally speaking, during this period the growth of imported intangibles is satisfactory, but the recession remains in domestic intangibles, apart from HTC sectors, where the rate is positive. The greatest growth rate corresponds to HTC sectors and can reach 45%.

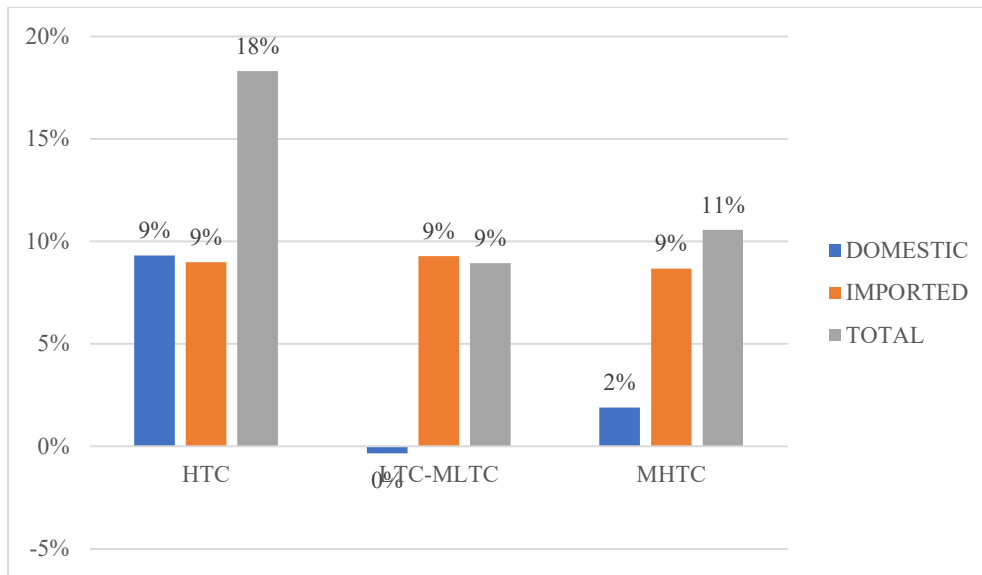


Figure 45: Growth rate (average annual) of J62-J63 inputs per origin, Greece, 2011-2014.

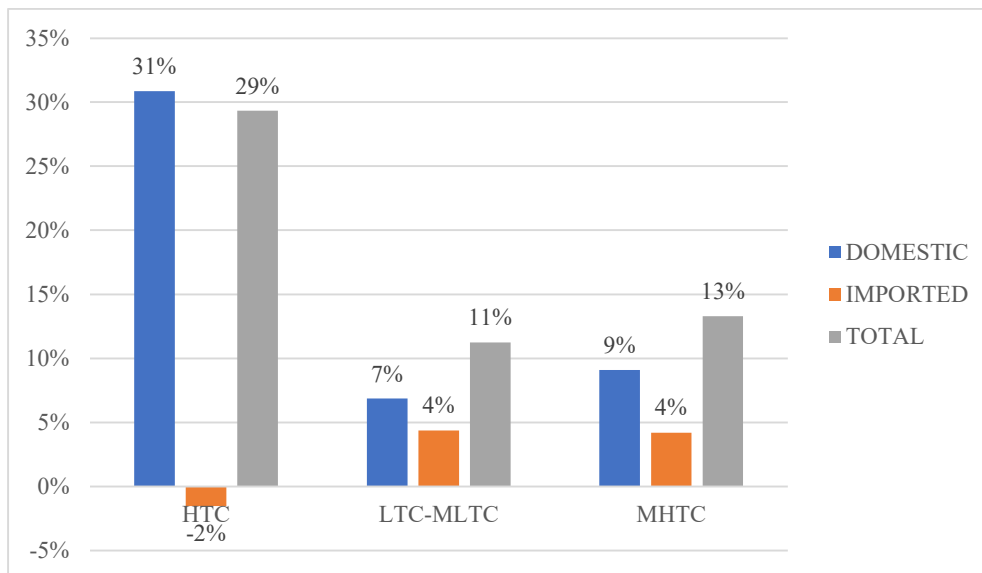


Figure 46: Growth rate (average annual) of M72 inputs per origin, Greece, 2011-2014.

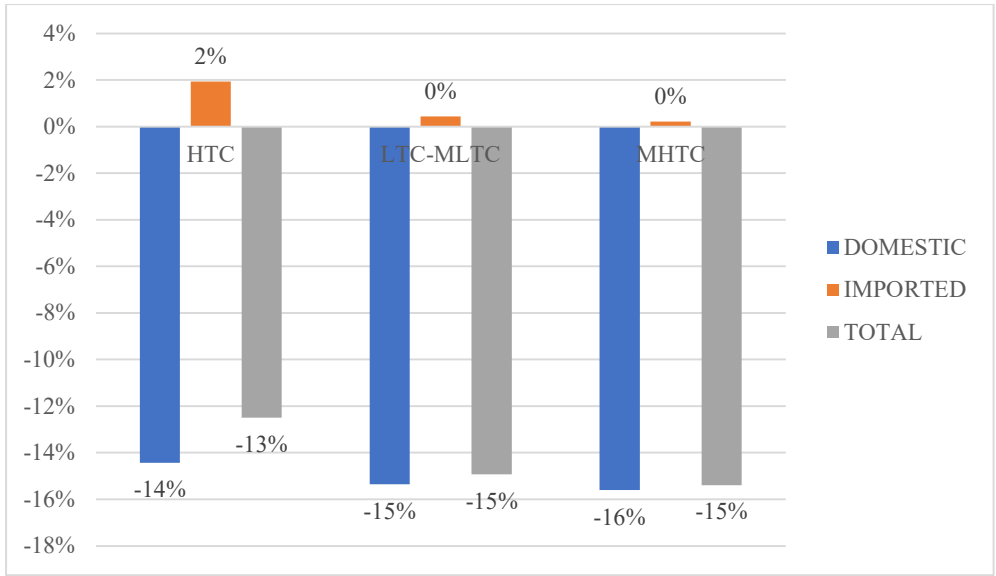


Figure 47: Growth rate (average annual) of M73 inputs per origin, Greece, 2011-2014.

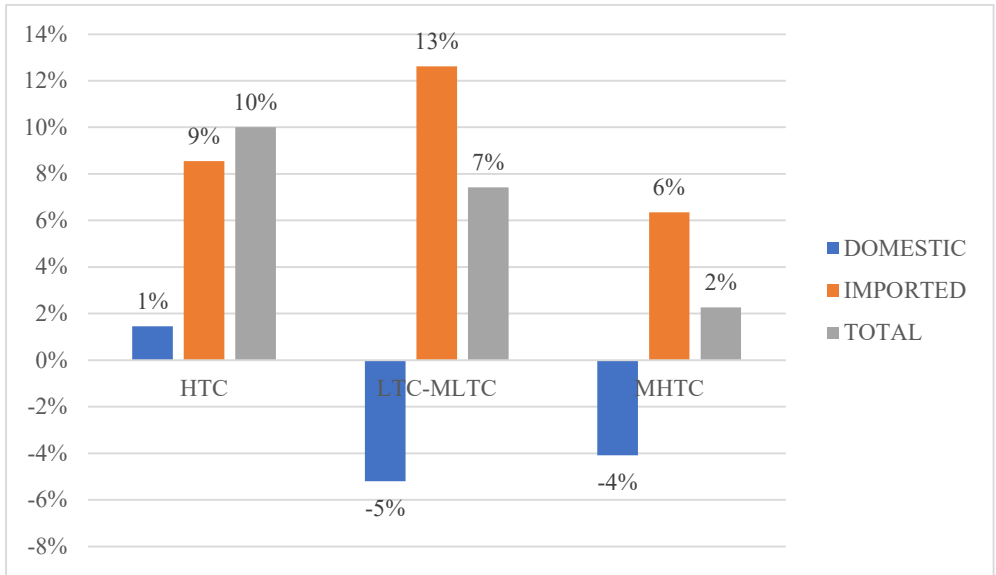


Figure 48: Growth rate (average annual) of N inputs per origin, Greece, 2011-2014.

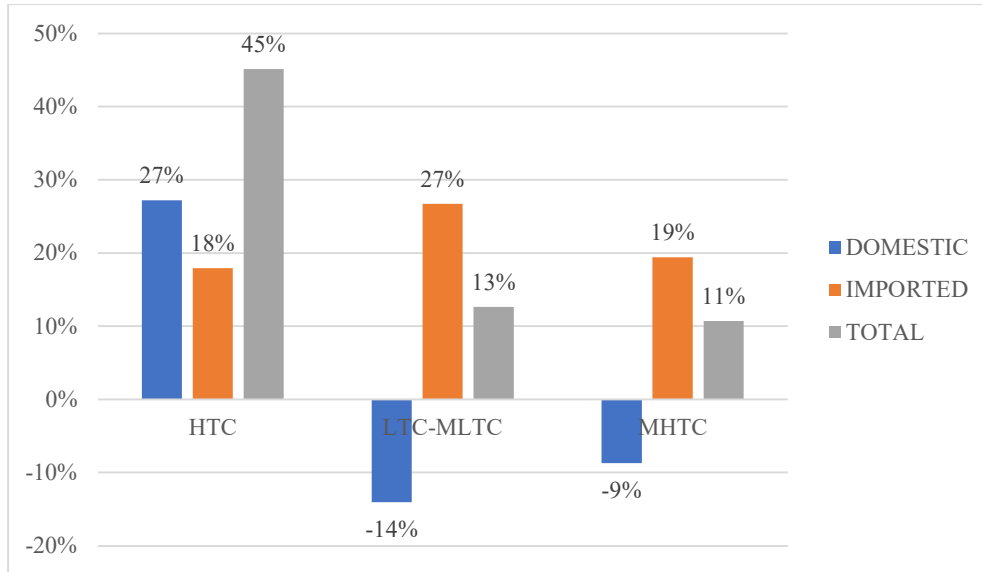


Figure 49: Growth rate (average annual) of total inputs per origin, Greece, 2011-2014.

The pre-crisis period (2000-2007) was a period of prosperity in Germany (Figures Figure 50 to Figure 54). In fact, the growth rate is independent from the technology intense level. In any case the growth rate is positive. The average growth rate is 28% in computer programming, consulting & information (J62-J63), 20% in research & development (M72), 17% in advertisement & market research (M73) and 27% in administration & support (N). In total, the average growth rate is 92%.

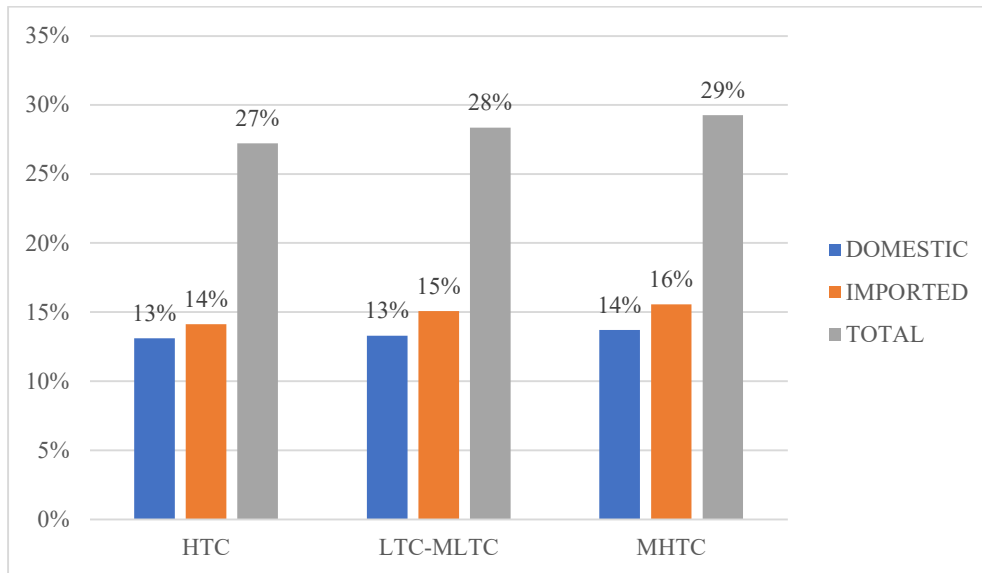


Figure 50: Growth rate (average annual) of J62-J63 inputs per origin, Germany, 2000-2007.

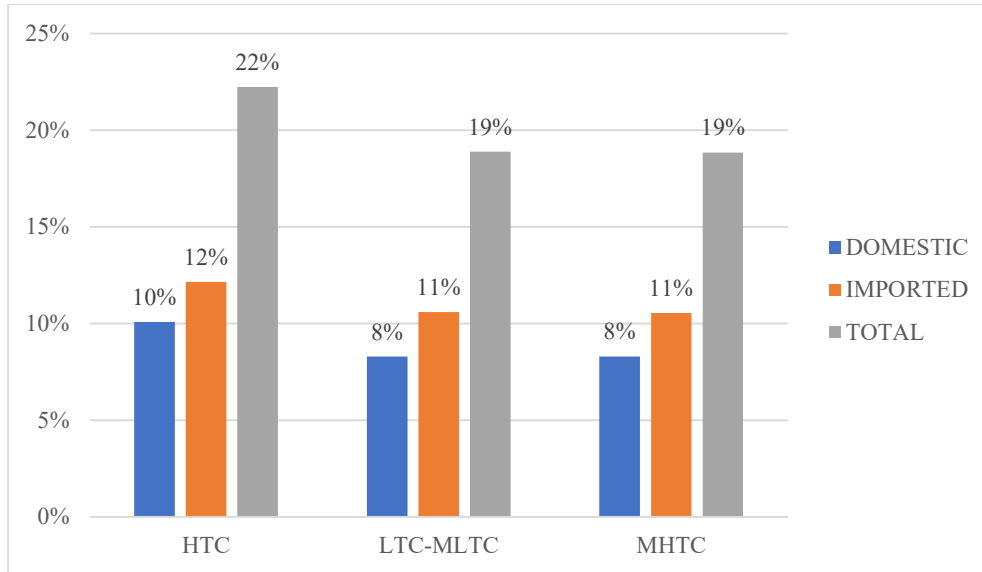


Figure 51: Growth rate (average annual) of M72 inputs per origin, Germany, 2000-2007.

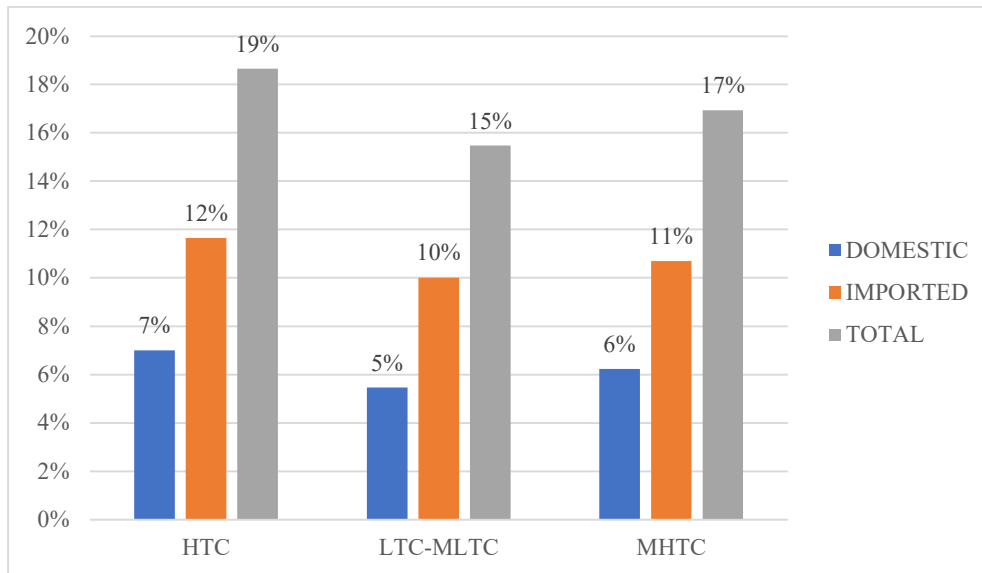


Figure 52: Growth rate (average annual) of M73 inputs per origin, Germany, 2000-2007.

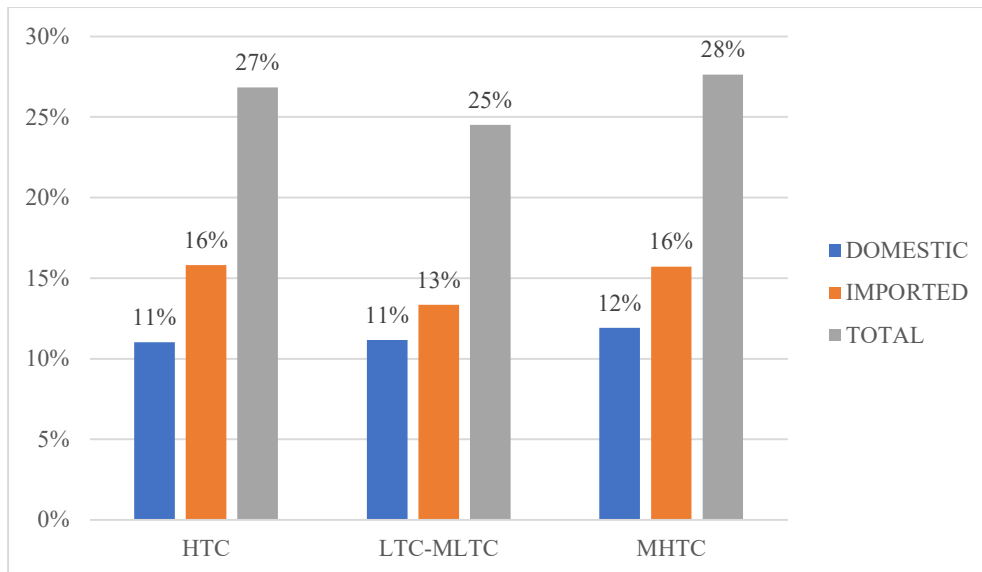


Figure 53: Growth rate (average annual) of N inputs per origin, Germany, 2000-2007.

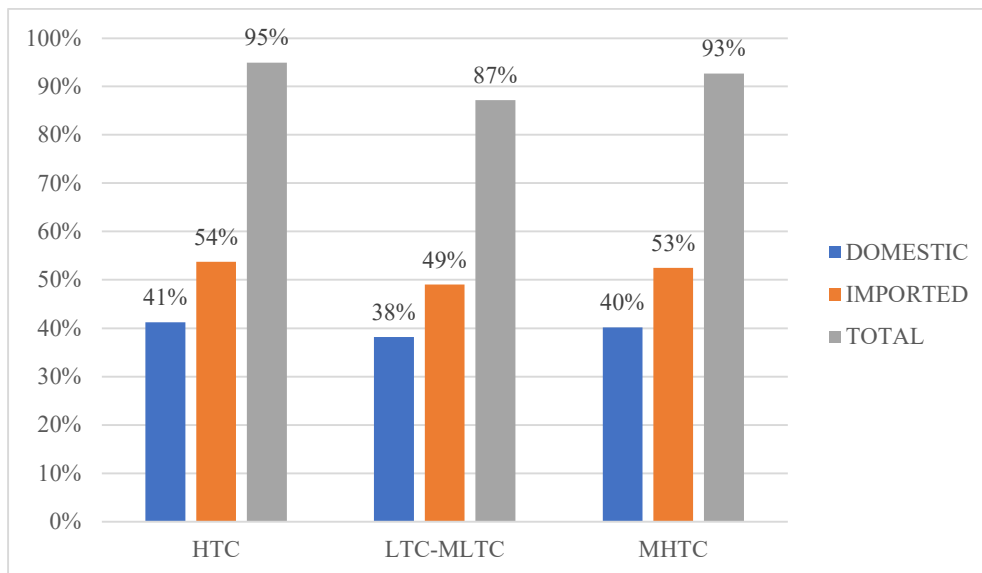


Figure 54: Growth rate (average annual) of total inputs per origin, Germany, 2000-2007.

During the economic crisis (2008-2010, Figures Figure 55: Growth rate (average annual) of J62-J63 inputs per origin, Germany, 2008-2010. to Figure 59: Growth rate (average annual) of total inputs per origin, Germany, 2008-2010. Figure 40), it is mostly a recession period, especially for HTC sectors. In computer programming, consulting & information (J62-J63), LTC, MLTC and MHTC sectors run through a slight prosperity period (up to 16%) considering imported intangibles. As for domestic intangibles, there is a stagnancy period. The growth rate at HTC sectors is negative (-15%). Research & development (M72) runs through a severe recession period, where growth rate can reach -88%. In advertisement & market research (M73) the growth rate is mostly negative, apart from imported intangibles of LTC, MLTC and MHTC sectors, where the growth rate barely overcomes 0%. The impact of the crisis to administration & support (N) is more satisfactory, where the growth rate of LTC, MLTC and MHTC

sectors is positive, mostly as far as imported intangibles are concerned, and HTC sectors' intangibles are stagnant. In total, the decrease is particularly related to domestic intangibles, especially in HTC sectors.

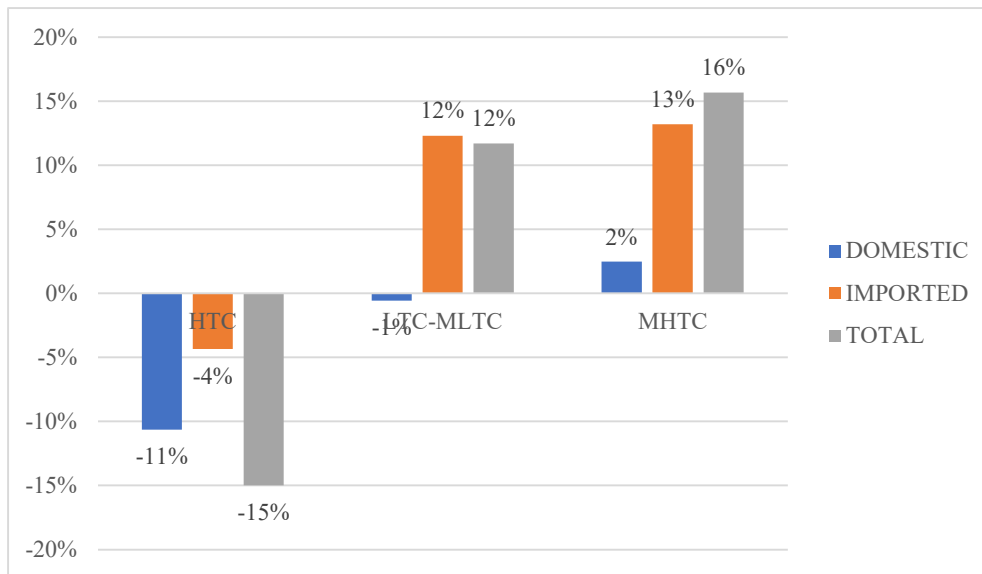


Figure 55: Growth rate (average annual) of J62-J63 inputs per origin, Germany, 2008-2010.

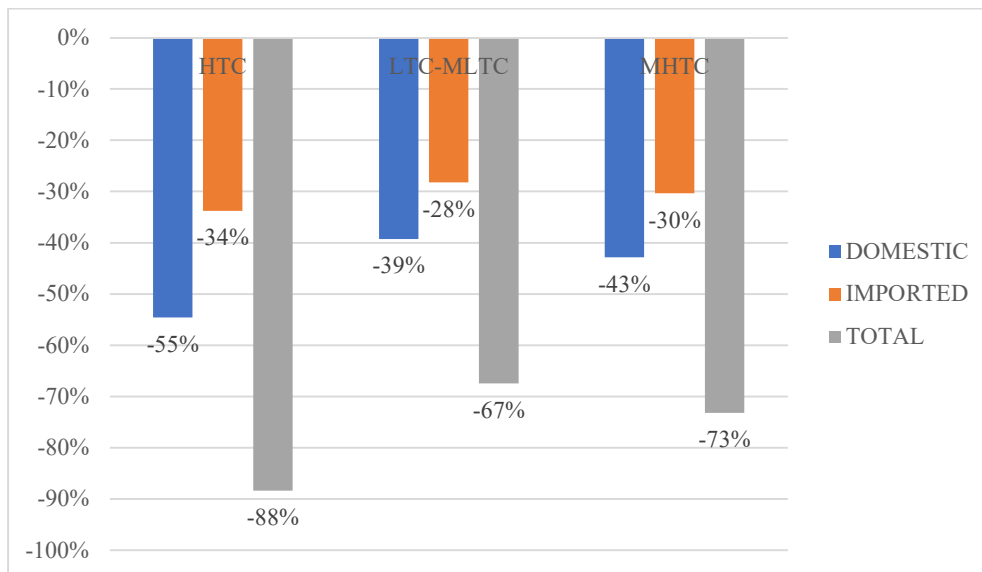


Figure 56: Growth rate (average annual) of M72 inputs per origin, Germany, 2008-2010.

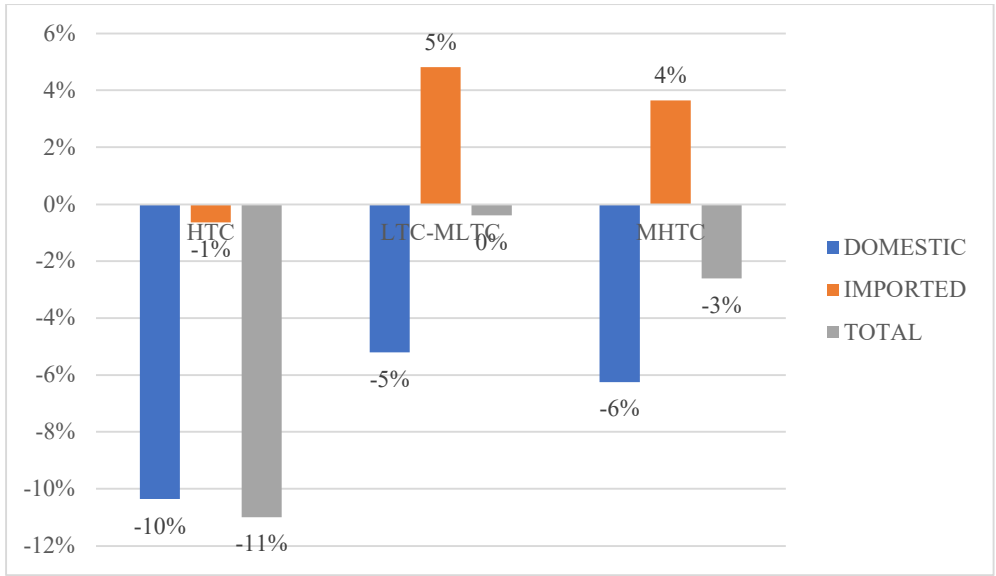


Figure 57: Growth rate (average annual) of M73 inputs per origin, Germany, 2008-2010.

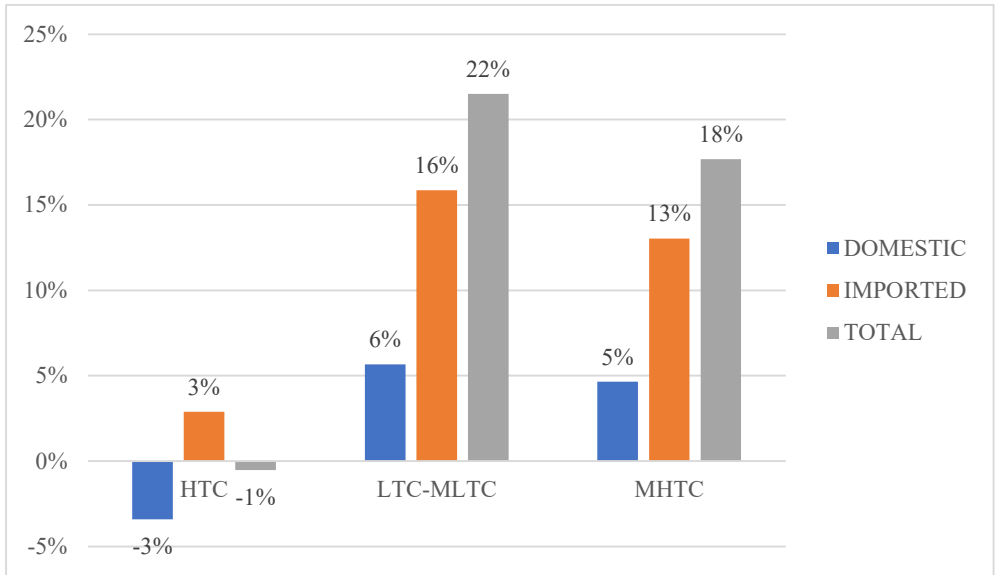


Figure 58: Growth rate (average annual) of N inputs per origin, Germany, 2008-2010.

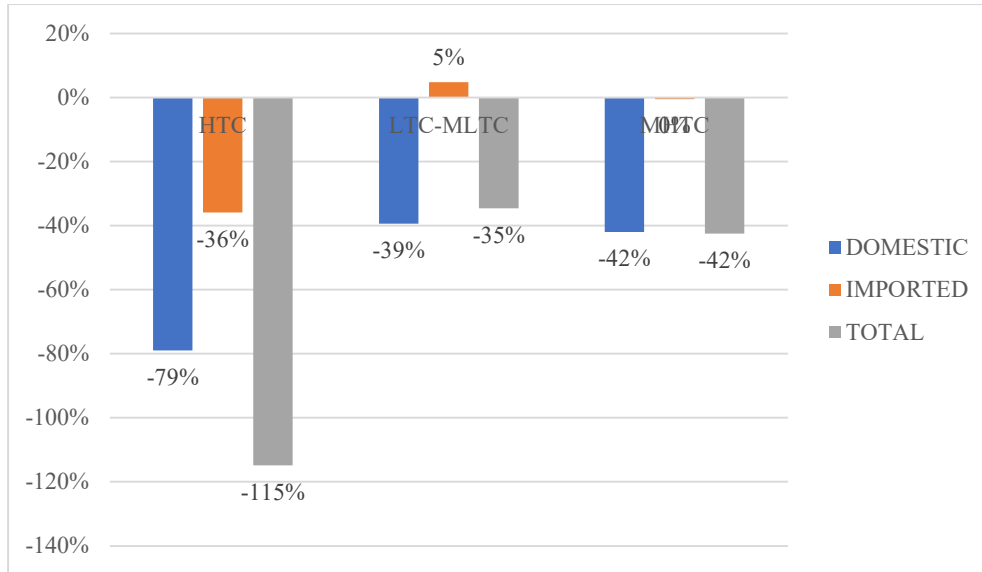


Figure 59: Growth rate (average annual) of total inputs per origin, Germany, 2008-2010.

The situation appears to be improving during the post-crisis period (Figures Figure 60 to Figure 64). Especially in HTC sectors the situation is inverted, in contrast to the crisis and severe recession period. In computer programming, consulting & information (J62-J63), both sector technology categories have growth rate equal to 24%, mainly due to imports. In research & development (M72) the growth rate is positive and it reaches 21% in HTC sectors. In advertisement & market research (M73) the growth rate is lower. Namely the maximum rate is 8% in HTC sectors. In fact, domestic intangibles run through a stagnation period. In administration & support (N) the growth rate is almost independent from technology intense level. Namely, the average rate is 13%. In total, it is about a prosperity period, where growth rate reaches 67% in HTC sectors.

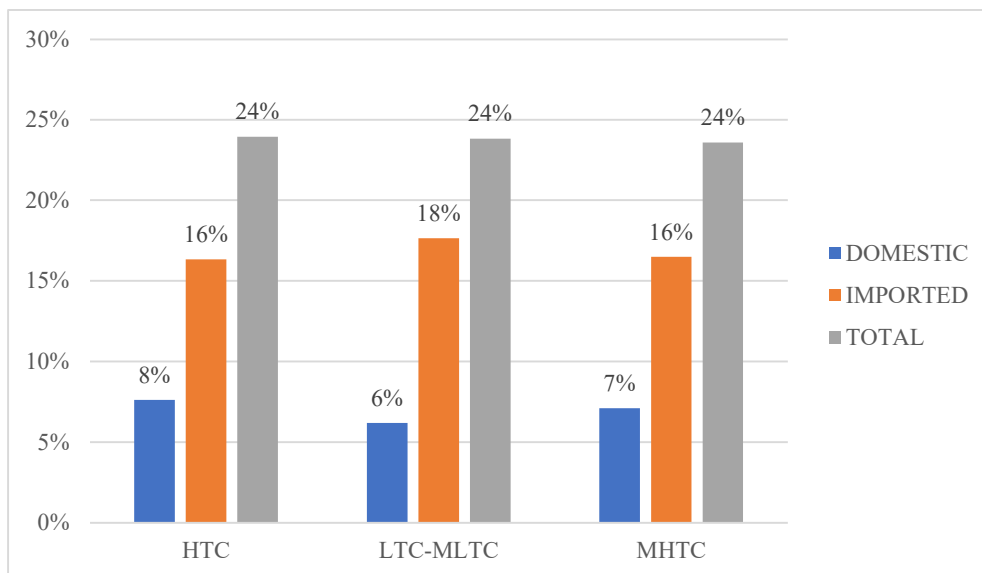


Figure 60: Growth rate (average annual) of J62-J63 inputs per origin, Germany, 2011-2014.

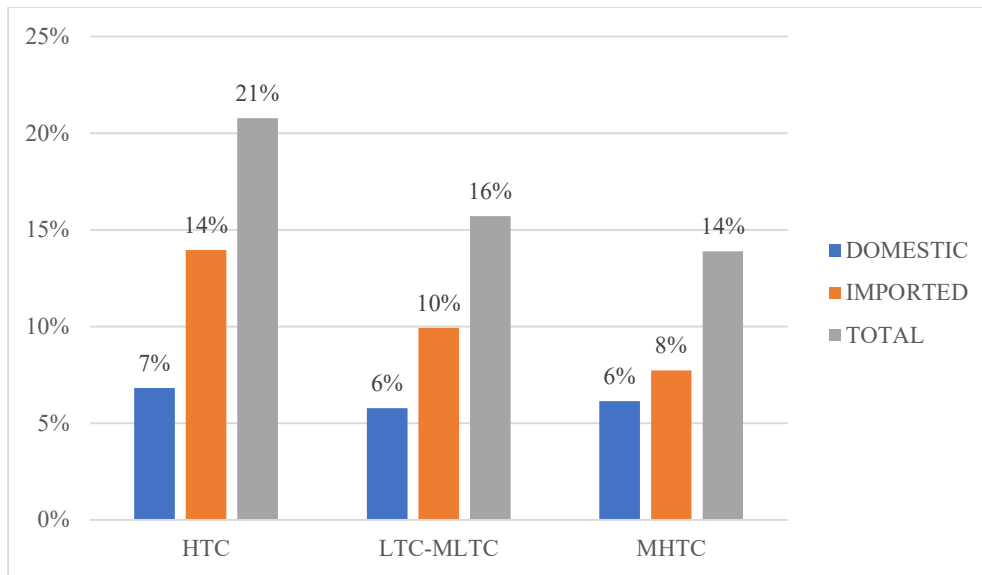


Figure 61: Growth rate (average annual) of M72 inputs per origin, Germany, 2011-2014.

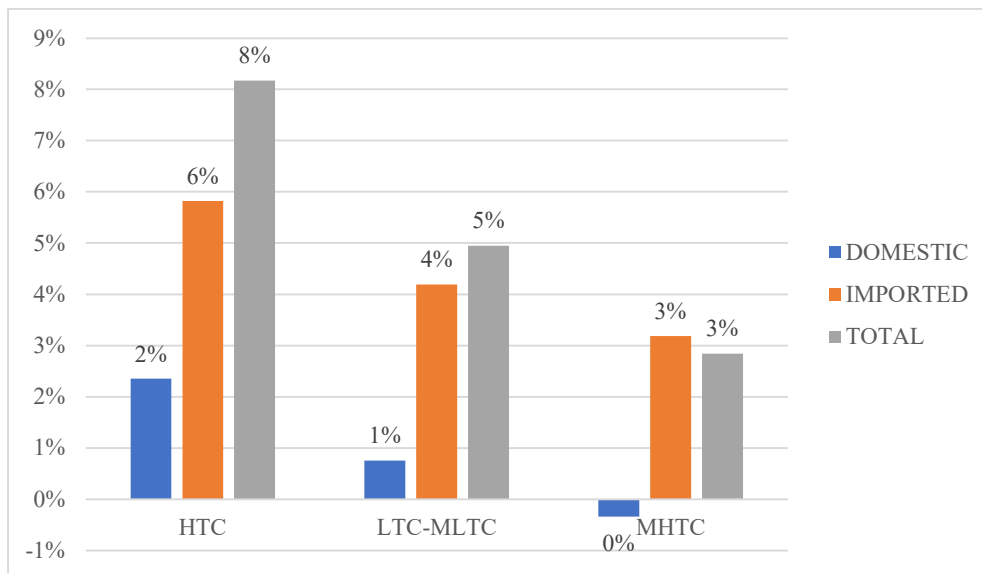


Figure 62: Growth rate (average annual) of M73 inputs per origin, Germany, 2011-2014.

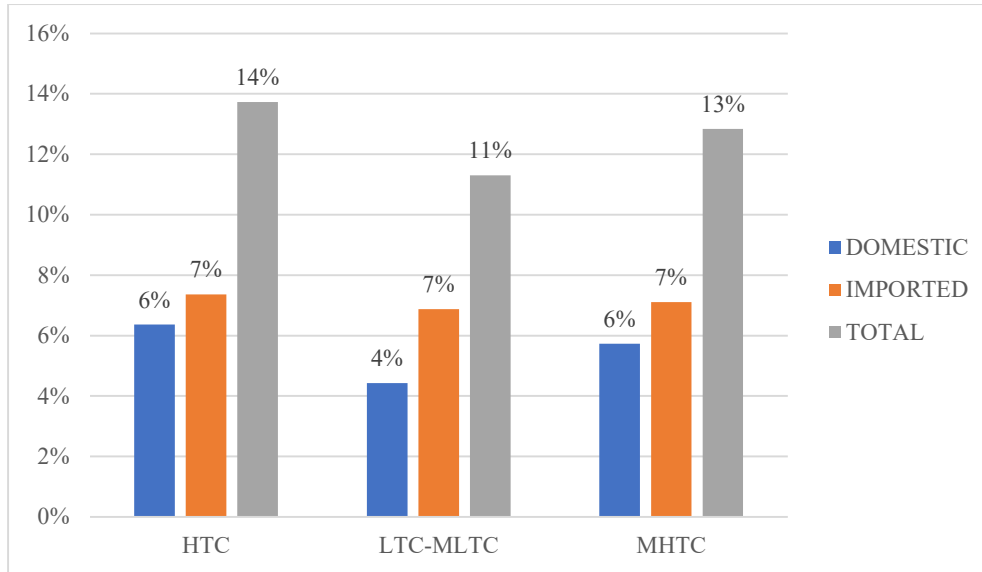


Figure 63: Growth rate (average annual) of N inputs per origin, Germany, 2011-2014.

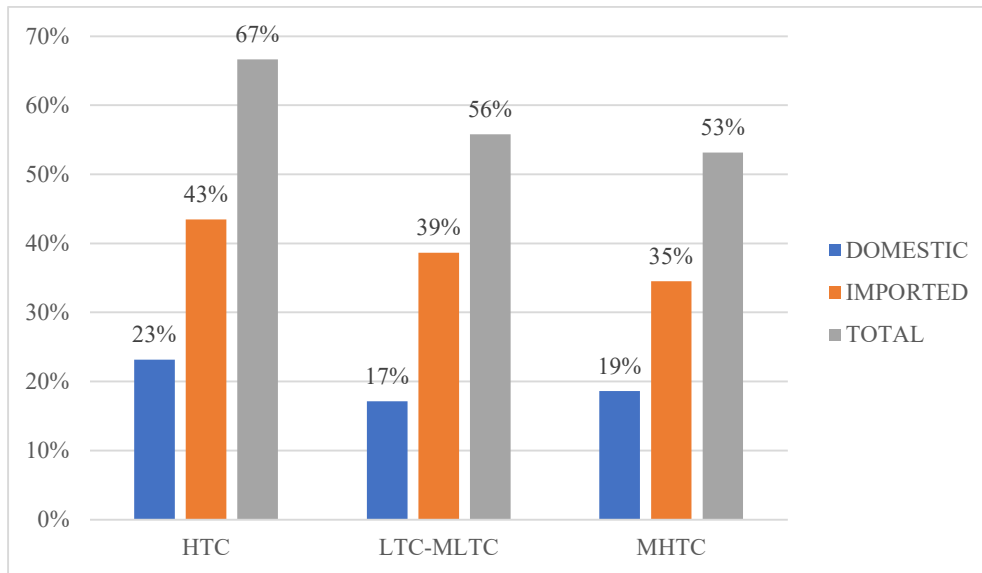


Figure 64: Growth rate (average annual) of total inputs per origin, Germany, 2011-2014.

Taking everything into account, both Greece and Germany run into a high prosperity period before the economic crisis. In fact, the growth rate during the pre-crisis period is even higher in Greece. Both countries' manufacturing sector weakens significantly during the years of economic crisis. After the crisis the situation is highly improved, but the performance of domestic intangibles is trailing, compared to imported intangibles. In fact, in Greece the growth rate is still negative in domestic intangibles of LTC, MLTC and MHTC sectors.

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