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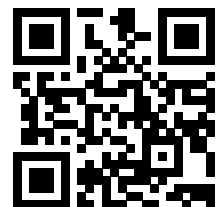
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HGX: The Anatomy of High Growth Exporters

Stjepan Srhoj¹, Alex Coad² & Janette Walde³

Abstract

Export boosting is a policy agenda in developed and developing countries. Previous work has found that a small number of *Superstars* contribute disproportionately to the economy's overall exports. Differently from *Superstars*, this study is the first to define *high growth exporters* (HGXs), provide their economic importance and depict their micro-level anatomy. By tracking HGXs in Croatia for over a quarter of a century, 44 out of 100 *Superstars* in 2019 were previously HGXs. Industry-wise, HGXs are concentrated in manufacturing, information and communication technology, transportation and storage sectors. HGXs are located in higher export active regions, neighboring advanced markets. HGXs represent only 0.5% of all firms and 18% of high growth firms (HGFs) in the economy, but are responsible for about 25% of new exports, and 5% of new jobs. During their growth episode, HGXs hire more employees from technology intensive industries with previous experience in exporting. They often hire on a single year work contract, and more frequently send new employees to work abroad. HGXs have the highest number of new products, and the concentration of HGXs' main export products decreases over time, thus, the growth is driven by multiple products and the simultaneous increase in the number of new export markets. HGXs export to closer markets than *Superstars*, but to more distant markets than other HGFs and exporters who tend to be more active in less developed markets. HGXs tend to increase their presence in the EU Single Market, introduce new products and substantially increase their unit price.

Keywords: exporting; firms; high growth firms; high growth exporters

JEL: F2; D22; L1

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1. Introduction

Considerable policy interest surrounds exporters, for several reasons. Firstly, exporters are found to be larger firms, more productive, more skill- and capital-intensive, and to pay higher wages than non-exporting firms (Bernard et al., 2007). Secondly, firms that grow via exporting do not cannibalize the market share of their domestic rivals, do not engage in domestic business-stealing, but bring in revenues from abroad (Wagner, 2019). Unsurprisingly, there is considerably policy interest in the manufacturing sector (e.g. “*European Industrial Renaissance*”, European Commission, 2014), on the grounds of manufacturing’s alleged superiority in terms of exporting, productivity growth, and innovation (Coad & Vezzani, 2019). Policy-makers have introduced a large range of short-term export boosting policies, initiatives to encourage firms to start exporting and deepen their exporting activity (for a review: Srhoj, Vitezic & Wagner, 2020), including public grants, tax credits, subsidized export loans, export credit guarantees, public institutions offering partner search, matchmaking, intelligence, analysis and organizing participation on trade fairs, or providing vouchers for outgoing economic missions, fairs and external counseling. A special focus of policy-makers are high growth firms (HGFs) because of their contributions to job creation, productivity growth and innovation (Benedetti Fasil et al., 2021). Export growth is a target for HGF policy (OECD, 2013, p. 27, Table 2.7), however, not much research has been done on the intersection of exporters and HGFs.

Export superstars, defined either as single, top five or even top 100 exporters by export value have received academic attention (Ciliberto & Jäkel, 2021; Freund & Pierola, 2015; 2020). Freund and Pierola (2015) show that top five export superstars contribute to 30% of all non-oil exports in their sample of 32 countries. Exclusively focusing on export superstars may be too narrow and lead to not including all-important players in economy. Superstars are already perceived as relevant stakeholders, they seem unlikely to have large export growth in future, although their small growth rates may already lead to large absolute values in exports or job creation. Due to creative destruction or structural change, export superstars might be displaced in the future. The question is, which firms besides export superstars can bring about new products and jobs necessary for economic growth? Candidates with the potential to become superstars include small and medium enterprises (SMEs). However, SMEs comprise over 90% of all firms, which makes it difficult to manage and tailor targeted policies for high growth (Coad et al., 2022; Shane, 2009). Another potential category could be current exporters, which are still a broad category of firms (Wagner, 2019; 2007) from which many will presumably lack high growth potential. HGFs are another category of firms that could displace export superstars in the future. HGFs are 3-5% of all firms, but are a heterogeneous category, making it difficult to predict which firms will be HGFs category next year, and HGFs usually lack growth persistence (Coad & Srhoj, 2020; Esteve-Pérez, Pieri & Rodriguez, 2022). This paper investigates another potential class of policy targets: High Growth Exporters (HGXs).

We contribute to the literature in several ways. Despite research on the characteristics of exporters (i.e. Bernard et al., 2007; Wagner, 2007; 2012; Atkin, Khandelwal & Osman, 2017), HGFs (i.e. Coad & Srhoj, 2020; Benedetti Fasil et al., 2021; Esteve-Pérez, Pieri & Rodriguez, 2022) and superstars (Freund & Pierola, 2015; 2020; Ciliberto & Jäkel, 2021), there is scarce literature on firms having high export growth. We define the class of HGX firms, track them over time to investigate whether they become superstars, and elaborate differences of HGXs compared to high-growth non-HGX firms, to exporters and to superstars. HGXs appear worthy of more academic and policy attention.

Our results show five cross-cutting themes. First, HGXs are dynamic and global: growing fast, hiring fast, introducing new products, expanding into new markets, and placing employees abroad. Second, there is some evidence that HGXs are relatively knowledge intensive, being more active in medium-tech or high-tech sectors such as manufacturing, information and communication technology (ICT), R&D-intensive sectors, and Knowledge-Intensive Services (KIS). Third, HGXs hire from other former HGXs and offer more short-term contracts on average. Flexible labor arrangements may benefit HGXs in terms of facilitating the reallocation of talent between HGXs, as well as facilitating the placement of employees in relatively precarious roles. Fourth, HGXs are not growing by concentrating on products or export markets. HGXs are not growing vulnerable, instead their growth involves reducing their reliance on individual products and export markets, and diversifying their sales portfolios. Fifth, HGXs are not the stereotypical cost-cutting entrants selling cheap gimmicks, but their growth occurs alongside robust increases in unit prices. HGXs differ from other categories of exporters in that they have been successful in growing their exporting activity in the EU market, which is one of the largest and most sophisticated export markets in the region. HGXs therefore constitute a genuine competitive threat to incumbents.

The paper unfolds as follows. Section 2 presents the three census datasets used in the analysis. Section 3 presents the HGX definition. Section 4 presents the anatomy of HGXs, investigating the HGXs at the firm-level, firm-employee level, firm-product level, and firm-market level. Section 5 discusses the results, academic and policy implications in the short and long-run. Section 6 concludes.

2. Data

Our analysis focuses on Croatia (see Figure 1 for its geographical location in Europe). World Bank classifies Croatia as a high-income country since 2017, and prior to 2017 as an upper middle-income country. Historically, Croatia fought war for independence, and became an internationally-recognized independent country in 1992. Prior to independence, Croatia was part of the Socialist Federal Republic of Yugoslavia, an economy which was organized as a mixture of a planned socialist economy and a market socialist economy (Horvat, 1986; 1971). After independence, Croatia transitioned to an open market economy, became part of the World Trade Organization in 2000, and of the Central European Free Trade Agreement (CEFTA) from 2002 to 2013. Since July 2013 it became an EU Member State, therefore part of the EU Single Market and no longer part of CEFTA (Josic & Basic, 2021). Policymakers in Croatia have shown considerable interest in supporting exporters, with studies documenting mixed success (e.g. Srhoj & Walde, 2020).

In 2019, Croatia's exports of goods and services as a percentage of GDP were 57%, considerably above the world average of 28.2%, or OECD member states' average at 28%. This indicator was already high in Croatia since its first measurement (1995: 27.2%), while the world and OECD member states averages were at 20.9% and 18.7%, respectively. Merchandise exports to high-income economies as percentage of total merchandise exports in Croatia was 79.9% in 1995 and 74.1% in 2019, while these figures were 76.9% and 68.2% for the world, and 79.6% and 75.6% for the OECD member states averages. Medium and high-tech exports as a percentage of manufactured exports in Croatia was 37% in 1995, and 48% in 2019, which is more than Australia (19%), Russia (27%), India (37%) or Brazil (39%), but less than Italy (54%), Spain (55%), Belgium (56%) or USA (64%).⁴

⁴ Source: World Bank Data. Link: <https://databank.worldbank.org/home.aspx> [Accessed: 24th July 2022]. For indicator *Medium and high-tech exports (% manufactured exports)* it is not possible to obtain world or OECD member state average.



Figure 1. Geographic location of Croatia in Europe

Note: Countries in light yellow are other European Union Member States, and those in grey are non-European Union countries. In the upper right is the map position in the world map. *Source:* Wikimedia Commons, link: https://commons.wikimedia.org/wiki/File:Croatia_in_European_Union.svg [Accessed: 24th July 2022].

Although several indicators of the Croatian economy suggest findings can be generalized to other countries, we are cautious about generalizing our findings due to Croatia's historical peculiarity. To address the issue of generalizability, most of our analysis is calculated for the period after entering the EU. Our initial study of HGXs should cause further research to replicate or extend the generalizability of the economic importance of HGXs.

The following subsections outline the micro-level datasets.

2.1. Firm Financial Data

Firm demographic and financial data comes from census data stemming from the Financial Agency (FINA) of Croatia. This dataset encompasses all publicly-listed and private limited companies incorporated in the Republic of Croatia. It includes full balance sheet and profit and loss statements of firms including information on firm employees, firm sales, imports and exports⁵, along with demographic information such as firm employment, age, NACE 4-digit industry, and micro location of the firms' headquarters (i.e. county and municipality). This full panel census data includes 2,297,130 observations and 234,176 unique firms with 410 variables over the period 1993–2019.

2.2. Firm Employee Data

⁵ There were inconsistencies in the variable *exports*. For example, a share of hotels reported their sales as exports because hotels are mostly used by foreign citizens (i.e. tourists). We examined such firms in a case-by-case manner, since this is not exporting in the definition of this study, we set the export values of firms in NACE 1-digit sectors 'Accommodation and food service activities' and 'Administrative and support service activities' to zero.

The employer–employee dataset stems from the Croatian Pension Insurance Institute (HZMO). Pensions are mandatory in the Republic of Croatia, and HZMO tracks all pension registrations that are either started or ceased; i.e., we have a census firm–employee dataset. Importantly, the employee is anonymized, but in a structured way so that we can track employees changing jobs over time. While employees are anonymized, the data includes variables such as start of work at the job, type of work contract, the date of work contract termination, reason for termination, employee occupation, qualifications and education, gender and age. In addition to these variables, the firm ID of the firms in which each employee works is also included. This full panel census data includes 6,329,064 observations, 312,769 unique employers⁶ and 2,009,420 unique employees over the period 2014–2020.

2.3. Firm Product Market Data

Firm product market data stems from the Customs Administration, Ministry of Finance of the Republic of Croatia, and was assembled by the Croatian Bureau of Statistics (DZS) and accessed in the DZS safe room. The Customs Administration data encompasses all imports and exports of goods disaggregated at the firm–market level encompassing the period 2008–2016. The variables include firm ID, the 8-digit Combined Nomenclature (CN8) product codes, the country market to which a firm exports or imports (i.e. destination market), together with amount of exports in tons and value of product exports of a firm in a particular market. To illustrate with a fictional example, we could identify a firm ‘Car Equipment Ltd.’ which exports to the United States, 500 tons of batteries, with a value of 5,000,000 euros. CN8 product codes change over time, and harmonizing product codes over time is needed in order to estimate the number of products, newly introduced products and the value of new products in a valid way (Baumgartner, Srhoj & Walde, 2022). We use the *Harmonizer* package in R (Baumgartner et al. 2022) to harmonize CN8 product codes over time. Finally, we enrich this data with information on bilateral distance between Croatia and the destination market, whether a destination market is a European Union (EU) Member State, CEFTA market, or other market (CEPII GeoDist database, Mayer and Zignago, 2011).⁷

3. Definition of Firm Categories

This study specifies several firm categories and defines the category of high growth exporters. Figure 1 illustrates the various categories and their nested structure. Superstars are defined as top 100 firms by export value in period t .⁸ Our high growth firms (HGFs) definition aligns closely with the OECD-Eurostat (2007) definition of the revenue-based HGFs, except that we use a more inclusive lower-bound size threshold of 5 employees instead of 10 employees, because of concerns in the literature that the threshold of 10 employees could be overly restrictive (Daunfeldt et al., 2015). HGFs are defined as firms having 5 or more employees and an average yearly sales growth rate of at least 20% over three consecutive years, i.e. $\frac{S_{t+3}-S_t}{S_t} \geq 0.728$, where S_t denotes sales at time t .⁹

⁶ This dataset includes firms, crafts, public institutions, and NGOs.

⁷ Several countries did not have bilateral distances, including Serbia, Kosovo and Montenegro. We therefore constructed them ourselves based on the GeoDist website instructions.

⁸ We use census dataset on all exporters to analyse Superstars in the Republic of Croatia with several definitions, the top 1, top 5 and the top 100 exporters by the absolute export value. Table A1 shows exports in total economy exports (%) of single, top 5 and top 100 exporters. Top 100 exporters account for 40-50% of total exports in the economy over the period 2013-2019. Table A2 gives descriptive statistics of Superstars, showing they have 730 employees, 167 million euro sales and 82 million euro exports at the mean, with high mean market shares at 38%.

⁹ Revenue-based HGFs are associated with higher aggregate productivity, which was not found for employee-based HGFs (Bisztray, de Nicola, & Muraközy, 2022).

Within the category of HGFs, *high growth exporters* (HGXs) are firms whose sales growth is driven by the growth of exports, i.e. firms for which a share of at least 50% of the minimum yearly sales growth by HGF definition is generated by exports. Thus, the additional criteria

$$\Delta X_{t+3} = X_{t+3} - X_t \geq \frac{0.728}{2} \cdot S_t,$$

where X_t denotes export at time t , holds for HGXs. We chose 50% as the percentage because we wanted a substantial part of the growth to be due to growth in exports, rather than having only HGFs who are exports but actually have little exports. The chosen approach does not exclude the possibility of becoming an HGX if an HGF does not export in the first period of interest (t).¹⁰ HGFs are defined as HGFs that are not HGXs. Figure 2 presents the various type of firms and their connections.

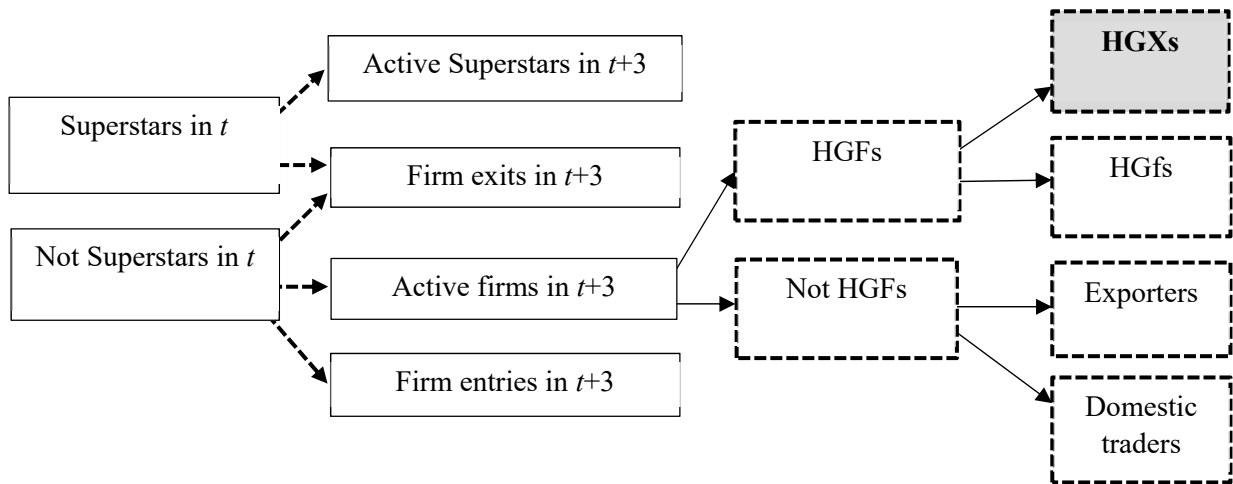


Figure 2. Unambiguous assignment of firms into firm types according to their sales volume or growth

Among the firms that are not Superstars or HGFs, firms are divided into exporters defined as firms with positive exports and domestic traders which do not export. The main analysis does not focus on the domestic traders because the literature (Bernard et al., 2007) already answered many questions related to the difference between exporters and domestic traders (non-exporting firms). Finally, firm entries and exits are important for job creation and innovation (Haltiwanger, Jarmin & Miranda, 2009), which is why we considered firm entry and exit for calculating the number of jobs and the exports creation of different types of firms in the economy. Given the three-year period that features prominently in the OECD-Eurostat (2007) definition of HGFs, firm entry is defined as any firm that does not exist in period t , but exists in period $t+3$, while firm exit is defined as any firm that exists in period t , but not in period $t+3$.

¹⁰ There are two consequences of not defining HGXs as simply HGFs that export in period t . Firstly, in the analysed sample, this would lead to a 55% increase in the number of HGX, and secondly, 25% of actual HGXs would be dropped as they have no exports in period t .

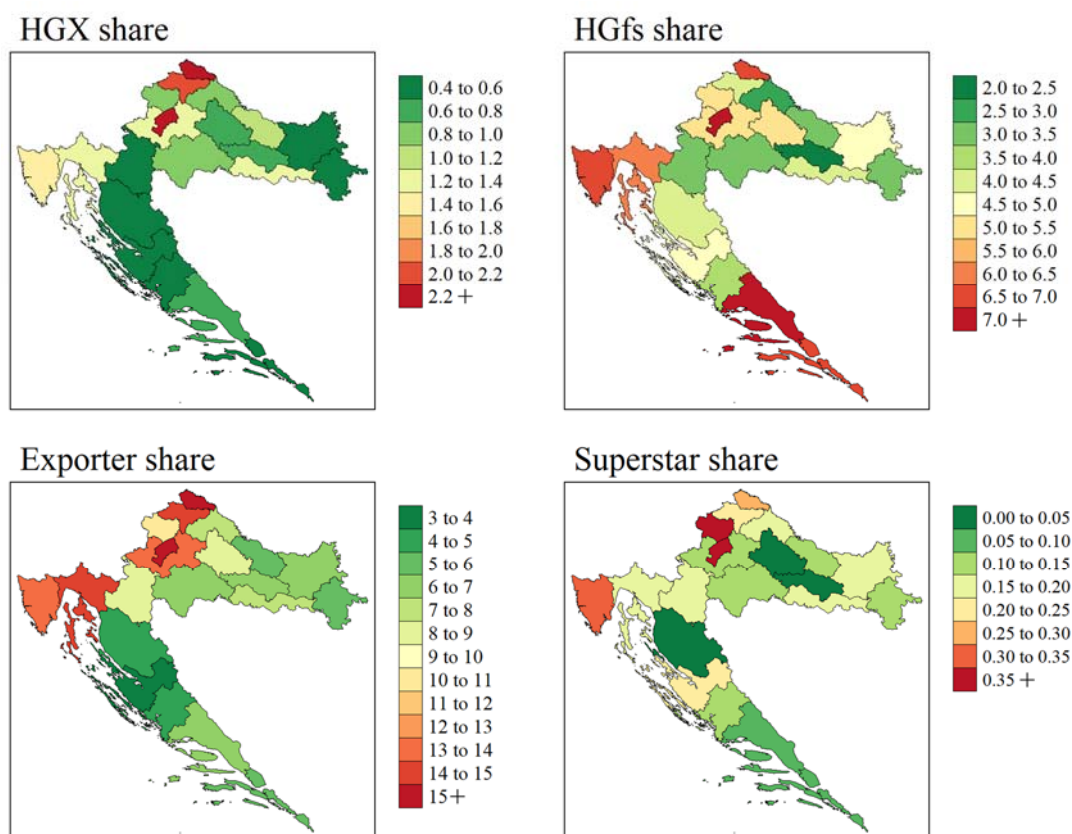


Figure 3. Firm types per NUTS 3 county human population.

Note: the number of firms per firm type is divided by NUTS 3 human population in 10,000

Figure 3 shows number of firms for each of Croatia's 21 NUTS 3 regions per 10,000 residents. Regardless of the type of firm (HGxs, HGfs, exporters, and Superstars) the highest shares are documented in the capital city probably due to agglomeration or spillover effects (Puga, 2010; Roca & Puga, 2017). The north-west regions bordering with Slovenia, which also has a history of exporting and higher shares of exporters (Bačić & Aralica, 2016) have higher shares of HGxs. These Croatian regions have strong international ties to Slovenia, Austria, Germany and Italy (Croatian Chamber of Commerce, 2018). Dalmatia (coast, south-west) and Slavonia (continent; north-east) have very low shares of HGxs, but also have low shares of exporters and Superstars. Except the south Dalmatian regions (i.e. Dubrovnik-Neretva and Split-Dalmatia), these have very high shares of HGfs. These regions are tourism-intense with HGfs coming from sectors such as construction, accommodation, restaurants and beverage service activities.

4. Results

Starting from 1995 until the last pre-pandemic year (2019) for each eight three-year period (Figure 4) we used the definitions and classified firms into the corresponding categories (i.e. Figure 2).

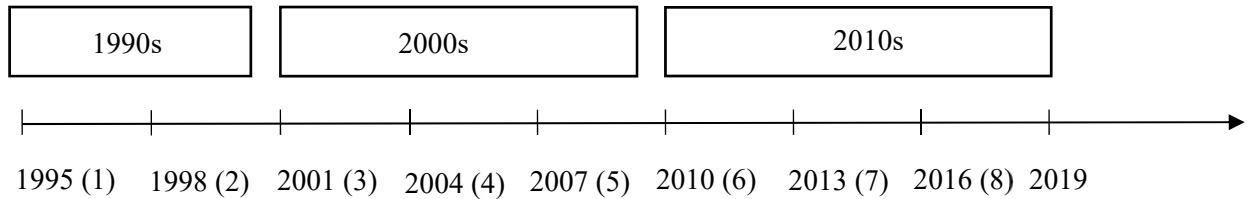


Figure 4. Time periods for classifying the firms into corresponding categories. The number of the time period is provided in brackets next to the start date.

In each three-year period there are 100 Superstars, thus, 800 Superstar observations with 290 unique Superstars over the period, while there are 2515 unique HGXs. Compared to Superstars, HGXs are more volatile. From the 100 Superstars in 2019, as many as 44 are previous HGX. Dependent on the decades, 5% of Superstars in 2019 were HGXs in 1990s, 21% were HGXs in 2000s, and 26% were HGXs in the 2010s (details in Table A3).¹¹ Additional analysis shows that the largest Superstar was previously not an HGX in the period 1995-2019, but was large already at the start of the analyzed period and did not come from the low-end of the firm size distribution. Among the top five largest Superstars, two Superstars were previously HGXs. With 44% of Superstars in 2019 being HGXs, we conclude that previous HGXs have a large chance to become Superstars over a long enough period. In other words, current HGXs are potential future Superstars which gives additional motivation for further investigating their characteristics in comparison to HGfs, Superstars, and exporters.

4.1. Sector Distribution

We examine the industrial differences among the firm categories in the period 2013-2016 (Table A4). To some extent, differences in the within and between distributions of sectors dependent on the firm categories are expected for tradeable and non-tradeable sectors. Superstars (63%) and HGXs (31%) are predominantly in the manufacturing sector. HGXs are more frequently in the transportation and storage sector (9%) than HGfs (4%), but similar to exporters (7%) and Superstars (6%). Wholesale and retail trade; repair of motor vehicles and motorcycles is a sector where there is considerable share of HGXs (13%), but less than HGfs (20%) and exporters (28%), with a similar share to Superstars (13%).

HGXs are actually more frequently in the information and communication technology (ICT) sector (15%) than HGfs (3%), and exporters (10%), while there are no Superstars in ICT in 2013. Similarly, HGXs (9%) are more active in professional, scientific and technical activities than Superstars (1%), similar to HGfs (10%), and less than exporters (17%). There are many HGfs in the construction sector (23%), but far fewer HGXs (8%), exporters (4%) and Superstars (1%). A similar distribution occurs for the period 2016-2019 (Table OA1) with a noticeable increase of HGXs in ICT, as well as emergence of an ICT Superstar in 2016.

¹¹ Note that individual firms can be HGXs in more than one decade.

4.2. New Exports

Table 1 provides insights into the net export creation of active firms in 2013, and their additional exports three years later (2016). HGXs are only about 0.5% of all the firms in the economy, they account for 24.9% of export growth (1456 out of 5841 million euro), while considering only the active firms (excluding firm entry) HGXs account for 28.8% of export growth. HGXs are 18.6% of the number of HGFs (528 out of 2846), and account for almost all of the export growth of HGFs (1456 out of 1562 million euro). HGXs have about 2.5 times the exports as HGfs in 2013, despite being only about 23% of HGfs by number. By the end of the growth period (i.e. 2016), HGXs have almost 10 times more exports than HGfs. In absolute exports value, in 2013, Superstars are almost 20 times larger than HGXs (6013 vs 309 million euro). The difference between the Superstars and HGXs falls by the end of the growth period (i.e. 2016) to 3.3 times (5789 vs 1765 million euro). Table OA2 repeats the analysis in Table 1 for the period 2016-2019, finding qualitatively the same results.

Table 1: Exports 2013 and 2016

	Number of firms (1)	Exports 2013 (2)	Exports 2016 (3)	Difference (4)	% change (5)	Only growing firms (6)	Exports growth (7)	% of new exports (8)
Entry & active firms	114651	11323	14767	3444	30.4	13173	5841	100
Firm entry	32771	0	793	793	-	3380	793	13.6
Firm exit	23519	689	0	-689	-	0	0	0
Active firms	81880	11323	13974	2651	23.4	9793	5048	86.4
HGFs	2846	432	1953	1521	352.1	978	1562	26.7
HGXs	528	309	1765	1456	471.2	528	1456	24.9
HGfs	2318	123	188	65	52.8	450	106	1.8
Superstars	91	6013	5789	-224	-3.7	52	963	16.5
All other firms	78934	4878	6232	1354	27.8	8763	2524	43.2
All firms 2013	105399	12012	-					
All firms 2016	114642	-	14767					

Note: Active firms are those existing both in 2013 and in 2016. Firm entry counts firms existing in 2016, but not in 2013. Firm exit counts firms existing in 2013, but not in 2016. We firstly split firms into Superstars and Not Superstars. Superstars are 100 largest exporters in absolute value in 2013. From 100 Superstars, nine Superstars are not active in 2016, with deeper case-by-case analysis showing these nine Superstars are merged or liquidated. Among those not Superstars, active firms are split into HGFs and other firms. HGFs cannot be Superstars in 2013. HGFs are split into HGXs and other HGFs (HGfs). All growing firms is a subgroup of firms that had positive change in exports from 2013 to 2016. Export values are given in million euro. Column % of new exports calculates share of new exports from all new exports between year 2013 and 2016.

In the period 2013-2016, the 528 HGXs contribute more to the overall export growth than the 91¹² Superstars (24.9% vs 16.5%, respectively), firm entry contributes 13.6% of new exports, and the rest of the contribution to new exports essentially comes from slow-growth non-Superstar firms. The contribution to exports from entries (793 million euro) is larger than the loss due to exit (-689 million

¹² From 100 Superstars, nine Superstars are not active in 2016, with deeper case-by-case analysis showing these nine Superstars are merged or liquidated.

euro). Superstars decline in exports (-3.7%) while the ‘other active firms’ category¹³ grew (27.8%). HGXs as a group grew their exports by 471%. In 2013 Croatia entered the EU, so the increase of exports during 2013-2016 could have benefitted from the EU accession. We also conduct the analysis for 2016-2019, and show HGXs have a similar absolute growth in exports as in 2013-2016 (1439 million euro in 2016-2019 vs 1456 million euro in 2013-2016).

4.3. New Employment

We investigate the job creation of different firm types over the period 2013-2016. Table 2 shows that the creation of new jobs from firm entries is smaller than the destruction of jobs from firm exits (85,470 vs -87,232). There are 32,771 new firms from 2013 to 2016, which are important for jobs in the economy, as they account for about 10% of all jobs (85,470 out of 864,662), and 38.2% of all new jobs (85,470 out of 223,741). HGXs make up a much smaller category of firms, only 528 firms, which make a disproportionate contribution to job creation. In 2016, the 528 HGXs account for about 38% of the number of the 91 Superstars jobs (23,277 vs 59,916, respectively), although when it comes to job creation (i.e. changes rather than levels), HGXs are growing fast (73.3% growth) while Superstars are actually destroying jobs overall (i.e. -11.9% growth). Table 2 also shows HGXs employ about 28% of the number of HGf employees in 2013 (13,430 vs 48,533), while this percentage grows to 33% in 2016 (23,277 vs 70,392). In relative terms, HGXs have a higher growth rate than HGfs (71% vs 45%).

Since there are 4 times fewer HGXs than HGfs, the HGXs make a disproportionately large contribution to job creation. In particular, HGXs grow on average by 18.6 employees (9847 / 528), while HGfs grow by 9.4 employees on average (21859 / 2318). Relatedly, looking only at the firms growing in employees from 2013 to 2016, HGXs are 0.5% of all firms in the economy but contribute 4.7% of all new employees in the economy, thus about 10 times more than expected considering their number (share of firms in the economy). HGfs are 2.2% of all firms in the economy, but contribute 11.2% of all new jobs, which is about 5 times more than expected by their share in the economy.

¹³ All other firms active in t and $t+3$ that are not HGfs or Superstars.

Table 2: Job creation 2013-2016

	Number of firms (1)	Jobs 2013 (2)	Jobs 2016 (3)	Difference (4)	% change (5)	Only growing firms (6)	Jobs created (7)	% of new jobs (8)
Entry & active firms	114651	779192	864662	85470	11.0	44969	223741	100
Firm entry	32771	0	85470	85470	-	21824	85470	38.2
Firm exit	23519	87232	0	-87232	-	0	0	0
Active firms	81880	779192	772279	-6913	-0.9	23145	138271	61.8
<i>From active firms:</i>								
HGFs	2846	61963	93669	31706	51.2	2034	35469	15.9
HGXs	528	13430	23277	9847	73.3	420	10521	4.7
HGfs	2318	48533	70392	21859	45.0	1614	24948	11.2
Superstars	91	68046	59916	-8130	-11.9	39	3226	1.4
All other firms	78934	649102	618650	-30452	-4.7	21070	99572	44.5
<i>Raw sample:</i>								
All firms 2013	105399	866424	-					
All firms 2016	114642	-	857718					

Note: Mean per firm is provided in brackets. Active firms are those existing both in 2013 and in 2016. Firm entry counts firms existing in 2016, but not in 2013. Firm exit counts firms existing in 2013, but not in 2016. We firstly split firms into Superstars and Not Superstars. Superstars are 100 largest exporters in absolute value in 2013. From 100 Superstars, nine Superstars are not active in 2016, with deeper case-by-case analysis showing these nine Superstars are merged or liquidated. Among those not Superstars, active firms are split into HGFs and other firms. HGFs cannot be Superstars in 2013. HGFs are split into HGXs and other HGFs (HGfs). All growing firms is a subgroup of firms that had positive change in employment from 2013 to 2016. Column % of new jobs calculates share of new jobs from all new jobs between year 2013 and 2016.

Analysis for 2016-2019 (Table OA3) shows similar results to Table 2. During 2013-2016, HGXs create 9847 jobs, while for 2016-2019 HGXs create 11,351 jobs. However, for the period 2016-2019 we also have data on firm-employee spells which allows more detailed analysis. Firm types are merged by firm IDs with firm-employee employment spells in the same period. Differences between HGXs and the other categories are not huge (Tables A5 and A6), although a few observations can be made. In particular, new hires at HGXs are more likely to have previous work experience in the mid high-tech sector, and in particular HGXs employ from other exporters, HGXs, and Superstars. HGXs are more likely to hire employees on 1-year contracts (i.e. short-term) and have considerably more new work contracts for working abroad (20.8%).

4.4. Firm-level characteristics

Next, we summarize firm-level characteristics for HGXs compared to the other firm categories in 2016 using a linear probability model based on variables from 2013 (period t). Monetary variables are log-transformed to address skewness. The dependent variable is a dummy indicating whether the firm is an HGX in period t+3 (year 2016) or not (=0). We computed the linear probability model for two subsets: one HGXs versus HGfs, and the other HGXs versus exporters. The following model was estimated three times, varying the reference group for HGX:

$$\begin{aligned}
 HGX = & \beta_0 + \beta_1 \cdot ForeignOwnership + \beta_2 \cdot Exporter + \beta_3 \cdot Importer + \beta_4 \cdot Log\ intangible\ assets + \\
 & \beta_5 \cdot Log\ R\&D + \beta_6 \cdot Log\ average\ wage + \beta_7 \cdot Log\ labor\ productivity + \beta_8 \cdot Log\ age + \\
 & \beta_9 \cdot Surplus + \beta_{10} \cdot \frac{EBIT}{Total\ assets} + \beta_{11} \cdot \frac{Retained\ earnings}{Total\ assets} + \beta_{12} \cdot \frac{Book\ value\ of\ equity}{Total\ liabilities} + \\
 & \beta_{13} \cdot Firm\ size\ categories + \beta_{14} \cdot NACE\ 1\text{-}digit\ sectors + \varepsilon,
 \end{aligned}$$

where the regression parameters/vectors are $\beta_0, \dots, \beta_{14}$ and ε is the remainder noise. Variance inflation factors indicate no strong multicollinearity ($GVIF < 4$), and heteroscedastic robust standard errors were used.

Results in Table 3 show foreign ownership is associated with higher probability of being an HGX compared to HGfs, and also compared to other exporters. Being export active in period t is associated with a higher probability of being an HGX compared to HGf. Since exporters per definition have to be exporters in period t, but about 25% of HGXs are not exporters in period t, in the second model there is actually a negative association between being an exporter and HGX status due to the firm category definitions.

HGXs are associated with higher $\frac{EBIT}{Total\ assets}$ and lower labor productivity compared to HGfs. Compared to exporters, HGXs are associated with higher average wage, younger age, but lower labor productivity and $\frac{Book\ value\ of\ equity}{Total\ liabilities}$. Log R&D and log intangible assets are not associated with HGX status once controlling for sectors, firm size and other firm characteristics. Relatedly, having a positive surplus is not different between HGX, HGfs and other exporters, nor is the quick ratio or $\frac{Retained\ earnings}{Total\ assets}$.

Table 3: Predicting HGX status (2013-2016)

Firm characteristics	Dependent variable		
	HGXs vs HGfs (1)	HGXs vs Exporters (2)	HGXs vs Exporters (5 or more employees) (3)
Foreign ownership	0.211*** (0.029)	0.049*** (0.008)	0.080*** (0.011)
Exporter	0.303*** (0.021)	-0.935*** (0.006)	-0.860*** (0.022)
Importer	-0.015 (0.016)	0.006 (0.004)	0.007 (0.008)
Log intangible assets	0.001 (0.002)	0.0002 (0.0005)	-0.0002 (0.001)
Log R&D	0.004 (0.005)	0.001 (0.001)	0.001 (0.002)
EBIT / total assets	0.089*** (0.033)	0.015 (0.011)	0.031 (0.023)
Quick ratio	0.008 (0.008)	0.001 (0.002)	0.008* (0.004)
Log average wage	-0.0001 (0.007)	0.010*** (0.002)	-0.007 (0.006)
Log labour productivity	-0.008** (0.003)	-0.009*** (0.002)	-0.017*** (0.004)
Log age	-0.002 (0.007)	-0.017*** (0.003)	-0.053*** (0.005)
Surplus dummy	0.020 (0.021)	0.001 (0.007)	-0.004 (0.012)
Retained earnings / total assets	0.002 (0.017)	0.006 (0.005)	0.005 (0.011)
Book value of equity / total liabilities	0.004 (0.004)	-0.002** (0.001)	-0.004** (0.002)
Observations	2,843	9,674	5,287
R ²	0.267	0.301	0.308
Residual Std. Error	0.335 (df = 2809)	0.190 (df = 9640)	0.250 (df = 5254)

Note: *p<0.10**p<0.05***p<0.01; The first linear probability model (LPM) includes HGXs and HGfs, the second LPM includes HGXs and exporters, while the third LPM includes HGXs and exporters with 5 or more employees. Superstars are excluded. All models include firm size and NACE 1-digit industry categorical variables, but are not reported for brevity reasons. Heteroscedastic robust standard errors were used.

The same models are run for period 2016-2019 which show quite similar results to Table 3 (Table OA4).

4.5. Product Mix

Products are subject to customs regulation and are tracked in detail. For comparisons among firm categories, we focus on export-active firms in 2013, but allow changes in any direction in 2016. Table 4 shows several interesting results. In the category of HGXs, the number of export products grows rapidly, faster than for export-active HGf. Although a smaller category of firms, HGXs start from a similar number of export products as HGf (2628 vs 2864), but their growth is about twice that of HGfs (3001 vs 1470). The rapid growth of HGXs export products takes place while Superstars actually decrease the number of export products (from 5154 to 4697).

The exporter category increases their number of export products per firm, but not as much as HGXs (0.6 vs 16.7 per firm). 75% of HGXs increase the number of export products, which is a considerably higher percentage than in the other firm categories (Superstars = 32%; HGfs = 37%; exporters = 27%). Clearly, HGXs are not just expanding the same products in new and/or existing markets, but are expanding the number of export products.

Table 4: Export products

	Firms	Export products 2013	Export products 2016	Diff.	Growth (%)	Only growing firms	Product growth	% of all additional
HGfs	325	2628 [8.1]	4098 [12.6]	1470 [4.5]	155.9	120	2266 [18.9]	7.9
HGXs	180	2864 [15.9]	5865 [32.6]	3001 [16.7]	204.8	135	3181 [23.6]	11.1
Other exporters	5792	56146 [9.7]	59517 [10.3]	3371 [0.6]	6.0	1536	22402 [14.6]	78.5
Superstars	94	5154 [54.8]	4697 [50.0]	-457 [-4.9]	-8.9	30	701 [23.4]	2.5

Note: brackets provide mean per firm

On average HGXs grow their number of export products, but to investigate the change in the distribution of the number of products we examine the deciles of number of products across firm types (Table 5). HGXs increase in number of products across all deciles, for example, at the 30% decile, HGXs grow from 3 to 7, at the median they grow from 6 to 11, while at 70th percentile they grow from 11 to 25 export products. As a robustness check, we also analyze the increase in export products when products are defined at the first 6-digit code of the CN8 code. Robustness results show similar patterns (although of course smaller in absolute values) for HGXs growth of export products (Table A7).¹⁴ Thus, HGXs grow, and this growth is not just due to sales growth of the same products, but due to more export products, with different CN8 codes. The growth in number of export products is substantially different from other firm types, for example, the first three deciles of HGfs do not export anymore, and they only increase in number of export products at the 80th and 90th percentiles. Similarly, exporters and Superstars decrease in number of export products across all or the majority of deciles.

Table 5: Export products: beyond averages

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Exported products 2013</i>										
HGfs	325	1	1	1	2	3	4	7	12	19
HGXs	180	1	2	3	4	6	9	11	22.2	45
Other exporters	5791	1	1	2	2	3	4	7	11	24
Superstars	94	7.6	15.8	21	29	39	48.8	62	84.4	132
<i>Exported products 2016</i>										
HGfs	325	0	0	0	1	2	4	7	16.2	36
HGXs	180	3	5	7	9	11	16	25.3	45	82
Other exporters	5791	0	0	0	1	2	3	6	11	25
Superstars	94	6	9	15	20	27	34.8	51.4	76	114

While HGXs grow in the number of export products, they might in addition explore new foreign markets. To examine this, we calculate the share of firms' top export product in total export value (Table 6). More than 50% of HGXs have 75% or more exports from a single product, also, more than 70% of HGXs have 50% or more exports from a single product. Over the three years (i.e. 2013-2016), at the median, HGXs decrease in the share of top export product in total exports. For example, at the 70th

¹⁴ In addition, we also analyze first 4-digit code of the CN8 code (Table OA5). Main results do not change.

percentile, HGXs largest export product represents 95% of total exports, three years later, this share is 86%; at the median, HGXs had 76% in 2013, and 62% in 2016; and at the 30th percentile, HGXs decrease from 57% to 49%. At all deciles, the share of HGXs' top export product decreases over time, however, at the 60th, 70th, 80th and 90th deciles HGXs' top product in 2016 is more than 70% of total exports. In contrast, Superstars have almost the same share of top export product in total exports over all deciles. HGfs and exporters decrease in top export product share, however, this finding is driven by the first three deciles where firms stop exporting by 2016.

Table 6: Share of largest export product: beyond averages

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Share of largest export product in total exports 2013</i>										
HGfs	325	0.33	0.46	0.57	0.69	0.78	0.89	1	1	1
HGXs	180	0.33	0.44	0.57	0.68	0.76	0.87	0.95	0.99	1
Other exporters	5791	0.34	0.46	0.56	0.66	0.79	0.91	1	1	1
Superstars	94	0.32	0.38	0.45	0.56	0.63	0.79	0.85	0.95	0.99
<i>Share of largest export product in total exports 2016</i>										
HGfs	325	0	0	0	0.18	0.38	0.48	0.68	0.86	1
HGXs	180	0.3	0.41	0.49	0.54	0.62	0.71	0.86	0.95	0.99
Other exporters	5791	0	0	0	0.25	0.43	0.56	0.73	0.92	1
Superstars	94	0.3	0.38	0.47	0.55	0.64	0.75	0.85	0.96	0.99

Table A8 shows additional information for 2013-2016, including the number of export products, the number of new products and the number of dropped products. Results show that 60% of HGXs have at least 2 products growing from 2013 to 2016. Up to 30% of HGfs have at least 1 product growing in exports, and up to 40% of exporters have at least 1 product growing in exports. After Superstars, HGXs have the second highest number of dropped products, for example, 70% of HGXs drop at least 1 product. As many as 80% of HGXs introduce 3 or more new products.

Table 7: Unit price: beyond averages

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Unit price 2013</i>										
HGfs	325	11	45	188	417	1197	1941	4357	10,795	25,129
HGXs	180	12	49	141	338	631	3324	10,736	38,655	152,653
Other exporters	5791	6	25	80	221	486	1174	2893	7145	27,185
Superstars	94	5	17	47	190	1572	3700	43,329	177,209	2,806,756
<i>Unit price 2016</i>										
HGfs	325	5	39	112	353	997	2136	4315	10,097	23,190
HGXs	180	30	88	202	441	1719	7681	20,357	68,680	350,253
Other exporters	5791	7	31	99	266	567	1389	3762	11,059	44,538
Superstars	94	4	18	47	116	857	2917	7682	119,183	1,476,783

As the final firm-product analysis, we focus on the mean export product unit price (Table 7). In particular, we have the information of the export value for each export product and the number of units in which products are exported. In 2013, HGXs show a wide range of mean unit costs, from as little as € 12 at the 10th percentile, € 141 at the 30th percentile, € 631 at the median, € 10,736 at the 70th percentile

up to as much as € 152,653 at the 90th percentile. By the end of the growth period (i.e. 2016), the mean unit prices increase to € 30 (10th percentile), € 202 (30th percentile), € 1719 (median), € 20,357 (70th percentile) and € 350,253 (90th percentile). On the other hand, HGfs and Superstars decrease in the mean unit prices across all deciles, while exporters increase across all deciles. Comparing HGXs and exporters it seems that HGXs increase their unit prices substantially more. However, it should be clearly stated that the share of this increase in unit prices stems from introduction of new products by the HGXs (i.e. Tables 4 and 5) which could have very different units, and therefore results in Table 7 are not necessarily strong evidence on quality upgrading, but could be a combination of both quality upgrading and introduction of new export products (Tables 5, A7, OA5).

4.6. Export Markets

This subsection analyses whether HGXs growth is driven by more export products to the same markets, or by diversifying export markets. Table 8 shows the number of firm-market observations across firm categories. HGXs are the only category of firms that have an increasing number of export markets. Their growth is impressive, the number of export markets in 2016 is almost twice the number of export markets they had in 2013. Between the 2013 and 2016, HGXs increase by 3.7 export markets on average. For HGfs, exporters, and Superstars the number of export markets decreases over the period 2013-2016.

Table 8: Export markets

	Firms	Export market 2013	Export market 2016	Diff.	Growth (%)	Scale ups	Growth	% of new markets
HGfs	325	788 [2.4]	752 [2.3]	-36 [-0.1]	-4.6	77	212 [2.8]	4.9
HGXs	180	739 [4.1]	1401 [7.8]	662 [3.7]	89.6	137	686 [5.0]	15.8
Exporters	5791	17999 [3.1]	15008 [2.6]	-2991 [-0.5]	-16.6	1189	3267 [2.7]	75.2
Superstars	94	1785 [19.0]	1708 [18.2]	-77 [-0.8]	-4.3	34	178 [5.2]	4.1

Note: brackets provide mean per firm. Export market is defined as a unique firm-market observation. Thus, if two firms both export multiple product to USA and UK in 2013, this is two export markets per firm and would be four markets in the column *Export market 2013*.

Table 9 shows HGXs increase the number of export markets in all deciles from 2013 to 2016. By the end of the growth period (i.e. 2016), 50% of HGXs have more than 5 export markets. On the other hand, 30% of HGfs and exporters stop exporting, and it seems that a majority decrease the number of export product-markets. At the upper deciles (70th, 80th and 90th percentiles), however, some HGfs grow by increasing the export markets. Hence, HGfs display heterogeneity: some HGfs stop exporting, while other HGfs intensify their exporting by exporting more products and being active in more export markets.

Table 9: Export markets: beyond averages

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Export markets 2013</i>										
HGfs	325	1	1	1	1	1	2	2	3	5
HGXs	180	1	1	2	2	3	3	4.3	6.2	10
Other exporters	5791	1	1	1	1	2	2	3	4	7
Superstars	94	4	7.6	11	13.2	16	20.8	22.1	29.4	35
<i>Export markets 2016</i>										
HGfs	325	0	0	0	1	1	2	3	4	6
HGXs	180	2	3	4	5	6	7	9	11	15
Other exporters	5791	0	0	0	1	1	2	2	3	7
Superstars	94	2.3	5	8	10.2	14	18	25.1	32	38

Several HGXs grow by concentrating on their largest export market (Table 10). More than 80% of HGXs have 50% of their exports from a single export market in 2013, while about 60% of HGXs have 75% of their exports from a single export market. Share of exports in the largest export market decreases among HGXs over the growth period. In other words, HGXs growth leads to less reliance on any individual export market, because HGXs growth spreads out into a more diversified portfolio of export markets. Apart from the first decile, Superstars are decreasing their share of largest market in total exports, however, the changes are much smaller than among HGXs. HGfs decrease their reliance on the single largest export market, however, at the end of the growth period, the upper deciles (70th, 80th and 90th percentile) focus their exports on a single export market (share of largest export market = 1). Finally, exporters decrease their reliance on their top export market, but at a much smaller rate compared to HGXs.

Table 10: Share of largest export market: 2013 and 2016

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Share of largest market in total exports 2013</i>										
HGfs	325	0.5	0.64	0.77	0.92	1	1	1	1	1
HGXs	180	0.43	0.51	0.61	0.74	0.81	0.93	0.99	1	1
Other exporters	5791	0.49	0.61	0.75	0.89	0.99	1	1	1	1
Superstars	94	0.23	0.29	0.33	0.4	0.53	0.6	0.69	0.88	0.98
<i>Share of largest market in total exports 2016</i>										
HGfs	325	0.42	0.52	0.64	0.71	0.85	0.97	1	1	1
HGXs	180	0.34	0.41	0.47	0.57	0.65	0.74	0.84	0.92	1
Other exporters	5791	0.42	0.54	0.65	0.77	0.89	0.98	1	1	1
Superstars	94	0.25	0.28	0.33	0.42	0.48	0.58	0.69	0.8	0.98

Results in Table 11 show in 2013, 78% of HGXs export to the EU Single Market, while at the end of the growth period, as many as 90% export to the EU Single Market. HGXs also increase the presence in CEFTA markets (from 61% to 68%) and other export markets (from 39% to 51%). Interestingly, the only category of firms growing in the EU market is HGXs, HGXs can benefit from new business opportunities by offering competitive products.

In 2013, 57% of HGfs export to EU Single Market, 65% export to CEFTA, and 23% export to other markets. By the end of the growth period, HGfs decrease their presence in the EU Single Market (to 37%) but increase their presence in CEFTA (83%) and other markets (29%). Finally, Superstars remain

present in the EU Single Market (97%) and other markets (78%) but decrease their presence in CEFTA markets (from 90 to 82%).

Table 11: Activity at export markets

	2013				2016			
	Obs.	EU	CEFTA	Other markets	Obs.	EU	CEFTA	Other markets
HGfs	325	0.57	0.65	0.23	207	0.37	0.83	0.29
HGXs	180	0.78	0.61	0.39	180	0.90	0.68	0.51
Other exporters	5791	0.60	0.65	0.26	3704	0.41	0.78	0.30
Superstars	94	0.98	0.90	0.79	92	0.97	0.82	0.78

HGXs increase mean distance to the active export markets across all deciles except for the largest decile (Table 12). In 2013, 50% of HGXs have mean distance of 573 kilometers (km); while in 2016, 50% of HGXs had a mean distance over 716 km. In 2013, about 70% of HGXs export to markets on average more than 850 km distant from Croatia, in 2016, 70% of HGXs have their mean distance to export market higher than 1150 km. Exporters increase their mean distance in the majority of deciles, although some deciles (70th and 80th percentile) experience a decrease in mean distance. Superstars increase their distance to export markets across all deciles, while exporters increase their distance in the mid and upper deciles.

Table 12: Mean distance of firms to their active export markets in 2013 and 2016

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Mean firm distance in km to export markets 2013</i>										
HGfs	325	226	226	331	394	485	610	853	1149	2040
HGXs	180	226	367	444	518	573	703	865	1532	2988
Other exporters	5791	226	226	342	394	499	588	774	1086	2373
Superstars	94	502	657	791	1071	1456	1731	2100	2792	3491
<i>Mean firm distance in km to export markets 2016</i>										
HGfs	325	226	226	310	414	458	546	692	989	2449
HGXs	180	354	447	559	648	716	875	1197	1798	2765
Other exporters	5791	226	230	351	407	460	551	692	1073	2578
Superstars	94	507	621	830	1174	1670	2044	2658	3008	3744

The main finding is that HGXs are further away from their export markets than HGfs and exporters, but not as much as Superstars.

4. Discussion

Previous literature on the economic contribution of exporters drew attention to large export superstars (Freund & Pierola, 2015; 2020). This study provides evidence for focusing also on the newly defined category of High-Growth Exporters (HGXs). While Superstars have achieved a large size, HGXs demonstrate growth. Awareness of HGXs may result in growth policies that (1) contrast the stability of Superstars' workforce with HGX's need for new employees, (2) ponder Superstars' requirements in terms of the education level of their employees compared to the skill requirements of HGXs, and (3)

consider the different relationships that Superstars and HGXs have with foreign markets. An exclusive focus on Superstars seems inappropriate. While Superstars are important because of their current large size, nevertheless in Croatia they are declining in terms of total exports (Table 1), number of exported products (Table 4), and overall job creation (Table 2). Forward-looking and proactive policy should focus on HGXs, which are likely the superstars of tomorrow.

We began with a sectoral analysis of exporting activity. HGXs are present in various sectors, but are more prevalent in manufacturing, wholesale & retail trade, and ICT. Tradeable sectors such as manufacturing are associated with R&D investment and productivity growth (Coad & Vezzani, 2019), highlighting the necessary policy interest in HGXs. Interestingly, there are no Superstars in the ICT sector over the period 2013-2016, perhaps because the ICT sector is relatively young, and insufficient time has elapsed to allow promising ICT firms to grow into the Superstar category. Since there are no ICT firms in the Superstars category, we could look for leading ICT firms in the HGXs category, which (given that HGXs could become superstars in the following periods) serve as promising candidates for tomorrow's superstars. As we show there are no Superstars in the ICT sector in 2013, although a first export Superstar in ICT appears in 2016 (Table OA1) and finally an additional (second) export Superstar in ICT appears in 2019.

4.1 HGXs and employment

We investigate the sources and characteristics of new HGXs employees. Do HGXs employees differ with respect to the new hires of exporters, HGfs or Superstars? During their growth episode, HGXs hire more employees from technology-intensive industries and employees with previous experience in exporting. HGXs are also observed to be more likely to hire on the basis of a single year work contract. In addition, HGXs are more likely to send new employees to work abroad. This is in line with the literature claiming the necessity of exporters to facilitate the connections to export markets (Srhoj et al. 2020). HGXs are particularly sensitive to information flows across countries, and prefer to have employees abroad as a way of organizing their international operations. Therefore, HGXs can benefit from flexible labor markets and contracts that allow workers to move between firms, contributing with their knowledge to enable growth in export markets of firms and thus HGXs.

4.2 HGXs and their product offerings

HGXs substantially increase export value over the three-year period. While HGXs grow in exports, their growth is not driven only by the top export product, because the share of the top export product in total exports substantially decreases (at the median from 76% to 62%). Instead, a robust finding is that HGXs increase in number of export products. Furthermore, growth in export products is not driven exclusively by new export products with incremental changes, but competitive products with higher unit prices that are sold in sophisticated export markets (such as the EU Single Market). In fact, a striking result is that the category that appears to benefit the most from new business opportunities (i.e. from the EU Single Market) by introducing new competitive products are HGXs.

HGXs' growth involves diversification in involving export products with high unit costs. In addition, our findings suggest that HGXs are not the stereotypical cost-cutting entrants, but are able to competitively sell high-cost products in developed export markets such as the EU. Therefore, HGXs are not just expanding the same products in new markets, but expanding the number of markets and also the number of products at the same time.

The ability of HGXs to introduce sophisticated new export goods is reminiscent of Braguinsky et al. (2021) who observe that it is often the same firms that push forward their technological frontier with new products that also simultaneously push forward their sales growth in known technologies and familiar products. Thinking about our results regarding number of export products, we could make the distinction between incremental innovation and GPT (General Purpose Technology) innovation. The latter is probably associated with a new technology that leads to a swelling of product offerings in many different directions at the same time, whereas the former is probably more limited in terms of growth directions. In this case, the export growth of HGXs resembles the phenomenon of "*growing like yeast*", whereby yeast makes bread grow evenly in many directions at the same time.

HGXs defy the trend observed for other groups of firms (e.g. HGfs, Superstars) that tend to prefer growth in closer export markets. HGXs are increasingly active in highly-developed EU markets rather than potentially less-developed export markets on poorer continents further afield. In contrast to HGXs, HGfs do not achieve growth in the large, rich and developed EU market but in other markets. This suggests that the growth of HGfs may be less interesting than the growth of HGXs, in the eyes of policymakers. A similar pattern is observed for (slow-growth) exporters. Superstars, for their part, are more globally competitive (presumably due to their previously-accumulated competitive advantage), although nowadays they are less dynamic than they used to be.

4.3 Policy interest in HGX

The impressive export performance of HGXs justifies policy interest in this category of firms. Note that the rapid growth of exports by HGXs is not merely a tautology, because: i) The HGX category refers to export growth, not export amount; and ii) if a firm is both a superstar and HGX, it will be called a Superstar in our analysis.

Our results show the importance of HGXs and provide new knowledge on their micro-level characteristics. A first step in designing policy to support HGXs, even without having causal knowledge, is awareness and recognition of this category of firms, their relative frequencies and proportions, their growth patterns in terms of new products and markets, and their overall economic importance. By providing a first look into the HGX phenomenon, we hope to spur on policy discussions. A second step in designing policy to support HGXs relates to empirical evidence on the determinants and causes of HGXs behavior. An important question is what policy-makers can do in the short-term and long-term to increase the probability of non-HGX firms becoming HGXs.

In the short run (1-2 years), a key question will be the ability to predict HGXs, and the ability of policy makers to nudge HGfs and exporters (and perhaps even non-exporting non-HGFs) to become HGXs, as well as helping HGXs on the way to becoming Superstars. If this is to be done, a monitoring system for policymakers could be established to better tailor a large set of existing short-term export boosting policies and initiatives to encourage exporting activity (for a review, see Srhoj et al. 2020). These policy initiatives to stimulate exporting activity include public grants, tax credits, subsidized export loans, export credit guarantees, public institutions offering partner search, matchmaking, intelligence, analysis and organizing participation on trade fairs, or providing vouchers for outgoing economic missions, fairs and external counseling. There is also evidence for positive effects of demand-driven instruments, such as foreign market access programs (Atkin et al., 2017) or public procurement for innovation (Stojicic et al., 2020).

Medium-term (3-5 years) policy instruments could include R&D grants and changes to incentives via tax reform (Dimos et al., 2022). Large and smaller EU or US funded grants for innovation or technology

upgrading have been shown to have a positive effect for those firms that apply (for review: Dvoulety et al., 2021; for empirical studies: Santorelli et al., 2022; Howell, 2017).

In the long-term (5+ years), a standard innovation toolkit (Bloom et al., 2019) could assist in stimulating more HGXs. Firstly, countries could increase the supply of skilled labor, for example, by an immigration policy that targets highly skilled individuals, and by improving the education system so that it develops the next generation of researchers and innovators. Secondly, since HGXs hire more on one-year contracts, changes to labor markets in order to enable more flexible work contracts might be beneficial, although of course, more research is needed on this topic. Finally, developing the venture capital market could benefit the emergence and scaling-up of HGXs.

5. Conclusion

Policymakers interested in job creation and economic development have shown a keen interest in High-Growth Firms (HGFs; Grover Goswami et al., 2019; Benedetti Fasil et al., 2021) as well as export boosting (e.g. involving export Superstars, Freund and Pierola, 2015; 2020; Srhoj et al., 2020). This paper presents evidence on a novel category of firms operating roughly at the intersection of these two groups, i.e. High-Growth Exporters (HGXs), defined as a subgroup of revenue-based High-Growth Firms with a substantial share of their growth (over 50% of revenues) coming from exports. We present a detailed analysis of HGXs, providing insights at the level of regions, industrial sectors, firms, employer-employee matching, firm-products, and firm-markets. These dynamic and export-active firms have an impressive performance in a variety of areas, including entry into high unit-cost product markets, entry into sophisticated export markets (such as the EU Single Market) and avoiding over-reliance on single products by engaging in growth through broad-based diversification.

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Appendix

Table A1: Economy export share of Superstars

Year	Exports in total economy exports (%)		
	Top 1 Superstar	Top 5 Superstars	Top 100 Superstars
2013	9.2	16.7	52.5
2014	7.8	15.9	50.2
2015	5.9	13.8	48.8
2016	4.9	11.6	45.5
2017	5.7	15.0	46.4
2018	6.6	14.8	43.9
2019	5.8	13.1	42.1

Table A2: Size of Superstars in the period 2013-2019

Year	Number of Superstars	Total employment [% of economy]	Median employment [Min.-Max]	Total sales in billion € [% of economy]	Median sales in million € [Min.-Max]	Median market share [Min.-Max]	Median exports in million € [Min.-Max]
2013	100	84082 [9.7]	426.5 [0-12127]	16.5 [20.7]	69.7 [21.3-3414]	39.5 [0.6-100]	39.6 [20.3-1109.9]
2014	100	84619 [9.8]	423.0 [0-13081]	16.2 [20.4]	70.4 [22.7-3229.1]	39.7 [0.6-99.9]	42.4 [22.6-1024.7]
2015	100	82223 [9.2]	385.5 [0-13978]	15.9 [19.4]	74.1 [25.8-2473.3]	42.1 [0.7-99.6]	47.3 [24.0-838.8]
2016	100	61282 [7.1]	368.5 [0-4598]	13.1 [15.9]	68.9 [23.9-1992.6]	38.5 [0.6-99.7]	41.6 [23.7-728.2]
2017	100	62579 [7.0]	417.0 [0-4225]	15.1 [17.1]	75.5 [27.5-2393.8]	35.4 [0.5-99.7]	46.1 [26.5-976.2]
2018	100	65091 [6.9]	461.0 [0-4125]	16.0 [16.3]	71.4 [28.5-2855.9]	37.4 [0.4-99.5]	46.3 [28.2-1181.7]
2019	100	66740 [6.6]	445.0 [0-4226]	16.2 [15.5]	69.1 [28.5-2857.4]	37.1 [0.5-99.7]	46.6 [28.4-1078.4]

Note: Share of Superstars is given in comparison to all the firms, and not just exporters. Total employment share is given in comparison to total firm employment in the economy. Single Superstar market share is calculated as its total sales divided by its total NACE 4-digit sector sales. The drop in the largest Superstar by employment (from 2015 to 2016 year) is due to restructuring of a large retailer.

Table A3: Do HGXs become Superstars: tracking for a quarter of a century

Period	Number of HGX observations	HGXs' transitions to Superstars status in 2019
1995-98	94	3
1998-01	335	3
2001-04	386	7
2004-07	475	12
2007-10	227	6
2010-13	343	10
2013-16	539	11
2016-19	576	12
<i>Unique:</i>		
1990s	418	5
2000s	1000	21
2010s	1317	26
Any	2515	44

Note. Decades aggregate unique HGX for the three-year periods in first column. The period 1998-2001 is aggregated in the 1990s. In each of the eight 3-year period there are 100 Superstars in period t, thus, 800 Superstar observations with 290 unique Superstars in 8 periods.

Table A4: Industry distribution: 2013-2016

Industry	All firms	All firms share	Exporter	Exporter share	HGf	HGF share	HGX	HGX share	Superstar	Superstar share
Agriculture, forestry and fishing	3004	0.029	188	0.018	59	0.025	16	0.030	2	0.022
Mining and quarrying	250	0.002	24	0.002	9	0.004	2	0.004	2	0.022
Manufacturing	12491	0.119	2475	0.241	376	0.162	172	0.326	59	0.648
Electricity, gas, steam and air conditioning supply	788	0.007	26	0.003	12	0.005	1	0.002	2	0.022
Water supply, sewerage, waste management and remediation activities	664	0.006	61	0.006	40	0.017	7	0.013	2	0.022
Construction	12516	0.119	373	0.036	487	0.210	42	0.080	1	0.011
Wholesale and retail trade; repair of motor vehicles and motorcycles	27445	0.260	3106	0.302	450	0.194	93	0.176	12	0.132
Transportation and storage	4003	0.038	866	0.084	98	0.042	54	0.102	7	0.077
Accommodation and food service activities	7116	0.068	0	0.000	185	0.080	0	0.000	0	0.000
Information and communication	4743	0.045	978	0.095	74	0.032	75	0.142	1	0.011
Financial and insurance activities	665	0.006	18	0.002	13	0.006	1	0.002	0	0.000
Real estate activities	4820	0.046	105	0.010	31	0.013	4	0.008	0	0.000
Professional, scientific and technical activities	16029	0.152	1826	0.178	233	0.101	52	0.098	2	0.022
Administrative and support service activities	4249	0.040	0	0.000	112	0.048	2	0.004	0	0.000
Public administration and defence; compulsory social security	59	0.001	3	0.000	0	0.000	0	0.000	0	0.000
Education	1059	0.010	42	0.004	47	0.020	0	0.000	0	0.000
Human health and social work activities	1292	0.012	26	0.003	38	0.016	0	0.000	0	0.000
Arts, entertainment and recreation	1071	0.010	72	0.007	23	0.010	3	0.006	0	0.000
Other service activities	2950	0.028	84	0.008	31	0.013	4	0.008	1	0.011
Activities of households as employers;	2	0.000	0	0.000	0	0.000	0	0.000	0	0.000
Other	173	0.002	0	0.000	0	0.000	0	0.000	0	0.000
Total	105389	1.000	10273	1.000	2318	1.000	528	1.000	91	1.000

Table A5: Characteristics of employment spells in the 2016-2019 period

	HGXs	HGfs	Exporters	Superstars
<i>Sample characteristics:</i>				
Unique firms	569	2701	9956	94
Unique employees	29494	99119	215950	29219
Unique firm-employee combinations	35910	117410	261752	34476
Observations	61263	154238	355442	50269
<i>Work contract characteristics:</i>				
Full time contract	0.403	0.320	0.404	0.389
Part time contract	0.597	0.680	0.596	0.611
Employee regular	0.620	0.831	0.821	0.775
Employee abroad	0.208	0.019	0.051	0.090
Employee foreigner	0.038	0.046	0.017	0.015
Employee youngster	0.111	0.087	0.097	0.107
Employee other	0.024	0.017	0.014	0.013
1 year contract	0.774	0.761	0.694	0.659
1-2 year contract	0.162	0.165	0.210	0.227
2+ years contract	0.064	0.074	0.095	0.114
<i>Employee characteristics:</i>				
Employee age	35.070	35.165	34.990	33.464
Male ratio	0.804	0.587	0.642	0.708
Lower educated	0.193	0.265	0.182	0.221
Secondary educated	0.495	0.528	0.543	0.453
Higher educated	0.133	0.087	0.146	0.183

Table A6: Previous employers of new hires in the 2016-2019 period

Previous employer characteristics:	HGXs	HGfs	Exporters	Superstars
Micro firm	0.212	0.251	0.230	0.132
Small firm	0.287	0.265	0.256	0.194
Medium firm	0.266	0.222	0.236	0.219
Large firm	0.235	0.262	0.278	0.455
Exporter firm	0.633	0.390	0.526	0.567
Same 2-digit industry	0.245	0.253	0.204	0.097
High tech	0.010	0.004	0.007	0.010
Med high tech	0.051	0.033	0.041	0.044
Med low tech	0.171	0.056	0.080	0.137
Low tech	0.121	0.088	0.140	0.142
KIS	0.207	0.173	0.200	0.294
High tech KIS	0.081	0.027	0.041	0.029
Low KIS	0.279	0.490	0.413	0.269
Superstar exporter	0.072	0.026	0.044	0.074
HGX	0.145	0.039	0.065	0.084
HGf	0.189	0.262	0.233	0.205

Exporter	0.330	0.221	0.320	0.267
Domestic	0.262	0.452	0.338	0.370

Table A7: Robustness check: Export products at 6-digit CN8 code

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Exported products 6-digit 2013</i>										
HGfs	325	1	1	1	2	3	4	6	11	18.6
HGXs	180	1	2	3	4	5.5	9	10	20	43
Other exporters	5791	1	1	1	2	3	4	6	10	21
Superstars	94	7.6	13	18.9	26	34	40	55.1	75.8	117.1
<i>Exported products 6-digit 2016</i>										
HGfs	325	0	0	0	1	2	4	7	15.2	32.2
HGXs	180	3	4	6	8	10	14	22	37.2	73.2
Other exporters	5791	0	0	0	1	2	3	5	10	22
Superstars	94	6	9	13	17	22.5	30	48.2	64.4	97

Note: For Table A7, we take the first 6 digits of the CN8 code.

Table A8: Growing, new and dropped export products

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Number of products growing in exports (13/16)</i>										
HGfs	325	0	0	0	0	0	0	1	2	5
HGXs	180	0	1	1	2	2	3	4	7	16
Other exporters	5791	0	0	0	0	0	1	1	2	5
Superstars	94	0.3	2	3	4.2	6.5	9.8	15	22.4	38.8
<i>Number of new products (13/16)</i>										
HGfs	325	0	0	0	0	1	3	5	11	26.6
HGXs	180	1	3	5	6	8	11	17.3	34.4	62.2
Other exporters	5791	0	0	0	0	1	2	3	7	16
Superstars	94	2	3	7	10	12	17	22.2	35.4	55.5
<i>Number of dropped products (13/16)</i>										
HGfs	325	1	1	1	2	2	3	4	7	12
HGXs	180	0	0	1	2	3	4.4	7	11	19.1
Other exporters	5791	1	1	1	2	2	3	5	8	15
Superstars	94	3	7.6	12	17.2	22	25.8	32.2	43.4	64

HGX: The Anatomy of High Growth Exporters

Online Appendix

Stjepan Srhoj, Alex Coad & Janette Walde

Table OA1. Industry distribution: 2016-2019

Industry	All firms	All firms share	Exporter	Exporter share	HGf	HGF share	HGX	HGX share	Superstar	Superstar share
Agriculture, forestry and fishing	3219	0.028	295	0.021	66	0.023	16	0.027	2	0.021
Mining and quarrying	223	0.002	32	0.002	9	0.003	3	0.005	1	0.010
Manufacturing	13150	0.115	3110	0.225	448	0.154	192	0.327	63	0.649
Electricity, gas, steam and air conditioning supply	797	0.007	49	0.004	13	0.004	1	0.002	4	0.041
Water supply, sewerage, waste management and remediation activities	755	0.007	82	0.006	55	0.019	5	0.009	2	0.021
Construction	12788	0.112	681	0.049	708	0.244	64	0.109	2	0.021
Wholesale and retail trade; repair of motor vehicles and motorcycles	27244	0.238	4106	0.298	500	0.172	76	0.129	12	0.124
Transportation and storage	4589	0.040	1016	0.074	131	0.045	53	0.090	9	0.093
Accommodation and food service activities	9202	0.080	0	0.000	200	0.069	0	0.000	0	0.000
Information and communication	5603	0.049	1445	0.105	114	0.039	90	0.153	1	0.010
Financial and insurance activities	449	0.004	22	0.002	14	0.005	1	0.002	0	0.000
Real estate activities	4946	0.043	138	0.010	44	0.015	4	0.007	0	0.000
Professional, scientific and technical activities	18275	0.159	2492	0.181	273	0.094	71	0.121	1	0.010
Administrative and support service activities	5230	0.046	0	0.000	162	0.056	0	0.000	0	0.000
Public administration and defence; compulsory social security	56	0.000	5	0.000	0	0.000	3	0.005	0	0.000
Education	1365	0.012	60	0.004	35	0.012	2	0.003	0	0.000
Human health and social work activities	1533	0.013	48	0.003	57	0.020	3	0.005	0	0.000
Arts, entertainment and recreation	1399	0.012	101	0.007	44	0.015	4	0.007	0	0.000
Other service activities	3597	0.031	103	0.007	30	0.010	0	0.000	0	0.000
Activities of households as employers;	2	0.000	0	0.000	0	0.000	0	0.000	0	0.000
Other	220	0.002	9	0.001	0	0.000	0	0.000	0	0.000
Total	114642	1.000	13794	1.000	2903	1.000	588	1.000	97	1.000

Table OA2: Export creation 2016-2019

	Number of firms (1)	Exports 2016 (2)	Exports 2019 (3)	Difference (4)	% change (5)	All growing firms (6)	Exports growth (7)	% of new exports (8)
Entry & active firms	136628	14273	18507	4234	29.7	14737	6927	100
Firm entry	40990	0	1040	1050	-	3943	1040	15.0
Firm exit	19004	494	0	-494	-	0	0	0
Active firms	95638	14273	17467	3194	22.4	10794	5887	85.0
<i>From active firms:</i>								
HGFs	3491	677	2145	1468	216.8	1072	1541	22.2
HGXs	588	477	1916	1439	301.7	588	1439	20.8
HGfs	2903	200	229	29	14.5	484	102	1.5
Superstars	97	6590	7108	518	7.9	61	1687	24.4
All other firms	92046	14273	17467	3194	22.4	9661	2659	38.4
<i>Raw sample:</i>								
All firms 2016	114642	14767	-					
All firms 2019	136628	-	18507					

Note: Active firms are those existing both in 2016 and in 2019. Firm entry counts firms existing in 2019, but not in 2016. Firm exit counts firms existing in 2016, but not in 2019. We firstly split firms into Superstars and Not Superstars. Superstars are 100 largest exporters in absolute value in 2016. From 100 Superstars, four Superstars are not active in 2019, with deeper case-by-case analysis showing these Superstars are merged or liquidated. Among those not Superstars, active firms are split into HGFs and other firms. HGFs cannot be Superstars in 2016. HGFs are split into HGXs and other HGFs (HGfs). All growing firms is a subgroup of firms that had positive change in exports from 2016 to 2019. Export values are given in million euro. Column % of new exports calculates share of new exports from all new exports between year 2016 and 2019.

Table OA3: Job creation 2016-2019

	Number of firms (1)	Jobs 2016 (2)	Jobs 2019 (3)	Difference (4)	% change (5)	Scale-ups (6)	Jobs created (7)	% of new jobs (8)
Entry & active firms	136628	803471	1016513	213.042	26.5	56632	307657	100
Firm entry	40990	0	126735	126735	-	27030	126735	41.2
Firm exit	19004	54247	0	-54247	-	0	0	0
Active firms	95638	803471	889778	86307	10.7	29602	180922	58.8
HGFs	3491	62791	101674	38883	61.9	2684	42232	13.7
HGXs	588	13566	24917	11351	83.7	488	11730	3.8
HGfs	2903	49225	76757	27532	55.9	2196	30502	9.9
Superstars	97	61170	62465	1295	2.1	63	7182	2.3
All other firms	92046	803471	889778	86307	10.7	26854	131507	42.7
All firms 2016	114642	857718	-					
All firms 2019	136628	-	1016513					

Note: Active firms are those existing both in 2016 and in 2019. Firm entry counts firms existing in 2019, but not in 2016. Firm exit counts firms existing in 2016, but not in 2019. We firstly split firms into Superstars and Not Superstars. Superstars are 100 largest exporters in absolute value in 2016. From 100 Superstars, nine Superstars are not active in 2019, with deeper case-by-case analysis showing these nine Superstars are merged or liquidated. Among those not Superstars, active firms are split into HGFs and other firms. HGFs cannot be Superstars in 2016. HGFs are split into HGXs and other HGFs (HGfs). All growing firms is a subgroup of firms that had positive change in employment from 2016 to 2019. Column % of new jobs calculates share of new jobs from all new jobs between year 2016 and 2019.

Table OA4. Predicting HGX status: 2016-2019

	<i>Dependent variable:</i>		
	HGX dummy		
	HGXs vs HGfs (1)	HGXs vs Exporters (2)	HGXs vs Exporters (5 or more employees) (3)
Foreign ownership	0.130*** (0.021)	0.025*** (0.005)	0.039*** (0.009)
Export active	0.350*** (0.014)	-0.932*** (0.019)	-0.816*** (0.026)
Importing	0.010 (0.013)	0.003 (0.004)	0.004 (0.006)
Log intangible assets	-0.002 (0.001)	0.001 (0.0004)	0.0005 (0.001)
Log R&D	0.008*** (0.003)	0.007*** (0.001)	0.008*** (0.001)
EBIT / total assets	0.047 (0.032)	0.014 (0.009)	0.038* (0.022)
Quick ratio	0.012** (0.006)	-0.0003 (0.001)	0.004 (0.003)
Log average wage	-0.001 (0.007)	0.016*** (0.002)	-0.008 (0.006)
Log labour productivity	-0.006** (0.002)	-0.008*** (0.002)	-0.017*** (0.004)
Log age	-0.080*** (0.010)	-0.041*** (0.003)	-0.107*** (0.006)
Surplus dummy	-0.035* (0.020)	-0.010 (0.006)	-0.035*** (0.013)
Retained earnings / total assets	-0.014 (0.014)	0.005 (0.004)	0.002 (0.010)
Book value of equity / total liabilities	0.006* (0.003)	-0.002*** (0.001)	-0.005*** (0.002)
Observations	3,490	13,151	6,656
R ²	0.303	0.206	0.238
Adjusted R ²	0.296	0.204	0.234
Residual Std. Error	0.313 (df = 3456)	0.184 (df = 13115)	0.248 (df = 6621)

Note: * p < 0.1, ** p < 0.05, *** p < 0.01. Linear probability model (LPM), first LPM includes HGXs and HGfs, second LPM includes HGXs and exporters, while third LPM includes HGXs and exporters with 5 or more employees. Superstars are excluded. All models include firm size and NACE 1-digit industry categorical variables, but are not reported for brevity reasons. Heteroscedastic robust standard errors were used.

Table OA5: Robustness check: Export products at 4-digit CN8 code

	Obs.	10%	20%	30%	40%	50%	60%	70%	80%	90%
<i>Exported products 4-digit 2013</i>										
HGfs	325	1	1	1	2	2	3	5	9	14
HGXs	180	1	1	2	3	4	6	8.3	13.2	28.2
Other exporters	5791	1	1	1	2	2	3	5	8	15
Superstars	94	5.3	10	14.9	19	23	32	38.1	50.4	68.5
<i>Exported products 4-digit 2016</i>										
HGfs	325	0	0	0	1	2	3	5	11.2	22
HGXs	180	2	3	5	6	8	11	16	24.2	48.1
Other exporters	5791	0	0	0	1	1	2	4	8	16
Superstars	94	5	7	9	13	15.5	21	30.3	45.4	70.1

Note: For Table OA5, we take the first 4 digits of the CN8 code.

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Stjepan Srhoj, Alex Coad, Janette Walde

HGX: The Anatomy of High Growth Exporters

Abstract

Export boosting is a policy agenda in developed and developing countries. Previous work has found that a small number of Superstars contribute disproportionately to the economy's overall exports. Differently from Superstars, this study is the first to define high growth exporters (HGXs), provide their economic importance and depict their micro-level anatomy. By tracking HGXs in Croatia for over a quarter of a century, 44 out of 100 Superstars in 2019 were previously HGXs. Industry-wise, HGXs are concentrated in manufacturing, information and communication technology, transportation and storage sectors. HGXs are located in higher export active regions, neighboring advanced markets. HGXs represent only 0.5% responsible for about 25% hire more employees from technology intensive industries with previous experience in exporting. They often hire on a single year work contract, and more frequently send new employees to work abroad. HGXs have the highest number of new products, and the concentration of HGXs' main export products decreases over time, thus, the growth is driven by multiple products and the simultaneous increase in the number of new export markets. HGXs export to closer markets than Superstars, but to more distant markets than other HGFs and exporters who tend to be more active in less developed markets. HGXs tend to increase their presence in the EU Single Market, introduce new products and substantially increase their unit price.

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