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Long-term dynamics shaping industrial path development:

The metalworking sector in Asturias (Spain), 1939-2018

Guillermo Antuña Martínez

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PhD in Economic History | Long-term dynamics shaping industrial path development | Guillermo Antuña 2024

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PhD in Economic History

Title

Long-term dynamics shaping industrial path development: The metalworking sector in Asturias (Spain), 1939-2018

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May 2024

UNIVERSITAT DE BARCELONA

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A mi abuelo, sin quien nada se entiende.

Aknowledgements

Es difícil darse cuenta del camino recorrido hasta que se atisba el final. Tan solo desde la meta es posible mirar atrás y comprender, con sorpresa, que el el punto de partida parece estar en un lugar diferente a cuando empezamos a caminar. Es la distancia del tiempo. Vivir, tratar de comprender, seguir.

No podría dedicar esta primera página de mi tesis doctoral a otro fin que no sea mostrar mi sincero y profundo agradecimiento a todas las personas que me han acompañado en este trayecto, y sin que las que no hubiera sido posible realizar este trabajo.

Quiero dar las gracias en primer lugar a mis directores, Jordi Catalan y Marc Prat, no solo por haber supervisado esta investigación, sino por haberme apoyado en los momentos más difíciles de este proceso, y por haber confiado siempre en mí y en mi trabajo. Su guía ha sido fundamental a lo largo de todos estos años, y ha sido un verdadero placer haber podido formarme y desarrollar los primeros pasos de mi carrera académica a su lado. Igual mención merece Joaquín Ocampo, sin quien nunca hubiera llegado hasta aquí. Él me animó a venir a Barcelona, a enrolarme en el Máster, a apostar por continuar con el doctorado. Me dio también la primera oportunidad de publicar junto a él, con una generosidad que, obviamente, yo no merecía. Es un tremendo honor poder decir que habéis sido mis maestros. Yo también he conseguido ver más lejos subido a hombros de gigantes.

No puedo imaginar un departamento mejor en el que haberme formado como académico que el Departament d'Història Econòmica, Institucions, Política i Economia Mundial de la Universitat de Barcelona, cuya historia se honra hoy con el Centre d'Estudis Jordi Nadal. Gracias al programa de Doctorado en Historia Económica por haberme dado la oportunidad de desarrollar mi investigación, y al proyecto *Capitalismo mediterráneo?: Éxitos y fracasos del desarrollo industrial en España, 1720-2020*, al que se adscribe este proyecto a través de una beca FPU del Ministerio de Ciencia, Innovación y Universidades.

Pero el alma del departamento siguen siendo todas aquellas personas que lo conforman. Quiero empezar dándole las gracias a Yolanda Blasco, quien desde el primer momento, aún como alumno de Máster, me abrió las puertas de esta casa y siempre ha estado presente cuando la he necesitado. Gracias también a Marc Badia, por el apoyo constante y la sonrisa perpetua, hasta en los peores días. A Montserrat Carbonell, quien me dio la primera oportunidad profesional en este campo, y a Miquel Gutiérrez, que dio la cara por mí y mi trabajo cuando más falta me hizo, y quien me ha seguido acompañando hasta este momento. Gracias a Sergi Lozano, compañero de aula y de investigación, por el conocimiento, el trabajo y el apoyo continuo. A Javier San Julián, por acompañarme en mi paso a un nuevo campo de la disciplina y por confiar siempre en mí. Quiero dar las gracias también a Anna Carreras, con quien tuve el placer de compartir docencia, por todo el aprendizaje. A Alfonso Herranz, quien desde el primer día me hizo sentir que este era mi lugar. No puedo olvidarme de quienes hacen que cada día sea un gusto venir a la Universidad: Sergio Espuelas, Enrique Jorge, Oriol Sabaté, José Péres, Tomás Fernández, Julio Martínez, Pep Colomé, Álex Sánchez, Raimon Soler, Ramon Ramon y el resto de profesores y profesoras de esta casa. Tampoco puedo dejar de agradecer a quienes han sido mis compañeros y compañeras del Programa de Doctorado, continúen su formación o estén ya disfrutando de su más que merecido reconocimiento. Gracias Xabi, Songlin, Wenxuan, Xavi, Jordi, Álex, Bruno, Noelia, María José, Martín, Julio, Juan, Pablo, Roser, Pau y Carlos. Gracias también a toda la comunidad académica que me ha apoyado durante estos años: Patricia Suárez, Adoración Álvaro, Daniel Tirado, Alfonso Díez-Minguela, Fernando Collantes, Anna Aubanell, Esther Sánchez, Jesús María Valdaliso, Mar Rubio, Joseba de la Torre, Pablo Cervera, Alfonso Sánchez, Montserrat Llonch, Isabel Lobato, José Ignacio Martínez, Isabel Bartolomé… Gracias por vuestra sabidura y ayuda. La mención más sentida es para Guillem Verd, soporte constante, primer lector y comentarista de todos mis trabajos, compañero de fatigas y eterno amigo.

Desidero inoltre ringraziare Andrea Colli e Veronica Binda per avermi ospitato durante la mia permanenza all'Università Bocconi di Milano, per essere stati coinvolti nella mia ricerca e nel mio lavoro e per essere stati dei sostenitori molto importanti nel proseguimento della mia carriera accademica. Grazie anche a Marco Doria, Grace Ballor, Valeria Giacomin e a tutti coloro che hanno reso il mio soggiorno in Italia un'esperienza accademica e personale indimenticabile.

Quisiera agradecer también el apoyo de la Fundació Ernest Lluch a mi investigación, y más concretamente a Ferriol Soria por su interés y confianza en mi trabajo. Gracias también a todo el equipo que conforma Grupo Daniel Alonso, especialmente a Daniel y Orlando Alonso por abrirme sus puertas y compartir tan generosamente conmigo su historia. Gracias también al equipo de SADEI y a José Luis Rebordinos de LNE, sin cuya ayuda no habría podido realizar esta investigación. Me gustaría hacer una mención especial a Guillermo Ulacia, figura fundamental en mi trayectoria y quien ha marcado un antes y un después en mi vida profesional. Desde la más profunda admiración, es un orgullo considerarte mentor y amigo.

Para acabar, Mamá, Papá, Tati, Diego, Sofi, Pili, Jose, Claudi, Javi, Familia. Gracies pol amor, por confiar colos güeyos zarraos. Gracies, amigos, por non dexame cayer. Grácies, Paula, per haver construït aquí la nostra llar, per fer d'aquesta la meva casa. Gracias, Abu, por cuidarme.

Dáime tira.

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Introduction

The Great Recession, the COVID-19 crisis and the military tensions on the global geopolitical map have returned industry to the center of political and social arenas. Different political agents that conform the European supranational sphere have taken on this perspective, which still places industry as the backbone of the entire economic region and are committed to developing models for the sector based on knowledge, energetic efficiency and specialization in niches with a high technological component.[1] Therefore, the reindustrialization of Europe has become a hot topic for academia in recent years (Capello & Cerisola, 2023; Christopherson et al., 2014).

Since the end of WWII, industry was the main driver of economic growth for developed economies (Landes, 1969; Rostow, 1959), and industrial policy a key element in the mix of government policies aimed at fostering economic development (Chang, 2002; Rodrik, 2004). Thus, the period known as the Golden Age of Western capitalism was structured around large vertically integrated firms characteristic of the Second Industrial Revolution, beneficiary of internal economies of scale and competing in an environment that Chandler defined as a 'global oligopoly' (Chandler et al., 1997; Chandler, 1990; Chandler & Hikino, 1997). Consequently, sectors such as steelmaking, chemistry, and automobile were identified as strategic, and their development became a matter of utmost priority for national governments (Catalan, 2010; Cockerill, 1974; Foreman-Peck & Federico, 1999). This model persisted until the 1970s, when it began to show signs of exhaustion. The oil shocks have been taken as indicators of a change of stage which, under the umbrella of industrial restructuring, marked the beginning of a deindustrialization process

[1] European Industrial Strategy 2050. More precisely, European Comission, *Towards knowledge-driven reindustrialization* (2013) and *Masterplan for a Competitive Transformation of EU Energy-intensive Industries Enabling a Climate-neutral, Circular Economy by 2050* (2019).

that has lasted to our days (Rodrik 2016; Kollmeyer 2009; Škuflić & Družić 2016).[2]

The rupture of the Fordist model marked the beginning of the Second Industrial Divide, which shifted the focus to more flexible production models and the leading role of SMEs (Evans, 2023; Piore & Sabel, 1984). From the firm perspective, this shift opened the door to examining these agents' performance as a Schumpeterian response to a structural crisis in the frame of a new stage of capitalism (Colli, 2002; Jones & Ward, 2004; Schumpeter, 2000). Similarly, under this paradigm, interest was revived in the spatial component of economic activity and productive specialization. On the one hand, the high degree of regional concentration inherent in the industries of the Second Industrial Revolution meant that deindustrialization impacted European regions unevenly, based on their traditional specialization and productive structure (Chesire, 1991; Di Berardino et al., 2021; Ganau & Kilroy, 2023; Nickell et al., 2008). On the other, renewed research on spatial economics found a strong link between the existence of complex productive ecosystems and economic growth (Kim, 1999; Krugman, 1992; Krugman & Venables, 1996). Therefore, since the late 20th Century, Alfred Marshall's foundational work (Marshall, 1920) has been revisited to delve into the study of ecosystems such as Industrial Districts (Becattini, 1991; Becattini et al., 2014; Popps et al., 2006; Porter & Ketels, 2009; Wilson et al., 2022) or Clusters (Cooke, 2001; Popp & Wilson, 2007; Porter, 1990, 1998). More concretely, due to their increasing relevance, later works delved into different dimensions of these concepts such as their emergence process (Brenner & Mühlig, 2013; Isaksen, 2016; Menzel et al., 2010), life-cycle (Bellusi & Sedita, 2009; Bergman, 2009; Klepper, 1997; Martin & Sunley, 2011; Popp & Wilson, 2007), trajectory (Humphrey & Schmitz, 2002; Trippl & Tödtling, 2008; Valdaliso et al., 2016) typology and structure (Catalan et al., 2011; Iammarino & McCann, 2006; Markusen, 1996; Porter & Ketels, 2009), policy implications (Asheim et al., 2017; Borrás & Tsagadis, 2008; Elola et al.,

[2] From the supply side, deindustrialization was analyzed as a natural stage of a mature industrial sector in those countries where it was more developed. From the demand, as a productive response to a consumption pattern that, full of manufactures, reoriented towards services. Theoretical origins of both approaches in Clark (1957) y Bell (1976), respectively.

2017; Fornahl & Hassink, 2017; Njøs & Jakobsen, 2016), and their impact on competitiveness (Feldman et al., 2005; González-Bravo et al., 2018; Grashof, 2021; Keeble & Wilkinson, 1999; Porter, 1998).

Building on these foundations, a growing body of literature has focused either on studying the process of deindustrialization and the creation of post-industrial societies (Araújo et al., 2021; Clark, 2022; Hassink, 2022; Kovalchuk, 2021; Pula, 2017; Rodrik, 2016), or on the possibilities for industry to position itself as a new engine of economic growth through emerging and sustainable activities (Aiginger & Rodrik, 2020; Capello & Cerisola, 2023; Chang & Andreoni, 2020; Hassink et al., 2019). In both cases, there is a broad consensus on the evolutionary and accumulative character of these processes, commonly explained in the framework of path dependence (Arthur, 1994; Boschma, 2004, 2015; Henning et al., 2013; Martin & Sunley, 2006). Thus, with a focus on industrial restructuring, it can be understood that certain regions' high degree of specialization in traditional industrial activities led them to a situation of potential lock-in (Law, 2018; Martin, 2010; Newey & Coenen, 2022). However, there can be cases where this specialization gives way to processes of path creation, that is, the generation of new activities related to the original activity thanks to the accumulation of capabilities in the long term (Boschma & Martin, 2010; Djelic & Quack, 2007; MacKinnon et al., 2019; Martin, 2010). The degree of interrelation between these emerging activities and the original activity will depend on the specific conditions of each region/ecosystem, which will determine the existing relatedness component between them (Balland et al., 2019; Boschma, 2016; Deegan et al., 2021; Hidalgo et al., 2018).

However, this literature has treated history as an exogenous agent to the processes under study, using the economic and institutional context as merely a backdrop in which insert processes of change or structural persistence, underestimating the role of contingency and agency (Garretsen & Martin, 2010; Grillitsch et al., 2022; Martin & Sunley, 2006; Popp & Wilson, 2007). Therefore, it is necessary to contribute clearly and relevantly to these debates from the perspectives of Economic History and Business History, emphasizing the potential of historical analysis and case study research

(Giacomin, 2018; Lubinski et al., 2024; MacKenzie & Perchard, 2022; Perchard et al., 2017) to contribute both to the study of deindustrialization and the search for hidden potential for reindustrialization in declining regions.

Notable voices have recently claimed how much 'history matters' to understanding evolutive structural dynamics of persistence and change. (Boschma & Frenken, 2006; Henning, 2018; Henning et al., 2013; Martin & Sunley, 2022). Nevertheless, there is a lack of works within this paradigm that use historical methods to construct complex narratives and truly introduce contingency and agency in analysing regional and sectoral trajectories in the long term. Consequently, although the explanatory potential of the dialogue between disciplines has been identified, still fewer works have attempted to clearly bridge Economic History, Business History, and Evolutionary Economic Geography.

This thesis investigates the evolution of the metalworking sector in the steelmaking region of Asturias (Spain) from the end of the Civil War in 1939 to 2018, with the aim of understanding which long-term factors and dynamics allowed this industry to become a regional leader amidst the decline of the hegemonic industries and rapid tertiarization. To achieve this, the thesis proposes a comprehensive long-term analysis that combines the study of institutional, business, and structural dimensions in order to obtain the greatest possible explanatory power.

The metalworking sector became a cornerstone of post-WWII industrial development, acting as a catalyst for overall industrial growth by consistently increasing productivity and, subsequently, economic growth. Therefore, developing a robust and diversified metalworking industry, along with steelmaking —the initial steps of its value chain— became a priority for both Western industrial powers and countries seeking to undergo a catch-up process (Pollard 1981; Landes 1969; Rosenberg 1982). In this sense, Spain and Italy have been considered key countries for analyzing industrial history from Southern Europe (Grohmann, 1991; Prados de la Escosura & Zamagni, 1992), both for their relatively late industrial development and for the predominant role that fascist regimes and State intervention had in this

process (Amatori, 2013; Castronovo, 2012; Catalan, 1992; Martín Aceña & Comín, 1991; Schwartz & Gónzalez González, 1978).[3]

In the Spanish case, Franco's long-lasting regime generated profound structural imbalances (Catalan, 2003; Comín, 2001; Fontana & Nadal, 1980; Fraile, 1991) and hampered Spanish industrial development in its transition to democracy (De la Torre & García-Zúñiga, 2013, 2014).[4] Until the beginning of democracy and the industrial crisis, Francoist industrial policy bolstered basic strategic industries –among which steelmaking held a predominant place–, generally prioritizing nationalist interests over economic rationality (Díaz Morlán & Sáez, 2019; Fernández de Pinedo, 2003; Fraile, 1992; Gómez Mendoza, 2000). This caused industrial restructuring to begin later than in other European countries, leading to more drastic reforms in an attempt to undergo a convergence process in the shortest possible time (Catalan, 2014; Méndez et al., 2003; Myro, 1989).[5] From a regional perspective, Asturias represents a paradigmatic case of this dynamic. The presence of coal deposits determined the region's industrialization from the end of the 18th Century (Nadal, 1975; Ocampo, 2004; Ojeda, 1985).[6] In autarky, the possibility of exploiting these resources determined the establishment of the national steel champion Ensidesa (Empresa Nacional Siderúrgica S.A.) in the region, turning Asturias into the main steelmaking pole of Spain from the 1950s (González González, 1988, 2004; Vázquez, 2004a) and reinforcing the region's traditional productive specialization in steelmaking, mining, and shipbuilding (Álvarez Miranda, 1993; Ocampo & Suárez Cano, 2018; Servén, 1989; Vázquez, 2004b). The promotion of these heavy industries, considered of strategic interest for national development, resulted in the Asturian economic splendor during the central decades of the

[3] The economic historiography of both countries is vast. This work selects studies that the author considers key to framing this research, without this detracting from others that may not be cited. For a panoramic view of both countries, see García Delgado (1989) and Zamagni (1990). For a comprehensive view of Spanish industrial history, the seminal work by Nadal et al. (2003).

[4] For an overall view of the country's political and economic transition, see De la Torre & Rubio-Varas (2022).

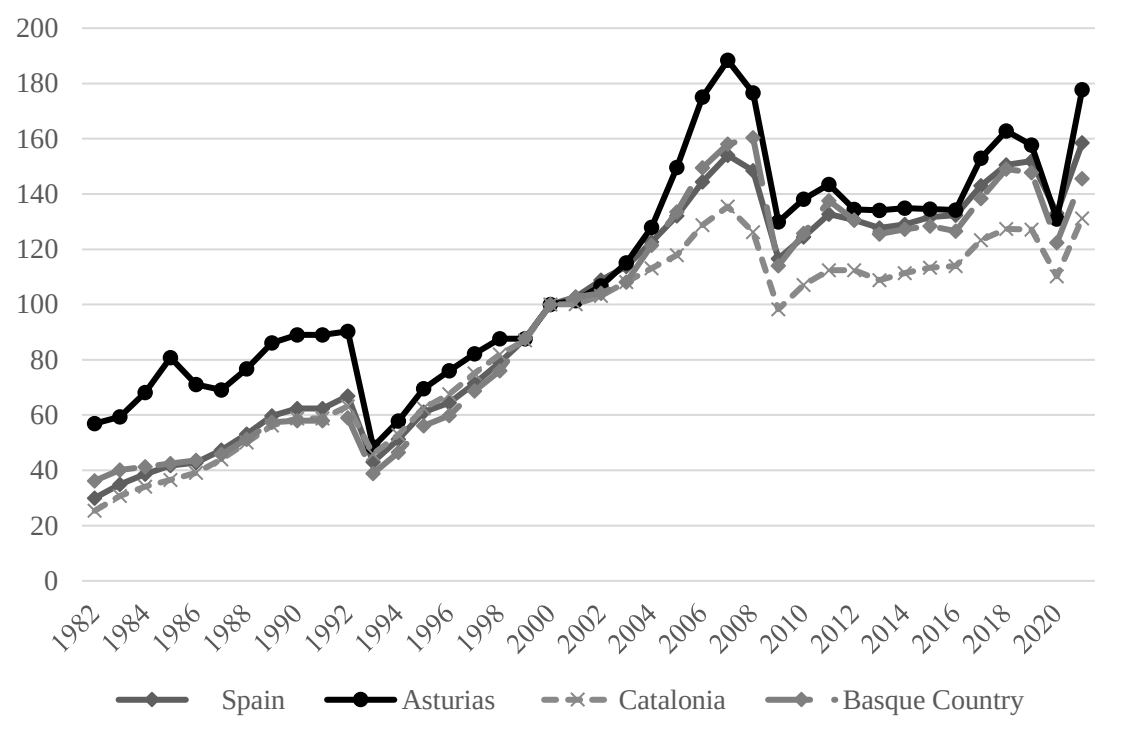
[5] A global perspective on the restructuring of the three traditional sectors tangentially referred to in this research: steelmaking (Díaz Morlán et al., 2009; Navarro, 2004), shipbuilding (Valdaliso, 2019a) and coal mining (Rabanal, 2009).

[6] Between 1860 and 1880, Asturias was the leading metallurgical region in Spain, until the introduction of the Bessemer process shifted leadership to the Basque Country (Escudero, 2005; Nadal, 1992).

20th Century (Ojeda & Vázquez, 1988) but also weakened its positioning in the face of the industrial crisis (Hernández Muñiz & Vázquez, 1991; Ruíz Valdepeñas, 1992; Vázquez, 1992).

Asturias was perhaps the region that suffered the most from the consequences of industrial restructuring in Spain, being relegated to the background in the regional economic context and falling far behind other traditionally industrial regions such as Catalonia or the Basque Country (Díez-Minguela, Galarraga & Tirado., 2018).[7] Consequently, the notion of Asturias as an industrial wasteland has persisted in the popular imagination, a diagnosis that does not match the image provided by a more detailed look at the data (Figure 1).

Figure 1. Evolution of total industrial production at the national level and in various regions, 1982-2020



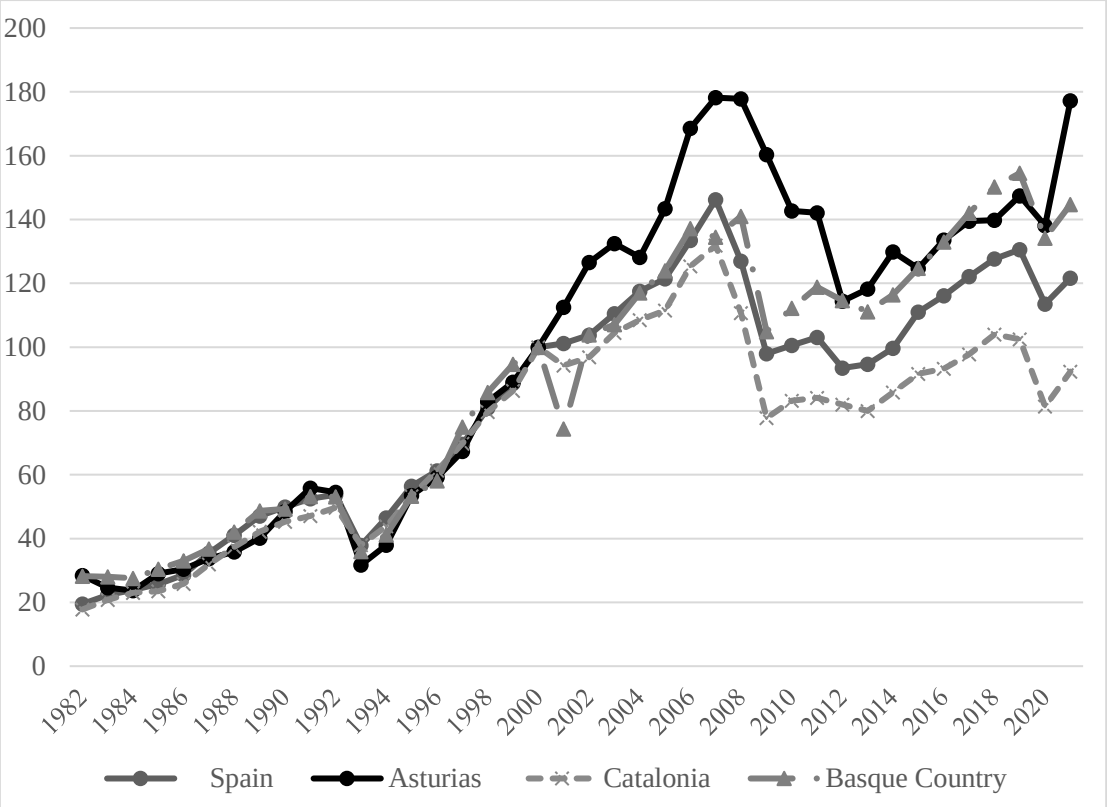
Source: INE (National Statistics Institute), industrial product survey. Index numbers base year 2000.

This image has been upheld due to the significant weight that the previously mentioned industrial sectors had in the region's productive structure and the rapid and drastic process of tertiarization that its economy underwent. However, a closer look at the metalworking sector also nuances these results

[7] Industrial policy was key in the industrial development of both regions. A recent perspective on both cases in Catalan (2019) and Valdaliso (2019b), respectively.

(Figure 2). This thesis aims to reconstruct this history and analyze the reasons behind a relative success overshadowed by structural problems stemming from an archaic industrial legacy and a short-sighted industrial restructuring, which prioritized the purchase of social peace over the creation of viable future lines of industrial development.[8]

Figure 2. Evolution of total metalworking production at the national level and in various regions, 1982-2020



Source: INE (National Statistics Institute), industrial product survey. Index numbers base year 2000.

The thesis is conceived as a compendium of four independent chapters, each possessing value on its own but forming a coherent and unified whole when combined. Each chapter is structured as a paper, meaning redundancies and repetitions occur within the thesis compendium. Efforts have been made to minimize these instances, though each chapter's integrity and internal coherence have been prioritized at all times over potential overlaps in the general compendium.

[8] The closest comparison within the Spanish framework is the Basque Country, considered the most successful case in undertaking such a transformation. An overview in Valdaliso (2013).

At the time of writing these lines, two of these papers have already been published in peer-reviewed journals, so they are presented here in their entirety and identical to how they appear published in the corresponding journals, albeit adapting the formal aspect to favor the harmony of the whole thesis. For this same reason, it has been decided to use a separate references section for each of them, including this introduction and the general concluding remarks, even though this generates repetitions.

Chapter 1, *'Revisiting the Francoist industrial policy: the 'unwanted' birth of a metalworking cluster in the industrial pole of Asturias (Spain), 1939-1985'*, analyzes the emergence of this cluster from a productive and institutional perspective. To do so, various official primary sources such as the Records of New Companies (1939-1960), the Yearbooks of the Provincial Delegation of Industry, the regional industrial censuses and Input-Output tables of Asturias (1968,1978,1985), and the yearbooks of the steelmaking company Ensidesa are combined. This allowed conducting a quantitative analysis of the emergence process, reconstructing time series and the evolution of the productive structure of the sector at the corporate level. This approach was qualitatively complemented to understand the Francoist regime's role in this process and the relationship between the regime and the companies within the ecosystem at a micro-level. Results show that, by the end of the Civil War, Asturias exhibited the necessary preconditions for the emergence of a metalworking cluster, primarily due to the mining and metallurgical specialization of the region since the late 18th Century. The creation of Ensidesa in 1950 was the triggering event that activated self-reinforcing dynamics, favoring the endogenous growth of the cluster until the beginning of the industrial restructuring. However, the studied documents reveal these metalworking companies' abandonment from the regime and the contradictions and disputes within the Francoist organisms. Despite constant requests from provincial delegates for direct support due to the sector's high development potential, the government only intervened to favor traditional industries such as steelmaking and coal mining.

Chapter 2, *'A Step Forward: the Asturian metalworking sector facing industrial restructuring, 1978-2000'*,[9] delves into the sector's performance during and after the industrial restructuring. Leveraging various official primary sources such as the aforementioned Input-Output tables (1978-2000) or regional accounts, this work reconstructs and analyzes diverse series (production, exports, employment), indicators (employment specialization coefficients or regional interrelation coefficients), and the productive structure at the company level. The results demonstrate that the sector's clusterization by the onset of the industrial restructuring enabled it to survive the crisis and grow after the 1990s, mainly driven by pocket multinationals which were able to integrate into high value-added stages in global value chains related to Industry 4.0. However, the role of industrial policy must be nuanced once again, as interventions primarily focused on restructuring traditional sectors. The metalworking sector indirectly benefited from public promotion for being competitive *ex-ante* and, in many cases, drove industrial investment plans.

Chapter 3, 'Industrial path creation, a business case approach: Daniel Alonso Group from steelmaking to wind power',[10] examines the Group's history as a sectorial benchmark in Asturias. Methodologically, the paper is built on a triangulation of the aforementioned macro sources, corporate archives (Daniel Alonso Group and Ensidesa), and oral history (various interviews with members of the Alonso Villarón family and other relevant stakeholders). Finally, diverse regional newspapers' archives fill the remaining gaps and enrich the narrative. The results illustrate how DAG followed a three-stage development process that aligns with the sector's trajectory. The Group originated and grew in the operational environment of steelmaking, became Ensdiesa's most prominent auxiliary company, and in 2007, abandoned its traditional specialization to focus on the renewables sector. Today, it is a global leader in manufacturing wind turbine towers and offshore structures.

[9] Antuña, G. (2022). Un paso al frente: el sector metalmecánico asturiano ante la reconversión industrial, 1978-2000. *Investigaciones de Historia Económica-Economic History Research*, 18(2), 124–135.
[10] Antuña, G. (2024). Industrial path creation, a business case approach: Daniel Alonso Group from steelmaking to wind power. *Business History*.

Chapter 4, *'Common roots, different paths: The influence of big steelmaking firms on the evolution of the metalworking sector in Asturias and Umbria, 1958-1010'*, presents a comparative sectorial analysis in the regions of Asturias and Umbria (Italy), trying to elucidate how the presence of large steelmaking companies affected the metalworking sector′ trajectory in both cases. To this aim, the work presents a longitudinal reconstruction of the sector′s structure at the company level in both regions and combines these data with an analysis of its spatial distribution at the municipal level and with data on GVA from 2000 onwards. The main sources used for this work were the Industrial Census of Umbria (1961, 1981, 2001, and 2011), the Industrial Census of Spain at a regional level (1958) and the Input-Output tables of Asturias (1978, 2000, 2010). Both sources have been standardized across these four temporal cuts, reconstructing the sector from the lowest possible level of disaggregation. The results show that despite the prominent role of steel in the industrial development of both regions, the trajectory of the metalworking sector in Asturias and Umbria is not replicable. Steelmaking's different role in generating agglomeration economies explains this divergence. In Asturias, Ensidesa generated numerous positive externalities and established a strong relationship with its operational environment, triggering the creation of a hierarchical cluster. Conversely, the Terni steelmaking company did not exert the same capacity for economic pull. The Umbrian metalworking industry is scattered across the territory and shows a low level of interrelation among its companies, reducing its competitiveness.

This thesis aims to advance our knowledge on long-term industrial dynamics, focusing on traditional sectors' capacity in developing related activities. From the perspective of industrial history, this approach allows for a deeper understanding of various industrial dynamics at the regional level, completing the traditional vision based on the study of major strategic sectors. Adopting this analytical logic, more focused on sectoral interrelation and value chains than on isolated activities, could enable tracing trajectories that explain the relative success of some sectors overshadowed by basic industries, and uncover hidden potential for developing future growth pathways in declining regions.

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I

Revisiting the Francoist industrial policy: the 'unwanted' birth of a metalworking cluster in the industrial pole of Asturias (Spain), 1939-1985

Abstract

Since the 1990s, the literature on clusters has gained significant relevance due to clusters' relationship with economic growth and business competitiveness. For this reason, many works have contributed to better understand their internal structure and life cycles. However, there is still much to learn about how these ecosystems emerge and how emergence functions as a process. This gap is particularly relevant in the case of public policies. Although recognized as a key factor in the development of existing clusters, their role in the initial phase of their life cycle has scarcely been studied.

This work analyzes the emergence of the metalworking cluster in the steelmaking pole of Asturias (Spain) from the end of the civil war to the beginning of the industrial restructuring, with special emphasis on the role that Francoist policy and its relationship with companies played in this process. The results show that Asturias exhibited numerous potential factors for the generation of this cluster since the 19th Century. The creation of the national steel champion Ensidesa in 1950 was the triggering event necessary to develop the self-reinforcing dynamics that led to the emergence and initial development of the metalworking cluster. However, Franco's regime systematically ignored the voices that, from within the institutions and given the sector's potential in the region, called for direct support. Resources were focused on enhancing the strategic base industries, from whose externalities the metalworking sector indirectly and organically benefited.

Keywords: cluster emergence, steel industry, industrial policy, Francoist regime, metalworking

1. Introduction

The end of the Second World War marked the beginning of the Golden Age of capitalism, characterized by the great eclosion of those industries related to the Second Industrial Revolution, the hegemony of large vertically integrated companies, and increasing state interventionism that regarded the industrial policy as a key factor for economic development (Chandler 1990; Amatori, Chandler & Hikino 1997; Pollard 1981). This paradigm reversed with the onset of the 1970s industrial crisis (Andreoni & Chang, 2017; Evans, 1995; Piore & Sabel, 1984), which in Europe led to a deindustrialization process that impacted regions to varying degrees depending on their specialization and productive structure (Hassink, 2022; Škuflić & Družić, 2016). From that moment onwards, industry was relegated to a secondary role in the political and academic spheres. However, the Great Recession and, more recently, the COVID-19 crisis have reopened the debate on European reindustrialization (Araujo et al., 2021; Clark, 2022).

Due to the paradigm shift brought about by the so-called Second Industrial Divide (Piore & Sabel, 1984), scholars revisited Marshall's agglomeration economies, trying to understand how the new spatial configuration of economic activity could favor economic development through endogenous growth processes (Krugman, 1991; Marshall, 1920). On this basis, Porter built his concept of 'clusters' as the geographic agglomeration of industries and related agents interconnected through knowledge, specialized labor, input-output transactions, and other linkages (Porter, 1990). These ecosystems were positively related to regional growth and firm performance (Boschma, 2004; Cooke, 2001; Porter, 1998), rapidly increasing interest in refining their conceptualization. One line of research stressed that clusters could adopt different typologies depending on their structural characteristics so that in hierarchical clusters, big firms could act as disseminators of their own capabilities and, therefore, as agents able to organize and invigorate their operational environment (Catalan et al., 2011; Chandler et al., 1997; Markusen, 1996). Other works focused on how clusters evolve through

different stages in their life cycle, determined by path-dependent forces but also by the continuous interaction of the agents that compose them (Boschma & Fornahl, 2011; Martin & Sunley, 2011; Popp & Wilson, 2007).

Nevertheless, literature on cluster analysis has mostly adopted an *in-media res* approach, primarily focusing on the dynamics of existing clusters, while there continues to be a lack of understanding regarding how and why these ecosystems originate (Elola et al., 2017; Feldman et al., 2005). As Giacomin (2018, p.276) underlines, 'despite efforts to generalize and categorize, studies fail to provide a clear-cut picture of how emergence works as a process'. It is also significant that, despite being considered one of the most relevant factors for existing clusters' development, the role of public policies in the origin of these ecosystems remains largely unknown (Asheim et al., 2017; Elola et al., 2017; Njøs & Jakobsen, 2016). While the positive impact of specific policies directly aimed at promoting or supporting existing clusters has been largely studied and demonstrated, there is still much to be known about all policies that, while not specifically targeting clusters, can indirectly trigger their emergence and influence their trajectory (Asheim et al., 2017; Borrás & Tsagadis, 2008; Elola et al., 2017).

The main issue with literature on cluster emergence is that it treats history as a relevant but exogenous factor, isolating the birth of a cluster from the historical context in which it occurs. Prominent works on cluster emergence have pointed out its path-dependent character or emphasized the importance of certain historical roots, circumstances or past events (Brenner & Mühlig, 2013; Isaksen, 2016; Menzel & Fornahl, 2010). However, due to the lack of historical analysis, emergence appears as a static outcome at a specific point in time rather than as the result of a complex and iterative process of change resulting from the actions of companies, institutions, and their relationship with their particular context (Feldman et al., 2005; Grashof, 2021; Trippl et al., 2015). Similarly, historical analysis allows a better understand of the role of institutions and public policies on cluster emergence, as public intervention depends on specific political and historical contexts and co-

evolve together with them and the agents they influence (Elola et al., 2017; Flanagan & Uyarra, 2016; Njøs & Jakobsen, 2016).

Some recent works have already addressed these questions from the perspective of Economic and Business History. Giacomin (2018) analyzed how the pre-existing rubber cluster favored the development of the palm oil cluster in Malaysia and Indonesia in the early 20th Century. This development leveraged an institutional environment conducive to its growth, and international traders' networks promoted its global expansion. This is consistent with Amdam & Bjarnar (2015), who demonstrated how the early concentration of traditional sectors at the local level gave rise to the emergence of maritime and furniture clusters in Norway. Catalan & Fernández-De-Sevilla (2020) have highlighted the importance of institutional support and industrial policy in the creation and development of the metalworking clusters in Barcelona and Sao Paulo, as well as the leading role that a large company can play in the overall sector. MacKenzie & Perchard (2022) also emphasized the relevance of public policies through the study of the Scottish Highlands, stressing the role of policy makers as triggers for change processes.

This paper analyzes the emergence of the metalworking cluster in Asturias (Spain), explaining how the Francoist industrial policy affected this process. The case of Spain is of great interest from an institutional point of view, as it represents a fascist dictatorship that survived in Europe after WWII. The end of the Spanish Civil War in 1939 resulted in a period of autarchy, which prevented the country's convergence with the rest of the Western powers until the successful consolidation of the liberalizing measures prescribed in the 1959 Stabilization Plan (Catalan, 1992, 2003; Fraile, 1991). In this period, Asturias became a key steelmaking region in the country after the creation of the national champion, Ensidesa, in 1950. Nonetheless, the effects of Franco's industrial policy on non 'strategic' industries remain unclear.

Official primary archival sources are the basis of this paper, built on a mixed-methods approach. One of this work's main contributions is the qualitative

use of the New Industries Files (1939-1960), which provides detailed information on the sector's companies and their relationship with the Francoist institutions. On the other hand, combining other primary sources allows a quantitative approach to measure the sector's evolution throughout the period studied. The obtained results show that the establishment of Ensidesa fostered a process of hierarchical clustering around the steel industry, confirming that the metalworking sector was already clustered at the onset of the industrial restructuring, allowing it to survive and become the regional benchmark from the 1990s onwards (Antuña, 2022a). In spite of this, the positive influence of the Francoist industrial policy was indirect and must be nuanced. On the one hand, it created a national champion that constituted the necessary triggering event for generating positive externalities and supported it with complementary policies on infrastructures and technical education. On the other hand, it produced severe deficiencies resulting from arbitrariness inherent in its autarchic industrial policy and systematically ignored the voices that identified the sector's potential, calling for direct support.

This study provides new insights into cluster emergence, emphasizing the potential that historical analysis holds for examining these processes (Catalan & Fernández-De-Sevilla, 2020; Giacomin, 2018; MacKenzie & Perchard, 2022) and understanding the role of non-cluster-oriented public policies on the birth and first development of such ecosystems (Asheim et al., 2017; Elola et al., 2017; Njøs & Jakobsen, 2016). It also offers a new perspective on Francoist industrial policy and the relationships that developed between companies in a non-strategic sector and diverse organs of the regime, and its long-term consequences (De la Torre & García-Zúñiga, 2013, 2014; García Ruíz, 2019; Antuña, 2022a).

The paper is organized as follows. Section 2 presents the methodology and primary sources used. Section 3 reconstructs and analyzes the emergence of the Asturian metalworking cluster and its evolution up to industrial

restructuring. Section 4 discusses the role that the Francoist regime played in this process. The work ends with some concluding remarks.

2. Methodoly and sources

This paper relies on the conceptualization of the metalworking sector presented in Antuña (2022a). This includes all activities that continue the value chain of steel from its basic production (steelmaking industry) and that, therefore, use this material as the principal input. In order to standardize the series, this classification is made by activities and not by products, adapting the specific classification of regional accounting to the CNAE code (in this case, CNAE 1952 and CNAE 1974). The three major categories making up the sector are Metallic Products, Machinery and Equipment, and Transportation Material.[1]

The presented analysis follows the 3-stage model proposed by Brenner & Müligh (2013), which departs from the existence of determined and required (1) 'prerequisites', identified as all the conditions (factors, resources) that must be present prior to the emergence of the cluster. These are necessary but insufficient, as their existence only allows a cluster to emerge, but some accident, random circumstance or (2) 'triggering event' has to occur. Finally, the (3) self-augmenting dynamics appear, reinforcing cluster development. This last stage encompasses the positive effect of local externalities (Krugman, 1991), which 'is the basis for all the theories and explanations found in the literature' (Brenner & Mühlig, 2013, p.482).

Combining this model with historical methods enables the integration of agents and their actions into the narrative, placing agency and contingency at the heart of an iterative process capable of generating a situation of potential lock-in and endogenous growth, enhancing the potential and relevance of in-depth case analysis to obtain richer knowledge (Feldman et al., 2005; Popp & Wilson, 2007). Consequently, certain 'accidents' or random incidents could

[1] According to the actual European NACE classification, this subsectors represent activities 25-28 and 33.

be explained within a particular context and as a result of specific agents' actions (Martin & Sunley, 2011; Pinch & Henry, 1999).

Using official primary sources allows for implementing a historical case analysis following this model and combining qualitative and quantitative work to achieve the most significant explanatory power. The main archival contribution of this paper is the exploitation of the New Industries Files (1938 -1960), kept in the General Administration Archive (AGA). The Law for the Organization and Defense of the National Industry (21/11/1939) regulated the creation of new industrial enterprises, as well as the expansion of their production, the increase in machinery, or the change of activity. The files detail the complete process of a request, from its proposal to its grant or repeal. It started with a proposal by the company/individual raised to the Provincial Delegation of Industry, accompanied by a detailed report. This public body published the request in the State Official Bulletin (BOE) so that other companies in the sector nationwide could make allegations. Gathered together with the report, the Provincial Delegate could deny the request or favorably elevate it to the National Steel Syndicate, which would similarly operate with the General Directorate of Industry, who would make the final decision.[2]

This source has been scarcely explored, except in Pires & Buesa, (2002) and Pires (2005), who used it from a systematic, quantitative perspective to study the relationship between entrepreneurs and the Francoist regime through the theory of State capture. Despite being a highly reliable source, the absence of some notable companies indicates that it is fragmented and not fully preserved. Therefore, a qualitative approach to this source is presented as the most rigorous and enriching for this paper, providing relevant information at three levels: a) to collect the reports and diagnoses made by the Provincial Delegation about the sectorial situation; b) to analyze the behavior of

[2] Pires (2005) collects the three fundamental reasons for denial: The existence of sufficient industries in that activity, the scarcity of raw materials, and the scarcity of foreign currency. However, the arbitrariness is clear, as there are no objective criteria on which such denials were based.

institutions in response to various demands; c) to obtain microdata of companies and their activities.

In order to reconstruct series and indicators on the sector's general behavior, it is necessary to combine this source with other official files. At the regional aggregate level, these sources are combined with the Input-Output tables of the Principality of Asturias for 1968, 1978, and 1985. These documents — produced and kept by the Society for Economic and Industrial Studies of the Principality of Asturias (SADEI)— have been chosen over others, such as the ones produced by the Syndical Statistical Service or the INE Industrial Statistics, for their higher statistical coverage ratio.[3] For 1958, the National Industrial Census of Companies created by this last body has been chosen, as it shows the best coverage ratios among the available sources.

3. The emergence and evolution of the Asturian metalworking cluster, 1950-1985

3.1. Prerequisites: the Asturian metalworking sector in the very long-term

Geographical factors played a significant role in defining the industrial origins of Asturias. The region's abundant coal deposits positioned it as a crucial hub in Spain's industrialization process, further facilitated by its coastal location. In the late 18th Century, the Royal Ammunition Factory of Trubia and the Royal Arms Factory of Oviedo represented the initial attempts to apply the 'English triad' in Spain. However, the inability to maintain a profitable and stable production based on the use of mineral coal, coupled with the French occupation that halted the operations of the Trubia factory in 1808, ultimately put an end to this endeavor (Antuña, 2022b; Nadal, 1975).

Since the 1840s, once the intensive use of mineral coal was finally established in Spain, Asturias became the top coal-producing region in Spain, a position

[3] A very detailed analysis of this issue is presented in Llopis & Fernández Sánchez (1998). As the authors indicate, the degree of regional coverage prior to 1964 was limited, which is exacerbated in the case here studied due to the atomized nature of sector. Data from the National Syndicate, even if reliable, are significantly underestimated. It is worth highlighting the value of the Asturian Input-Output tables. The first one, from 1968, constitutes the first regional table of this kind produced in Spain. The national significance of the Asturian industry aroused equal statistical interest, which means that the statistics produced by these bodies are the most accurate as they offer a much higher degree of coverage.

maintained until the closure of these mines initiated with the industrial restructuring of the 1980s. Mining activities played a crucial role in infrastructure development throughout the 19th century, mainly reflected in the construction of roads and a railway network that connected the mining valleys in the interior (Langreo and Caudal) with the coastal cities of Avilés and Gijón, which ports were also expanded and adapted to foster industrial growth. Examples included the road connecting Langreo and Gijón (1842) and the railway link between these two towns (1852), which later extended to Mieres, Oviedo, and Avilés. This is the origin of the 'Asturian eight', conformed around the connections that joined the coal valleys with the port cities, agglomerating most of the region's industry and population (Benito del Pozo, 1993; Ocampo, 2004).

The exploitation of coal mines had significant forward linkages for the Asturian productive structure, leading to the creation of diverse metallurgical companies seeking to benefit from the proximity of coal and the associated infrastructures. At the corporate level, this resulted in both progressive processes of birth and growth through vertical integration of large companies that occupied the steel value chain (coal mining, metallurgy, finished products) and the creation of smaller establishments working for other companies in their environment. Although they undertook various corporate modifications later on, some of these early large metallurgical companies were the Asturian Mining Company (1844, future Fábrica de Mieres S.A.), Sociedad Gil y Cia. (1856), and Sociedad Metalúrgica de Langreo (1857) (Ocampo, 2004; Ojeda, 1985). Consequently, the advancement in mining and metallurgy boosted the shipbuilding industry. The transition to steam-powered ships, coupled with the intensification of maritime trade in minerals, increased the demand for large vessels, favouring the establishment of industrial shipyards. While traditional shipyards were located in the western end of the region, the new industrial-oriented shipping companies set up in

the ports of Gijón and Avilés (Ocampo & Antuña, 2020; Ocampo & Suárez Cano, 2018).[4]

In addition to leading coal mining, Asturias held the metallurgical leadership between the 1860s and 1880s, when innovations driven by the adoption of the Bessemer method for steelmaking shifted this position in favor of the Basque Country. The high-quality nature of Basque iron ore for steel production facilitated a successful transition to steelmaking in this region, supported by the iron and coal trade route established between Bilbao and Cardiff. This end-of-century productive and commercial leadership was the final necessary boost for accumulating a locally-based industrial capital, which, although already existing previously, then experienced its splendor. The most paradigmatic example was the creation of Altos Hornos de Vizcaya S.A. in 1902., the country's most important private steelmaking company (Fernández de Pinedo, 1992; Nadal, 1975).

In contrast, this transition did not occur in Asturias, where state investments and foreign initiatives, like those from Belgium, Britain and France, historically dominated the mining and metallurgical sectors. For instance, only two of the six major metallurgical foundries established before the Spanish Civil War (1936) had Spanish share capital: Gil y cía. (1856) and Sociedad Metalúrgica de Langreo (1857) (Nadal, 1992). The lack of significant local initiatives intensified with the loss of national leadership. Nevertheless, the importance of foreign capital in Asturian companies attracted foreign machinery and technology, which also facilitated the recruitment of engineers and technicians from abroad to contribute their expertise to the region's industrial development (Muñiz, 2019; Pérez Lorenzo, 1985).

At the beginning of the 20th century, three major companies led the Asturian steel industry: Sociedad Metalúrgica Duro-Felguera S.A (previously Sociedad

[4] On the contrary, the development of the railway did not provide a significant boost to the iron and steel industry and the metalworking sector, as it did in England or France. The Railway Act of 1855 favored the importation of railway materials at the expense of domestic production (Ocampo, 2004).

Metalúrgica de Langreo), Fábrica de Mieres (the former Asturian Mining Company), and the newly created Sociedad Industrial Asturiana Santa Bárbara (which acquired the Fábrica de Moreda y Gijón, created in 1879). As previously noted, these large foundries coexisted with other smaller companies and with multiple metalworking workshops, generally of limited specialization. In 1916, although Asturias accounted for only 3.5% of the country's population, it ranked fifth among Spanish regions in terms of industrial establishments related to the metallurgical industry, with a total of 49 of which 12 were dedicated to basic metallurgy, 10 to metallic products, 13 to machinery and equipment, and 14 to repairs (Fernández Pérez, 2005, p.169).

In the turbulent Spanish context of the late 19th century, the power accumulated by Asturian entrepreneurs led to its sector's oligopolization. Together with Basque steel entrepreneurs, they created a solid industrial lobby to demand tariff protection for their industry, the strongest in the country, alongside textile Catalan entrepreneurs. In the case of Asturias, this oligopoly, together with the extraordinary profits obtained from the business bubble represented by WWI, prevented entrepreneurs from making significant investments to increase competitiveness. Thus, a deep crisis struck the industry at the end of the conflict, prompting them to seek national protection once again, in this case, thanks to Primo de Rivera's dictatorship (1923-1930) and extending until the outbreak of the Civil War in 1936 (González González, 1988).

These factors explain why Asturias became a potentially strategic industrial pole for the Francoist dictatorship initiated in 1939. In summary, based on the analytical framework presented in the previous section, Asturias possessed multiple potential factors for the emergence of a leading metalworking cluster: (1) abundant coal deposits near the coast and an established production structure for its exploitation, (2) an infrastructure network established to serve the regional industry, and (3) a significant industrial agglomeration in the 'Asturian eight'. This triggered the concentration of the population, fostering the offer of both (4) skilled and

non-skilled industrial workforce and (5) a growing demand for manufactured metal products driven by urbanization. From a business perspective, significant factors include (6) inter and intra-sectoral linkages based on input-output relationships along the coal and steel value chain, and (6) significant foreign influence in capital, knowledge, and machinery, easily disseminable due to agglomeration and close relationships maintained among the companies.

As a result, it is not surprising that several heavy industries sheltered by the National Institute of Industry were established in the region after the war, such as Siasa (1942) for scrap metal manufacturing or Endasa (1949) for aluminium production. Meanwhile, the Francoist industrial policy favored the creation of new industrial shipyards and the expansion of the existing ones (Ocampo & Suárez Cano, 2018). Nonetheless, the metalworking industry suffered severe structural problems resulting from autarchy, presenting a fragmented productive structure characterized by tiny, non-specialized establishments originating from the urgency and provisionality of the post-war landscape.[5] Given that the shortage of steel was the main bottleneck identified, all eyes focused on the start-up of Ensidesa.

3.2. Triggering event: the birth of Ensidesa, 1950

The Spanish steel industry stagnated from 1939 to 1948, only reaching its 1929 production levels by 1954, falling short of domestic demand (Fraile, 1992). In a context of severe scarcity of mineral inputs, capital goods, and significant energy shortages due to post-war autarchy, the sector's oligopolistic nature prevented the expansion of production in the terms demanded by the regime. Private steel companies had made significant investments to increase their capacity during the crisis following WWI, encouraged by public contracts for infrastructure construction during Primo de Rivera's dictatorship (1923-1930). The suspension of those plans, combined with the crisis resulting from the Great Depression, caused entrepreneurs to distrust the national consumption forecasts expressed by the

[5] New Industries Files, nº 1.271, nº 11.681.

Francoist regime. In addition, AHV's acquisition of the Compañía Siderúrgica del Mediterráneo in 1940 gave the Basque company a virtual monopoly on national steel production, tremendously increasing its bargaining power (Fraile, 1991; Schwartz & Gónzalez González, 1978) The sector's lethargy seriously compromised Franco's reconstruction and industrial growth plans, as steelmaking was considered a strategic activity for national development and a fundamental basis for its military expansion. The situation of Spanish isolation worsened with the defeat of the Axis powers in WWII, urging to make a decision that unblocked the situation in the steel industry (Catalan, 1992, 2002).

Therefore, in 1950, Juan Antonio Suanzes —Minister of Industry and President of the National Institute of Industry (INI), constituted in 1941— decided to create a national champion that could significantly increase steel production and supply the domestic market without the need to reduce tariffs. The creation of Ensidesa was framed within an INI policy that transitioned from the autarkic-militaristic interventions of the post-war period, based on Axis policies, to the promotion of strategic sectors characteristic of the import substitution model of the 1950s (Catalan, 2011). The creation of the company increased tensions with the private sector, towards which Suanzes exhibited a hostility that shaped the interventionism of INI's industrial policy at this stage as one of Suanzes's main aspirations was the subordination of private activity to the national interest (Gómez Mendoza, 2000; San Román, 1999).[6] In this case, although 35% of Ensidesa's capital was offered to private steel companies, none of them wanted to participate in the operation, as they opposed the emergence of a major competitor in a market that was already under control. Entrepreneurs preferred a regulated market similar to the one

[6] This issue generated significant controversy in Spanish economic and industrial history. Authors such as Gómez Mendoza (2000) or San Román (1999) highlighted the totalitarian vocation of the INI during Suanzes's presidency, whose ultimate goal was to promote autarky and control all companies under its competencies. On the other hand, Schwartz & González (1978) and Martín Aceña & Comín (1991) argued that the creation of the INI was motivated by the passivity of Spanish entrepreneurs towards the industrial promotion plans of 1939-1941, and that the interests of the business class were respected on numerous occasions afterwards. The debate, broader than briefly presented here, is documented in Gómez Mendoza (2000) and the rebuttal represented by Comín's work (2001). A detailed summary of the various positions can be found in Catalan (2002), more supportive in turn of the opinion favoring Suanzes's totalitarian ambition.

designed by Primo de Rivera in the 1920s, where the State acted as a financier and demander, but not as a producer (Martín Aceña & Comín, 1991; Ojeda, 2000; Schwartz & Gónzalez González, 1978). Given the refusal of the steel entrepreneurs to participate in the capital of the new company, nor to meet the government's steel production expectations, Empresa Nacional Siderúrgica S.A. (Ensidesa) was created in 1950 with an initial capital of 1,000 million pesetas fully subscribed by the INI, increased to 12,000 million by 1958 (Vázquez, 2004).[7]

From a geographical standpoint, the classic European model had concentrated fully integrated steel mills in inland areas, prioritizing proximity to primary inputs (coal, iron, etc.). However, since the end of WWII, the Japanese localization model prevailed, based on steel mills located in coastal regions. This model, which found its pinnacle in Europe with the implementation of the Sinigaglia Plan in Italy, brought steel production closer to the market and favored the utilization of inputs from abroad (Balconi, 1991; Díaz Morlán et al., 2009; Pounds & Parker, 1955). Asturias combined the defining factors of the two predominant models of steel industry localization. Specifically, the city of Avilés allowed the plant to be situated near its estuary and industrial port, directly connected by train to the coalfields of the region's interior.[8] This situation facilitated the domestic supply of raw materials in the early years and the importation of coal (from the United States, Poland, or Germany) and iron (from Morocco, Mauritania, or Sweden) once the production growth made it necessary, coinciding with the progressive opening of the Spanish economy in the 1960s (Vázquez, 2004). Ensidesa began operations in 1957, and in 1963 produced 24,8% of the total Spanish steel, showing 864 million pesetas of gross profits.[9] By 1962, Ensidesa was already

[7] Ensidesa yearbooks, 1951 and 1958.
[8] Ensidesa yearbook, 1951.
[9] Ensidesa was not clearly in deficit until the absorption of Uninsa in 1973, which marked a turning point in its financial statements. By 1975, it showed a loss of 764 million pesetas. It did not recover from this point on (Martín Aceña & Comín, 1991). In 1961, due to the clear expansion of the national steelmaking market, Duro Felguera, Fábrica de Mieres y Fábrica de Moreda formed Uninsa as the private response to Ensidesa. Due to the company's poor performance, the INI progressively intervined its capital until it was finally absorbed by Ensidesa in 1973, adding the plant in Gijón to the original one in Avilés (González González, 2004).

the INI company with the highest capital disbursement, a situation that would continue until the mid-1970s (Catalan & Monteagudo, 2003, pp. 366-367).

One of the most notable consequences of the creation of Ensidesa was its demographic impact, supported by the paternalistic policy of Francoist developmentalism (Table 1). The region's total population rose from 895,804 in 1950 to 1,129,556 in 1981, reaching its historical peak and finally configuring the actual 'Asturian eight'. The industrial development linked to the steel industry resulted in rapid population growth in cities where this activity was located (Avilés, Gijón) and the adjacent municipalities, overflowed by this growth. At the same time, the mining valleys of Nalón and Caudal, which had been the main poles of migrant attraction in previous decades, were now relegated to a secondary position.

Table 1. Population evolution in the main Asturian municipalities, 1950-1980

	1950	1960	1970	1980
Gijón	108,546	122,357	184,698	256,433
Oviedo	100,813	124,407	152,453	184,473
Avilés	21,340	48,620	82,433	87,996
Siero	32,340	34,620	36,332	40,350
Mieres	58,768	71,092	65,923	58,718
Langreo	54,676	66,323	59,465	56,347
Castrillón	8,088	11,861	13,459	20,425
S.M. Rey Aurelio	20,469	28,051	27,815	25,561
ASTURIAS	895,804	994,670	1,052,048	1,129,556

Source: SADEI, historical census. Note: 1980 data correspond to the 1981 census.

Although Spain did not benefit from the Marshall Plan, signing the Madrid Agreements between the Francoist regime and the United States in 1953 facilitated Ensidesa's creation. A specially agreed-upon line of financing covered one-third of the initial investment. Additionally, the signing of this pact (which preceded the 1959 Stabilization Plan in opening the country to foreign trade) eased the direct involvement of foreign companies in the construction of the new factory. Thus, American and German companies led the initial phases of constructing the Avilés steel mill.[10] Part of these contributions were based on bilateral agreements, which, for example,

[10] INI yearbook, 1954.

involved exporting minerals and raw materials obtained from mines owned by Ensidesa as payment for the shipment of machinery and components for the Avilés plant until it became operational. Other agreements directly entailed opening credit lines for purchasing machinery and equipment intended for Ensidesa and its subsidiaries.[11]

Foreign firms handled the main construction of the new plant, while Spanish and Asturian companies were tasked with making and installing machinery and equipment, and Ensidesa's technical team oversaw the coordination and acted as a mediator among all parties. However, interactions with foreign entities extended beyond equipment shipments. Yearbooks highlighted Ensidesa engineers and local concessionary company technicians visiting abroad to monitor component production and receive process training. Foreign firms sent personnel to Avilés to oversee equipment installation, while Ensidesa's machinery procurement and foreign technician collaborations extended to other ventures throughout Asturias, fostering knowledge and technology transfer. Ensidesa's need for auxiliary services spurred a network of collaborations among local companies and subcontractors, enhancing specialization. In 1956, the Avilés plant employed 18,137 workers, with 5,500 company staff and the remainder from subcontractors.[12]

Equally important was the significant infrastructural development that accompanied the plant's construction. In addition to the infrastructures directly intended for the company's activities, the 'Asturian eight' finally came out thanks to a series of extensive civil works that went together with the creation of Ensidesa (Benito del Pozo, 1993, 2014). Some examples were the successive port expansions of Avilés and Gijón to serve the thriving manufacturing industry, the opening of different commuter rail lines and branches connected to Ensidesa's internal line between Avilés and Gijón, and the Avilés-Oviedo-Gijón highway. It was designed in the 1960s within the national framework of highways and known as the 'Y' due to its characteristic

[11] Ensidesa yearbooks, 1951-1960.
[12] Ensidesa yearbooks, 1956.

sketch, but could not begin construction until 1971, inaugurating five years later (Fernández García, 1984; Roselló, 1983; Ruíz Romero, 2004).

These civil works also extended to education, as once migratory flows laid the foundation for a broad supply of labor, technical training became a central issue. The creation of Ensidesa transformed Asturias into a reference hub for the development of the Francoist model of technical education, legislated by the Organic Law of Industrial Training of 1955. A year later, the Ensidesa Apprentice School and the Avilés School of Industrial Mastery were founded. However, the most important work of the fascist government in this regard was the Labor University of Gijón, also created in 1956 with 800 boarders and 500 ordinary students, and which today still houses the Polytechnic Campus of the University of Oviedo (Díaz González, 2017).[13]

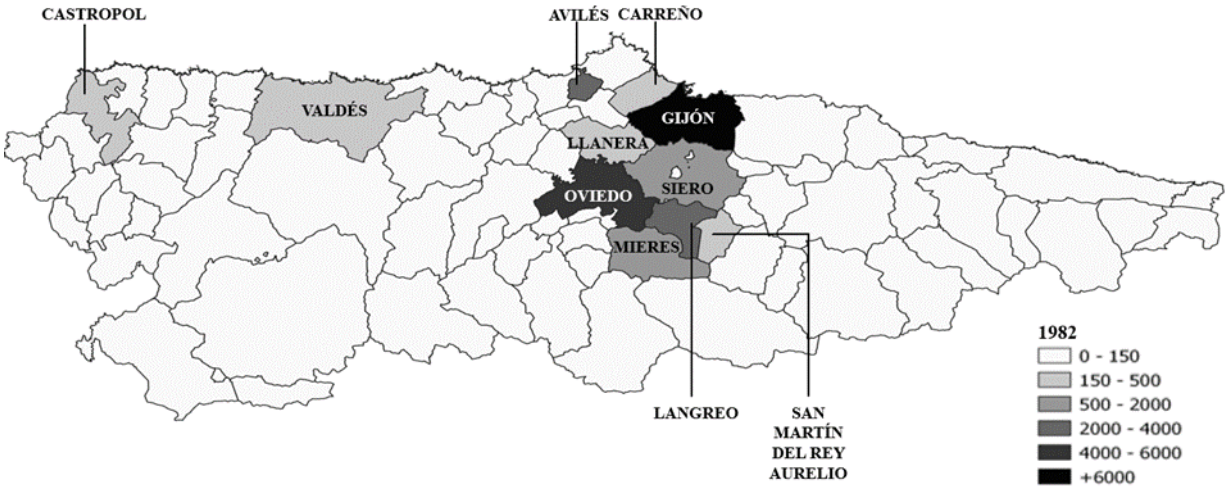
3.3. Self-augmenting processes: the metalworking sector in Asturias from Ensidesa to the industrial restructuring, 1958-1985

The spatial distribution of metalworking activity in the industrial restructuring onset shows a clear concentration in the traditional coal basins (Nalón and Caudal) and in the cities of Avilés and Gijón, headquarters of Ensidesa (Figure 1).[14] To these, we must add Oviedo, influenced by the capital city effect, as well as by the presence of the Empresa Nacional Santa Bárbara, one of the most prominent firms in Spanish military industry.

[13] Yearbook of the Superior Council of Industry. Province of Oviedo, 1954.

[14] In 1961, due to the clear expansion of the national steelmaking market, Duro Felguera, Fábrica de Mieres y Fábrica de Moreda formed Uninsa as the private response to Ensidesa. Due to the company's poor performance, the INI progressively intervined its capital until it was finally absorbed by Ensidesa in 1973, adding the plant in Gijón to the original one in Avilés (González González, 2004).

Figure 1. Distribution of metalworking employment in Asturias by municipalities, 1982



Source: Antuña (2022a), p.136.

This agglomeration does not explain by itself the interrelation between the metalworking and the steelmaking industries, as it is influenced by endogenous variables.[15] The Input-Output tables allow for the calculation of regional technical coefficients for these industries, which measure the degree of interrelation between the different branches based on commercial flows.[16] The regional coefficients for the years 1968 and 1985 show two distinct moments for the metalworking sector in Asturias (Table 2). The fall in demand for steel from all branches shows the industry's retreat in the prelude to restructuring and the effects of the first adjustments, which explains the significant increase in its reuse. The evolution of Metallic Products reflects the gradual reduction of its importance within the Asturian industrial economy, as is the case with Transportation Material, which was also already immersed in the adjustment process. Machinery and Equipment expanded its activity within the network, maintaining its supply to other sectors and increasing its reuse. The increase in intrasectoral relationships explains this,

[15] This area coincides with the previously mentioned 'Asturian eight', which concentrated more than 70% of the regional population (Benito del Pozo, 1993).

[16] The regional technical coefficient is given by the expression Arij=Xrij/Xj, where Xrij represents the consumption of goods or services produced in the region by branch i and used in its production by branch j, and Xj is the total value of the production of branch j.

as different companies in this same branch collaborated and acted as suppliers and clients.

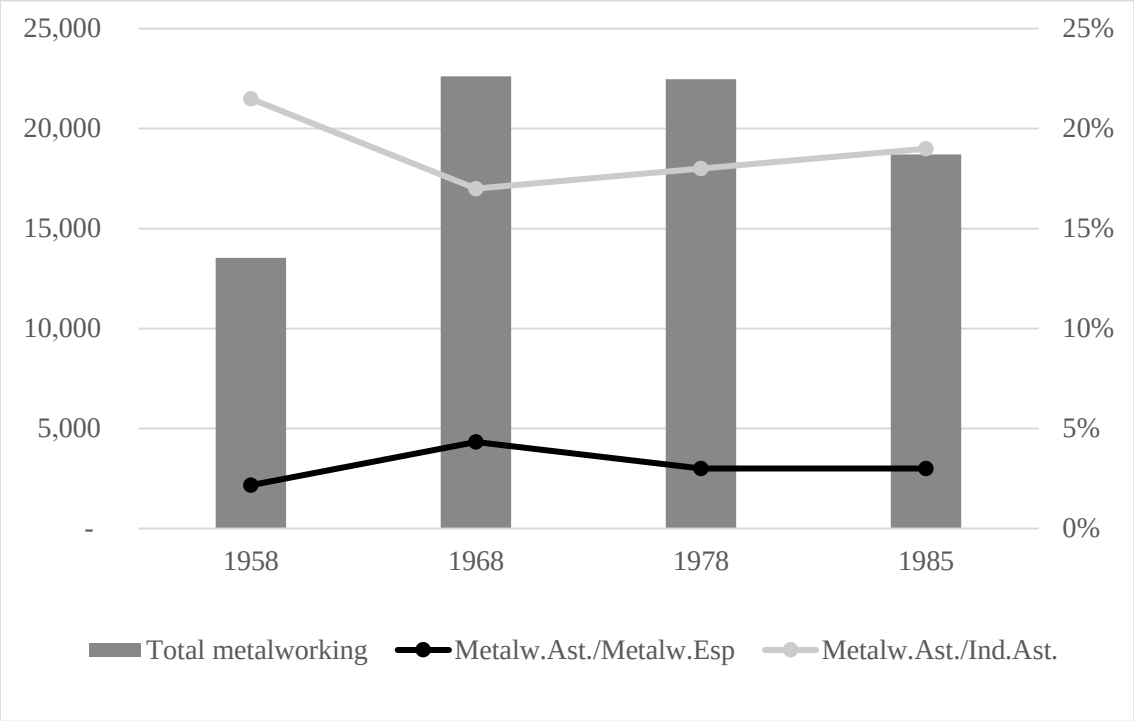
Table 2. Regional technical coefficients of the metalworking and steel subsectors, 1968 and 1985

1968	Steelmaking	Metallic Products	Machinery and Equipment	Transportation Material
Steelmaking	0.051	0.183	0.049	0.024
Metallic Products	0.041	0.240	0.067	0.011
Machinery and Equipment	0.088	0.011	0.019	0.008
Transportation Material	0.000	0.000	0.000	0.301
1985	**Steelmaking**	**Metallic Products**	**Machinery and Equipment**	**Transportation Material**
Steelmaking	0.315	0.030	0.004	0.007
Metallic Products	0.049	0.038	0.038	0.027
Machinery and Equipment	0.087	0.010	0.047	0.017
Transportation Material	0.000	0.000	0.002	0.000

Source: own elaboration with data from SADEI, Input-Output Tables. Vertically, the demand that branch j makes of branch i for the production of one unit. Horizontally, the sales of branch i to branch j for the production of one unit.

The lighting of Ensidesa's first blast furnace marked a turning point in the Spanish steel and industrial landscape, and the same happened in Asturias through its manufacturing industry. The 1959 Stabilization Plan set a new course for the Spanish economy, which, in the case of the steel industry, translated into sustained growth until 1974, with Ensidesa as the leading company. The metalworking sector took off in Asturias in the late 1950s (Figure 2). Despite the increase in its employment, its weight on total industrial occupation fell due to the relative expansion of large industries in Asturias. However, since the late 1970s, with the onset of their decline, the metalworking sector began to show its leadership, initiating a relative increase in total industrial employment that would not stop.

Figure 2. Metalworking employment evolution in Asturias, 1958-1985



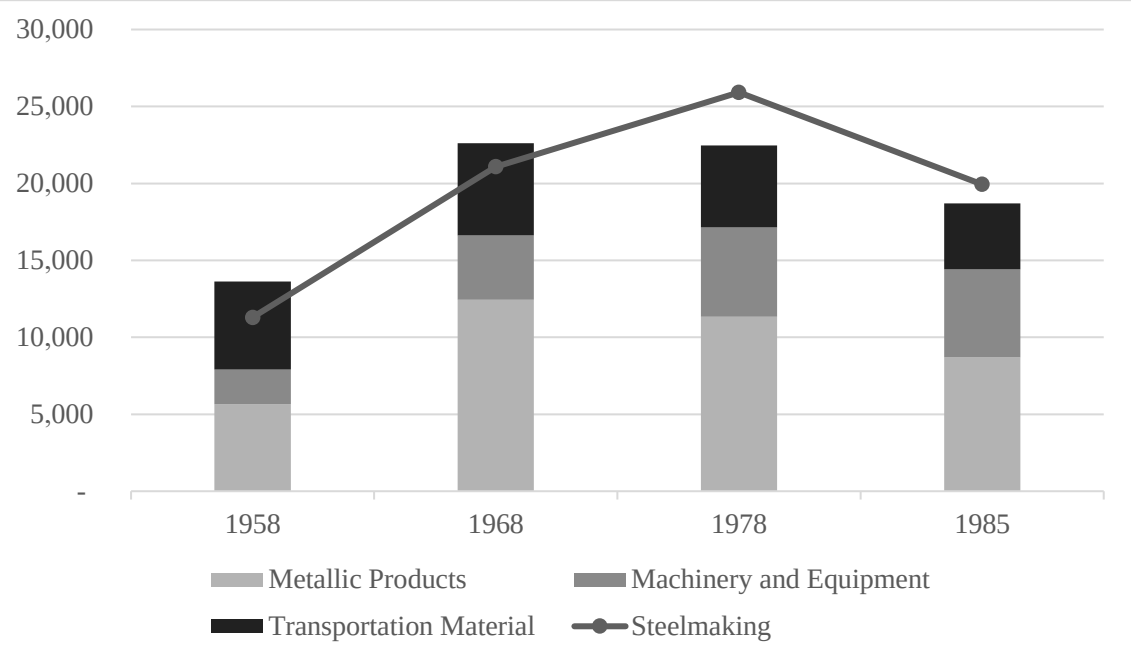
Source: Own elaboration with SADEI, Input-Output; INE, Spanish Industrial Census, 1958. In bars and on the left axis are the total employees. In lines and on the right axis, the percentage results.

In aggregate terms, the sector suffered the impact of the restructuring adjustments in the 1980s, although, unlike the steel industry, it could recover during the following decades. The decline observed in the early eighties responded to the industrial crisis triggered in Europe by the oil shocks. In Spain, the crisis of large industries began to be noticed, as in the rest of Europe in the mid-1970s. Although the first Restructuring Plan dates from 1984, The UCD Government identified in 1981 that since 1974, the steel sector and its related activities had been undergoing a period of crisis, although the adjustment plan launched by RD 878/1981 had limited impact (Arce, 2006; Navarro, 2004).

Figure 3 shows the internal composition of the metalworking sector. Broken down by activity branches, the notable weight of Metallic Products is consistent with the existence of comprehensive steelmaking, as this segment is the closest to primary manufacturing and constitutes the lowest value-added part of the steel production chain. The Transportation Material branch mostly

responded to the evolution of shipbuilding, which followed a similar path to the steel industry, with the adjustments mainly affecting large public and private shipyards (Ocampo & Suárez Cano, 2018; Valdaliso, 2019).

Figure 3. Evolution of Asturian steel and metalworking employment broken down by branches, 1958-1985



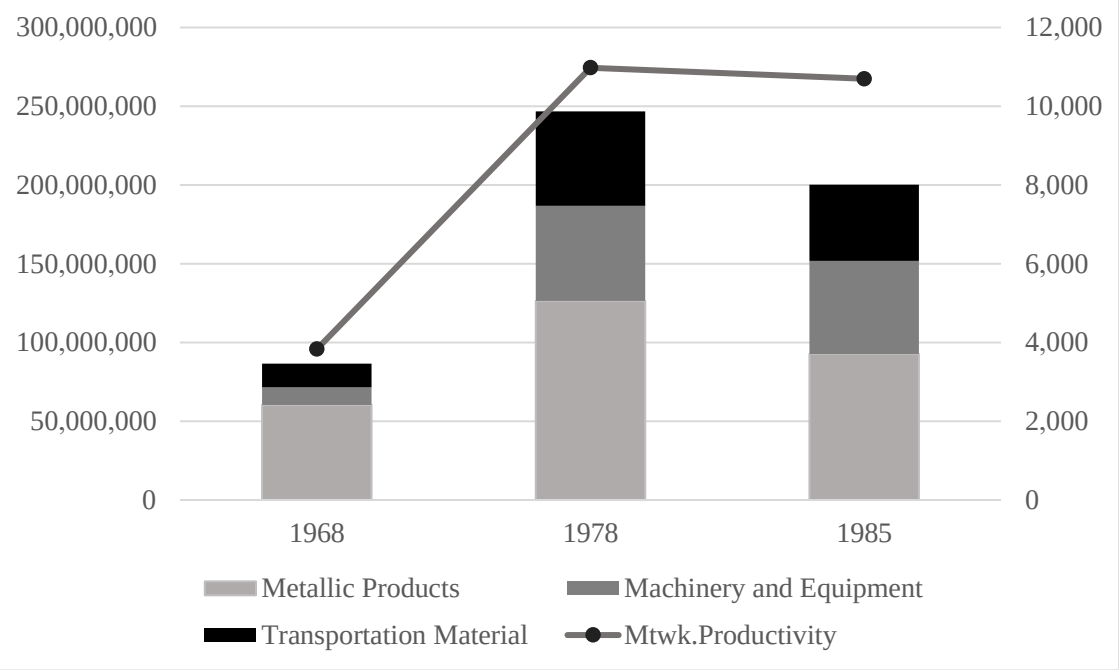
Source: Own elaboration with SADEI, Input-Output; INE, Spanish Industrial Census, 1958.

Nevertheless, it is worth noting the advancement of Machinery and Equipment, whose relative weight in the total sector increased by more than ten percentage points, reaching 30% in the last year studied. This segment's growth represents the dynamism brewing within the sector, as the manufacturing of machinery and capital goods acts as the backbone of industrial growth. Overall, the results are consistent with the interrelations shown in Table 2, and together, they demonstrate the progressive consolidation of the productive branch that generates more added value, growing in the face of the contraction of more traditional activities.

This scenario aligns with the progress in terms of production and productivity. The sustained increase in both variables in the metalworking sector during the years of developmentalism was halted by the industrial crisis

of the 1980s (Figure 4).[17] However, the activity of Machinery and Equipment would barely change in the last period, with the fall of the aggregate due to the contraction of Metallic Products and Shipbuilding. The onset of deindustrialization fundamentally affected these two subsectors, more closely linked to basic industry, while Machinery and Equipment maintained the apparent total productivity.

Figure 4. Evolution of Asturian metalworking production by branches and total labor productivity, 1968-1985



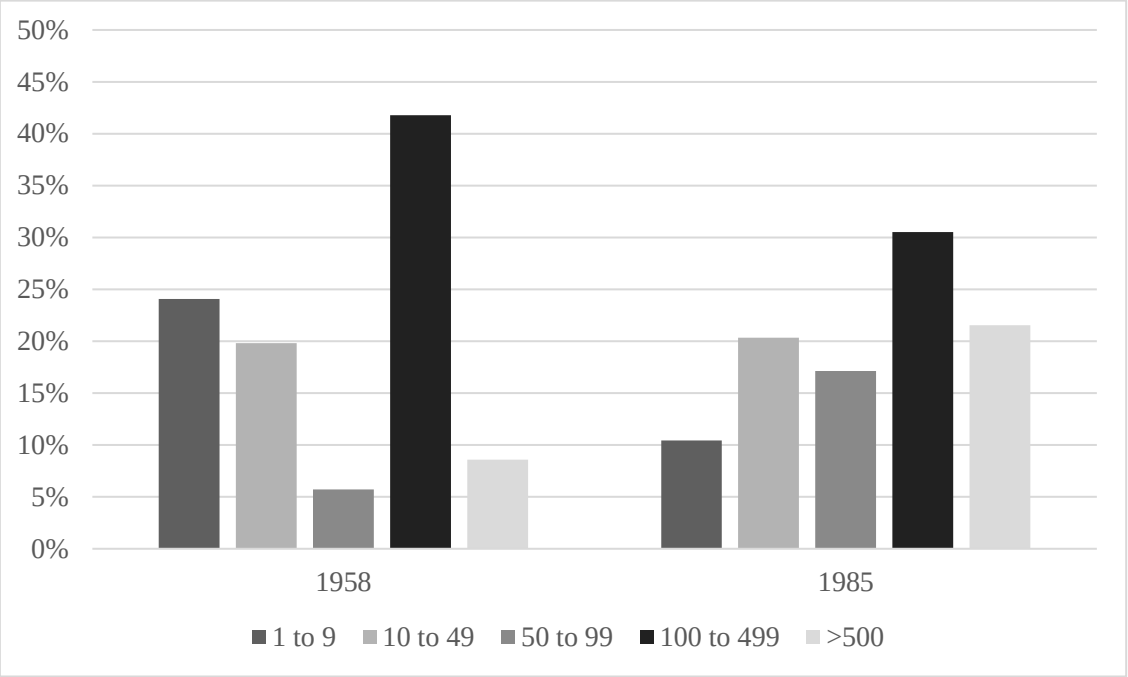
Source: Own elaboration with SADEI, Input-Output. 2010 constant pesetas(k). No data is available for 1958. Productivity is based on total production, as there is no data on added value for 1968. On the left axe, total production. On the right, labor productivity.

A reconfiguration of its internal structure accompanied sectorial growth, and these years witnessed both the birth and consolidation of a series of companies that would end up leading the activity by the end of the century. The sector transitioned from being characterized either by tiny workshops or large oligopolistic companies to concentrating employment in medium and medium-large firms (Figure 5). As a result, the average size of metalworking

[17] The decline in productivity that accompanied deindustrialization and began with the computer age was especially noted by Robert Solow in 1987. This phenomenon is known as the Solow Paradox or Productivity Gap (Triplett, 1999).

companies tripled during the period studied, going from 7.57 employees per company in 1958 to 21.26 in 1985.

Figure 5. Distribution of metalworking employment in Asturias by firm size, 1958-1984



Source: Own elaboration with SADEI, Input-Output.

Throughout the period, Metallic Products continued to concentrate a significant portion of its employment in small, low-skilled workplaces. On the other end, large shipyards such as Juliana Constructora Gijonesa S.A. or Duro Felguera employed more than 500 workers in shipbuilding. After the restructuring, many of them faced closure or restructurings that, in most cases, proved to be unviable in the long term, shifting the leadership to medium-sized shipyards located in the western region (Ocampo & Antuña, 2020; Ocampo & Suárez Cano, 2018). Machinery and Equipment represented the significant weight gained by companies with 50 to 500 employees. These medium-large companies would play a leading role in the region after the industrial restructuring, somewhat taking over the role Ensidesa once held.

4. The role of the Francoist industrial policy on the emergence of the metalworking cluster in Asturias

Following the results presented so far, it is evident that the State's role in Asturias's industrial development was significant. However, it is also observable that all direct interventions identified to date are either related to the establishment of Ensidesa in the region or to the development of other industries considered strategic by the regime. Due to its importance as a technological catalyzer, it would be reasonable to consider the metalworking sector as part of this group, as developing a robust and diversified metalworking industry became a priority for Western industrial powers during the analyzed period (Landes, 1969; Pollard, 1981; Rosenberg, 1982). Nonetheless, in the organization of Spanish post-war industrial policy, the role of the metalworking industry was marginal, while the regime focused its attention on basic sectors such as steelmaking, chemistry, or mining (Buesa, 1982). Over the decades, and following the country's gradual opening beginning with the Stabilization Plan of 1959, the importance attributed to this sector would be almost exclusively increased by the automobile industry, which would concentrate the attraction of foreign capital and the creation of supplying companies (Catalan, 2000; De la Torre & García-Zúñiga, 2013).

Francoist intervention in industrial development dates back to the Law for the Organization and Defense of the National Industry (21/11/1939), which regulated the creation of new industrial enterprises, as well as the expansion of their production, the increase of machinery, or the change of activity.[18] From a business standpoint, this strict regulation was not without nepotism, and personal relationships, power dynamics, and political connections often took precedence over economic rationality (Fernandez-Moya & Puig, 2021; Toboso, 2007). As previously noted, in the Asturian case, this discretionary character and the general political uncertainty had repercussions among the region's most prominent industrial entrepreneurs, who were reluctant to

[18] This type of intervention had already been applied in the fascist warzone since 1938 and originated from the Royal Decree of November 4, 1926, promulgated by Primo de Rivera. It was accompanied by the Law for the Protection of New Industries of National Interest (24/10/1939) and the Law for the Creation of the National Institute of Industry (25/9/1941) (Pires, 2005).

undertake significant investments to increase production. From the supply side, because the constraints on raw materials caused by the harsh autarchic policy compromised the viability of these activities. From the demand side, because they did not trust the quota system and the steel consumption estimates promised by the regime (Catalan, 1993; Schwartz & Gónzalez González, 1978).

The situation was even more challenging for entrepreneurs in the metalworking sector, who, in addition to the scarcity caused by autarchy, also suffered from the fascist institutional apparatus' contradictions due to the secondary role assigned to this activity. Therefore, the early identification of this sector's potential in Asturias is surprising and preceded the creation of Ensidesa. In 1941, a report from the Provincial Delegation to the Ministry of Industry detailed the conditions of metalworking manufacturers in Asturias. Faced with the National Syndicate's refusal to approve La Felguera Industrial's addition of welded iron tube manufacturing to screw manufacturing, engineer Jesús Canga argued that the mining industry, which produced 75% of the national total, was barely able to supply itself with these goods, fundamental for the development of its activity.[19]

The defense of Jesús Canga and the Provincial Delegation was based fundamentally on two arguments that he extrapolated to the entire sector. The first was the modest capacity of this new plant, as precisely due to its small size, it would not demand a large quantity of inputs. The second argument was the possibility of exploiting agglomeration economies in the Nalón Valley. The new plant would be located near Duro Felguera —one of the largest metallurgical companies— and the coal mines, reducing transportation costs. Finally, on November 11, the Ministry of Industry approved the creation of Asturiana de Tubos, a division of La Felguera Industrial dedicated to this activity, with a monthly capacity of 300 tons.[20]

[19] New Industries Files, nº 1.271.

[20] Four years later, they would achieve an expansion of their productive capacity to 2,100 tons per year (file nº 19.913). Along the way, La Felguera Industrial obtained approval to create an electromechanical workshop with machinery valued at 94,500 pesetas, which, in the same way, would supply the mining

The importance granted to coal mining as a generator of value chains contrasted with the precarious level of professionalization and technical development of the Asturian mining sector. As indicated in the cited report:

> *'The life of the coal mines in Asturias [...] was always quite precarious, leading to a normal economic situation of poverty, which did not allow for the development of transformation industries, finding it necessary to export 85 to 90% of its production to the rest of Spain, with its main markets being the Mediterranean coast and the Basque provinces.'*[21]

The Provincial Delegation quickly identified the need to develop this transformation industry so that the basic industries, such as steelmaking and coal mining, could find sufficient regional demand for their production. Just as with mining, the Provincial Delegation appealed to the Ministry to directly promote the metalworking industry in Asturias to support the development of regional steelmaking, given the lack of incentives for Asturian entrepreneurs to increase their production:

> *'The only industry of importance from the coal point of view that was established in Asturias from old times was the steel industry, with its three factories Duro Felguera, Fábrica de Mieres, and Moreda y Gijón, to which we can add the Military Factories of Trubia and Oviedo. The first three generally had a languid life [...] mainly due to the lack of transformation industries in their vicinity, because, just like the coal industry, they are forced to export their products to the Mediterranean.'*

Finally, the delegate himself, Jesús Canga, defended the potential that Asturias showed to become a leading metalworking hub for the rest of the country, warning the central government that the region had significant locational advantages for developing this industry in the country. In his concluding arguments, Canga defended that:

> *'[...] any new iron transformation industry has its best location in Asturias because it produces iron, coal, and electric power, the latter produced by its waterfalls and thermal power stations at the coal mine entrance [...] For all the reasons stated, we consider that not only*

industry with motors, electric meters, and more. On June 20, 1945, the Ministry granted them authorization to repair such material, but not to manufacture it, as they were denied access to the quota of primary inputs (file nº 13.195).

[21] File nº 1.271. This situation was not new since as early as the 1860s, Pedro Duro identified these regions as his main reference markets due to the lack of a significant metalworking fabric in Asturias (Ocampo, 2004).

> *should all kinds of metallurgical transformation industries in this region be authorized in general, but they should also be encouraged, giving them the maximum facilities.'*

The Provincial Delegation's demands were not met from Madrid. The scarcity of raw materials in autarchic Spain hindered the proliferation of new companies and restricted the growth capacity of the existing ones, a fact that was compounded by the arbitrariness and preference of INI industries in the allocation of inputs quotas (Catalan, 2002). Although imports of primary goods increased significantly during the 1950s, the Yearbooks of the Higher Council of Industry repeatedly emphasized the scourge that the scarcity of raw materials and primary inputs posed for the national industry, identifying it as the main problem for its development.[22]

In the Asturian case, the metalworking industry severely suffered from the internal contradictions of Francoist industrial policy and its governmental bodies. Thus, while there was an institutional push for sectoral concentration in large strategic companies, access to the scarce primary inputs available to the national industry was restricted. This situation generated conceptual tension in the Francoist industrial policy itself. On the one side, it hindered the creation of new small enterprises, which consumed few resources but contradicted the productive logic of the regime due to their limited production capacity. On the other, it limited larger companies' growth and generation of internal economies of scale capacity by restricting their access to primary goods, as their requirements were significantly higher than those of minor establishments.

As a result, many requests related to creating small metalworking establishments were sent to the 'free market' for raw materials, *de facto* invalidating them or diverting them to the underground economy.[23] Others,

[22] Yearbooks of the Higher Council of Industry. Oviedo Delegation, 1950-1960.

[23] This notion of a 'free market' actually referred to how the regime acknowledged the existence of a black market for raw materials to which it directly sent small entrepreneurs whom it did not wish to grant access to the input quota. The prices in this market were so high that resorting to them implied, in many cases, the infeasibility of the activity. A representative and detailed example can be found in the New Industries Files, nº 52.310, in which Celso Álvarez Villa was denied the opening of a small workshop unless he resorted to the free market for inputs. Same occurred to Lino González Rodríguez, who, despite having the approval of the Provincial Delegation to set up a small metal marquetry workshop, was granted a business license by the Ministry but no access to quotas (file nº 58.588).

made by larger companies to expand their capacity, were accepted as long as they did not involve an increase in their quotas for raw materials.[24] The arduous and arbitrary access to quotas finally functioned as an entry barrier added to the high initial investment required in certain market niches. To these circumstances must be added the high bargaining power of those larger, already established companies, whose situation, like in the case of steelmaking, would end up bordering on oligopoly. Notably, the companies' competitive logic also reflected the contradictions of the autarchic model. After the publication of a company's request to expand its productive capacity, the objections from its competitors usually focused on the claim that there was already sufficient productive capacity in the market, underutilized due to access to raw materials. Subsequently, it is common to find later requests from these same companies seeking an increase in their production capacity.[25]

Following this, at the end of the 1950s, the Asturian metalworking industry found itself in a situation relatively similar to the one described in the previous decade, reflecting an archaic and precarious structure. The mismatches in the supply of resources were continuous. The bottlenecks for coal, which Jesús Canga had referred to more than a decade earlier, remained. In 1954, 80-90% of the coal intended for consumption by the regional metalworking industry was not being used, as the transformation industries could not find a market for their production. Equally, access to metal quotas remained very restricted: it was estimated that in 1954, the transformation industry had only received 45% of its theoretical needs.[26]

[24] In the case of Industrial Alonso, they requested access to new machinery valued at 539,000 pesetas. While the National Steel Syndicate supported the investment, arguing that all of this machinery was acquired in Spain, the Ministry explicitly stated that despite this acquisition and the resulting increase in capacity, their quotas would not be modified. It was the year 1955, and the company had a capital of 5 million pesetas and 60 workers. New Industries Files nº 44.884.

[25] In the case of Asturias, allegations mainly came from Catalan and Basque companies, seeking to prevent the entry of Asturian competitors into their market due to the risk that in the future they might become more competitive thanks to cheap access to nearby steel. Within the region itself, one case of market control was notable: Luís Adaro held a leading position in the supply of tools and machinery for mining. In 1954, he mobilized the objections of more than seven mining companies to prevent the aforementioned Industrial Alonso from accessing this market. Finally, the latter decided to give up its efforts after reaching an agreement with Adaro (file nº 42.644).

[26] Yearbook of the Higher Council of Industry. Province of Oviedo, 1954.

In this context, all hopes were pinned on Ensidesa's progress. The rest of the regional steel companies looked at it suspiciously, but its implementation constituted the main incentive for creating or expanding metalworking industries in the region. This sentiment was expressed in 1952 by naval engineer José R. Camps-Santamarina on behalf of Construcciones y Reparaciones Marítimas S.A. when requesting an expansion of their mechanical workshops in Avilés:

> *'The creation in Avilés by the National Institute of Industry of the great National Steelworks, the National Aluminum Company (Endasa), the Asturian Steelworks, and the new chemical industry with 1.5 billion in capital under study by the INI, as well as the creation of Cristalería Española and other private industries established here, are completely transforming the appearance of the town […] The increase in the production of irons and steels indicated by official statistics, and the performance that we will soon have with the launch of the National Steelworks, are factors that necessitate the expansion of the existing steel and metalworking industries.'*[27]

The potential for establishing a solid value chain around steel was not only identified by metalworking companies.[28] In 1957, the Provincial Delegation of Industry submitted a report to the General Directorate of Industry detailing the precarious situation of the Asturian metalworking industry. The document describes a fragmented productive structure, very similar to the one outlined by Canga in 1941. A large part of the metal manufacturing establishments in the region originated from the urgency and provisionality of the post-war period, so they were tiny and had a very low level of specialization. The report continued to present Asturias as a region with tremendous metalworking potential, as it possessed, alongside the steel industry, important sources of coal and metallic minerals and was also one of the country's leading electricity producers. For all these reasons, the Provincial Delegation noted that:

[27] New Industries Files, file nº 40.093. The technical report is not preserved, and therefore, the extent of the expansion cannot be quantified. However, in the year of the request, they detail using rolled steel (60,000 kgs.), cast iron (12,000 kgs.), molded steel (3,000 kgs.), and bronze (3,000 kgs.) as inputs. They did not request an increase in their quota as they did not consider it necessary.

[28] The companies that justify their applications based on the future establishment of the steel industry are numerous, for example Construcciones Metálicas Asturianas (file nº 52.696), Industrial Avilés (file nº 48.130), or Talleres Guifer (file nº 52.314), among many others.

> *'[...] the new industrial plants should be backed by capitals capable of acquiring and sustaining modern and efficient production elements, and of making possible technical assistance from specialized firms [...]. This is tantamount to advocating for the establishment of significant plants, which should also have a generous cadre of specialized technicians and workers, or the assistance of guaranteed firms.'*[29]

To reverse this situation, the inevitable participation of the State, which controlled and directed the country's industrial activity, was required. In the same report, and as suggested by the previous paragraph, an appeal was made to the Ministry of Industry not only to favor the metalworking business but also to extrapolate the conditions of such a request to the bulk of the sector in the region. Thus, it was considered that:

> *'The fruits of the State's intervention in the industrialization of Spain, stimulating, guiding, and channeling the establishment of new industrial plants [...] constitute a flattering harvest for the country. But these same applications, applied to a specific province (Asturias) and a particular type of industry (metalworking), can change, for the better, the landscape of the iron and metal transformation industries.'*

Once again, the Ministry did not meet these demands. Asturian metalworking companies did not receive direct incentives from the INI, nor were they favored by external agreements. The aforementioned Pacts of Madrid (1953) allowed companies to negotiate the import of foreign machinery under bilateral agreements. Nonetheless, the regime's control continued introducing profound contradictions in these operations. For example, it could deny the supply of second-hand machinery –when it was the only offered by a certain foreign company– and then deny the acquisition of new machinery because of currency conflicts or because it was claimed that it could be acquired in Spain, even when no national firm presented a project to manufacture it.[30]

A decade later, and once more, the Provincial Delegation presented a 'suggestion' to the Ministry of Industry to develop a metalworking hub in the region, highlighting 'the importance for the national economy of creating a

[29] New Industries Files, file nº 11.681.
[30] Examples of diverse problems to import machinery in Fundición Nodular (files nº 56.646, nº67.867), Industrial Alonso,(file nº 44.884), or Aguinaco (file nº 52.360).

robust manufacturing industry in Asturias.' The Delegation pointed out the availability of raw materials, the development of infrastructure, and the presence of highly qualified personnel in the sector. Consequently, it was contended that 'at present, this industry, although significant, does not reach its full potential, and a substantial portion of our basic productions are exported in their raw form only to be processed elsewhere.'[31] Once again, the requests were not addressed.

Although the main source for this work ended in 1960, we can continue to follow Francoist intervention in the Asturian industry through the implementation of the so-called Development Plans (1964-1967, 1970-1972). Article 6 of the Law of 28/12/1963, states that 'The action of the State in favor of raising the standard of living in regions or economic areas with low income per inhabitant will be carried out by promoting their industrialization, agricultural improvement, and modernization of services.' Similarly, the preamble of the Decree of 30/01/1964, notes that the promotion poles 'will be located in populations where there is no industry' but which have resources for their potential development, while the Industrial Development Poles 'are those located in populations that, having a considerable industrial activity, cannot be compared with the industrialized areas of the country.'

Asturias did not become part of Development Plan I but did join Plan II through the Oviedo Development Pole, as outlined in the Government Presidency Decree 240/1969 of February 21, which extended the first plans and defined the areas affected by Pole II. The geographical limits of the action were confined to the above-mentioned 'Asturian eight' and aimed to diversify the Asturian economy, which, as shown, was highly specialized in basic industries such as mining or steelmaking. The intervention offered a series of incentives for the location of private companies in the affected area, such as the possible compulsory expropriation of land, non-repayable grants up to 10% of the total investment, preference in obtaining official credits, and various reductions and tax exemptions.

[31] Yearbooks of the Higher Council of Industry. Oviedo Delegation, 1962.

At the aggregate level, the results of the Oviedo Development Pole have been interpreted as positive, as between 1971 and 1983, 19,139 jobs were created, exceeding the target figure of 17,500, with a total investment of nearly 134,000 million pesetas. However, it cannot be said that the development plan directly favored the metalworking sector. Firstly, because this sector only represented three branches of the 29 activities that could be subscribed to these aids in Oviedo.[32] Secondly, because the metalworking industry was just one of the many intended to be promoted, so there was no strategic logic to promote this concrete sector (Fernández García, 1984).

Metalworking was the most successful among all the industries participating in the plan, representing 27.6% of the total investment granted and 64.4% of the total employment generated. However, as previously stated, this success cannot be directly attributed to planned industrial policy. It seems more a result of an organic logic where those already more competitive activities could capture a larger number of aids granted in a regime of competitive concurrence among very diverse branches of activity. Thus, the success of the metalworking sector in attracting investments within the framework of the Oviedo Development Pole is not the result of an industrial strategy aimed at directly promoting it but rather of its capacity to organically benefit from a plan of aids intended for a set of very different activities. This is consistent with what happened during the industrial restructuring when the regional industrial policy was oriented towards restructuring declining sectors, while the metalworking sector led the financing plans based on a competitive logic (Antuña, 2022a).

5. Concluding remarks

This work analyzes the emergence of the metalworking cluster of Asturias from the end of the Civil War to the industrial restructuring and the Francoist industrial policy's role in it. In the post-war landscape, the sector showed a precarious and archaic structure, characterized by small manufacturing establishments mainly dedicated to tooling and repairs. Asturias presented

[32] The total list of activities allowed in the development poles at the national level consisted of 57 activities.

many factors for its potential development, mainly inherited from its mining and metallurgical legacy from the mid-19th century. Nevertheless, the constraints and contradictions generated by Franco's autarchic industrial policy did not allow this potential to be uncovered, even when State bodies in the region were clamoring for direct incentives for this industry. The creation of the national steelmaking championship, Ensidesa, in 1950 broke this bottleneck. It supplied the basic steel necessary for developing metalworking activities and generated a series of positive externalities (labor pool, infrastructures, technical training, etc.) that triggered the sector's agglomeration in its operational environment. Since the late 1950s, the metalworking sector in Asturias developed hand in hand with the steel industry, around which a clustered environment emerged. This ecosystem was characterized by increasingly interconnected medium-sized companies dedicated to manufacturing machinery and capital goods, with this branch taking over from basic Metallic Products as the cluster's leader.

Although the creation of Ensidesa was a public initiative, it must be highlighted that the development of a robust and dynamic metalworking hub in the region was not on the Francoist industrial agenda. The Ministry of Industry never directly promoted this activity, even when the Provincial Delegation of Industry had revealed its potential by the end of the civil war. The sector was relegated to the background during the autarchy and the following opening of the Spanish economy as it was not considered a strategic industry. Subsequently, in the framework of the 1960-1970s Development Plans, the Development Pole of Oviedo included these activities among many others, as it was designed under the logic of competitive concurrency. The sector organically benefited from this plan because it was the most competitive regional industry in generating viable projects and attracting investments, not because it was conceived to boost its take-off finally. Therefore, it can be argued that the role of public policies and industrial policy in the emergence of the Asturian metalworking cluster was clearly indirect. The regimen concentrated its resources on promoting large, basic industrial sectors and systematically ignored the voices of those who, from

within the Francoist institutions themselves, called for direct support to promote these activities.

This paper takes advantage of the potential of historical analysis to analyze cluster emergence. This approach combines agency and structural change, placing the involved actors at the center of the study and analyzing the interrelationship between entrepreneurs and institutions (Catalan & Fernández-De-Sevilla, 2020; Feldman et al., 2005; MacKenzie & Perchard, 2022). It also sheds light on the indirect effects of non-cluster-oriented public policies on the appearance of these ecosystems (Asheim et al., 2017; Elola et al., 2017; Njøs & Jakobsen, 2016), and contributes to our knowledge on Franco's industrial policy beyond traditional strategic industries and its long-term effects (Antuña, 2022a; De la Torre & García-Zúñiga, 2013). Finally, from the standpoint of Economic and Business History, it engages in a tangible dialogue with Evolutionary Economic Geography in the study of how path-dependence shapes regional development, specifically how relatedness affects its industrial path creation (Asheim et al., 2017; Hassink et al., 2019; MacKinnon et al., 2019). This represents a clear response from our disciplines to the identified need to bring the historical perspective closer to EEG and, thus, to the claim that in evolutionary studies, 'history (really) matters' (Boschma & Frenken, 2006; Henning, 2018; Martin & Sunley, 2022).

Aknowledgments

I would like to thank Professors Jordi Catalan, Marc Prat, Adoración Álvaro, Grace Ballor, Andrea Colli, Veronica Binda, Valeria Giacomin, and the attendees of the 9th Annual Meeting of the Danish Society for Economic and Social History for their comments on this work.

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II

Un paso al frente: el sector metalmecánico asturiano ante la reconversión industrial, 1978-2000[1]

Resumen

Este trabajo analiza la evolución del tejido metalmecánico asturiano entre la reconversión industrial y el cambio de milenio, y matiza la visión de Asturias como un territorio desindustrializado. Desde mediados del siglo XIX, la aglomeración de actividades transformadoras en torno al carbón y la metalurgia favoreció la generación progresiva de economías externas. Estas terminarían por generar un entorno clusterizado, que permitió al metalmecánico superar el declive de los grandes sectores hegemónicos y reorientar su actividad más allá de sus mercados tradicionales. Dicho salto estuvo liderado por una base empresarial emergente, de clara vocación internacional y especializada en proyectos de alto componente tecnológico.

A su vez, este enfoque podría suponer una nueva línea de investigación en el estudio de otras regiones siderúrgicas en declive, mediante el análisis de dinámicas de largo plazo que desemboquen en el desarrollo de actividades relacionadas con la Industria 4.0.

Palabras clave: Metalmecánico, industria, reconversión, Asturias

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To cite: Antuña, G. (2022). Un paso al frente: el sector metalmecánico asturiano ante la reconversión industrial, 1978-2000. *Investigaciones de Historia Económica-Economic History Research*, 18(2), 124–135. SJR Q1.

1. Introducción

El sector metalmecánico ha sido históricamente considerado como eje vertebrador y motor del desarrollo industrial por su función de catalizador tecnológico para el resto de actividades fabriles. El incremento sostenido de la productividad manufacturera se ha basado en dicho avance técnico, que ha permitido mantener la competitividad de las empresas y, con ellas, de las economías industriales (Landes, 1969; Pollard, 1981; Sanchís y Cubel, 2007; Gutiérrez-Poch, 2019). Pese a todo, la Historia Económica no ha prestado demasiada atención a la evolución de este sector, y ha tendido a centrarse: a) bien en alguno de los grandes subsectores que lo integran y que por su propio peso han merecido estudios específicos, caso del automóvil o de la construcción naval[1]; b) bien a utilizarlo como elemento transversal para el análisis de otras realidades, caso del papel de la importación de maquinaria y componentes en el desarrollo económico de un territorio (Catalan, 1995; Eaton y Kortum, 2001; Ducoing y Tafunell, 2013).

El metalmecánico es un sector aún por definir, una suerte de cajón de sastre conformado por diferentes ramas de actividad aparentemente muy dispares entre sí. Por este motivo resulta impreciso referirse a él como un conjunto unitario a nivel nacional, ya que tanto su estructura como su devenir histórico varían profundamente de un territorio a otro, en función de la especialización industrial de la propia región en que se ubique.

En este sentido, Asturias es un claro ejemplo de región cuyo desarrollo industrial responde históricamente a un modelo basado en el aprovechamiento de ventajas comparativas derivadas de su dotación de recursos naturales. Desde mediados del siglo XIX el carbón determinaría su estructura económica, así como su alto grado de especialización en el sector metalúrgico, factor clave para comprender la trayectoria del Principado en el largo plazo (Martínez-Galarraga, Rosés y Tirado, 2015; Díez-Minguela, Martínez-Galarraga y Tirado, 2018)[2]. La hulla de los valles del Nalón y el

[1] Como ejemplo ver Catalan (2017) y Valdaliso (2003), respectivamente.
[2] Ambas obras permiten seguir, en función del PIB, la posición relativa de Asturias respecto al resto de regiones españolas desde 1860.

Caudal sería también el principal reclamo para la implantación de ENSIDESA (Empresa Nacional Siderúrgica Sociedad Anónima) en los primeros años cincuenta. Desde entonces, el metalmecánico mantendría con la industria matriz una relación bidireccional y endogámica, confluyendo así los factores de oferta y demanda operantes en la localización industrial. Ante la falta de una estructura industrial diversificada, en Asturias la siderurgia ejercía como proveedor de acero mientras, simultáneamente, se erigía como cliente principal para los productos metálicos y, en menor medida, para la maquinaria[3].

Por tanto, sería lógico pensar que la crisis y posterior reconversión siderúrgica acarrearían el declive metalmecánico en la región. Las investigaciones en Historia Económica relativas a la reconversión industrial la han estudiado como un proceso homogéneo, centrándose exclusivamente en los grandes sectores industriales en declive. Por este mismo motivo, aún perdura la idea de que Asturias quedó reducida a un páramo industrial desde los años ochenta, aunque los datos no respaldan esta creencia: en el año 2018, el sector metalmecánico ocupaba en Asturias a 18.878 personas, un 36% del empleo industrial de la región y un 5% del total. A su vez, el conjunto representaba un 27% del VAB industrial, y un 26% de sus exportaciones manufactureras, por valor de 1.144 millones de euros[4].

Esta posición parece haberse logrado mediante el aprovechamiento de las externalidades propias de un entorno clusterizado, fraguado durante décadas gracias a las capacidades generadas por la aglomeración metalmecánica en torno a la metalurgia básica. El interés sobre este tipo de dinámicas surge a finales del siglo XIX cuando, en sus estudios sobre organización industrial, Alfred Marshall identificó tres tipos de ventajas competitivas –economías externas– derivadas de la concentración geográfica de la actividad empresarial: la existencia de una oferta estable de mano de obra especializada, de una red de proveedores de bienes intermedios y empresas

[3] Relación ya identificada en el informe *La Industria Siderometalúrgica en Asturias* (1971). SADEI (Sociedad Asturiana de Estudios Económicos e Industriales) y NEI (Nederlands Economisch Instituut).
[4] Calculado con datos de SADEI (*Estadísticas Laborales* y *Comercio Exterior de Asturias*) e INE (Instituto Nacional de Estadística, *Estadística Estructural de Empresas*).

auxiliares, y de un entorno que favorezca la propagación del conocimiento, la innovación y el desarrollo técnico (Marshall, 1963). Dichas externalidades articulan el conocido como distrito *marshalliano* (Catalan, Miranda y Ramon-Muñoz, 2011).

Posteriormente, Michael Porter volverá sobre la *triada marshalliana* para formular su teoría sobre *clusters* y competitividad. Así, partiendo de las externalidades antes mencionadas, Porter define un *cluster* como la concentración geográfica de empresas, proveedores y agentes transversales, relacionados a través de externalidades de distinta naturaleza (Porter, 1998; Porter y Ketels, 2009). A su vez, estas entidades han revitalizado el papel de las pequeñas y medianas empresas en los mercados globales, al permitirles superar sus límites de capacidad incrementado su productividad y generando un entorno favorable a la internacionalización (Valdaliso, 2010).

Con este trabajo se aspira a abrir una nueva línea de investigación sobre un sector muy poco tratado, tomando como referencia una de las regiones que más sufriría el proceso de reconversión para, además, ofrecer una visión alternativa de este último: la de las industrias que crecieron en torno a los gigantes y consiguieron sobrevivir más allá de su ocaso. El presente artículo trata de reconstruir la andadura del sector metalmecánico entre el inicio de la reconversión industrial y el cambio de milenio, así como de analizar los factores que propiciaron su desarrollo. Como hipótesis de partida, se sostiene que el sector aprovechó las capacidades generadas por su aglomeración en torno a la siderurgia para reinventarse y superar el declive de esta última, a través de un proceso de clusterización que le permitiría dar el salto a los mercados internacionales.

El trabajo se inicia con una breve nota metodológica. El apartado 3 describe el cambio de modelo que desembocaría en la reconversión industrial. El cuarto apartado recoge la evolución del sector metalmecánico asturiano entre los años 1978 y 2000. En el quinto se pretende demostrar la existencia de un *cluster* metalmecánico asturiano. Por último, en el apartado 6 se detallan las conclusiones y se proponen futuras líneas de investigación.

2. El tejido industrial metalmecánico como objeto de estudio

La conceptualización realizada sobre el sector metalmecánico en este trabajo se lleva a cabo desde la visión de las diferentes actividades que lo componen. Por tanto, podríamos decir que estamos ante un sector de sectores, compuesto por ramas productivas heterogéneas, por lo que es necesario diferenciarlo de otras dos agrupaciones con las que habitualmente es confundido:

a) el sector de bienes de equipo, que recoge otros servicios añadidos, como el diseño industrial, y que excluye la producción de bienes finales, así como la rama naval y la del automóvil.

b) el sector metal, que incluye todas las ramas metalmecánicas más la metalurgia básica. Actualmente, la integración hacia adelante de la siderurgia, con un mayor peso de los productos acabados y transformados, ha difuminado su frontera con «Productos metálicos»[5]. En perspectiva histórica, se considera más apropiado tratar a la metalurgia como una entidad independiente, tanto por el peso autónomo de la siderurgia integral, como por su particular andadura en el último siglo.

Se podría definir el sector metalmecánico como aquel conjunto de actividades transformadoras que, partiendo de la producción metalúrgica básica como input principal, se dedican a la fabricación de bienes destinados tanto a la demanda intermedia como, en menor medida, al consumo final.

En este trabajo se ha homogeneizado los códigos CNAE: 74 y 93, que a su vez han tenido que ser armonizados en base a la clasificación específica utilizada en la contabilidad asturiana. La estructura sectorial que se utilizará en el resto del texto se recoge en la Tabla 1, utilizando tres niveles de división: sectores, subsectores y ramas de actividad.

[5] Una parte importante de los datos disponibles a partir de 1994 recogen como un único conjunto «Metalurgia y Fabricación de productos metálicos», pudiendo distorsionar el análisis si esta puntualización no es tenida en cuenta.

Tabla 1. Composición de los sectores metalmecánico y metalúrgico por subsectores y ramas de actividad

METALÚRGICO
1. Productos siderúrgicos
2. Producción y primera transformación de metales no férreos
METALMECÁNICO
1. Productos metálicos
2. Maquinaria, equipo, electrónica y precisión
Maquinaria, equipo y material mecánico
Maquinaria, equipo y material eléctrico
Aparatos electrónicos, de radio, televisión y comunicaciones
Instrumentos de precisión, médicos, ópticos y relojería
3. Material de transporte
Fabricación de vehículos y sus componentes
Construcción y reparación naval
Otro material de transporte

Fuente: elaboración propia según CNAE-74, CNAE-93 y el sistema asturiano de clasificación regional.

El grueso de los datos utilizados para el presente trabajo proviene de SADEI (Sociedad Asturiana de Estudios Económicos y Empresariales). Esta sociedad pública, adscrita a la Consejería de Hacienda, es la fuente más rica y minuciosa para el estudio de la economía asturiana, pues se encarga de realizar, entre otras tareas, las tablas Input-Output, así como de proporcionar soporte metodológico en la elaboración de las cuentas regionales. La información obtenida del análisis de las mencionadas tablas se ha complementado con la recogida en otros informes y publicaciones, señalados en el apartado Fuentes.

Al homogeneizar las tablas Input-Output se ha tenido en cuenta la introducción del modelo europeo contable SEC-95. Como consecuencia, las series relativas a producción y exportaciones, así como los diferentes indicadores, están recalculados al coste de los factores. Igualmente, se han ajustado utilizando el deflactor del VAB manufacturero propuesto por Prados de la Escosura con base 2010 (Prados de la Escosura, 2017). Cuando se haga referencia a una cifra en un año concreto, se hará en pesetas corrientes.

3. La quiebra de los sectores industriales hegemónicos: un cambio de modelo productivo, 1970-1980

Los años setenta marcarán un punto y aparte en la historia industrial. El final de la era Bretton-Woods y las crisis del petróleo pondrían de relieve la extenuación de un modelo de crecimiento que, si bien había marcado el desarrollo occidental durante las décadas pasadas, adolecía de profundas debilidades estructurales (Myro, 1989; Méndez, Sánchez y Benaul, 2003; Catalan, 2014). Ambos acontecimientos rubricaron el fin de la hegemonía del modelo industrial *fordista*, asociado a la gran empresa verticalmente integrada, que hacía descansar su fortaleza en el aprovechamiento de economías internas de escala con vistas a expandirse y alcanzar posiciones de liderazgo en un entorno que Chandler bautizó de «oligopolio global». La crisis del estándar imperante en la época dorada traería consigo la aparición de un nuevo paradigma: de un patrón de integración vertical se evolucionó hacia otro de especialización vertical, en el que cada país o región se orientaba, mediante la externalización, en fases específicas de la cadena de valor. Esta vía se favorecía de la reducción progresiva de los costes de transporte, así como de la liberalización y paulatina integración de los mercados mundiales, generándose los principales flujos comerciales entre países industrializados y con una tendencia intrasectorial (Feenstra, 1998; Hummels, Ishii y Yi, 2001).

Otra cuestión diferencial es que, a partir de los años ochenta, las crisis ya no inducirían a las pequeñas y medianas empresas a regresar a modelos de producción tradicionales, posponiendo sus esfuerzos de inversión, sino que estas intentarán encontrar una salida innovadora a través del desarrollo tecnológico y los proyectos *llave en mano* (Piore y Sabel, 1984). La cooperación entre agentes relacionados tomaría a partir de entonces especial relevancia, pues muchas de las empresas operantes en este nuevo paradigma no desarrollan su propia tecnología, por lo que su capacidad para integrar eficientemente los sistemas y componentes proporcionados por otros agentes se convertirá en un importante factor de competitividad (García Canal, 2017). Este cambio de pauta pondría en jaque a los grandes sectores asociados a la

II Revolución Industrial, de los que la siderurgia representa quizá un ejemplo paradigmático (Piore y Sabel, 1984; Chandler, 1990, 1992).

La siderurgia europea había entrado desde principios de la mencionada década en una situación de crisis generalizada. El sector se encontraba en plena fase expansiva, siguiendo las halagüeñas expectativas de consumo de acero a nivel global, basadas en las elevadas tasas de demanda que habían mostrado sus industrias de destino tradicionales –como la del automóvil– en los años anteriores. A partir de la primera mitad de los setenta, estos mercados comenzaron a dar signos de saturación, lo que se traduciría en una reducción de la demanda de bienes de equipo, principal cliente siderúrgico (Piore y Sabel, 1984).

Por otro lado, la competencia en el mercado europeo se incrementaba, al fortalecerse el sector en países que tradicionalmente habían tenido un peso relativamente menor en dicho escenario, como Italia y Holanda; al tiempo que progresivamente se hacía notar la presencia de países de reciente industrialización –NICs, *Newlly Industrialized Countries*–, que operaban con estrategias de bajos precios, primero desde el Sudeste Asiático y, posteriormente, desde el Este de Europa (Bernabé, 1982; Pérez, 1994; Díaz Morlán, Escudero y Sáez, 2009). La escasa rentabilidad empresarial, sumada al proceso inflacionario general, redujo la tasa de inversión, crucial para el desarrollo de la industria primaria y transformadora, agravando de forma estructural la crisis del metal (Catalan, 2014).

Es en este contexto en que han de enmarcarse los problemas que padecerá la industria asturiana que, desde sus orígenes, se había concentrado en torno a tres de los sectores que sufrirían más gravemente la reconversión industrial: la minería, la metalurgia y la construcción naval[6]. Al haber sido considerados como estratégicos por el régimen franquista, el período 1950-1970 había supuesto para ellos un importante auge. Con la decisión de localizar ENSIDESA en Avilés, Suanzes respondía a la misma llamada del carbón

[6] El carbón, y con él la metalurgia, determinaron la especialización productiva de Asturias, siendo la base sobre la que se sustentaría el sector transformador, incluyendo la industria naval a partir del vapor. Para profundizar en el papel de estas actividades en la industrialización asturiana ver Nadal (1975), Ojeda (1985) y Ocampo y Suárez Cano (2018).

asturiano que, un siglo antes, habían sentido empresarios franceses, belgas y luxemburgueses (Nadal, 1975; Ojeda, 1985; Ocampo, 2004). Dentro de una opción que subordinaba la racionalidad económica a los intereses «nacionales», la creación de ENSIDESA nacía de la necesidad de incrementar la producción de acero para abastecer al mercado doméstico. Para ello se crearía una gran siderurgia integral que desoligopolizara el sector sin necesidad de reducir los aranceles, y también como respuesta a la parsimonia inversora de los empresarios privados que, aletargados por la deriva proteccionista imperante desde finales del siglo pasado, se mostraban pesimistas en sus predicciones en cuanto a la demanda futura de acero en el país (Schwartz y González González, 1978; González González, 1988; Martín Aceña y Comín, 1991).

La crisis siderúrgica se manifestó en España con cierto retraso en comparación al resto de Europa, y la tardanza en la adopción de políticas estructurales de calado hizo que sus consecuencias fueran más largas y profundas. Debido a la propia coyuntura social de la época, la transición política se priorizó a la económica y, por el mismo motivo, se tardó mucho tiempo en tomar medidas de reestructuración que pudiesen quebrar la paz social (Navarro, 2004b; Arce, 2006). La política española de reestructuración terminaría por concentrar la siderurgia integral en el Principado, manteniendo únicamente una miniacería en Vizcaya –inaugurada en 1996 y previa fusión de Altos Hornos de Vizcaya (AHV) y ENSIDESA–, y clausurando la cabecera de Sagunto como consecuencia del plan de 1984 (Fernández de Pinedo, 2003; Díaz Morlán, Escudero y Sáez, 2008).

Centrándonos en el caso asturiano, con un sector industrial poco diversificado más allá de las tres ramas citadas, la entrada de la economía asturiana en la reconversión industrial no era muy esperanzadora. ENSIDESA mostraba a finales de los años setenta un claro problema de sobrecapacidad, así como una insostenible estructura de costes. La falta de racionalidad en la organización de la producción había reducido a mínimos los índices de productividad, muy alejados de los de aquellos países europeos que ya habían empezado años antes sus planes reconversores (Navarro, 2004a, 2004b; Vázquez, 2004). La

decisión de potenciar el sector siderúrgico en la región, y la posterior deriva hacia la unificación de la actividad integral en Asturias, distaban mucho de la senda elegida por el País Vasco. Allí, el Gobierno autonómico apostaría abiertamente por una política diversificadora que impulsara nuevos sectores fabriles de alto componente tecnológico (Valdaliso, 2013).

4. La respuesta del sector metalmecánico asturiano a la reconversión industrial

4.1. El impacto de los ajustes y la adhesión a la CEE, 1978-1990

El Plan Siderúrgico Nacional de 1974, de marcado carácter expansivo, tuvo que ser cancelado por el Gobierno de la UCD en 1980, pues su sobreestimación del consumo doméstico de acero lo hacía inviable en el nuevo escenario (Pérez, 1994). Entretanto, el segundo *shock* petrolífero puso de manifiesto la necesidad de abordar un profundo proyecto reconversor, que afectaría a once actividades industriales en declive, entre las que destacaban la siderurgia y la construcción naval[7]. Pero ante la previsión del impacto negativo que tendría en el empleo, y del malestar social que generaría en regiones como Asturias o País Vasco, la intervención prevista no fue llevada a cabo en profundidad. Tendría que ser el Gobierno socialista de Felipe González el que finalmente iniciase la reconversión, con Solchaga al frente del Ministerio de Industria y Energía[8]. Como sectores prioritarios, los ajustes sobre la siderurgia y la construcción naval se aplicarían a partir de 1984, siempre con la mirada puesta en la inminente entrada de España en la Comunidad Económica Europea (CEE) (Arce, 2006; Maluquer, 2014).

En materia de ocupación, el sector metalmecánico asturiano consiguió resistir razonablemente bien el envite de la primera intervención gubernamental, sustentado por el subsector «Maquinaria, equipo, electrónica y precisión», que en 1990 presentaba cifras muy similares a las de 1978. Este hecho, sumado al decrecimiento generalizado del empleo industrial, se reflejó en un incremento del peso de la ocupación metalmecánica sobre el conjunto del

[7] Un tímido primer ajuste fue llevado a cabo según el RD 876/1981, en el que ya se identificaban las líneas maestras para la posterior reconversión.
[8] RDL 8/1983 de Reconversión y Reindustrialización, que daría pie a la posterior Ley 27/1984.

sector secundario, así como en su mantenimiento con relación al total nacional (Tabla 2). Este relativo buen hacer no debe buscarse en la política pública de recolocación: además de promover la jubilación anticipada, el plan socialista crearía los Fondos de Promoción de Empleo (FPE)[9], que no consiguieron favorecer el trasvase de empleo siderúrgico hacia la empresa privada operante en actividades transformadoras (Ruíz Valdepeñas, 1992). Buen ejemplo del fracaso de dicho plan es el impacto indirecto que la reconversión siderúrgica provocó durante esta década en la ocupación del subsector «Productos metálicos», el más estrechamente relacionado con la industria matriz.

Tabla 2. Evolución de la ocupación en los subsectores metalmecánicos y el metalúrgico en Asturias, 1978-2000

	1978	**1985**	**1990**	**1995**	**2000**
Metalúrgico	25.916	19.936	14.731	9.647	9.206
Metalmecánico	**22.475**	**18.710**	**18.029**	**14.190**	**18.062**
Productos metálicos	11.333	8.706	9.210	7.170	9.023
Maquinaria, equipo, electrónica y precisión	5.799	5.707	5.581	4.756	6.488
Material de transporte	5.343	4.297	3.238	2.264	2.551
Metalmec. Ast./Metalmec. Esp.	3%	3%	3%	2%	2%
Metalmec. Ast./Ind.Ast.	17%	19%	21%	20%	29%

Fuente: Elaboración propia a partir de SADEI, *Tablas Input-Output*, e INE, *Anuarios Estadísticos de España*.

Mención aparte merece la situación del subsector «Material de transporte». Pese a que las ramas «Fabricación de vehículos y sus componentes» y «Otro material de transporte» incrementaban sus plantillas –ocupando conjuntamente a 1.370 activos en 1990–, su cifra total de ocupados caería arrastrada por la reconversión naval. Durante la aplicación del plan, entre 1984 y 1990, los astilleros asturianos perdieron un 48% de sus efectivos totales, concentrándose el 70% de estas pérdidas en aquellos con más de 500 trabajadores, como el astillero público Juliana Constructora Gijonesa S.A. o

[9] *El libro blanco de la reindustrialización* (1983). MINER.

el privado Duro Felguera[10]. A partir de entonces, algunos se verían abocados al cierre definitivo, y otros buscarían su supervivencia a través de fusiones que en muchos casos terminarán por no ser viables en el largo plazo (Ocampo y Suárez Cano, 2018).

Tanto los ajustes navales como los siderúrgicos se vieron directamente determinados por la adhesión de España a la CEE y a la Comunidad Europea del Carbón y el Acero (CECA) en 1986, manifestando dos hechos: que las estimaciones y las intervenciones derivadas del plan de 1984 eran insuficientes, y que la siderurgia española seguía sin ser competitiva en el mercado europeo (Navarro, 2004a). La actividad metalúrgica había seguido creciendo hasta 1985, momento en que se desplomaría a consecuencia de los ajustes derivados del plan aplicado a partir de 1984 y de su entrada en la Comunidad. Comercialmente, la adhesión de España a la CECA tendría un impacto muy significativo para el sector metalúrgico ya que, mientras las ventas españolas al mercado europeo estaban sujetas a una limitación «voluntaria», las importaciones no podían ser restringidas. Así, mientras el consumo de acero foráneo por parte de la industria española aumentaba notablemente hasta 1990, las exportaciones siderúrgicas no dejaban de caer (Navarro, 2004b; Díaz Morlán y Sáez, 2019).

Pese a ser estos los años más duros de la reconversión, y a pesar del doble impacto –desde la oferta y la demanda– que supondría la caída de la metalurgia regional, el sector metalmecánico asturiano conseguiría engancharse al ciclo económico positivo de 1985-1990 y aprovechar el nuevo horizonte europeo para reorientar su producción (Figura 1). Frente a la asfixiante situación de la siderurgia –cuyas exportaciones cayeron de los 170.921 millones a los 88.952 millones en este período–, el sector transformador se mostraría muy dinámico en los mercados exteriores, hasta representar sus exportaciones el 18% del total industrial del Principado en 1990.

[10] Desde 1860, la actividad naval de Duro Felguera en Gijón derivaba del importante flujo comercial mantenido por la empresa con el País Vasco, donde se abastecía de hierro mientras aprovechaba los retornos del carbón y los hierros elaborados (Ocampo y Suárez Cano, 2018, p. 3).

«Productos metálicos» –subsector más importante en volumen dentro del metalmecánico y el más dependiente de la metalurgia– se vio muy afectado por el ajuste sufrido en ENSIDESA, lo que empeoraría levemente los resultados de todo el sector[11]. Entre 1978 y 1985, las ventas de «Productos metálicos» a la metalurgia se verían reducidas en un 77%, y ya nunca regresarían a su nivel inicial. Sin embargo, desde ese último año conseguiría reorientar su actividad hacia adelante, proveyendo de inputs a otras actividades, lo que explica su tendencia a converger con el resto de subsectores hasta el año noventa. En este caso, dicho viraje se orientaría hacia el mercado español –que representaba el 60% del total fabricado ese mismo año–, después de un ligero repunte de sus exportaciones en 1985, cuando alcanzaron un 11% sobre su valor total producido, para estabilizarse en torno al 7% desde entonces.

Contrariamente, «Maquinaria, equipo, electrónica y precisión» se vería favorecido por el incremento de la demanda por parte de la industria asturiana, incluyendo la importante inversión tecnológica en las plantas de ENSIDESA: a finales de los ochenta, las ventas en la región representaban un 63% de su fabricación total. Al mantenerse al alza la demanda regional, el subsector tenía escasos incentivos para competir más allá de nuestras fronteras. Además, a nivel desagregado se observa que la rama «Maquinaria, equipo y material eléctrico» mostraba un comportamiento muy inestable, fluctuación que anulaba la tendencia positiva del conjunto, y contrastaba con la estabilidad de «Maquinaria, equipo y material mecánico», que de forma constante destinaría en torno al 6% de su producción a mercados internacionales.

El dato más sorprendente es el incremento de la actividad del subsector «Material de transporte», que en 1990 se cifraba en 41.130 millones de pesetas, un 14,2% más que en 1978. Como parte de este se estancaría la rama «Construcción y reparación naval», frenada por una caída continuada de la demanda desde los años setenta, así como por una progresiva liberalización

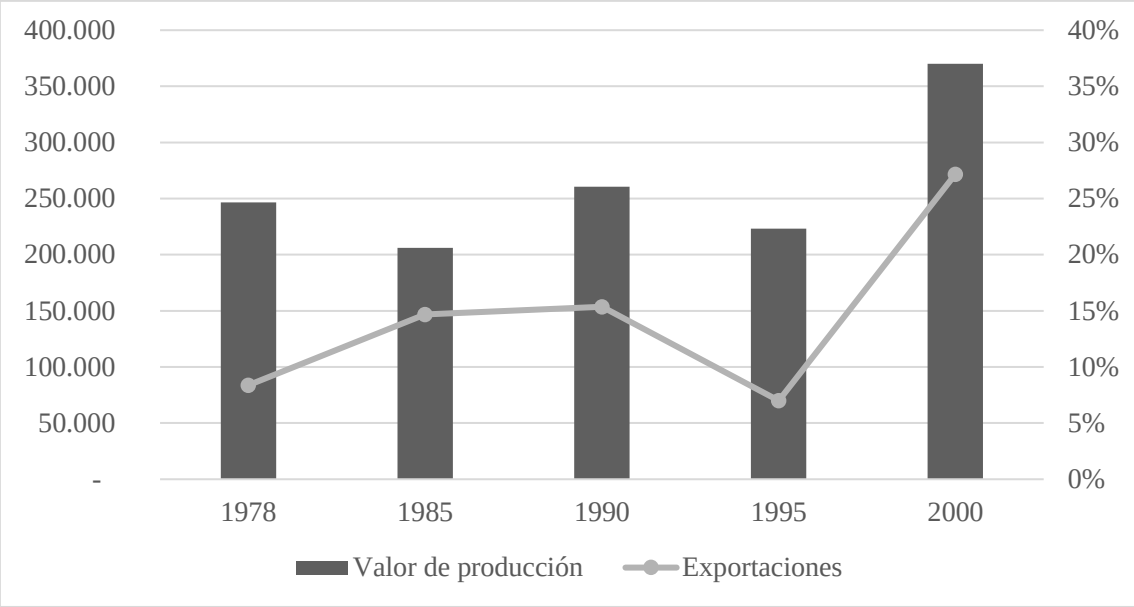
[11] La importancia de «Productos metálicos» se explica por la tradición metalúrgica de la región, eslabón inmediatamente anterior a los transformados en la cadena de valor. Para comprobar cómo evoluciona el peso relativo de cada subsector sobre el conjunto, ver Anexo 1.

de los mercados que estaba desplazando la contratación hacia astilleros internacionales con menores costes productivos (Valdaliso, 2003). Lo que se produjo en la construcción naval durante estos años fue un relevo empresarial, en virtud del cual los astilleros especializados en actividades de alto valor añadido reemplazarían a los gigantes públicos y privados de Gijón y Avilés. La permuta se concretó en el caso de los astilleros del Occidente asturiano, Gondán y Armón, cuya participación en la actividad no dejaría de aumentar, hasta ostentar entre ambos el 40,3% de las entregas navales en Asturias entre 1987 y 1990 (Ocampo y Suárez Cano, 2018, p. 6).

Frente a los severos ajustes navales, la tendencia positiva del subsector «Material de transporte» se debe al progreso de «Fabricación de vehículos y sus componentes», así como al de «Otro material de transporte», ya que en ambas ramas el valor de producción se duplicó hasta 1990. En la automovilística sería crucial la llegada de Suzuki a la región, en 1984, cuando adquirió el 36,5% del capital de la gijonesa Avello, empresa que terminaría por controlar completamente en 1988. La factoría de la compañía nipona, destinada a la fabricación de motocicletas de pequeña y gran cilindrada, contaba entonces con una capacidad máxima de fabricación anual de 63.000 unidades (Avella, 1993). Igualmente relevante sería el papel de Armstrong Amortiguadores, que comenzó a operar en Asturias en 1976, cuando la firma británica adquirió Amortiguadores Bulnes. Tras ser proveedor principal de AUTHI en Pamplona, en los primeros años ochenta la planta asturiana se convertiría en suministrador de referencia para Ford en Valencia, fabricando los amortiguadores del modelo Fiesta. El crecimiento de la compañía la llevaría a ser absorbida en 1989 por la multinacional americana Tenneco, que la renombraría como Monroe Amortiguadores[12].

[12] Para profundizar en la evolución de la actividad y la propiedad de la compañía, ver www.vauste.es

Figura 1. Evolución de las exportaciones metalmecánicas asturianas sobre el valor de producción, 1978-2000



Fuente: Elaboración propia con datos de SADEI, *Tablas Input-Output*. El valor de producción está expresado en millones de pesetas constantes de 2010. El peso de las exportaciones sobre el mismo está expresado en porcentaje.

El subsector «Material de transporte» se mostraría como el más orientado hacia el mercado exterior: en 1990 le corresponderían 16.446 millones de pesetas, el 40% del valor fabricado, frente al 19% de 1978. Este crecimiento encaja con su dinámica productiva, anteriormente explicada. En primer lugar, «Construcción y reparación naval» se erigió como la rama más destacada al final del período, con ventas al exterior por valor de 14.572 millones de pesetas. Pese a la entrada en el mercado de competidores a bajo precio, provenientes principalmente del Sudeste Asiático, la orientación de los astilleros medianos hacia el nicho de embarcaciones bajo demanda permitiría que la construcción naval asturiana fuese cada vez más competitiva en el extranjero. Por último, la importancia del capital foráneo en la pequeña rama automotriz asturiana le otorgaba un carácter intrínsecamente internacional. Partiendo de unos niveles de exportación prácticamente nulos hasta 1985, «Fabricación de vehículos y sus componentes» conseguiría triplicar sus ventas fuera de España en tan solo diez años.

El sostenimiento de la actividad metalmecánica durante los años más duros de la reconversión industrial la situaron en una posición de fuerza dentro de

la estructura económica regional. Frente al inicio de la veloz terciarización de la economía asturiana, y la crisis vivida por sus grandes sectores hegemónicos, el sector incrementaba su peso en el VAB industrial de la región, consiguiendo igualmente mantener su importancia con respecto al total del sector a nivel nacional (Figura 2). Paralelamente, la productividad estimada por ocupado se incrementaba un 37% en el mismo período, siendo la tasa de variación para el conjunto de la industria asturiana de un 52%[13].

4.2. El tejido metalmecánico en el más largo plazo: entre la crisis y el mercado global

Tras el ciclo económico positivo del quinquenio anterior, los primeros noventa traerían consigo una recesión generalizada que, en línea con la situación europea, provocaría una brusca contracción de la inversión industrial (Velasco y Plaza, 2003). Sin embargo, la creación del mercado único europeo en 1992, así como de la Organización Mundial del Comercio (OMC) en 1995 –acompañadas de nuevas devaluaciones– facilitarían la recuperación de las ventas al extranjero, favoreciendo que la segunda mitad de los noventa se tornara un período de importante expansión para la industria española (Maluquer, 2014; Catalan, 2019).

La recesión afectó duramente al sector metalúrgico europeo, que se vería comprometido por un incremento en el precio del petróleo fruto de la Guerra del Golfo, así como por la entrada masiva de acero barato procedente de Europa oriental a partir de 1991. La situación se agravaría en el caso español, por cuanto los ajustes siderúrgicos seguían a rebufo del resto de países, provocando que las medidas tomadas de cara a la incorporación al marco CECA se mostraran de nuevo insuficientes (Navarro, 2004b).

En tal escenario, ENSIDESA presentaba todavía unos altísimos costes productivos con relación a otras empresas. El repunte competitivo de finales de la década pasada parecía un espejismo, pues en 1991 la acería registraba pérdidas históricas (Vázquez, 2004). El fracaso del intento reconversor condujo a la creación de la Corporación Siderúrgica Integral S.A. (CSI), resultante de la fusión de ENSIDESA y AHV previa intervención del Instituto

[13] Productividad aparente = VABcf/ocupados.

Nacional de Industria (INI) y del Banco Industrial de Crédito. Aunque con matices, la creación de CSI ha sido generalmente considerada como un éxito, y en 1994 la corporación generaba de nuevo beneficios. Finalmente, y como parte de la política privatizadora del primer Gobierno de Aznar, en 1997 se constituirá Aceralia Corporación Siderúrgica S.A., con el grupo luxemburgués Arbed como socio mayoritario (Sierra, 2000; Navarro, 2004a; Catalan, 2014).

El plan CSI —que de nuevo recogía un duro ajuste de plantilla— tuvo repercusiones profundas sobre el empleo en el sector metalúrgico asturiano: tan solo entre 1990 y 1995, la rama siderúrgica perdería casi 5.000 activos. A diferencia de lo ocurrido en el quinquenio 1980-1985, el metalmecánico no se salvaría esta vez de la recesión, si bien a finales de siglo conseguiría recuperar valores muy similares a los de 1990, lastrado únicamente por las cifras del sector naval, castigado de forma directa por los ajustes reconversores. Esta recuperación colocaba al sector como referente industrial en materia de ocupación en una Asturias terciarizada, aunque sería menos acentuada respecto al metalmecánico nacional, que proporcionalmente había perdido muchos menos efectivos entre 1990 y 1995 (Tabla 2). En este aspecto, los ajustes de «Productos metálicos» se vieron recrudecidos por la convulsa situación siderúrgica, si bien conseguiría sobreponerse a partir de 1995. Por su parte, el descenso constante de «Material de transporte» vendría determinado aún por los efectos de la reconversión naval.

De nuevo sería «Maquinaria, equipo, electrónica y precisión» el subsector que mostrara la tendencia más estable, alcanzando niveles históricos de ocupación en el año 2000. Esta dinámica estuvo liderada por «Maquinaria, equipo y material mecánico», que apenas sufrió los efectos de la crisis y en este último año contaba con 3.649 ocupados. Por su parte, la rama «Maquinaria, equipo y material eléctrico» sí se vería afectada por la recesión, aunque se recuperaría posteriormente hasta cifras casi idénticas a las de 1990.

La producción global del sector metalmecánico mostró una clara dinámica de rebote, ya que, tras el desplome provocado por la recesión, su actividad repuntaría notablemente en el último quinquenio del siglo XX. Este

incremento estuvo especialmente espoleado por el aumento de la demanda intermedia a nivel global, hecho del que conseguiría favorecerse notablemente el sector asturiano (Figura 1). El Ministerio de Industria ya identificaba en 1995 la apertura exterior como una posible arma de doble filo, pues mientras los bienes de equipo españoles se posicionaban como un segmento de gran especialización, el pequeño tamaño medio de las empresas dificultaba su acceso a economías internas de escala[14].

Si bien en el plano internacional, y al menos en el corto plazo, el sector metalúrgico no logró cumplir el objetivo de expansión marcado con la creación de Aceralia –entre 1995 y 2000 las ventas del conjunto al extranjero se redujeron un 12%–, el crecimiento metalmecánico al final de los noventa radicó en gran medida en la capacidad que tuvieron sus diferentes subsectores para aprovechar la integración de los mercados mundiales. En el año 2000, sus exportaciones representaban ya el 28% del total de la industria regional, un 10% más que en 1990.

Las cifras productivas del subsector «Productos metálicos» decrecerían ligeramente durante la crisis, para recuperarse a partir de 1995 orientadas hacia el mercado nacional. El posicionamiento internacional del subsector resultaba comparativamente más complicado, al operar este en un nicho de mercado en que las estrategias de bajo precio eran más viables que la especialización. El incremento de sus ventas al exterior, aunque notable, resultó menos pronunciado que en aquellas ramas altamente especializadas. Entre los años 1990 y 2000 sus ventas quedaron confinadas al mercado interior, representando sus exportaciones un máximo del 11% sobre la producción total en el año 2000, valores equiparables a los logrados en 1985.

Por su parte, la actividad de «Maquinaria, equipo, electrónica y precisión» conseguiría mantenerse estable y al alza durante la recesión, tendencia sostenida desde 1978. El subsector despegará finalmente a partir de 1995, impulsado a partes iguales por las ramas mecánica y eléctrica, que crecerán en torno al 70% hasta el año 2000. El gran avance del subsector se debió a

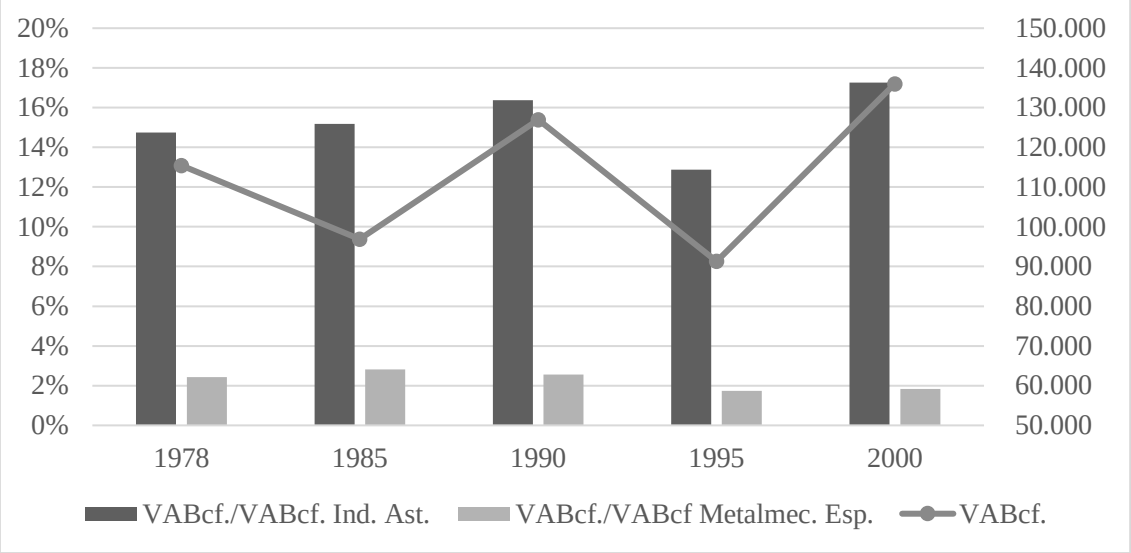
[14] El *libro blanco de la industria: una política industrial para España* (1995). MINER.

la focalización de sus capacidades en rebasar sus mercados tradicionales. Al desagregar los destinos de su actividad, puede observarse cómo el peso de la demanda asturiana y española sobre sus ventas se estabilizó, respectivamente, en torno al 40% en el último quinquenio, mientras las exportaciones alcanzaban los 16.945 millones de pesetas al final del mismo período, cerca de un 20% de su valor de producción total. En este sentido, la instalación del grupo alemán Thyssenkrupp en la región, en 1992, parecía un buen reflejo de la confianza en el potencial industrial asturiano. Bajo la denominación Thyssenkrupp Norte S.A., la compañía emplazó en Mieres una planta destinada a la fabricación de cintas y escaleras mecánicas, localización a la que se sumaría en 1996 la planta Airport Solutions, especializada en pasarelas aeroportuarias[15].

El subsector «Material de transporte» sería el más castigado en materia productiva por la recesión de principios de los noventa. En la rama de la construcción naval, el estancamiento de los pedidos durante la década anterior, así como los ajustes derivados de la reconversión, hundirían la actividad hasta 1995. Pese a todo, la nueva base empresarial liderada por los astilleros del Occidente, junto a una rama automovilística pequeña pero dinámica, conseguirán hacer resurgir al subsector: en el año 2000 el valor final de la producción agregada de «Material de transporte» se incrementaba un 18,6% respecto a 1990. Esta evolución responde a la línea de especialización ya perfilada en el período anterior. Si la rama «Construcción y reparación naval» siempre había tenido una mayor orientación internacional, este rasgo se acentuó con el liderazgo ejercido por los astilleros medianos, que al final del período destinaban a los mercados exteriores el 78% de su actividad. La rama del automóvil siguió la misma tendencia con un 56,7%, aunque, en este caso, el mercado nacional pesaba mucho más que el regional en el porcentaje restante.

[15] Paralelamente, la empresa instaló un centro de I+D+i en Gijón en 1996 (La Nueva España, varias fechas).

Figura 2. Evolución del VABcf metalmecánico en Asturias respecto al total de la industria asturiana y al sector en España, 1978-2000



Fuente: Elaboración propia a partir de SADEI, *Tablas Input-Output*, e INE, *Anuarios Estadísticos de España*. El valor absoluto del VABcf está expresado en millones de pesetas constantes de 2010. Su peso sobre las otras dos variables está expresado en porcentaje.

En cómputo global, la todavía difícil situación de la siderurgia agravaría el efecto que la recesión de la economía española ejerció sobre el sector metalmecánico en Asturias. Este hecho lo sumiría en una profunda crisis durante el primer quinquenio de los años noventa, de la que, sin embargo, conseguiría sobreponerse rápidamente en la segunda mitad de la década. Esta brusca caída dañaría ligeramente su posición con relación al conjunto del sector a nivel nacional –oscilando, pese a ello, en cifras muy similares a las mostradas anteriormente, entre un 2% y un 3%– ya que, a nivel agregado, este último aún conseguiría crecer ligeramente durante estos años. Pese a ello, a nivel regional el metalmecánico se consolidaría como referente manufacturero, incrementando su importancia en una economía industrial en declive y en rápida transición hacia la terciarización (Figura 2). Como apunte final cabe destacar el papel que el buen hacer del subsector «Maquinaria, equipo, electrónica y precisión» pareció repercutir sobre el total de la industria, especialmente desde el mecanizado, incrementándose la productividad aparente sobre la ocupación del sector fabril en un 39% en la última década.

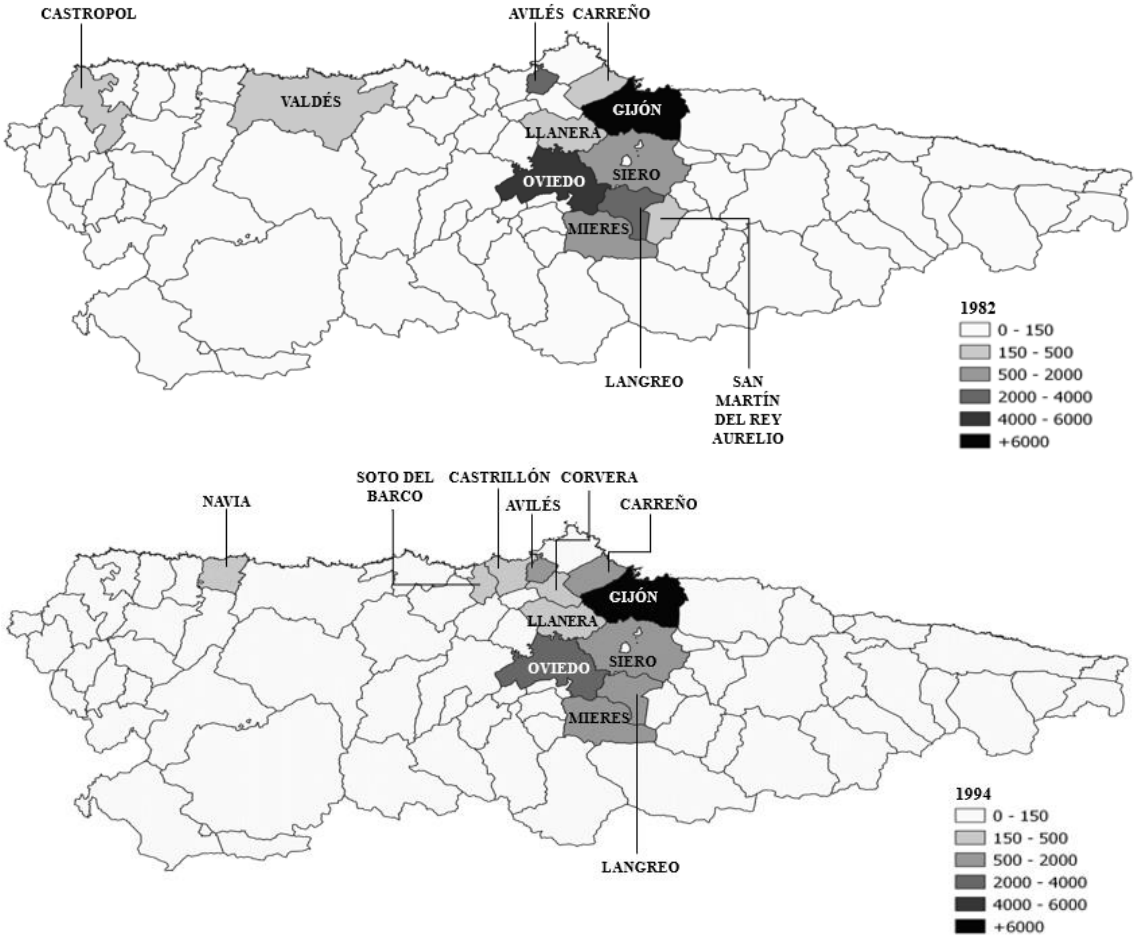
5. El *cluster* metalmecánico de Asturias

Al inicio de la reconversión industrial, la distribución geográfica de la actividad metalmecánica en Asturias era un claro reflejo del devenir histórico de la industria en la región: desde los focos originarios de los valles hulleros del Nalón (Langreo) y el Caudal (Mieres), esta había pasado a concentrarse en Gijón y Avilés tras la implantación de ENSIDESA. A estos concejos debemos sumar Oviedo, que supuso igualmente un importante polo de atracción tanto por su privilegiada posición geográfica, como por el efecto capitalidad. Dichos municipios estructuran el conocido como *ocho asturiano*, eje vertebrador de la región, organizado como un sistema metropolitano polinuclear –de cuya influencia se favorecieron otros concejos cercanos–, y que ofrecía a las empresas la posibilidad de beneficiarse de las externalidades y rentas de situación generadas por el desarrollo industrial posterior a 1950 (Benito del Pozo, 1993). Esta pauta se refleja en la evolución de concejos colindantes con Gijón, Avilés y Oviedo, frente al decaimiento de las Cuencas Mineras (Figura 3).

A lo largo del período, el sector se estructuró en torno a una base conformada por empresas medianas, entre los 100 y 200 empleados, cuya relevancia estratégica las haría consolidarse como *tractoras* por su efecto dinamizador sobre el resto[16]. Esta evolución responde a un proceso de reorganización jerárquica: ante el declive de las grandes empresas en torno a las cuales se había concentrado la actividad en las décadas anteriores, emergían ahora nuevos actores que tomaban su testigo, impulsados por las capacidades acumuladas durante décadas a la sombra de aquellas (Catalan, Miranda y Ramon-Muñoz, 2011)[17].

[16] En volumen de empleo predominarían las empresas de entre 1 y 50 empleados, que en el año 2000 concentraban el 44% de los activos.
[17] Ver Anexo 2.

Figura 3. Distribución por concejos del número de activos en el sector metalmecánico asturiano, 1982 y 1994



Fuente: Elaboración propia con datos de SADEI, *La Renta de los Municipios Asturianos*. Años extremos elegidos según disponibilidad de datos.

Como apunte complementario a esta aglomeración, cabe destacar que los coeficientes de especialización regional en materia de ocupación superaban la media española, tanto al inicio como al fin de la reconversión industrial, si bien es cierto que, debido a la rápida terciarización asturiana, el nivel decrece ligeramente: de 1,31 en 1978 a 1,11 en el 2000[18].

Aun así, la concentración geográfica es un factor necesario pero no suficiente para la identificación de un *cluster*. Según la definición de Porter mencionada en el apartado 1, las empresas y organizaciones que lo conformen deben estar relacionadas entre sí, bien sea a través de flujos comerciales, bien a través de

[18] Índice de especialización regional con relación al empleo del sector en el conjunto de España, expresado mediante la fórmula Ce=(Eir/Er)/(Ei/E) donde Eir hace referencia al empleo del sector *i* en la región *r*; Er es el empleo total de la región; Ei es el empleo sectorial en el país y E es el empleo total del país. Un valor superior a 1 indica mayor peso relativo del sector en el empleo de la región que en el conjunto del país.

conexiones intangibles en materia de innovación y desarrollo. Cabe apuntar que esta conjunción tiende a ser positiva, de forma que las industrias con altos valores de relación comercial muestran habitualmente un patrón similar en innovación y cooperación (Navarro, 2003).

Los coeficientes técnicos entre los subsectores metalmecánicos y la metalurgia muestran –sin tener en cuenta las ramas energéticas, cuya producción es transversal como input a cualquier actividad– los valores más altos de la economía industrial asturiana[19]. Asimismo, nos ofrecen una imagen de la evolución de la cadena de valor metalmecánica en la región (Tabla 3).

[19] El coeficiente técnico regional viene dado por la expresión Arij=Xrij/Xj, donde Xrij expresa el consumo de bienes o servicios producidos en la región por la rama *i* y utilizados en su producción por la rama *j*, y Xj es el valor total de la producción de la rama *j*.

Tabla 3. Coeficientes técnicos regionales de los subsectores metalmecánicos y el sector metalúrgico, 1978 y 2000

1978 **Compras** **Ventas**	***Metalúrgico***	***Productos metálicos***	***Maquinaria, equipo, electrónica y precisión***	***Material de transporte***
Metalúrgico	0,011	0,197	0,054	0,028
Productos metálicos	0,029	0,043	0,075	0,048
Maquinaria, equipo, electrónica y precisión	0,011	0,009	0,070	0,015
Material de transporte	-	-	-	-
2000 **Compras** **Ventas**	***Metalúrgico***	***Productos metálicos***	***Maquinaria, equipo, electrónica y precisión***	***Material de transporte***
Metalúrgico	0,036	0,185	0,065	0,037
Productos metálicos	0,004	0,025	0,039	0,027
Maquinaria, equipo, electrónica y precisión	0,022	0,017	0,048	0,031
Material de transporte	-	-	-	0,048

Fuente**:** Elaboración propia con datos de SADEI, *Tablas Input-Output*. Leído en vertical, las cifras expresan la demanda que la rama *j* realiza de la rama *i* para la producción de una unidad. En horizontal, las ventas de la rama *i* a la rama *j* para la producción de una unidad.

La lectura más informativa del cuadro se realiza desde el punto de vista de la demanda («compras», fila superior de la tabla). Se observa que el desarrollo del sector metalmecánico incrementó ligeramente la demanda que sus subsectores hacían de la producción metalúrgica regional. La excepción sería el caso de «Productos metálicos», que se vería afectado por la integración hacia delante de la cadena de valor siderúrgica, hasta solaparse en ciertos eslabones con su propia actividad, lo que a su vez explica el incremento de inputs reutilizados por la metalurgia.

La importancia de «Productos metálicos» como proveedor intermedio –cada vez más destinado al mercado nacional, como se apuntaba anteriormente– se redujo considerablemente en favor de la maquinaria[20]. La demanda que todos los subsectores harían de «Maquinaria, equipo, electrónica y precisión» se incrementó durante este período, aumentando así la importancia que su actividad ejercería sobre el resto. En este caso, la excepción se daría en la reutilización de su propia producción, disminuida por la progresiva implementación de tecnología y maquinaria foránea en su actividad. Por último, y de forma lógica, la contribución de «Material de transporte» al desarrollo del resto de actividades es nula, si bien destaca el repunte de la producción para su propia reutilización sectorial, debido a su paulatina especialización en fases intermedias de la cadena productiva. En resumen, la dinámica global del sector encajaría con el patrón de un metalmecánico dinámico y que evolucionaba técnicamente, por lo que dependía cada vez de más y mejor maquinaria para continuar desarrollándose.

Este avance técnico no vendría impulsado únicamente desde el interior de la industria. A partir de los años ochenta, la vertiente reindustrializadora de la reconversión propondría una política de promoción de suelo industrial que promoverá gran parte de los polígonos industriales y parques tecnológicos actualmente existentes en la región, en los que el metalmecánico fue siempre el sector predominante (Benito del Pozo, 2014). Especialmente relevantes serían los espacios dedicados a la implantación de agentes tecnológicos y del conocimiento, cuya relación con las empresas del sector metalmécanico ha sido siempre muy estrecha, actuando como agentes facilitadores en el avance hacia un modelo de fabricación avanzada.

En este sentido, la creación del Parque Tecnológico de Asturias en 1991 (Llanera) supuso un punto de inflexión en la apuesta de la región por el desarrollo tecnológico ligado al sector industrial. Desde su fundación, el espacio –en que conviven empresas y organizaciones transversales, tanto de carácter público como privado– ha estado claramente dominado por

[20] La caída de la demanda de productos metálicos por parte de la industria tiene su contraparte en su incremento por parte de la construcción. El coeficiente técnico regional entre «Productos metálicos» y «Construcción» pasa de 0,020 en 1978 a 0,126 en el año 2000.

actividades relacionadas con las TICs, la ingeniería y los bienes de equipo de alto componente tecnológico. Cabe destacar la implantación ese mismo año de la sede de la Fundación ITMA (Instituto Tecnológico de Materiales de Asturias), orientada a la investigación e innovación basada en materiales, donde el acero tendrá un papel destacado[21].

No menos importante sería la creación, en el año 2000, del Parque Científico-Tecnológico de Gijón, centro neurálgico de la Milla del Conocimiento Margarita Salas[22]. El complejo fue proyectado en torno al campus gijonés de la Universidad de Oviedo, sede de los principales estudios técnicos ofertados en la región, y que desde 1994 acogería al Instituto Universitario de Tecnología Industrial de Asturias (IUTA) del que, junto a la Universidad y otros agentes de conocimiento asociados, forman parte como colaboradoras las empresas más importantes del sector metalmecánico de la región[23].

Los facilitadores tecnológicos y centros de conocimiento, junto con distintos entes públicos como el ya citado IDEPA (creado en 2002 y heredero del antiguo Instituto de Fomento Regional) o Asturex (Sociedad de Promoción Exterior del Principado de Asturias, fundada en 2005) serían una pieza clave en la red que, en 2016 e impulsada por la patronal del metal en Asturias (FEMETAL), terminaría constituyéndose como MetaIndustry4, *Cluster* de Fabricación Avanzada que en 2019 contaba con 57 asociados. Seis años antes, aunque en este caso impulsado por el gigante siderúrgico Arcelor Mittal, surgiría el Polo del Acero, conformado por 18 organizaciones[24].

La apuesta del metalmecánico por la innovación se reflejaba igualmente en el mayor esfuerzo relativo que este sector realizaba en materia de inversión en I+D+i en comparación con el resto de la economía asturiana: en el año 2000

[21] En 2005, la Fundación crearía el Centro Tecnológico del Acero y Materiales Metálicos en Avilés. Ver www.itma.es

[22] Desde 2004, el espacio acogería a su vez a la Fundación PRODINTEC, agente tecnológico especializado en la potenciación de la industria asturiana a través de la innovación en procesos de fabricación y productos.

[23] Para el listado completo de colaboradores, ver www.iuta.uniovi.es

[24] En 2001 Aceralia, Arbed y Unisor crearían el Grupo Arcelor, que en 2006 se fusionaría a su vez con Mittal Steel. ArcelorMittal Asturias sigue siendo la única planta siderúrgica integral de España. En 2018 contaba con una plantilla que rondaba los 5.400 empleados, y su presencia sigue siendo clave para la región, pues de ella dependen todavía muchas empresas metalmecánicas consideradas como auxiliares.

el conjunto representaba el 44,8% del gasto total regional en esta materia[25]. Como apunte final, es destacable que en 1998 Asturias fuese la cuarta región española con mayor número de empresas ligadas a actividades de ingeniería y con una facturación superior a los 3.000 millones de pesetas, solo por detrás de Madrid (25), Vizcaya (11) y Barcelona (6) (Méndez, Sánchez y Benaul, 2003, p.487).

6. Conclusiones

En este trabajo se ha revisado la visión tradicional mantenida sobre la reconversión industrial en España, que la emplazaba como punto final para el tejido fabril asturiano. La metalurgia básica, heredera de los yacimientos hulleros, había sido un pilar estratégico de la economía asturiana desde mediados del siglo XIX y, muy especialmente, desde la creación de ENSIDESA. La concentración de actividades transformadoras en torno a la siderurgia propició la aparición de ventajas competitivas alejadas del carbón, que el sector metalmecánico supo aprovechar tras el declive de las industrias hegemónicas. Esta aglomeración derivaría en la generación de un entorno clusterizado, que permitió a un grupo de medianas empresas –tanto asturianas como extranjeras y con un marcado perfil exportador– convertirse en referentes industriales para Asturias.

Ante la caída de ENSIDESA, «Productos metálicos» conseguirá reorientarse hacia el aprovisionamiento de bienes intermedios para diversas actividades, contando con el mercado español como principal destino. Por el contrario, «Maquinaria, equipo, electrónica y precisión» concentraría sus esfuerzos en abastecer la creciente demanda de maquinaria por parte de otras ramas asturianas, que vinculaban sus posibilidades de supervivencia a la necesidad de modernizarse. Sobre esta base, a partir de 1995 el subsector conseguirá dar el salto a los mercados internacionales a partir de una oferta que, a través de la innovación, progresivamente se especializaría en pedidos bajo demanda y de alto componente tecnológico.

[25] INE, *Encuesta sobre innovación tecnológica en las empresas* (2000).

Un sendero muy similar recorrería el subsector «Material de transporte», aquel con mayor presencia relativa en el extranjero. En este sentido destaca la construcción naval, cuya competitividad exterior descansará sobre una nueva base empresarial focalizada en actividades de alto valor añadido (buques de apoyo, embarcaciones de recreo y suministro a la industria *off-shore*).

De cara al futuro, será conveniente profundizar en la caracterización de dicho *cluster*, así como en su repercusión sobre el global de la economía asturiana. Igualmente, será de interés ampliar el escenario estudiado, llevándolo al análisis comparativo con otras regiones europeas que partiesen de unas ventajas comparativas similares, de forma que se puedan valorar las vías de salida seguidas por las regiones siderúrgicas en declive a partir de los años setenta.

Agradecimientos

Este trabajo cuenta con la financiación del Ministerio de Universidades a través de una beca FPU adscrita al proyecto *¿Capitalismo mediterráneo?: Éxitos y fracasos del desarrollo industrial en España, 1720-2020* (PGC2018-093896-B-I00).

Quiero expresar mi agradecimiento a los profesores Jordi Catalan y Marc Prat, directores de la tesis en que se enmarca este trabajo, por su dedicación y sus valiosas enseñanzas, así como al profesor Joaquín Ocampo por su apoyo y por compartir generosamente conmigo su sabiduría. Igualmente quisiera dar las gracias a los revisores de IHE, que han contribuido enormemente a mejorar la primera versión de este trabajo, y a los profesores Miquel Gutiérrez, Anna Aubanell, Yolanda Blasco y Vittorio Galletto por sus comentarios sobre el mismo. Gracias también a Guillermo Ulacia por su confianza constante, a Ramiro Lomba y Javier Galán de SADEI, que me facilitaron el acceso al grueso de los datos que componen este estudio, y a José Luis Rebordinos por abrirme las puertas de la hemeroteca de LNE.

Fuentes

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Anexos

Anexo 1. Peso de los subsectores sobre el conjunto metalmecánico asturiano, 1978 y 2000

	1978			2000		
	Empleo	**Producción**	**VAB**	**Empleo**	**Producción**	**VAB**
Fabricación de productos metálicos	50%	51%	51%	50%	47%	50%
Maquinaria, equipo, electrónica y precisión	26%	25%	26%	36%	31%	34%
Material de transporte	24%	24%	23%	14%	22%	16%

Fuente: Elaboración propia con datos de SADEI, *Tablas Input-Output*.

Anexo 2. Empresas metalmecánicas con más de 150 empleados, 1980 y 2000

1980

NOMBRE	CNAE-74	PLANTILLA
S. M. DURO FELGUERA (DIQUE)	371	2.343
FÁBRICA NACIONAL DE CAÑONES Y FÁBRICA DE ARMAS	329	2.184
S.A. JULIANA	371	1.259
EMPRESA N. ALUMINIO S.A.	224	984
SDAD.IND.ASTURIANA STA.BÁRBARA	316	847
ELÉCTRICO I. CRADY S.A.	342	686
ASTILLEROS DEL CANTÁBRICO	371	564
AVELLO S.A.	383	400
TALLERES DE MOREDA S.A.	325	288
FUNDICIÓN NODULAR S.A.	325	241
ARMSTRONG AMORTIGUADORES	363	221
M. TUBERÍA INDUSTRAL, S.L.	312	190
INDUSTRIAL AVILÉS S.A.	311	186
FUENTE TRUBIA S.A.	311	170
AGUINACO S.A.	311	164

Fuente: SADEI a través de FEMETAL, con datos de la Tesorería de la Seguridad Social.

2000

NOMBRE	CNAE-93	PLANTILLA
GRUPO DURO FELGUERA SA	2951	1.571
EMPRESA NAL. SANTA BÁRBARA INDUSTRIAS MI	2960	793
HIERROS Y APLANACIONES SA	2811	286
ESMENA SA	2811	255
THYSSEN NORTE SA	2952	244
METALÚRGICA ASTURIANA, S.A.	2821	233
TREFILERIA MOREDA SA	2873	228
FUNDICIÓN NODULAR, S.A.	2951	220
MEFASA (MECAN. Y FABRIC. S.A.)	2956	188
SAMOA INDUSTRIAL SA	2912	167

Fuente: SADEI a través de FEMETAL, con datos de la Tesorería de la Seguridad Social.

III

Industrial path creation, a business case approach: Daniel Alonso Group from steelmaking to wind power[1]

Abstract

The need for European reindustrialization has boosted the debate on regional path creation. Through a business case approach, this work contributes to this literature by exploring the history of Daniel Alonso Group, a paradigmatic example of an entire sectorial trajectory. Born in the steelmaking region of Asturias (Spain) in 1957 as a small metalworking workshop, DAG is nowadays represented worldwide by Windar Renovables, a top firm in the wind power sector.

DAG reflects the 3-stage cumulative process that allowed the Asturian metalworking sector to survive industrial restructuring and create new development paths: 1) birth around the steelmaking industry, 2) endogenous growth based on self-reinforcing dynamics 3) delocking, diversification, and international expansion moving towards Industry 4.0.

Keywords: steel industry, wind power, path creation, reindustrialization, cluster

[1] This work is published at *Business History*. Here, the paper is reproduced in its entirety, adapting the editing format to those of this monograph.
To cite: Antuña, G. (2024). Industrial path creation, a business case approach: Daniel Alonso Group from steelmaking to wind power. *Business History*. JCR Q1.

1. Introduction

Since the 1970s, Europe has undergone a profound deindustrialization process that, due to its inherent heterogeneity, impacted countries and regions responding to very varied stimuli and idiosyncrasies (Di Berardino et al., 2021; Škuflić & Družić, 2016). However, the 2008 financial crisis and, more recently, the one resulting from Covid-19 have reopened the debate on European reindustrialization.[1] Examining the long-term dynamics of traditional industrial regions now in decline could shed light on their hidden potential for developing future paths for growth. Hence, studying their historical evolution and productive dynamics has become an increasingly relevant issue for the academic literature in recent years (Capello & Cerisola, 2023).

Path dependence has frequently served as a valuable framework to understand regional evolution and, by extension, the dynamics of those sectors that comprise their productive structure, placing historical analysis at the forefront of the study of regional economic development (Martin & Sunley, 2006; Garretsen & Martin, 2010; Henning et al., 2013). Nevertheless, path dependence approaches rely on the inherent notion of lock-in and focus on persistency trends. By contrast, recent visions close to Evolutionary Economic Geography place change at the center of the analysis, highlighting the role of location, contingency, and agency. This led us to focus not just on persistency but on evolution and change, and so on when, how and why a 'delocking' occurs (Boschma & Martin, 2010; Martin, 2010).

Therefore, path creation emerges as relevant as path dependence, two concepts that need to be addressed as complementary dimensions and not as mutually exclusive. Following this, the capacity for new growth paths to develop –and so their nature– will be determined by the prior conditions and trajectory of the ecosystem in which they appear (Garretsen & Martin, 2010; Martin & Sunley, 2006). Applied to an industrial ecosystem, this means that

[1] Three of the principle reports on this topic published by the European Commission are *Towards knowledge-driven reindustrialization*, *For a European industrial renaissance* and *Masterplan for a competitive transformation of EU energy-intensive industries*. Main guidelines in *European Industrial Strategy 2050*.

path dependence will determine industrial path creation, as its capabilities accumulated over time will shape those it has in the present and those it will be able to develop in the future (Boschma, 2016; Hassink et al., 2019; Kogler & Whittle, 2018).

From a sectoral perspective, traditional path dependence theory argued that a 'delocking' process results from external forces or chance events, triggering shocks that can alter or even eliminate the original trajectory. In contrast, an agency-centered view delves into individual actions and the bidirectional interaction between agents' decisions and their context (Martin & Sunley, 2006; Garretsen & Martin, 2010). Evolutionary perspectives also emphasize the active role of companies in shaping new growth paths for their competitive environment. Although the ability to generate novelty can be path-dependent, companies —and thus entrepreneurs— actively participate in and influence these processes (Garud & Karnoe, 2001). This bidirectional perspective yields two key insights

The first is the need to bring historical analysis closer to business and management studies, emphasizing its potential in studying firm/organizational paths. In this regard, the theory of organizational path-dependence —boosted by Sydow, Schreyogg & Koch (2009, 2020) and built upon the seminal works of (Arthur, 1994; David, 1986)— relies on a three-phase model. Phase I (Preformation) involves unpredictable decisions made by agents, often triggered by minor events with unknown consequences. In Phase II (Formation), these initial decisions set in motion self-reinforcing processes promoting organizational growth through mechanisms like increasing returns and positive feedback. These dynamics facilitate a potential Phase III (Lock-in), where persisting traditional patterns may lead to inefficiency or even extinction. Notably, reaching this third stadium is not unavoidable. Thus, an organization can reach delocking thanks to deliberate decisions and changes that allow it to create a new growth path based on previously accumulated capabilities (Djelic & Quack, 2007). Processes of change and pathbreaking are challenging but not impossible, and the question of how these path-dependent dynamics can be disrupted and lead to path-

creation remains as relevant as understudied (Law, 2018; Stache & Sydow, 2023).

The second insight is the potential to analyze these processes not as isolated events but as part of the ecosystem in which companies are embedded. Historical methods facilitate this comprehensive view through the analysis of context, change over time, causality, contingency and complexity, which increases our understanding on how these elements shape strategy, decision making and firm behavior, but also on how contingency and human agency affect structural dynamics (Perchard et al., 2017; (MacKenzie & Perchard, 2022).[2] This reinforces the proposition that, ultimately, 'history matters' in both persistence and change processes. Consequently, interdisciplinary dialogue between fields like Evolutionary Economic Geography, Management Studies, and Business or Economic History becomes imperative (Boschma & Frenken, 2006; Henning, 2018; Perchard et al., 2017).

However, there is a substantial lack of studies that analyze these dynamics focused on firm performance, and ever fewer use the case study to scale the obtained results to broader economic dynamics. This paper addresses this gap by offering a bottom-up approach that merges regional and sectorial/cluster perspectives with the narrative of a leading firm in its ecosystem. To this aim, I analyze the evolution of Daniel Alonso Group (DAG), located in the industrial city of Avilés (Asturias, Spain), as an illustrative case of a company that leveraged its accumulated capabilities to overcome a potential lock-in resulting from the industrial restructuring. DAG successfully appeared as a global benchmark in a sector distinct from its traditional specialization but still linked to the steel value chain. This success serves as an exemplar of the journey undertaken by other prominent metalworking companies in the region.

The deindustrialization initiated in the 1980s represents a manifestation of Schumpeterian 'creative destruction' intrinsic to industrial capitalism. A comprehensive examination of post-industrial societies offers insights into

[2] For more detail on historical 5Cs see Andrews & Burke (2007).

the consequences of destruction, the plausible (or not) resulting creation, and the roles played by both public and private agents in this process (MacKinnon, 2020; Rubio-Varas, De la Torre & Connors, 2022).[3] Industrial restructuring —which was especially harsh in steelmaking regions with prominent mining legacies— exhibited distinct patterns resulting from each territory's specific structural and institutional traits, giving rise to distinct post-industrial landscapes. The Sydney Steel Corporation (SYSCO) case on Cape Breton Island (Nova Scotia, Canada), is a poignant example of unmitigated regional deindustrialization. Established as a publicly owned company in the late 1960s, SYSCO failed to attract a private purchaser and ultimately ceased operations in 2001, marking the end of both the corporation and the last coal mines in the area (MacKinnon, 2020). In the French region of Lorraine, the gradual shutdown of iron mines coincided with the restructuring and acquisition of the Usinor group by the Arcelor conglomerate. Notably, in this instance, collaboration between public and private entities facilitated the emergence of 'reconversion industries', primarily driven by the automotive sector. While its implementation exhibited geographical variations, and the employment generated fell short of that in traditional industries, this sector has played a vital role in sustaining the steel industry and ensuring industrial occupation (Raggi, 2019).

The case of Asturias resembles the latter but lacks a national key industry comparable to the automotive sector. In the region, the Francoist regime (1939-1975) boosted 'strategic' activities for the nation's economic development, such as steelmaking, coal mining, and shipbuilding. This specialization turned Asturias into the country's principal steelmaking pole from 1950 onwards, but also made it more vulnerable to the impact of industrial restructuring (Díaz Morlán et al., 2009; Rabanal, 2009; Valdaliso, 2019). However, from the 1990s, Asturias witnessed the emergence of a diversified, globally-oriented metalworking network that became the regional benchmark thanks to the development over decades of a hierarchical cluster around the public steelmaking company Ensidesa (Antuña, 2022).

[3] Built on Schumpeter (1942).

DAG's case matches the three-stage process that allowed the sector to tackle a 'de-locking' and emerge successfully from industrial restructuring. The Group was created in the 1950s as a small metalworking workshop, benefiting from the positive externalities generated by the creation of Ensidesa in Avilés. From the early 1970s until the turn of the millennium, it grew in the shadow of the steelmaking industry, becoming one of Spain's largest suppliers of industrial services with its company Daorje. Finally, in 2007, it abandoned the provision of auxiliary services and specialized in the emerging wind energy sector by creating Windar Renovables, a nowadays world leader in manufacturing towers for wind turbines and offshore foundations. It is currently present in five countries (Spain, India, Brazil, Mexico and Russia) and employs more than 1,500 people worldwide, showing a turnover of around €350m in 2019.

At the microsphere, DAG's history illustrates how a small metalworking company survived the industrial restructuring and became a world leader in the wind energy market, a key segment of the European green transition.[4] At the meso, it reflects how certain self-reinforcing dynamics enabled the company to specialize in a different, high-value-added branch of the steel value chain. This is the case of hierarchical clusters, in which a core activity –usually represented by a large company, in this case, Ensidesa– structures the entity and organizes a substantial part of its internal connections –Input-Output, labor, knowledge–, determining and boosting the capabilities that smaller companies can develop within it (Catalan et al., 2011; Delgado et al., 2016). At the macro level, it shows how path dependence affects regional specialization and path creation (Deegan et al., 2021; Kogler & Whittle, 2018), and reinforces the need for industrial policy to boost and conduct these processes by fostering the growth of emerging sectors and markets and the renewal of the business ecosystem (Balland et al., 2019; Wigger, 2023).[5]

[4] Bilgili et al. (2011). A comprehensive view in WindEurope, *Wind energy in Europe*.

[5] Although this theoretical framework is out of scope, this paper can also contribute to questions concerning family firm internationalization. DAG is a family business that became a world benchmark in a very high-added-value market niche, partly thanks to the skills accumulated in a highly specialized industrial environment. A comprehensive characterization of family firms as international companies in Lubinski et

The article organizes as follows. Section 2 presents the adopted methodology and describes the main primary sources. Section 3 briefly reviews the history of Asturias' metalworking sector in the long term. Section 4 delves into the history of DAG. The paper ends with some concluding remarks.

2. Methodological remarks

The convergence between business theory and the use of history in organization studies presents certain epistemological challenges but also significant potentials arising from combining theory with meaningful use of primary archival sources (Rowlinson et al., 2014). Within the framework of organizational path-dependence, this combination becomes not only enriching but intrinsically necessary to provide a deep and detailed analysis of the case under study (Kipping & Üsdiken, 2014). Thus, for the dialogue between business theory and history to be fruitful, it is essential to emphasize that historical narratives involve a rigorous combination of evidence, analysis, and interpretation to conform a detailed retrospective account (Perchard et al., 2017).

In business history, this rigor requires a cautious approach to private archival sources. As Decker (2013) acknowledges, during the reconstruction process it is an essential part of the historian's work to truly understand archival absences, which implies recognizing a certain degree of agency in the original composition of these sources. While it is not always feasible to pinpoint the causes or timing of such gaps, combining different sources can help fill them. In these cases, source triangulation can shed light on archival silence, revealing the archive's authentic voice.

Such an analysis constitutes the baseline of this paper, focused on the previously unexplored original archive of DAG. However, this source has homogeneity issues due to two fundamental reasons. Firstly, due to the relatively small size of the group's companies during the early decades of its history and to a relatively high degree of informality, much of the

al. (2013). Recent research on the influence of their environment, their professionalization degree and their specialization in Eddleston et al. (2019) and Hennart et al. (2019).

documentation related to that period has not been preserved. Secondly, DAG's corporate structure is extensive and complex, as it comprises over thirty societies including wholly owned and partially intervened firms. This resulted in the loss of documentation from some companies or in its actual custody by other unrelated organizations. This paper focuses on the core societies of the Group and their principal subsidiaries (Table 1). Therefore, all shown data will likely be slightly underestimated, which in no case modifies the narrative or the presented results.

Table 1. DAG's core organization chart, 1957-2018

Name	Constitution	Core business	Shareholder's equity (k€)
Talleres Daniel Alonso Rodríguez (Tadarsa)	1957[1]/1975	*Manufacture of dump bodies for industrial trucks.* Manufacture of metallic structures, machinery and mechanical equipment	24,054
Danima	1970	*Manufacture of dump bodies for industrial trucks.* Engineering, services and equipment for environmental, public and military projects.	13,835
Daorje	1974 (2007)	Industrial services for the steelmaking industry	13,908
Daorje mantenimientos especializados	1990	Diverse industrial services	2,199
Daorje Medioambiente	1994	Waste management	5,029
Aplacansa	1979 (2007)	Purchase and processing of steel	5,571
Dacero	2007	Purchase and processing of steel	22,877
Windar Renovables	2007	Design and manufacture of towers for wind turbines and offshore foundations	68,960
Tadarsa Eólica	2007	Manufacture of towers for wind turbines	16,771
Tadarsa Logistics	2007	Management of Windar logistic processes	2,615
Windar Offshore	2014	Design and manufacture of offshore foundations	1,043
Windar Technology and Innovation	2020[2]	Windar R+D services	-157
Idesa	2014[3]	Engineering for oil&gas	20,738

Source: DAG corporate dossiers and Sabi. Notes: in brakes, cessation of activity or sale. In italics, the original activity that varied over time. Shareholder's equity in 2018 or year

of cessation. [1]Commencement of business without legal registration of the company. [2] Year of creation. [3] Year of acquisition.

Before the 1990s, only the accounting books of Daorje (1974 onwards) and Aplacansa (1979-1985) are available, existing comprehensive evidence for all the studied companies from that decade onwards. The paper also relies on complementary primary evidence, as it is the case of a historical list of employees disaggregated at the company level provided by HR, and so of the different dossiers on projects and business lines provided by Operations. However, historical documentation on Daorje's workforce was lost after the firm's sale, so until the 1990s, only estimations coming from external sources are available. The Sabi database and historical documents from the Trade Register of the Principality of Asturias archive complete this information.

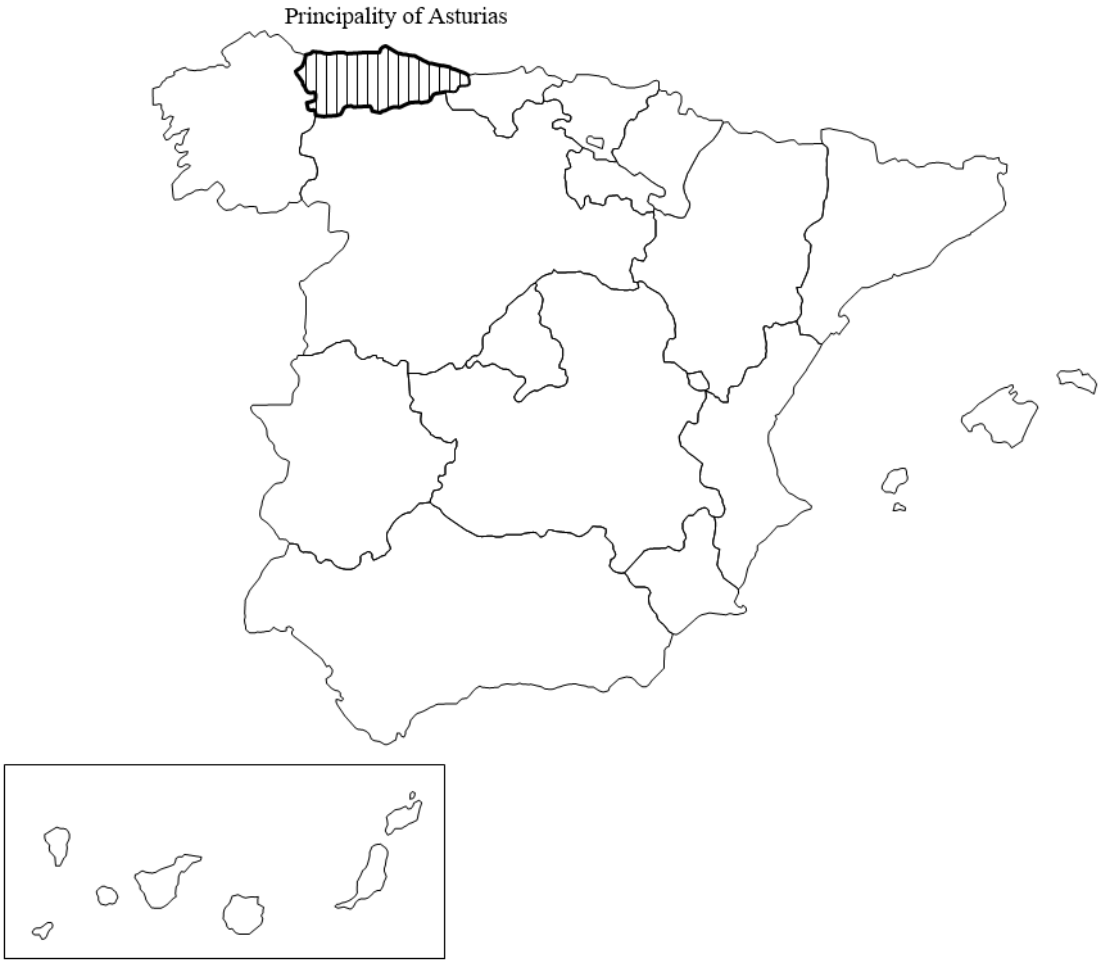
Documents related to external agents fill the gaps in internal primary sources, providing complementary data or facilitating the original's verification, and enriching the narrative. On the one side, diverse official documentation provides information on the economic and political context and DAG's relationship with the state-owned company Ensidesa. On the other, the historical archives of the regional newspapers El Comercio and La Nueva España (LNE onwards) contain specific data on relevant projects or key variables. Finally, diverse semi-oriented interviews with various personalities implicated in DAG's trajectory contribute valuable qualitative information. These involve family members of the board, other related external agents, and workers with positions of interest for this paper. This evidence is cross-checked with the primary sources mentioned above or with other testimonies.

3. Metalworking sector in Asturias, an overview: very long-term capabilities to face industrial restructuring

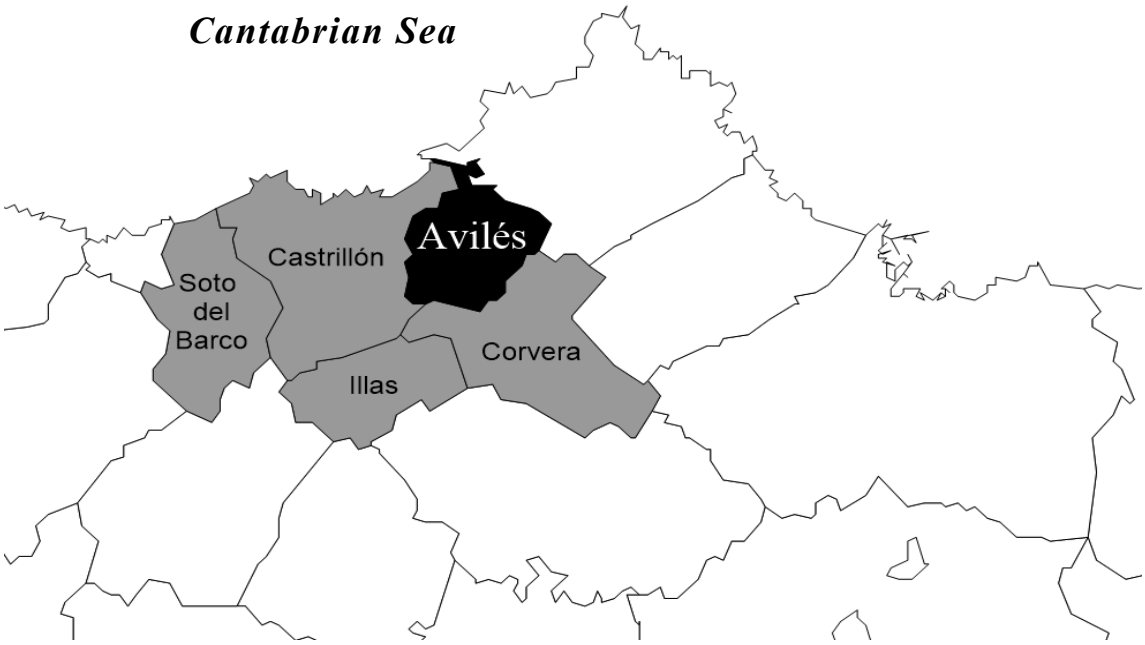
The Principality of Asturias represents a paradigmatic case of regional deindustrialization in Spain after the mid-1980s, of which Avilés has traditionally been an archetypical local example (Figure 1, Table 2). However, recent data qualify this view. In 2019, the functional urban area of Avilés showed the highest concentration of relative industrial employment in

Spain (27.3%) and was among the top European UFAs in terms of industrial multinationals agglomeration.[6]

Figure 1. Principality of Asturias and Avilés functional urban area



[6] INE (National Institute of Statistics), *Indicadores Urbanos 2021*.



Source: Own elaboration. Functional Urban Area by INE.

Table 2. Asturias and Avilés total population and industrial employment, 1950,1980 and 2018

	1950		1980		2018	
	Population	**Industrial employment**	**Population**	**Industrial employment**	**Population**	**Industrial employment**
Asturias	895,804	–	1,128,756	370,061 (31.6%)	1,028,244	51,150 (13.6%)
Avilés	21,340	–	87,996	25,150 (69%)	78,715	6,333 (21.6%)

Source: SADEI (Asturian Institute of Economic and Industrial Studies), Historical Census and Regional Accounts. Notes: In brackets, percentage of total employment.

Since the last decade of the 18th century, abundant coal deposits triggered the proliferation of metallurgical initiatives that benefited from this mineral's proximity. Asturias held Spanish metallurgical leadership in both industries from 1860 to 1880, when it shifted to the Basque Country due to the introduction of steel obtained by the Bessemer procedure (Nadal, 1975). The twist gave rise to a strong oligopoly with high lobbying power, a situation that lasted unflappable until the outbreak of the Civil War in 1936 (Anes, 1988; González González, 1988; Ocampo, 2004).

This long metallurgic tradition turned Asturias into a potential development pole for the Francoist regimen based on three industries considered of strategic 'national' interest: coal mining, steelmaking and shipbuilding. Specifically, the coastal city of Avilés benefited from two agglomeration factors: the proximity of raw materials and inputs and the existence of an important port located on the estuary, connected by train to the rest of the country. These conditions favored the implantation of many large companies in the city, supported by the National Institute of Industry (INI). Relevant examples were Siasa (1942), oriented to manufacture scrap iron, Endasa (1949) for aluminum, and different public and private shipyards (Benito del Pozo, 1991; Ocampo & Suárez Cano, 2018).

Nonetheless, steelmaking was the most significant case, represented by the creation of Ensidesa in 1950.[7] In autarchy, the public giant aimed to significantly increase steel production and supply the entire domestic market; by 1960, the company already produced nearly 60% of national pig iron, 35% of finished steel and 25% of rolled products (Martín Aceña & Comín, 1991; Vázquez, 2004a, 2004b). The creation of Ensidesa and the rest of the heavy industry in Asturias was an excellent boost for the metalworking sector.[8] From the supply side, it facilitated the provision of steel and raw materials in a nearby environment. From the demand, the need for auxiliary services increased exponentially, from manufacturing basic metallic products to supplying and repairing machinery.[9] In addition, it benefited from the infrastructural development that accompanied the industrial boom, such as the refurbishing and expansion of the ports of Avilés and Gijón, and the construction of new rail and road connections (Benito del Pozo, 1993; Ruíz Romero, 2004). Therefore, intuitively the metalworking sector should have collapsed together with the hegemonic industries, but it overcame the crisis and became the region's industrial benchmark. In 2018, it employed 18,878

[7] Ensidesa, *annual report (1950).* The report highlights how the aforementioned characteristics were decisive in establishing the factory in Avilés.
[8] Superior Council of Industry. Province of Oviedo, *Annual Report* (1954), pp.237-238.
[9] NEI (Netherlands Economic Institute) and SADEI (1968), *La industria siderometalúrgica en Asturias.*

people, 37% of industrial employment and 5% of the total, representing 27% of industrial GVA and 26% of manufactured exports, worth 1,144M euros.[10]

The development of a three-stage clusterization process allowed this success. The first one supposed the birth of the ecosystem, as the agglomeration of large industrial firms in Avilés generated external scale economies that triggered the creation of many small metalworking companies in the area.[11] The second witnessed an endogenous growth period, in which these emerging companies grew around the large, basic industry, benefiting from the self-reinforcing forces generated in its operative environment. Finally, the capabilities accumulated in this context allowed the metalworking sector to overcome the decline of hegemonic industries. The sector survived the 1985-1995 crises and grew afterwards, leaping into global markets led by a set of medium-sized companies specialized in high-tech projects on demand (Antuña, 2022) of which DAG was part (Table 3).

Table 3. DAG's employment and the Asturian metalworking sector, 1980-2015

	1980	**1995**	**2000**	**2005**	**2010**	**2015**
Metallurgy & steelmaking	22,173	8,012	8,713	8,835	10,715	9,968
Metalworking	19,936	14,284	15,824	16,494	17,074	15,771
DAG	171	439	905	881	920	1,558
DAG/Metalworking	0.9%	3.1%	5.7%	5.3%	5.4%	9.9%

Source: SADEI, internal accounts. Notes: Salaried employment only. The last regional data available at the required level of disaggregation is from 2015.

[10] Own elaboration using data from IDEPA (Economic Development Agency of the Principality of Asturias).

[11] But not only, as Asturian industry was also concentrated in the city of Gijón, in the vicinity of Oviedo and in the Nalón and Caudal mining basins. All of them function today as a large metropolitan area in which locates most of the Asturian industrial network.

4. Daniel Alonso Group, 1957-2018

4.1. The origins: a metalworking workshop and the entrance in Ensidesa, 1957-1974

During the 1950s, the establishment of Ensidesa and other major companies led to various externalities that had a significant impact on Asturias' industrial landscape.[12] The substantial demand for labor initiated a positive migration flow, resulting in a diverse workforce that included unskilled laborers and engineers handpicked by the Francoist regime. Like many others, Daniel Alonso Rodríguez (Arija, Burgos, 1934) moved to Asturias with his family in pursuit of better employment prospects. Cristalería-Española S.A., the Spanish subsidiary of the French multinational Saint-Gobain, was operating in Arija since 1906. Attracted by the city's industrial dynamism, the factory relocated to Avilés in 1952, where it still operates near the port producing glass components for the automotive industry (Sánchez Sánchez, 2011).

Daniel Alonso joined Cristalería in 1957, where he quickly honed his expertise in metalworking activities. Despite his new position, Alonso exhibited a clear and early ambition to establish his own business. During his prior apprenticeship in a mechanical workshop, he observed that many of the industrial trucks operating in Avilés were GMC-type vehicles from World War II or even Soviet trucks that had served in the Spanish Civil War. These models featured wooden dump bodies, presenting an excellent opportunity to retrofit them with new metallic ones. That same year, Alonso rented a small space near Cristalería's factory, a location that was no coincidence. The recently established factories required an infrastructure network to facilitate intercity mobility and expedite supply chains. As a result, the regime orchestrated the development of various road and rail connections and the expansion of the ports of Avilés and Gijón. In Avilés, the estuary brought together the principal factories of the city, as companies sought to benefit from the location economies generated in the area (Benito del Pozo, 1991;

[12] In the Spanish context, the creation of Ensidesa broke the bottleneck generated by the steel shortage during the post-war autarchy. Additionally, after the 1959 Stabilization Plan, the demand for manufactured goods in the country increased significantly (Catalan, 1995, 2002).

Morales Matos, 1980). Alonso then started manufacturing and repairing dump bodies made out of steel using flat parts discarded by local shipyards. Soon after, he identified the opportunity to manufacture these bodies out of aluminum. This lighter material, easily obtained from the equally close Endasa, increased the charge per journey, as it lowered the total tare.[13]

In 1959, Alonso left Cristalería to focus on his independent business, which remained highly informal and rudimentary.[14] Alonso operated on his own or accompanied by two young helpers when required, under a non-registered society commercially named Talleres Alonso.[15] Following a transitional change of location, he acquired a larger space in 1965, just in front of the estuary and with direct access to the road that borders it. This new workshop, which today remains the DAG headquarters, was valued at 1M pesetas, fully covered and financed by the Alonso Villarón family.[16]

This juncture represented the first turning point in DAG's history. Thanks to his extensive knowledge of metalworking activities, a local contractor hired Alonso to complete the repair works at the industrial facilities of Mefasa, a recently created subsidiary of Asturiana de Zinc, one of the most relevant companies in Avilés. During these central years of the Francoist regime, contracts awards were usually arbitrary, with many decisions influenced by personal connections justified through notions of 'efficiency and trust.'[17] Due to the good results obtained, the mentioned contractor introduced Alonso to

[13] The bulk of this paragraphs comes from an interview with Daniel Alonso, February 2022. This information is contrasted with numerous statements made in the press over the years and by José María Urbano, a local journalist specialized in economics.

[14] Restrictions on new industries initiated by Law on the Organization and Defense of National Industry (21/11/1939) partly explain this informality, which led to the profiling of small workshops operating outside the law and accessing raw materials through unregulated channels (Pires, 2005). A rich example from the firm perspective in (Catalan, 2006).

[15] El Comercio, 09/13/1981. An article published in LNE 02/22/1997 also references Talleres Dani, operating in the first 1960s.

[16] Talleres Daniel Alonso Rodríguez and Danima articles of association, Trade Register of the Principality of Asturias.

[17] A deep debate exists on the relation of the business sphere and the Francoist regime (e.g. Fernández-Moya & Puig, 2021; Toboso, 2007). Personal networks and institutional influence facilitated the concession of licenses to important businessmen and certain companies even when their proposals that were not competitive.

several engineers with decision-making power in awarding small contracts to provide auxiliary services for Ensidesa.[18]

From then on, Daniel Alonso initiated small-scale maintenance assignments at Ensidesa's facilities, subcontracted by more established auxiliary firms, until securing his first independent contract in 1969. As noted, informal relations were crucial for public concessions during the Francoist era. Therefore, the major or better-connected companies tended to overestimate their proposals, well aware that they were likely to be accepted regardless. The project involved the fabrication of a mechanical ram or "pusher" for the coke oven batteries at the Avilés factory. Daniel Alonso submitted a bid for ten days of work, priced at 80,000 pesetas, an estimate four times lower than his competitors. Despite the inherent risks, his track record inspired trust, and against all odds, he completed the project as agreed.[19]

This achievement resulted in the professionalization of his business activity and represented the *de facto* birth of the Daniel Alonso Group. DAG's growth and maturity phase started in 1970 with the progressive constitution of societies oriented towards different business lines within the metalworking industry. Using the evolution of their share capital, the only homogeneous indicator available for this decade, Table 4 illustrates the expansion of these original companies.

[18] Daniel Alonso, same interview.
[19] Daniel Alonso, same interview, contrasted by information provided by José María Urbano, interviewed April 2021.

Table 4. Evolution of the share capital of DAG's original companies, 1975-2007

	1975	1985	1995	2000	2007
DANIMA (1970)	750,000	17,240,000(2)	83,620,000(4)	83,620,000(4)	225,220,256(7)
DAORJE (1974)	200,000	200,000	200,000,000(1)	300,010,597(2)	300,010,597(2)
TADARSA (1975)	15,000,000	15,000,000	15,000,000	15,000,000	15,000,000
APLACANSA (1979)		3,000,000	520,000,00(1)	105,986,398(2)	105,986,398(2)

Source: Trade Register of the Principality of Asturias. Notes: figures in current pesetas, as they appear in the original enlargement registers. In brackets, the accumulated number of increases in share capital.

Alonso founded Danima on October the 28th 1970 to continue his original activity, manufacturing and repairing dump bodies for industrial trucks. Five years later, on April the 30th 1975, he created Tadarsa, specialized in manufacturing and mechanizing metallic parts and components.[20] This company served a dual role: first, as a supporting workshop for other acquired contracts, and second, to pursue new projects related to providing industrial services, machinery, and capital goods. In 1970, Alonso hired his first three technicians, reaching 22 five years later.[21]

4.2. Domestic growth: Daorje, industrial services and first diversification, 1974-2007

For the metalworking sector, the period between the 1970s and the turn of the century is divided into two very different phases. The first goes up to 1984 with the beginning of the Spanish steelmaking restructuring. This was a time of domestic expansion, which benefited from the increasing returns on the externalities arising within the ecosystem. While the paternalistic policy of the regime triggered the creation of numerous regional technical schools,[22] the growing demand for specialized industrial services by large traditional firms increased the size and qualification degree required for their auxiliary

[20] Dates and core activity as covered on the articles of association, Trade Register of the Principality of Asturias.
[21] Documents on historical workforce provided by HR.
[22] Prominent public institutuions were the Universidad Laboral de Gijón (1956) and the Escuela de Maestría Industrial Juan Antonio Suanzes de Avilés (1955), but many other were linked to the companies themselves, such as the apprenticeship school of the mentioned Ensidesa (1954) and Cristalería Española (1959).

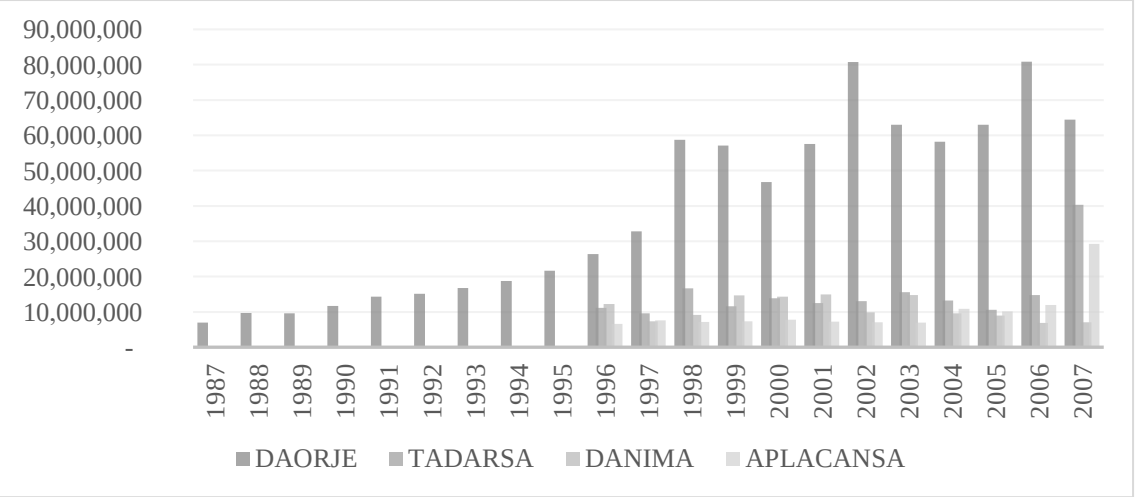
companies. This fact, together with the progressive international opening of the country and the continuous infrastructural development facilitating the connection between cities and companies, intensified the diffusion of knowledge and technology within the ecosystem.

In the case of DAG, securing auxiliary contracts for Ensidesa was crucial for developing a high level of productive specialization and workforce qualification, as it allowed early contact with high-quality machinery and personnel from abroad. The Pact of Madrid, signed with the US in 1953, financed part of the construction and startup of Ensidesa's plants. This international collaboration saw active engagement from American, German, and British companies, who supplied machinery and provided skilled engineers responsible for training the personnel of Ensidesa and its auxiliary companies.[23] The obtention of contracts for Ensidesa continued developing during the 1970s, coinciding with the various phases of expansion undertaken by the state-owned company. The most relevant one was the acquisition of Uninsa in 1973, an operation that added the factory of Gijón to the original one of Avilés (González González, 2004a). The original project for Ensidesa estimated a total workforce of around 10,000 workers. In 1975, the company employed around 24,000 people, 14,670 in Avilés (Morales Matos, 1980).

This growth and the optimistic future forecasts triggered the creation of Daorje, the leading company in this DAG consolidation and internal growth stage (Figure 2). Established in 1974, Daorje exclusively provided auxiliary services for Ensidesa, an activity that quickly became DAG's core business.[24] This step represented the first strategic reorganization of the group. Daorje would concentrate the bulk of resources and turnover during the coming decades, with the rest of the firms and activities organized around it.

[23] Ensidesa *annual reports 1951-1958*. The ongoing involvement of these foreign companies in Ensidesa's factories throughout the 1960s and 1970s can be tracked through the minutes of the board meetings.
[24] Daorje articles of association, Trade Register of the Principality of Asturias.

Figure 2. DAG leading companies' turnover, 1987-2007



Source: Daorje's annual accounts and Sabi. Notes: period selected based on data availability. In constant euros, 2015 prices.

Reasonable expectations about future development motivated a step towards vertical backward integration. The goal was to lower fixed costs and enhance flexibility by gaining control over the initial phase of the supply chain. In 1979, Daniel Alonso created Aplanaciones Gruesas Cantón S. A. (Aplacansa), intending to integrate the acquisition and treatment of steel into the Group processes, "flattening" the thick plate for its subsequent manufacture.[25] The firm acted both as a supplier and a supporting workshop for the other companies, leveraging the proximity of raw steel sourced from Ensidesa.

Danima continued to expand within its market, specializing in the production of customized dump bodies for industrial trucks. To offer increasingly comprehensive services and sustain its growth, the company merged with the French firm Marell. Founded in 1919, Marell had long been an industry leader, focusing on the manufacture of mechanized components for trucks. The most recognizable is the Ampliroll® mechanized arm, registered in 1970.[26] After several joint projects, Danima Marrell S. A. was born in 1980 to bring both dumping bodies and mechanized systems together, and four years later, Marrell acquired 33.3% of the share capital.[27] This merger

[25] Aplacansa articles of association, Trade Register of the Principality of Asturias.
[26] More information available in www.marrel.com
[27] Danima Marrel articles of association, Trade Register of the Principality of Asturias.

resulted in an unexpected reorientation of Danima's core business. That same year, the company developed a project that culminated in the creation of the principal waste management plant of Tenerife.[28] This first experience boosted the firm to take over the Cogersa project, the waste management plant of Asturias, which currently serves the entire region.[29] From then on, Danima included manufacturing machinery for waste treatment plants in its portfolio and started offering waste management services. Its growth led Daniel Alonso to finally regain full ownership. In 1998, after several interventions on its share capital, the businessman recovered the company for DAG as Danima Ingeniería Ambiental S.A. (Danima Environmental Engineering), its current social denomination.[30]

The rise of this environmental business line also affected Daorje's activity, although it did not replace its principal business. This company created a small division focused on waste management services for the public and the private sectors. Daorje Medioambiental was born in 1994 to provide industrial and urban waste collection and treatment services. The firm achieved contracts for waste management at the mentioned Cogersa plant in Asturias and urban waste collection at the national level. In addition, Danigal, created the same year and based in Galicia, won the "SIGRE" contract in 2002 for collecting and managing pharmaceutical packaging and waste in Spain.[31]

Tadarsa continued focusing on manufacturing machinery and mechanical equipment. During this period, the company expanded its customer portfolio, approaching the energy sector by supplying machinery and maintenance services for power plants. The most relevant case was the industrial services contract signed with Endesa in Teruel in 1981, initiating a strong partnership which lasted for several decades and extended to five more plants in Spain.[32]

[28] El Comercio, 09/29/1984.
[29] El Comercio 06/06/1989.
[30] Danima register files, Trade Register of the Principality of Asturias.
[31] Daorje and Danigal register files, Trade Register of the Principality of Asturias. Some examples of Daorje Medioambiental activity and projects in El Comercio 10/01//2000. The award of the "SIGRE" contract to Danigal in https://docplayer.es/22067643-Recogida-transporte-seleccion-clasificacion-y-valorizacion-de-residuos-farmaceuticos.html
[32] Founded in 1944 by the Francoist regime and privatized in 1998, Endesa is nowadays one of the three more important energy companies in Spain. The relation with DAG was detailed by Daniel Alonso, interview February 2022, and completed with El Comercio 10/20/2015.

Tadarsa also operated as a support workshop for Daorje. An example is the concession of two contracts with Ensidesa in 1985, valued at 254,1M pesetas, to repair the stainless-steel bells of the annealing furnaces 1-3 of the Avilés factory.[33]

At the end of the 1980s, Danima and Tadarsa simultaneously operated at the regional and national levels.[34] During this decade, they also started leading DAG's first international operations, increasing exports from 66M to 180M pesetas from 1980 to 1988.[35] Latin America represented the principal target market. Asturias held a strong relationship with that region, favored by a migratory flow that was especially intense in 1880-1930 (Anes, 1987). Some of the most relevant destination countries for DAG were Cuba, México or Venezuela, while others like France or West Germany represented the European niche.[36]

Nevertheless, the industrial crisis of 1985-1995 disrupted the virtuous cycle. Among the most severely affected were small, less specialized companies, which struggled to adapt to the restructuring challenges. In contrast, larger, more diversified firms assumed a leading role during this period. They had already achieved a high level of expertise and possessed the scale necessary to remain competitive in the new landscape, especially since Spain's entry into the European Common Market.[37]

As introduced before, Daorje's activity for the regional steelmaking industry was the DAG's spearhead by that time. Counterintuitively, in the mid-term, the company benefited from the restructuring process initiated in 1984, as it

[33] El Comercio, 06/15/1985 & 08/03/1985.
[34] Some projects detailed in El comercio, 11/02/1988, 06/06/1989, 11/11/1989 & 11/17/1990. It is worth noting that in the early 1990s, Danima opened a new business line at the Spanish level, working for the army through the IVECO-PEGASO truck company. These projects opened the door to the small division of mechanized components for civil works developed in the future. Details in LNE, 06/06/1991 & 01/24/1996.
[35] El Comercio, 13/09/1981 & 13/12/1993.To the original figures in dollars it is applicated the exchange rate of January 1980. Bank of Spain, *Tipos de cambio de la peseta frente a las monedas más relevantes (1959-1998).*
[36] Concrete projects in El Comercio, 01/12/1988 & 09/19/1990.
[37] The common market would present a double-edged sword for Asturian companies, as documented in Ministry of Industry and Energy (1983), *Libro blanco de la reindustrialización* and later expanded in (Castells et al., 1994).

entailed a colossal flow of public investments for the factories of Ensidesa. The persistence of the Francoist regime and the problematic political and economic transition to democracy delayed the restructuring of the Spanish steelmaking industry compared to the Community framework (Díaz Morlán et al., 2009; Navarro, 2004). In the case of Ensidesa, besides to a severe adjustment in employment and production, the 1984 plan contained a public investment of 100,000M pesetas in the Avilés and Gijón factories and additional 77,000M pesetas for technological improvements and machinery replacement. Despite its dimension, the intervention did not achieve its goals and resulted in the creation of Corporación Siderúrgica Integral (CSI) in 1991, merging Ensidesa and the Basque steelmaking company Altos Hornos de Vizcaya. CSI concentrated all the comprehensive Spanish steelmaking industry in Asturias and implied a new investment of 700,000M pesetas.[38] Following the global trend, this restructuring process culminated with the firm's privatization. In 1997, Aceralia was born, merging Arbed and Usinor in 2002 to conform Arcelor, which MittalSteel finally acquired in 2006 (González González, 2004b).

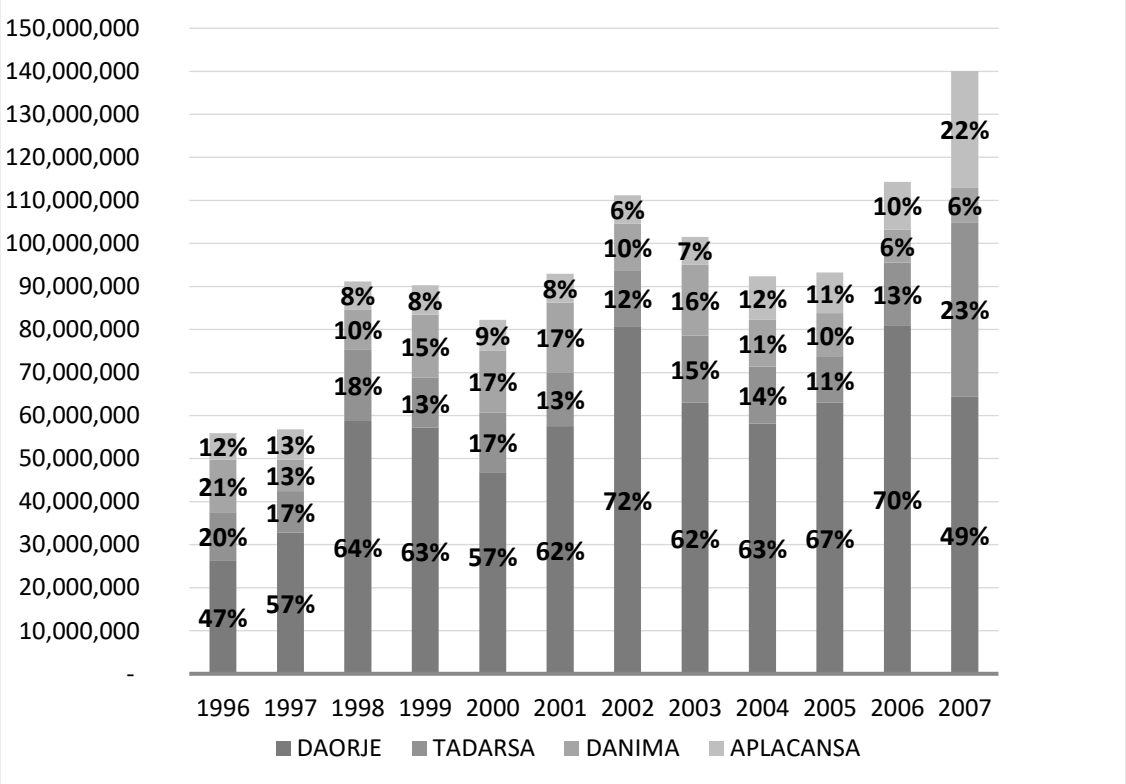
Daorje's growth was gradual and sustained throughout the mentioned period. Commencing with the acquisition of minor maintenance contracts shortly after its establishment, its significance within Ensidesa steadily increased. Notable projects included the creation of a gas pipeline linking the annealing furnace to the power plant (valued at 65.1M pesetas) and a contract for the construction and installation of metallic structures for electrical facilities at the Avilés factory, with an estimated worth of 28M pesetas.[39] In 1992, Ensidesa represented 75% of Daorje's activity.[40] As it continued to expand, the company assumed new responsibilities within Ensidesa/CSI, which initiated outsourcing some production processes as part of its internal

[38] CSI (2001), *Plan de competitividad de Ensidesa y Altos Hornos de Vizcaya.*
[39] Minutes of Ensidesa's board of directors nº 484,489,498 & 500 (1990-1991). Also letters and communications by Ensidesa with Banco Herrero and INI to request credit for the total ammount of the contract, which was conceded. Dated 09/28/1990, 09/25/1990 & 10/10/1990.
[40] LNE 11/07/1992.

restructuring. One instance was Daorje's absorption of firms responsible for tinplate packaging services in 1993.[41]

During the second half of the decade, privatization gave a final boost to Daorje's expansion (Figure 3). This process entailed a profound reorganization of Aceralia's productive strategy and structure, accompanied by a significant investment in technology and refurbishment of its factories. The investment plan that accompanied the creation of Aceralia included a planned investment for the Asturias factories of around 110,000M pesetas for the next five years (González González, 2004b). Some of these investments resulted in large projects awarded to Daorje, complementing its regular services.[42]

Figure 3. Distribution by companies of DAG's total turnover, 1996-2007



Source: Daorje's annual accounts and Sabi. Notes: period selected based on data availability. In constant euros, 2015 prices.

[41] El Comercio, 05/10/1993. This type of operation, which became commonplace over the years, blurs the real dimension of Daorje.

[42] E.g. In 1998, Aceralia approved the creation of a new galvanizing line at the Avilés factory, of which Daorje was one of the concessionaires. In 2001 it awarded Daorje the construction of a waste treatment plant for the coke battery with an estimated investment of 300M pesetas. El Comercio, 01/20/2000 and LNE, 08/16/2001 respectively.

DAG's growth during this period represents an industrial dynamic concealed by the harsh structural consequences of the industrial restructuring (Table 5). While the steelmaking sector suffered severe adjustments in production and workforce, from which it would not recover, the metalworking sector resisted and could return to growth from the mid-1990s onwards, as shown in Table 3. In the words of Daniel Alonso, in 1999, only 7% of Aceralia's production was transformed in Asturias, but it generated more employment than the company itself.[43]

Table 5. Distribution by companies of DAG's total workforce, 1980-2015

	1980	1995	2000	2005	2010	2015
TADARSA	30	67	60	118	98	89
DANIMA	2	13	21	40	33	30
DAORJE[1]	135	352	798	686		
APLACANSA/DACERO	1	7	26	37	116	186
IDESA						96
WINDAR					564	1,157
DAG	168	439	905	881	811	1,558

Source: Historical workforce relation provided by HR and completed with Sabi. Years based on data availability. Notes: [1]Figures are underestimated due to the impact of indirect employment. In 2007, Daorje registered 991 workers, according to HR files. That figure reached more than 1,200 employees summarizing its subsidiaries. El Comercio, 07/31/2007.

In 2000, resulting from its expansion, DAG was created *de jure* as an entity to encompass and represent the increasingly complex corporate structure. The ownership and management of the Group remained in the hands of the Alonso Villarón family, with Daniel Alonso, father and founder, acting as Chairman. His four children conformed to the Executive Board, although only two out of four, Orlando and Jesús Alonso, were involved in management activities.

[43] LNE, 03/14/1999. Alonso also declared that the existence of diverse multinational in the district increased the potential of smaller companies.

4.3. To renewables: Windar, wind power and the birth of a multinational, 2007-2018

Once the industrial restructuring was over, the challenge for the Asturian metalworking sector was to continue growing in a post-industrial environment. The integration of world markets resulted in foreign competitors taking over the low-value-added stages with low-price strategies, so growing meant being able to compete in the higher segments of the value chains. By the first 2000s, the Asturian leading industrial firms were medium-large companies with highly specialized labor force and equipment. This nature allowed them to focus on high-tech projects on demand which required high flexibility and sufficient size. In this scenario, public-private initiatives turned pivotal for the sector's expansion. The creation of technological and business parks –some already projected and developed during the 1990s– boosted firms' cooperation and knowledge diffusion. In addition, many public/private agents were created to respond to this industry's needs. It is the case of technological and knowledge agencies, facilitators for internationalization and, finally, the constitution of MetaIndustry4, the Asturian Cluster of Advance Manufacturing, of which DAG is among the most prominent members.

Despite having sustained DAG's expansion over the past decades, the European steelmaking sector showed constant signs of volatility by the turn of the century. The hard adjustments resulting from the restructuring process had left profound structural consequences, and uncertainties regarding future energy legislation, requirements, and trends also posed a potential threat to operational margins, given the energy-intensive nature of the industry. Furthermore, emerging low-cost competitors, primarily from Asia, were steadily capturing market share.[44] The steel sector's relative instability had a ripple effect across its entire network of related activities. In the auxiliary segment, the strategic focus shifted towards consolidating more horizontally integrated auxiliary groups, unaffiliated with a single major company but

[44] International Iron & Steel Institute, *Steel Statistical yearbook, 2000-2007*.

capable of providing comprehensive industrial services applicable to various sectors.[45]

The venture-capital 3i Group tried reinforcing its industrial position in Spain following this market tendency. The British firm launched an acquisition and consolidation plan for the industrial maintenance market niche, which 3i considered atomized and unspecialized in this country.[46] In April 2006, 3i agreed with Gamesa, the second-largest producer of wind turbines worldwide, to purchase 100% of Gamesa Energía y Servicios and Siemsa Este, two subsidiaries specialized in providing industrial services for wind farms. The operation reached €170M and resulted in the merger of both firms as Global Energy Systems.[47]

Following this substantial investment, 3i proceeded to implement the next phase of its strategy to enhance its presence in the industrial services market. The company set its sights on Asturias, encouraged by the optimistic outlook for the regional steel industry following the creation of ArcelorMittal in 2006. Given its role as the primary service provider to ArcelorMittal, the acquisition of Daorje appeared to be a logical and viable choice. DAG had already considered comprehensive steelmaking a mature sector, and the significant scale of Daorje's operations within ArcelorMittal had made its activities highly labor-intensive in a context of challenging and tense labor relations resulting from the several restructuring plans.[48] In 2007 Daorje was sold for €130M in an operation that allowed DAG to start new businesses in emerging activities.[49]

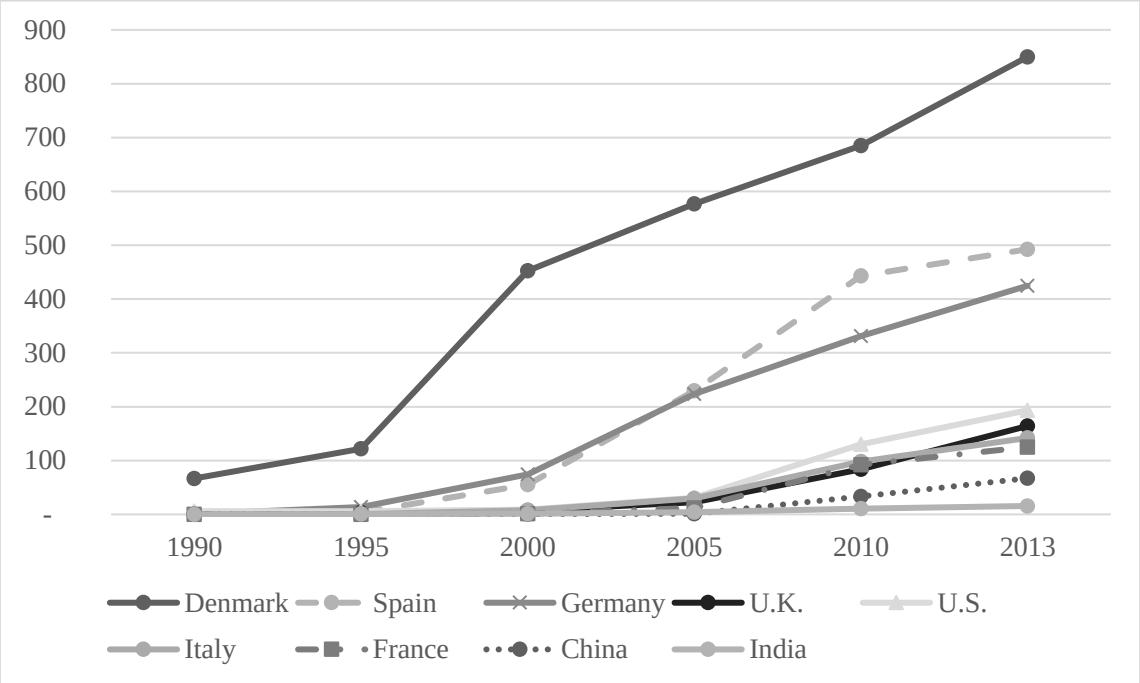
[45] Interview with Guillermo Ulacia, April 2021. Among other positions, Ulacia was Chief Operating Officer of CSI, Vice President of Aceralia and Arcelor, and Executive Chairman of Gamesa.
[46] Guillermo Ulacia, November 2022.
[47] 3i Group Media Centre 07/04/2006 https://www.3i.com/media-centre/corporate-and-portfolio-news/2006/gamesa-reaches-an-agreement-with-3i-to-invest-in-its-advanced-services-company/; Cinco Días (El País) same date https://cincodias.elpais.com/cincodias/2006/04/07/empresas/1144417180_850215.html
[48] José Luis Cardiñanos, May 2021. Cardiñanos, is Daorje's current Sales Manager for the Industrial Division and worked for the company before its sale.
[49] Orlando Alonso, August 2022, Mergr M&A Deal Summary ttps://mergr.com/3i-private-equity-acquires-daorje-grupo and LNE, 05/08/2007. https://www.lne.es/economia/2007/08/05/daniel-alonso-vende-parte-grupo-21850945.html

Since the last 1990s, Daniel Alonso had identified renewables as a potential sector in which the wind energy market stood out, showing strong growth tendencies. Predictions were correct: world-installed capacity grew from 1,930MW in 1990 to 318,117MW in 2013. In the European scenario, the legislative advocacy that laid the groundwork for the green transition started boosting the wind power industry. In 2007, the EU target was to reach 20% of the total energy mix from renewable sources by 2020. On the specific side of wind power, European plans expected to reach 213GW of installed capacity by the same year.[50]

Spain quickly became a world leader in the wind energy sector since its emergence in the 1990s, closely following Denmark, the global pioneer in adopting this technology (Figure 4). Starting from 1997, Spain combined direct incentives —such as local content requirements and the promotion of public-private partnerships— with indirect incentives, such as the initial establishment of feed-in tariffs to stabilize the market and stimulate investment (Dinica, 2008; Meyer, 2007). These policies, which evolved over time and directly involved autonomic governments, promoted the creation of a mix of foreign and local companies operating in an environment conducive to knowledge generation and innovation while facilitating the integration of wind energy into the mainstream energy supply (Barcelona, 2012).

[50] Commission Communication January the 10th 2007, *Renewable Energy Road Map*; European Wind Energy Association, EU Energy Policy to 2050. The Great Recession compromised many of these objectives, severely contracting investments.

Figure 4. Cumulative installed wind power capacity in selected countries, 1990-2013 (W/p)



Source: Earth Policy Institute (EPI), *World Cumulative Installed Wind Power Capacity and Net Annual Addition, 1990-2013.Population by World Bank.*

By that time, Gamesa held 50.6% of the Spanish market share of wind turbine production. However, its operational strategy was based on rigid vertical integration, which started compressing profit margins. Guillermo Ulacia joined the company in 2006 as Executive Chairman after quitting executive positions in Arcelor, with the main goal of refocusing Gamesa's core business on those segments of the value chain in which the company was more competitive while the entire structure gained flexibility. The first move was the above-mentioned sale of GES to 3i Group, outsourcing the industrial services division. The second was also to externalize the tower section manufacturing area, the value phase that generated the lower operating margin.[51]

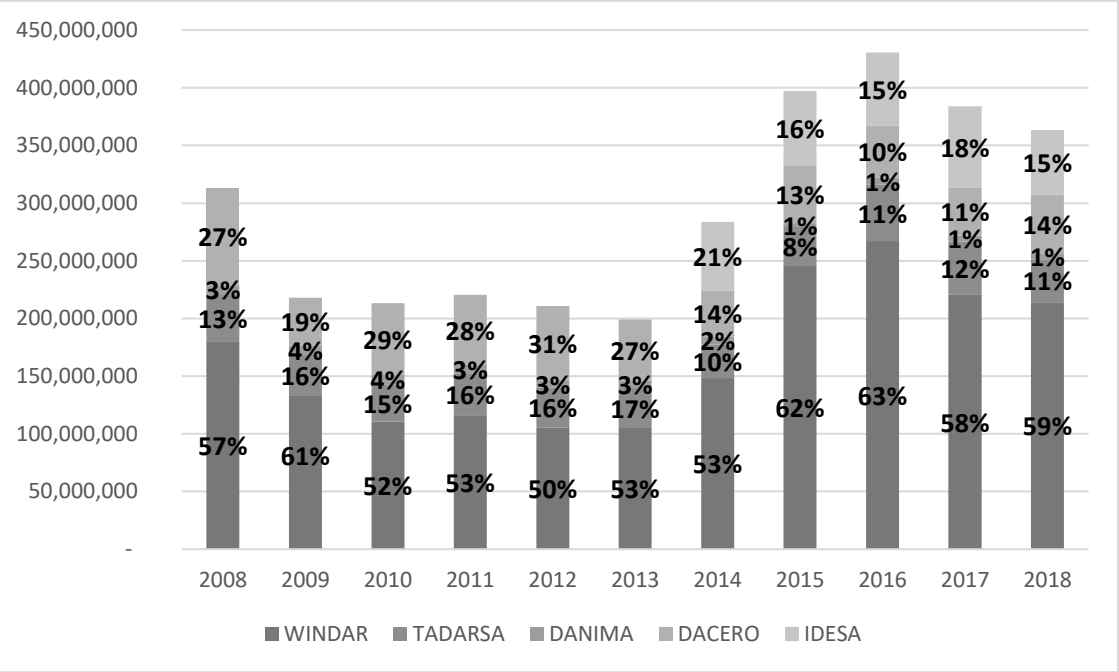
DAG's relationship with Gamesa dated from years before. By the hand of the Basque company, the Group had already approached the wind power industry, a potentially attractive market segment for DAG, as Jesús Alonso publicly

[51] Guillermo Ulacia, April 2021.

declared in 2000.[52] By the end of the 1990s, Tadarsa started manufacturing tower sections for Gamesa in Avilés, and in 2007, DAG became Gamesa's leading supplier in Spain.[53]

The outsourcing decisions made by Guillermo Ulacia and the close link between the two companies gave rise to a new strategic alliance that finally crystallized in a joint venture. DAG contributed most of the share capital, while Gamesa acquired 32% and offered its factories in Pamplona, Zaragoza, and Linares, as well as expert engineers to support the initial stages of the process. The company was created in 2007 as Windar Renewables under the presidency of Orlando Alonso, becoming the new centerpiece of the DAG structure (Figure 5 and Table 5).[54]

Figure 5. Distribution by companies of DAG's total turnover, 2008-2017

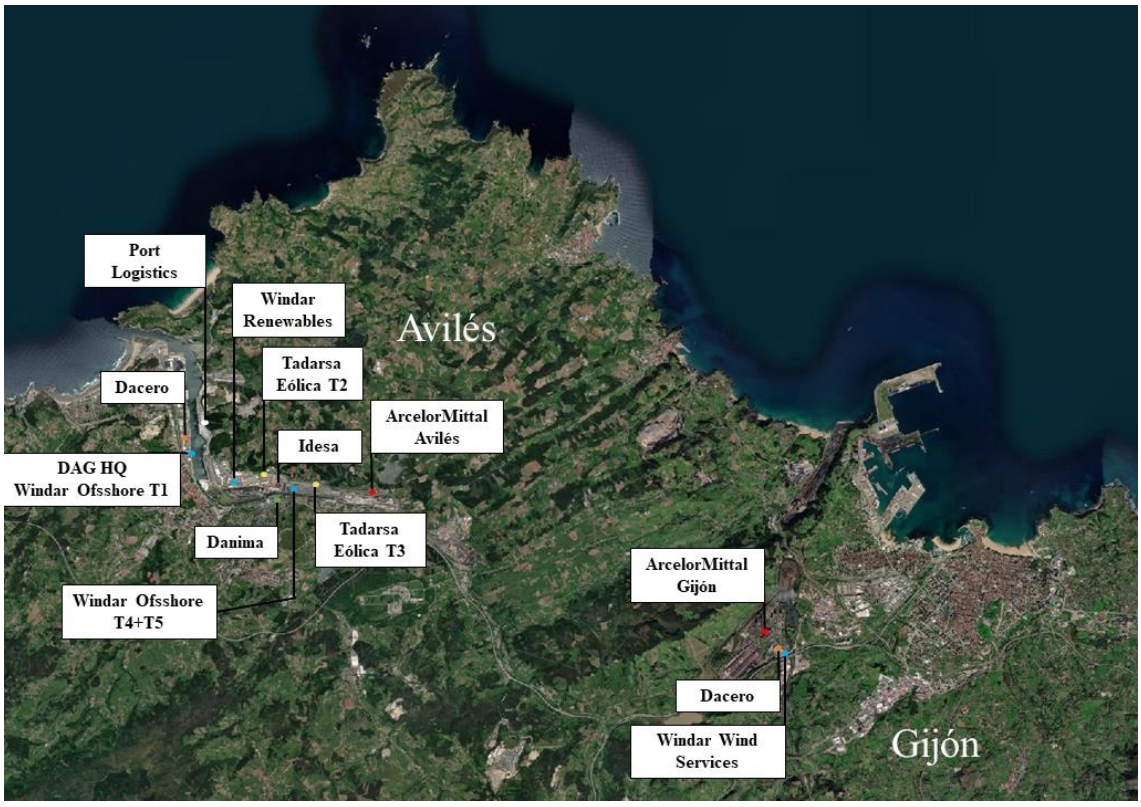


Source: Windar annual accounts and Sabi. Notes: constant euros, 2015 prices.

[52] El Comercio, 04/08/2000 and LNE, 07/01/2001. In addition, DAG was in charge of the assembly of the first wind farm of Asturias, created in 2001, as reported in El Comercio 04/01/2001.
[53] Orlando Alonso, August 2022; El Comercio, 01/14/2007.
[54] Guillermo Ulacia, November 2021 and April 2022; Orlando Alonso, August 2022 and Gamesa Annual Reports, 2007-2010.

This significant transformation marked the Group's second strategic reorganization, allowing them to cover the entire steel value chain. For the first stage, DAG created Tratamiento Integral del Acero (Dacero) as a renovated Aplacansa to acquire and process raw steel for manufacturing tower sections. Dacero was established just 900m from the only continuous thick plate mill existing in the country, located at the ArcelorMittal steel mill in Gijón. DAG quickly emerged as one of ArcelorMittal's most prominent clients for heavy plate, a critical development amid the surge of low-priced steel imports from Asia. This strategic location established an optimal supply chain in terms of quality and flexibility. In its inaugural year, Dacero procured 50,000 tons of steel plate to initiate production in 2008.[55] This integration of the entire value chain is reflected in its spatial dimension. All phases are distributed along only 21km between Dacero's factory and Windar's logistics centre in the port of Avilés (Figure 6).

Figure 6. Location of DAG's facilities in Asturias



Source: Own elaboration.

[55] Orlando Alonso, August 2022; Guillermo Ulacia, April 2021 and El Comercio, 06/22/2008.

Tadarsa divided its principal activity into two divisions: Tadarsa Eólica, which provided manufacturing support to Windar as its principal productive workshop, and Tadarsa Logistics, focused on the logistic management of the entire value chain, from transportation to the on-site assembly in the shipping areas in the port of Avilés.[56] Independently, Danima continued operating in the environmental engineering market, designing and manufacturing equipment for waste management projects, and providing logistic equipment for the Spanish army and the governmental division of public works. Finally, in 2014, DAG acquired Idesa Engineering, located in Avilés and Gijón. Presided by Jesús Alonso, the company designs and develops comprehensive projects for the oil&gas industry.[57] The strategic reorganization of the Group's companies entailed a similar process at the corporate level. Initially, the Chairmanship remained in the figure of Daniel Alonso while his sons Orlando and Jesús acted as executive board members. In 2015 Daniel Alonso announced his retirement but kept the position of Honorary Chairman, so Jesús assumed his role. At the same time, Orlando became DAG CEO while holding his former role as Windar Chairman, while Sonia and Daniel remained as non-executive members of the board.[58]

However, despite the initial promising prospects, the 2008 crisis and the evolving market situation quickly appeared to jeopardize Windar's emergence. By 2010, wind tower manufacturing in Europe started to stagnate, while other non-community countries showed higher growth projections. Tower segments represented a product from more to more standardized, in which internal scale economies constituted an essential competitive factor, rapidly increasing competition and narrowing the market.[59] The forecasts for the Spanish market did not seem any more hopeful. Economic recession drastically reduced private investment, decreasing energetic demand while the energy sector deficit increased. In 2011, only 1050 MW were installed in

[56] Corporate dossiers and presentations provided by DAG. Concurrently, Tadarsa keep producing capital goods, machinery, and industrial metallic structures
[57] Idem.
[58] José María Urbano, April 2021 and LNE, 14/03/2015. https://www.lne.es/aviles/2015/03/14/daniel-alonso-entrega-cuatro-hijos-19845233.html
[59] Orkestra, *Análisis de la cadena de valor de la industria eólica vasca: oportunidades y ámbitos de mejora* and Windar dossiers.

the country, a 5.1% increase in cumulative installed capacity, the lowest percentage growth in Spain's history. Additionally, the Conservative Party's rise to power resulted in a reform through Royal Decree-Law 1/2012, which removed national incentives for installing new wind farms (Montoya et al., 2014; Sahu et al., 2013).

In this scenario, Windar decided to adopt a global view. Windar renegotiated the contracts signed with its partner in a first move, securing almost the entire Gamesa order book for onshore tower sections.[60] From this moment onwards, Windar's growth focused on global expansion, developing two main business lines represented by the tower section (on and offshore) and the offshore foundations divisions. The characteristics and potentialities of each would determine the development strategy for each market niche.

The firm's strategy consisted of taking advantage of its cumulated capacity and strong position in Europe to access new emerging markets. The starting point was India, which showed significant growth potential but lacked relevant national producers. Although Gamesa initially supported the project (as by the time this firm opened a blade factory in the same region), this first step also represented an excellent chance for Windar to expand its client base beyond its partner. In 2012, Windar created Windar Renewable Energy, a manufacturing plant in the Indian region of Gujarat with nearly 1,680 sections/year capacity.[61]

The success achieved in India was twofold, as Windar not only entered a new emerging market but created a strong reputation as a multinational company. This first experience led the firm to continue its aggressive internationalization strategy. In 2013, using the commercial name of Torrebras, Windar opened a new factory in Bahía, Brazil, with 720 sections/year capacity. Unlike the initial experience, which focused on the Indian national market, this operation aimed to supply the Brazilian domestic market but also to approach the Latin American region. In 2015, the company

[60] Orlando Alonso, August 2022.

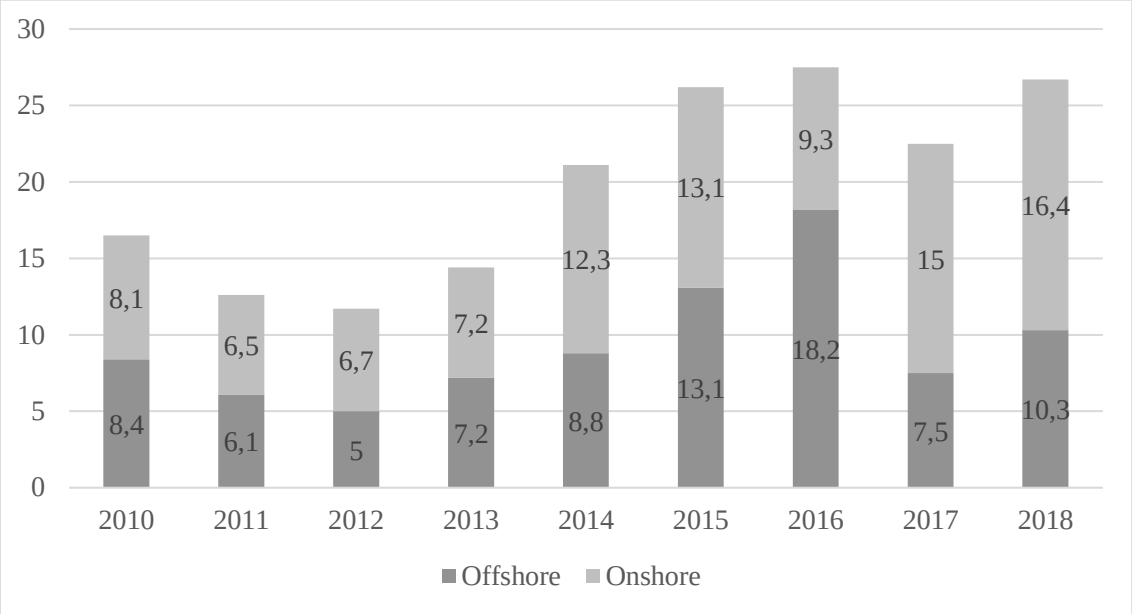
[61] India's potential for wind power growth and the industrial importance of Gujarat are analyzed by the Spanish Institute for Foreign Trade (ICEX) in *El mercado de la energía eólica en India* (2019). The report goes back to information included in the *Indian Wind Atlas-2015.*

covered this supranational region entirely, opening a new plant with a capacity for more than 700 towers in Tamaulipas, Mexico (Windarmex). Global expansion was completed in 2018 with the opening of a factory in Rostov, Russia, with 400 towers/year capacity. Vestas, one of Windar's most important customers, initiated the project in this case. After winning a public contract to supply turbines, Vestas chose Windar as its tower manufacturing partner. The project crystallized in the creation of WRS Towers, aimed at supplying the Russian market, and led by Windar together with the Russian companies Rusnano MC and Severstal PSJC. In 2019, Windar produced 4,102 tower sections, representing approximately 4.8% of the turbines installed worldwide.[62]

The experience in India represented a turning point for Windar's division of wind tower manufacturing. However, almost simultaneously, the opportunity to grow in a different but related business line appeared. While increasing competition compressed the steady-growing onshore market, the production of offshore foundations showed as an emerging segment in Europe. After a relatively timid start, it gained traction over the years, especially after 2014, when the EU developed its Maritime Spatial Planning, a framework for countries to align their maritime space with different national objectives (Figure 7). The 16 member states that signed the agreement allocated approximately 52,000km^2 of this space for developing offshore power initiatives, the equivalent of about 220GW. Concretely, all but 3 member states (Italy, Portugal and Greece) located sufficient areas to meet their 2030 horizon, while Estonia, Latvia, Finland and Sweden acted beyond that goal.[63]

[62] Orlando Alonso, August 2022. Market share from DAG dossiers and GWEC, *Supply Side Analysis 2019* estimating usual 4-section towers.
[63] WindEurope, *Offshore wind in EU*. The text refers to Directive 2014/89/EU. The 16 mantioned countries as assessed by WindEurope are Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Lithuania, the Netherlands, Poland, Sweden, Greece, Italy, Spain and Bulgaria.

Figure 7. New asset finance in wind energy, Europe 2010-2018 (€bn)



Source: WindEurope, *Financing and investment trends. The European wind industry in 2018.*

Nonetheless, these projects entail more risk than manufacturing tower sections. In most cases, offshore foundations are developed on demand, require a close long-term relationship with the client, substantial up-front investment risks and imply the operational and logistic management of complex value chains. Therefore, by integrating this business line in Europe, Windar accessed a market that represented a high-added-value niche because of its size and high technological component.

The opportunity appeared in 2011 when Zublin awarded Windar the manufacture and assembly of a 4-leg jacket foundation for a transformer substation in the offshore wind farm of Anholt, Denmark. The project's magnitude and novelty implied high accessing investment and a short profit margin forecast, but it would open the door to entering this highly specialized and tech-oriented market niche. The 4-leg jacket was manufactured and assembled in Avilés, and the achievement was not only short-term but also fulfilled expectations for the future. In 2012, Windar started producing tower segments for the offshore European market, and in 2014 Windar Offshore was created to compete for foundations projects.

In 2015, energy giant Iberdrola commissioned Windar 29 jackets and 116 pin-pales for the Wikinger project in the Baltic Sea, Germany. The project's size led to the creation of a Temporary Joint Venture with Navantia —a Spanish public shipbuilding company competing in the high-tech military and civil markets— which located part of its activity in the shipyards of Fena, Galicia. This project positioned Windar as one of the world leaders in the offshore niche and kept the TJV with Navantia alive for future projects. That were the cases of Hywind for Statoil in Scotland in 2016-2017 (5 spar-type floating foundations), Nissum Bredining for Siemens in Denmark in 2017 (4 3-leg jackets and 12 pin-piles) or East Anglia One for Iberdrola in England in 2017-2018 (42 3-leg jackets and 126 pin-piles).

The same strategy was implemented to combine 'in-house' resources to access initiatives with different requirements. In 2017, a new TJV was born within DAG by joining Windar and Idesa to obtain the Merkur project for GeoSea. While Windar provided its knowledge, factories, manufacturing capacity and logistics, Idesa contributed with its expertise in engineering and design. The project required 66 Transition Pieces (TPs) for a wind farm in the North Sea, which the TJV produced, assembled and delivered from the port of Avilés. A year later, the same merger won the Deutsche Bucht project, 31 TPs ordered by VanOord and sent to the German Exclusive Zone near Borkum.

However, it was not only the scale of these projects that encouraged collaboration between companies. The high level of specialization in these manufacturing and assembly processes involved a high technological component. Equally important would be the treatment of the materials according to diverse marine conditions. In this case, *ad-hoc* steel treatment was required to optimize its use in each location. These needs originated the relationship between Windar and ArcelorMittal R&D centre in Avilés. This joint research aimed to achieve the best treatment for the steel used in each of Windar's offshore projects according to their specific needs.

In 2019, Idonial, a research centre for developing materials specializing in the metal sector, joined this tandem. ArcelorMittal's R&D centre and Idonial

created the so-called Steel Square in the Avilés Science and Technology Park. This location accumulated the R&D centres of eight multinational companies and hosted the creation of Windar Technology and Innovation (Wtech) in 2020.[64] WTech, which currently employs more than 20 workers, originated as a spinoff from Windar's innovation department. Its main goal is to support any company within the group in four major areas: Product Design, Manufacturing Engineering, Process Engineering, and ICT. The R&D center is part of an open innovation industrial ecosystem that prioritizes public-private collaboration. It is nowadays integrated into the Knowledge Cluster, conformed by 12 multinational companies such as ArcelorMittal, Gonvarri, and SATEC.[65]

5. Concluding remarks

The case of Daniel Alonso Group is that of a small metalworking workshop that, in seventy years, became a world leader in the wind power sector. This success is structured in an accumulative 3-stage process that allowed the company to survive a potential lock-in resulting from industrial restructuring, specializing in a highly-specialized emerging sector still related to the steel value chain. This work argues that this was not an isolated story and connects it with the trajectory of the metalworking sector in Asturias, Spain.

In the first stage, the creation of the public steelmaking company Ensidesa in Avilés in 1950 triggered the agglomeration of many small metalworking companies in its surroundings. The establishment of this company, together with other large industrial firms, directly favored the provision of inputs but also generated diverse externalities on its operative ecosystem (e.g. extensive supply of skilled and non-skilled labor force, creation or renewal of infrastructures, attraction and diffusion of knowledge and technology). The Daniel Alonso Group was born in this context. The company started manufacturing dumping bodies for the industrial trucks operating in the area and gradually diversified its activity towards manufacturing machinery and

[64] The last paragraphs' information and data come from Orlando Alonso, August 2022, and different dossiers provided by Windar. For more information on Steel Block, see http://steelblock.es/ (English version).
[65] Corporate dossiers from WTech and LNE, 05/04/2023.

capital goods. Consequently, it obtained its first contract as an industrial services supplier for the growing steelmaking industry.

Up to the mid-1980s, the Asturian metalworking companies acted both as clients and auxiliary companies for larger industrial firms, benefiting from the external economies of the ecosystem. This second stage would have a turning point in the industrial restructuring, which meant the fall of the large hegemonic companies in the region. However, the capabilities accumulated over decades allowed the metalworking sector to survive this decline, led by a group of medium-large companies that diversified their original activities and markets. That was the case with DAG. While the Group's two original companies continued their activity, Daniel Alonso created Daorje in 1974 to provide auxiliary services for Ensidesa. The firm benefited from significant public investments in the Asturian steelmaking factories resulting from the industrial restructuring and the subsequent sectorial privatization and became the region's most significant industrial services provider and one of the most relevant in the country.

In the third and last stage, the regional metalworking sector leaped to the international markets by the turn of the century, specializing in high-added value and high-tech projects on demand. The existence of a cluster ecosystem promoted the generation of a virtuous circle based on the interrelationship between tractor companies and other public/private stakeholders. In the case of DAG, the capabilities accumulated around the steelmaking industry allowed the Group to reorient itself towards a new business once its traditional niche started to stagnate, identifying the opportunity and moving towards the emergent wind power sector. Together with Gamesa, they created Windar Renovables in 2007, today one of the world's leading manufacturers of tower segments for wind turbines and offshore foundations. This shift drove an internal and comprehensive reorganization of DAG's structure, whose companies relocated at all stages of the steel value chain.

The story of Daniel Alonso Group reflects, from a business case approach, the trajectory of an entire industrial ecosystem. The case contributes to the existing literature on path creation and regional/sectoral delocking processes

within the context of deindustrialization (MacKenzie & Perchard, 2022; MacKinnon et al., 2019). It is also consistent with theories on how belonging to a cluster increases firms' ability to withstand crises and grow in their aftermath (González-Bravo et al., 2018), and provides insights from the firm level on how clusters located in old industrial regions can reorient their trajectories, opening new development paths based on their previous specialization (Trippl & Tödtling, 2008; Valdaliso et al., 2016).

This case has relevant implications for the European reindustrialization process literature too. From the perspective of declining industrial regions, it sheds light on how long-term dynamics define regional specialization, situating relatedness as a central element for diversification and industrial path creation (Boschma, 2016; Hassink et al., 2019). DAG's story underlines that new successful industrial paths can be developed based on activities related to the original specialization by advancing stages in the traditional value chain. Spotlighting these long-term paths can facilitate identifying successful sectorial experiences hidden by its region's decline (Capello & Cerisola, 2023), which could help industrial policy optimize resources in the framework of smart specialization (Deegan et al., 2021; Wigger, 2023). Finally, this paper aims to revitalize the business case study as an analytical dimension that enriches analyses focused on regions, sectors and clusters. If the evolutionary perspective is the natural progression of Economic Geography (Boschma & Frenken, 2006; Henning, 2018), Business History can provide outstanding contributions to debates on de/reindustrialization, repositioning the firm as a core analytical subject.

Aknowledgments

I would like to thank Daniel Alonso for sharing his story, and Orlando Alonso for kindly providing me access to Daniel Alonso Group and supporting this research. I also thank those who participated in interviews, meetings, or provided me with documents, and Mauro Arias for accompanying me throughout the process. I gratefully acknowledge Professors Jordi Catalan, Marc Prat, Joaquín Ocampo, Miquel Gutiérrez, Tomás Fernández de Sevilla, Yolanda Blasco, Adoración Álvaro, Daniel Tirado, Alfonso Díez, Andrea Colli, Veronica Binda, Andrew Popp, the participants in the XIII International Congress of the AEHE, the 2022 EBHA Conference, the Ramon Carande Seminar at the University of Seville, and two anonymous reviewers. Their comments have significantly improved this work. The remaining errors are my own.

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IV

Common roots, different paths: The influence of big steelmaking firms on the evolution of the metalworking sector in Asturias and Umbria, 1958-2010

Abstract

This paper conducts a comparative analysis of the metalworking sector's evolution in Asturias (Spain) and Umbria (Italy) from the late 1950s to the Great Recession's onset. Focus shifts from traditional studies on steelmaking to the metalworking industry, positing that a major steel company's presence could catalyze a dynamic and competitive metalworking sector via agglomeration effects and diverse spillovers.

Results show that the impact of big steelmaking firms was uneven across regions, so it was the evolution of the metalworking industry. Asturias benefited from Ensidesa's establishment, leading to a clustered, interrelated metalworking sector thriving on externalities and evolving into a high-value-added, globally integrated network post-industrial restructuring. Conversely, Umbria's Terni steel company did not catalyze similar growth, with the metalworking sector remaining dispersed, serving traditional industries under subcontracting relationships without significantly influencing regional development.

Both regions saw the emergence of medium-sized, high-added-value Machinery and Equipment companies. However, Asturias's firms were larger and more competitive, indicating that spatial agglomeration and inter-company relations were crucial for sustaining growth and competitiveness in the metalworking industry.

Keywords: Asturias, Umbria, metalworking, steel industry, industrial agglomeration

1. Introduction

As the discussion on the reindustrialization of Europe becomes a focal point in political discourse, the exploration of industrial dynamics has emerged as a critical area of interest for the academic community. This surge in interest aims to thoroughly comprehend the process of deindustrialization along with its repercussions and examine the potential developmental trajectories the industrial sector might offer for the future (Capello & Cerisola, 2023; Christopherson et al., 2014). Through the concepts of relatedness and industrial path creation, a growing body of literature studies, from an evolutionary perspective, how different territories can develop (or not) new growth paths based on the capabilities accumulated over time around their traditional specialization sectors (Boschma, 2016; Hassink et al., 2019; Hidalgo et al., 2018). Within the framework of path-dependence, this allows interpreting how certain productive ecosystems 1) became immersed in a lock-in that, with the onset of the industrial crisis, led to stagnation, decline, or extinction; 2) how the accumulated capabilities in these processes of endogenous growth allowed them to undertake a de-locking process to survive this phase or even grow after an initial adjustment period (Martin & Sunley, 2006; Garretsen & Martin, 2010; Henning et al., 2013).

Due to the high degree of territorial concentration of the Golden Age traditional industries, the spatial dimension became of utmost interest in explaining industrial dynamics since the late 20th century. After the so-called 1980s Second Industrial Divide, interest shifted from the Chandlerian tradition towards small and medium-sized companies and their role in generating complex productive ecosystems (Chandler, 1990; Chandler & Hikino, 1997; Piore & Sabel, 1984). Thus, departing from the Marshallian agglomeration economies,[1] modern interpretations highlighted the significance of small enterprises, specialization, and informal organizational structures in industrial districts, blurring economic and social lines (Becattini

[1] Alfred Marshall's identified the positive externalities of industrial agglomeration in the late19th century: a pool of specialized workers, related industries, and the generation of diffuse knowledge. This 'triad' would drive future studies on economic agglomeration and its positive impact on economic growth (Krugman, 1991; Marshall, 1920).

et al., 2014; Catalan et al., 2011; Popps et al., 2006). This model laid the foundation for the diffuse industrialization of Third Italy (Bagnasco, 1977; Becattini, 1991; Brusco, 1982) and opened the door to the study of medium-sized enterprises as the driving force behind 'Fourth Capitalism' (Castellani & Pompei, 2013; Colli, 2002). Contrastingly, Porter's cluster model offers more flexibility in company types, suggesting that large firms could drive cluster dynamics (Porter, 1998; Porter & Ketels, 2009). This is the case in hierarchical clusters, in which large companies agglomerate related industries around them and boost their operational environment (Catalan & Fernández-De-Sevilla, 2020; Markusen, 1996). While the exploitation of internal economies of scale and the extensive use of semi-skilled labor force have traditionally been considered two of the main competitive advantages of big firms, this does not necessarily prevent them from generating positive externalities and positively impacting related industries through spillovers of diverse nature (Chandler et al., 1997; Keppler, 2010).

The spatial component is not only relevant for understanding productive dynamics but also from a territorial perspective. The impact of deindustrialization in Europe was regionally uneven, affecting more profoundly those regions heavily specialized in the leading industries of the Second Industrial Revolution (Clark, 2022; Nickell et al., 2008), among which the steel industry represents a paradigmatic example. Some recent studies have focused on the process of deindustrialization of steel-producing regions and the impact that this process had on their productive, political, and social fabric. In Latin European countries, Raggi (2019) showed how in the French region of Lorraine, the maintenance of steel activity after its privatization at the end of the century and the implementation of a significant array of public policies facilitated the establishment of the automotive industry in the region, which partly helped alleviate the labor effects of deindustrialization. In Spain, Valdaliso (2020) underlines how the previous steelmaking specialization of the Basque Country favored the agglomeration of the machine-tool industry and the emergence of a cluster environment that, with strong support from the regional government, allowed the sector to overcome the industrial crisis and internationalize in the 2000s. In a similar

vein, but representing a much more relative success case in aggregate terms, Antuña (2022, 2024) argues that the agglomeration of metalworking activity in Asturias around the steelmaking industry enabled the sector to benefit from cluster dynamics, allowing it to emerge strengthened after industrial restructuring, led by an emerging base of pocket-multinationals. By contrast, Doria (2022a) analyzed in detail the deindustrialization of Genoa (Ligura), an Italian traditional steel and shipbuilding hub, where the public-private partnership, key in the city's industrial development, has not yet been able to offer a viable response to reindustrialization.

Despite these advancements, there is a lack of comparative case-studies that facilitate the identification of development patterns among regions with similar potentials for developing industries related to the steel value chain in Southern Europe. This work compares the evolution of the metalworking sector in Asturias (Spain) and Umbria (Italy) from the end of post-WWII reconstruction (1958) to the start of the Great Recession (2010). More precisely, it seeks to determine if the existence of a prominent steelmaking company (Ensidesa and Terni, respectively) triggered the development of a robust and diversified metalworking sector capable of surviving industrial restructuring and promoting regional industrial development after the adjustments.

The cases of Asturias and Umbria fit into a tradition of industrial historiography that has recurrently compared trajectories in Italy and Spain within the context of Southern Europe and Mediterranean Capitalism (Binda & Colli, 2011; Binda, 2013; Binda & Merlo, 2020; Catalan, 1992).[2] Both regions have a prominent steelmaking history linked to private initiative in the mid-19th century, and were then key in developing this industry during their fascist regimes.[3]

[2] Regarding the role of big manufacturing firms in the recent economic development of both countries, see Carreras & Tafunell (1993), Amatori & Colli (1999) and Binda & Colli (2011).

[3] Although it is beyond the scope of this paper, a global perspective on the role of fascist regimes can be traced through the history of the National Institute of Industry (INI) in Spain (Martín Aceña & Comín, 1991; Schwartz & González González, 1978), and the Institute for Industrial Reconstruction (IRI) in Italy (Castronovo, 2012; Amatori, 2013).

However, for this same reason, the deindustrialization process significantly impacted them, been relegated to a secondary position in the overall regional context, overshadowed by more dynamic industrial regions such as Catalonia and the Basque Country in the case of Spain and Piedmont, Liguria, and Lombardy in Italy.[4] A comparative approach can provide valuable insights into the steel industry's role as a stimulant of related industrial activity and, more specifically, help us understand whether and how it could boost a dynamic and competitive metalworking sector. This can increase our knowledge about the deindustrialization process experienced in both regions, but also shed light on the possible existence of hidden potential in an industry capable of generating future growth paths.

Methodologically, and based on the available sources, this work proposes a longitudinal structural analysis of these metalworking sectors to 1) reconstruct and study their long-term evolution, 2) better understand their relationship with the parent steelmaking industry, and 3) rind points of convergence or disparity to try to identify a development pattern. These data are cross-referenced with the geographical distribution of the sector and Gross Value Added (GVA) data available since the year 2000, pointing towards the impact of industrial location on competitiveness through positive externalities.

The results show that steelmaking's influence varied between the two regions, with metalworking industries exhibiting different development paths due to disparities in its pull effect and sectoral location patterns. In Asturias, the establishment of Ensidesa in 1950 spurred the metalworking sector's growth, agglomerated around the steel industry, forming a hierarchical cluster benefiting from Ensidesa's externalities and its integration with the local operational environment. Despite industrial restructuring, the sector evolved with medium-large firms specializing in high-value-added segments, integrating into global value chains. In contrast, Umbria's steel company,

[4] A review of the industrialization of these countries by regions in Di Vittorio et al. (2004). Regarding the relative evolution of regions within the framework of their national economies and some key determinants, see Díez-Minguela, Galarraga & Tirado (2018) for the case of Spain and A'Hearn & Venables (2013) for Italy.

Terni, did not significantly impact mechanical activities, leading to a dispersed growth of metalworking driven by demands from traditional industries like food and textiles. From the 1980s, regional metalworking in Umbria saw the rise of smaller regional champions connected to extra-regional value chains through subcontracting, isolating their success from broader industry development.

The paper is organized as follows: section 2 details and discusses the available sources and presents the adopted methodology according to them. Section 3 briefly introduces the history of steelmaking in both regions. Section 4 presents the sector's analysis. Finally, section 5 summarizes some concluding remarks and suggests future research directions based on the obtained results.

2. Methodological remarks

Asturias and Umbria (Figure 1) are relatively small regions that, due to their traditional specialization in the steel industry, have severely suffered the consequences of deindustrialization from the 1980s.

Figure 1. Asturias and Umbria location in Spain and Italy

Source: Own elaboration.

In terms of employment, this impact was especially violent in Asturias, which, with the restructuring plans, started a rapid process of tertiarization. Therefore, given this situation, the similar relative weight of industrial GVA on the total industry suggests disparities in the structural evolution of the manufacturing sector and its competitiveness (Table 1).

Table 1. Population, industrial employment, and industrial GVA in Asturias and Umbria, 2021

2021	Population	Industrial Employment	Industrial GVA
Asturias	1,012,117	48,910 (12.9%)	21.5%
Umbria	858,812	64,400 (17.6%)	21.0%

Source: Own elaboration with data from SADEI and ISTAT. Notes: in brackets, the percentage of industrial employment of the total.

Intending to analyze the evolution of the metalworking sector in both regions —the next stage in the steel value chain— this study presents an in-depth, longitudinal analysis focused on the evolution of their business and labor structures. The comparative perspective also provides insights into the similarities and divergences between both cases, allowing for the determination of whether there is a common development pattern or not.[5]

The conceptualization of the metalworking sector is based on the proposal made in Antuña (2022). Thus, the evolution of the different sub-branches has been aggregated into the three subsectors proposed in Table 2, whose aggregate constitutes the metalworking sector. The steelmaking industry (part of Metallurgy) is not considered in this group and is mentioned independently. Following Ferrucci & Picciotti (2013), it is considered that subsector 1 belongs to the group of Medium-Tech industries, while subgroups 2 and 3 are High-Tech. This has implications for the competitiveness of the entire sector, as it is assumed that branches with a higher technological component generate greater added value and more positive externalities than those less advanced in the value chain.

[5] In historical perspective, this type of approach is recurrent in the study of Italian industrial realities due to the nature of the available sources. For the case of Umbria see e.g. Casavecchia (2013), Covino (2005) or Ferrucci (2008).

Table 2. Metallurgy and metalworking sector composition

METALLURGY
METALWORKING
1. Metallic Products
2. Machinery and Equipment (mechanic, electric and electronic)
3. Transportation Material (shipbuilding, automotive components, and others)

Source: Antuña (2022).

Due to the lack of a single source encompassing both case studies, this analysis merges two sources to conduct a thorough comparative examination of the productive structures in Asturias and Umbria following significant homogenization efforts. Historically, Asturias stands out for its detailed regional accounting, notably due to the swift establishment of the Sociedad Asturiana de Estudios Económicos e Industriales (SADEI) during the late Franco era, tasked with generating such data. Consequently, the regional Input-Output tables for Asturias (1968, 1978, and every five years from 1985) offer extensive sectoral insights on production, employment, trade, and more. The strategic importance of the Asturian industry led to comprehensive regional reports from the INI (later INE), achieving broader coverage compared to other regional studies nationally. Conversely, Italy's regional economic studies, centralized by ISTAT, typically featured higher levels of sectoral aggregation, limiting comparable sectoral detail in production or trade. Nevertheless, Italy boasts an early and very detailed industrial census revealing the productive structure at a high sectoral and territorial breakdown level, including municipal data. This information, transferable to the Spanish context, forms the foundation of this study. The homogenization of both sources starts from the highest possible level of disaggregation, reassembling the branches of activity from the smallest unit and considering the NACE code to make national classifications CNAE and ATECO replicable.

It should be mentioned that Italian censuses distinguish between companies and workplaces. The count on societies has been used to analyze the business structure, while data on employment is based on productive establishments.

When discussing industry in general terms, the definition of 'industry' does not consider the construction sector. References to aggregated employment take into account total occupation, whereas employment distribution by business size or number of companies considers only wage employment.

This study adopts a historical framework that starts in 1950, marked by the founding of the steelmaking company Ensidesa in Asturias and the start of the decade that, after the post-WWII reconstruction, led to the 'Italian miracle'. The analysis spans until 2010, just at the onset of the Great Recession. The timeline is divided into four sections for focused observation: 1) initial industrial development, 2) crisis and restructuring, 3) stabilization and turn of the millennium, and 4) onset of the Great Recession. This structuring guides the selection of yearbooks. For the Asturian case, the Industrial Census of Spain has been chosen for 1958, the first available at this level of disaggregation. Later, regional Input-Output tables by SADEI for 1978, 2000, and 2010 provide data on business and employment, offering broader coverage than national censuses. Additionally, the study includes data from 'Renta de los Municipios Asturianos'. For Umbria, the General Census of Industry and Commerce by the ISTAT, with editions from 1961, 1981, 2001, and 2011, is used to align with the defined periods.

Finally, from the year 2000 onwards, homogeneous annual data on GVA can be shown, although the level of disaggregation is not as high as in the rest of the work (the data for Italy combines Metallurgy with Metallic Products, and Machinery and Equipment with Transportation Material). This allows for a final approach to understanding how structural evolution and geographical location patterns have impacted the sector's competitiveness.

3. Necessary background: A brief overview of the steelmaking industry in both regions

3.1. Asturias, from coal mining to comprehensive steelmaking[6]

The origins of the Asturian metallurgical sector can be traced back to the waning years of the 18th century, when coal enhanced the development of metallurgical activities, shaping the region's economic structure in the long term (Ocampo, 2004; Ojeda, 1985). The Royal Munitions Factory of Trubia was conceived as Spain's first attempt to adopt the 'English casting' method. However, as noted by Professor Jordi Nadal, it would ultimately represent the initial failure of the Industrial Revolution in Spain (Nadal, 1975).

Despite these setbacks, the presence of coal in Asturias spurred various mining initiatives, accompanied by metallurgical activities intending to take advantage of 'mine-mouth coal'. Asturias maintained metallurgical leadership until the last decade of the 19th century, when the introduction of steel through the Bessemer process shifted the balance in favor of the Basque Country (Nadal, 1975; Escudero, 2005). This situation endowed Asturian entrepreneurs with a relatively high capacity to exert pressure on the central administration. From 1891, they leveraged this influence to advocate for greater tariff protection, a privilege they would secure and maintain until the outbreak of the Civil War (González González, 1988).

This longstanding tradition positioned Asturias as a potential hub for industries fostered by the Francoist regime. Particularly, the city of Avilés benefitted from two additional agglomeration factors: the proximity of raw materials (primarily coal and iron) and a significant port in the estuary, connected by rail to the rest of the national market. Therefore, it is no coincidence that the National Institute of Industry (INI) boosted the development of strategic companies in this location, such as SIASA (1942) for scrap manufacturing and ENDASA (1949) for aluminum production. Concurrently, large shipyards, also protected by Francoist economic policy,

[6] Setting a general framework for the evolution of the steel industry at the national level is beyond the scope of this paper, which focuses on the metalworking sector. For an aggregated view of the Spanish steel industry, see González González (2004). For regional perspectives, excluding Asturias, see Fernández de Pinedo (2003) for the Basque Country and Díaz-Morlán & Sáez (2008) for Sagunto (Valencia).

were established in Avilés and the Bay of Gijón (Benito del Pozo, 1991; Ocampo & Suárez Cano, 2018). Attracted by the industrial growth of the district, other major companies with foreign capital followed these initiatives, such as Cristalería Española S.A. in 1952 (a subsidiary of the French society Saint-Gobain) and Asturiana de Zinc in 1957. However, the crown jewel of this industrial expansion was undoubtedly the creation of Ensidesa in 1950.

The decision to locate Ensidesa in Avilés was a response by Juan Antonio Suanzes to the allure of Asturian coal, which a century earlier had attracted French, Belgian, and Luxembourgish entrepreneurs (Nadal, 1975; Ojeda, 1985; Ocampo, 2004). Within a framework that subordinated economic rationality to 'national' interests, the creation of Ensidesa emerged from the necessity to increase steel production to supply the domestic market. This led to creating a large integrated steelmaking company aimed at de-oligopolizing the sector without reducing tariffs. It was also a reaction to the investment lethargy of private entrepreneurs who, numbed by the protective trend prevailing since the end of the last century, were pessimistic in their forecasts about the future demand for steel in the country (González González, 1988; Martín Aceña & Comín, 1990; Schwartz & Gónzalez González, 1978).

The creation of Ensidesa was crucial in breaking the bottlenecks caused by decades of autarkic policies. Becoming operational in 1957, by 1960 Ensidesa was producing almost 60% of Spain's national pig iron output, as well as 35% of finished steel and 25% of rolled products, respectively, in Avilés. This growth facilitated the surge in Spanish industrial activity until the onset of the industrial crisis, which emerged in Spain somewhat later compared to the rest of Europe (Díaz Morlán et al., 2009; Vázquez, 2004a, 2004b).

In the Asturian context, industrial restructuring was particularly intense due to the region's traditional specialization. Ensidesa underwent a severe adjustment plan in 1984 and gradually declined until it absorbed the Basque private steel company AHV in 1992. Four years later, as part of the privatization policy of the Conservative Party’s first government, there was an announcement regarding the complete privatization of the company. Eventually, in 1997, Aceralia Corporación Siderúrgica S.A. was formed, with

the Luxembourg-based group Arbed as the majority shareholder (Sierra, 2000; González González, 2004; Navarro, 2004). In 2000, the group became part of the international conglomerate Arcelor, which in 2007 led to the formation of ArcelorMittal, the current owner of the company.

3.2. Umbria, Terni between the private and public spheres[7]

Before Italian unification, Umbria's productive structure was markedly agrarian, characterized by a deficient communications system and a property system based on 'mezzadria' which constrained both individual land ownership and capital accumulation. Tiny companies predominated, especially prominent in the textile, olive oil, and metallurgical sectors. After unification, Umbria experienced its first crisis in the nascent manufacturing sector, as the influx of cheaper products from the rest of the country compromised the competitiveness of domestic manufactures. However, this did not affect the metallurgical sector, which in Terni would soon be considered of national strategic interest (Bortolotti, 1960).

In 1874, the construction of a large canal intended for hydroelectric power production was approved, which would soon become the main driver of Umbrian industry. At the same time, the central government was considering the creation of a steelmaking enclave to boost the national military industry. In this context, the city of Terni was considered an ideal location, as in addition to the recently created canal, its central position in the country facilitated the transportation of production while keeping the region away from potential border conflicts. Thus, in 1881, the Fabbrica d'Armi di Terni was born, and in 1884, the Società degli Alti Forni, Fonderie ed Acciaierie di Terni (Saffat) was created, a private initiative but with a spirit and part of the public capital (Bonelli, 1975; Bortolotti, 1960).

The original plan was for the steel company to specialize in the creation of thick sheet metal for the construction of ships in the shipyards of the north of the country, and special steels intended for the war industry, using lignite

[7] For the same reason noted in footnote 6, for an integrated view of the steel industry in Italy, see Balconi (1991) and Ranieri (2014). At the regional level, for Liguria see Doria (1989; 2005), for Lombardy Semeraro (2024), for Tuscany Tonarelli, for Naples Felice (2017), and for Apulia Romeo (2019).

obtained from the mines of Umbria and iron ore brought from the deposits on the island of Elba (Bonelli, 1975). However, the high costs of its startup and the problems in carrying out the first contracts initiated a financial crisis in 1887 that, after a financial rescue, placed the company at the center of controversy almost until the outbreak of WWI, as the collusion of public interests with private interests and capital generated constant political and economic tensions. The truth is that, despite the difficulties the company went through, in Umbria its startup attracted other private capitals aimed at metal manufacturing, mainly located in the province of Terni, while light mechanics and the textile sector continued to predominate in Perugia, far from the influence of Terni's steelmaking. However, by the early 20th century, it was clear that in Umbria there was not a sufficient manufacturing industry to absorb the capital goods manufactured in Terni, as almost all the industrial capital came from other Italian regions, such as Tuscany or Lombardy, to which the production was also destined (Bettoni & Marmottini, 2001; Bonelli, 1975).

The growth of Terni continued at the beginning of the 20th century, becoming the most prominent company of the Italian steel cartel. However, as pointed out earlier, this situation did not exempt it from experiencing significant cyclical fluctuations. The overall steelmaking sector was compromised during this period, and both Terni and the rest of the Italian steel industry had to be rescued again in 1911 (Amatori & Colli, 1999). After the end of WWI and following a brief post-war crisis, both Terni and the metalworking companies experienced a period of expansion that lasted until the outbreak of the Great Depression. During the 1930s, a large part of the Italian steel industry came under the control of the public conglomerate Finsider (1937), which, after the creation of the Istituto per la Reconstruzione Industriale (IRI) in 1933, would end up owning the majority of the country's steel companies, among which Terni was one of the most important societies (Amatori, 2000). Once under public control, Terni was considered a key asset for producing military material during WWII. The boost provided by the Fascist technocrats and the outbreak of war led Terni to reach its zenith in 1942, when it directly

employed more than 25,000 people, a number that sharply decreased as the conflict progressed. (Bonelli, 1975; Ranieri, 2013).

After the end of the conflict and during the reconstruction period, Terni became part of the Sinigaglia Plan for the restructuring and modernization of the Italian steel industry. Following the initial post-war adjustment and the war-induced economic boom caused by the Korean War in 1950, the Terni operations completely shifted to the production of special steels for civilian uses, while the Sinigaglia Plan reorganized integrated cycle steel production at the Genoa-Cornigliano, Bagnoli, and Piombino plants. In 1964, also in response to the 'Southern Question,' the Taranto plant was inaugurated. (Bonelli, 1975; Ranieri, 2013; Doria, 2022b). The Italian steelmaking industry experienced a decade of splendor after Oscar Sinigaglia's success; by the early 1960s, it was already one of the most competitive in Europe (Ranieri, 2013).

This steel splendor, as in the Spanish case, was behind the so-called 'Italian miracle', which likewise came to an end with the industrial crisis of the 1970s. Similar to the Spanish steel industry, the companies belonging to the Finsider group were in deficit until the 1990s and, after the liquidation of Finsider in 1988, Italy joined the European wave of privatization.[8] Terni was no exception, and after two corporate restructurings and its complete specialization in the production of stainless steel, it was absorbed as ThyssenKrupp Acciai Speciali Terni in 1994 (Balconi, 1991).

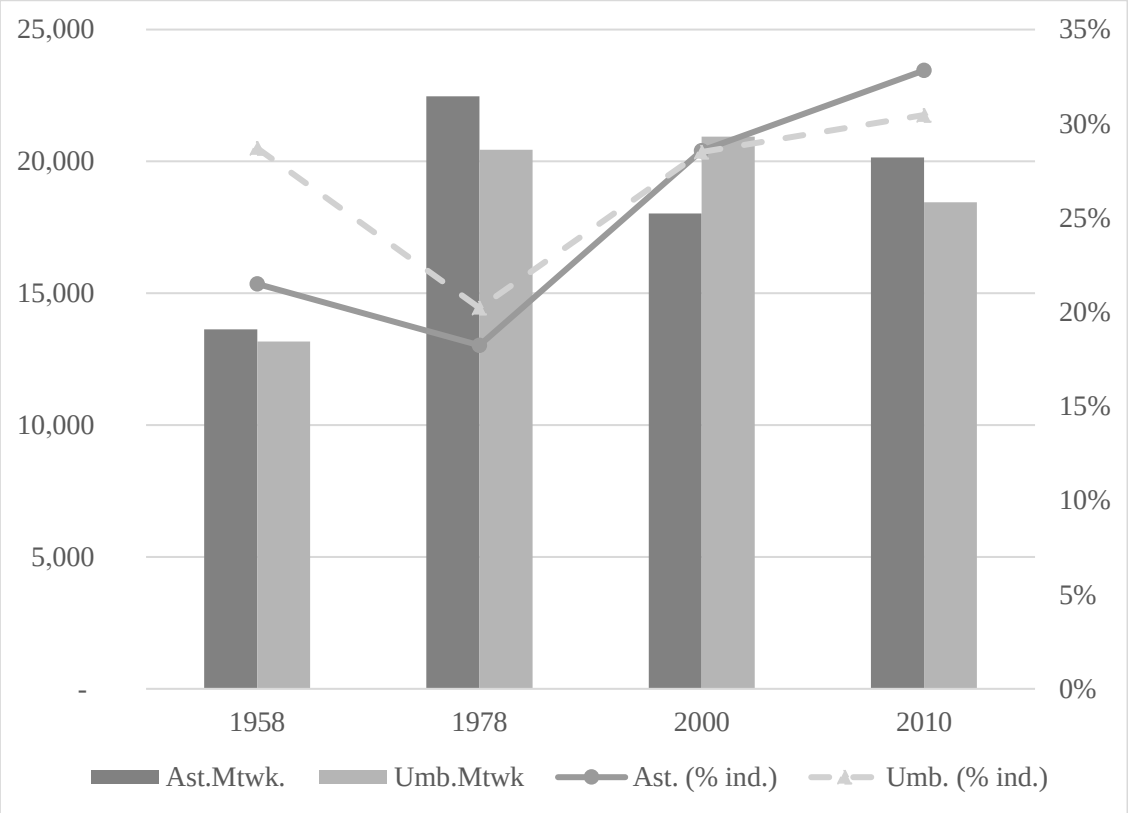
4. The long-term evolution of the metalworking sector in Asturias and Umbria, 1950-2010

Regarding employment, the metalworking sector demonstrated a similar development pattern in both regions (Figure 2). The strong expansion of total industrial occupation explains the reduction in the relative weight of metalworking employment despite its individual increase. After undertaking the crisis adjustments (and the impact of the early 1990s crisis in the Spanish case), the metalworking sector stabilized as a reference industrial sector in

[8] A significant case study at the public-private intersection over the long term in the field of advanced manufacturing is Finmeccanica, tracked by Zamagni (2009).

both regions, growing steadily to represent more than 30% of industrial employment in both cases. In Asturias, the adjustments related to restructuring must be compounded by a significant economic crisis in the first half of the 1990s, which deepened the industrial crisis. Since 1995, the sector expanded steadily until it suffered the effects of the contraction in industrial investment caused by the Great Recession. The Umbro case showed a slightly different and somewhat unique dynamic. The crisis of the 1970s affected the Umbra industry to a lesser extent than other regions, as its manufacturing fabric, even while transitioning towards a modern organizational model, expanded by recovering much of the workforce previously migrated to other regions and absorbing a last remnant of agricultural labor. Although the Umbra economy suffered the generalized slowdown of the 1980s (Bracalente, 1989), the sector recovered by the end of the decade and continued growing until the turn of the millennium.

Figure 2. Asturias and Umbria total metalworking occupation and its weight on total industrial occupation, 1958-2010



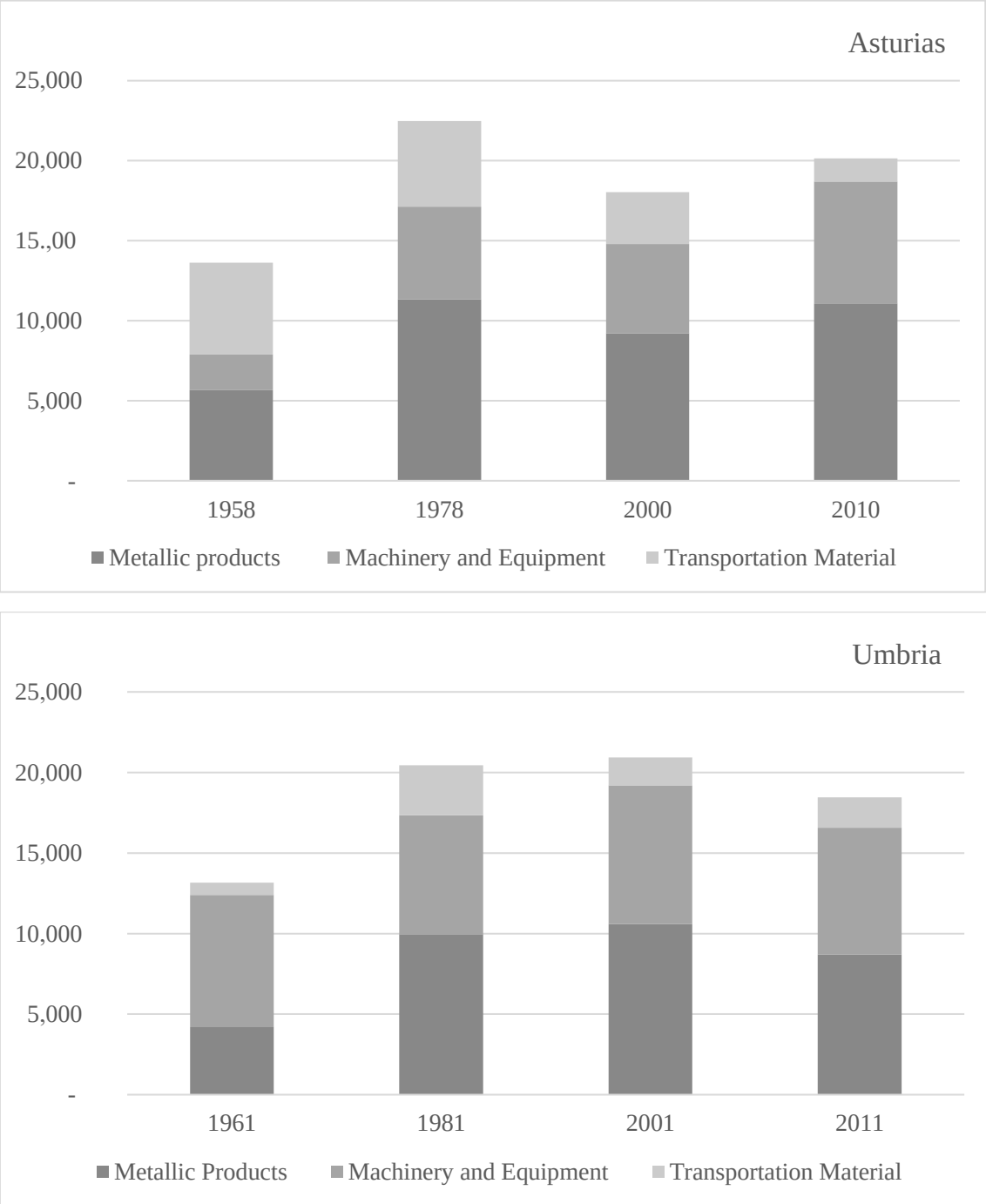
Source: Asturias: INE, Censo Industrial de Empresas 1958 and SADEI, Input-Output tables. Umbria: ISTAT, Censimento Industria e Servizi. Notes: On the right axis, metalworking occupation. On the left, percentage of industrial occupation.

The breakdown of employment by subsectors clearly shows the steelmaking heritage of these regions, as the 1960s-1970s occupation growth was strongly driven by the manufacture of Metallic Products, the closest activity to primary production in the steel value chain and the one that generates the least added value (Figure 3). In the Asturian case, Metallic Products grew hand in hand with the steel industry but also showed a more unstable trend, weighed down by its dual nature. This subsector was the most affected by restructuring and fluctuations in industrial investment cycles, shocks that particularly impacted the notable base of small metal workshops upon which it was founded. However, the important presence of medium and large enterprises, which concentrated more than 3,000 workers in companies with over 500 employees, counterbalanced the significance of small businesses. Some of these companies were constituted as associated metallic workshops to the private metallurgical firms that existed before the creation of Ensidesa. Over time, as these declined, other significant new companies emerged aimed at providing auxiliary services and assembly works for steelmaking and other large industries.

In Asturias, shipbuilding led Transportation Material, whose decline determined the progressive reduction of this sector's weight in the metalworking aggregate. The fall of the large public and private shipyards in Gijón and Avilés paved the way for medium-sized shipyards of the western end, specializing in vessels with a high technological component, case of Gondán or Armón (Ocampo & Suárez Cano, 2018). The subsector that showed a more stable trend will be Machinery and Equipment. At the beginning of the period, the weight of this branch was practically residual, a sign of an archaic productive structure still in transition (see chapter 1). Until 1978, the branch grew driven both by small electro-mechanical workshops and large machinery-producing companies, again in many cases heirs to the large 19th-century steel companies. In this case, the historical peak of employment concentrated in large-sized companies was reached that same year. From then on, the trend shifted towards concentration in medium and medium-large companies, with 65% of total employment concentrated in companies with

between 50 and 500 employees, making this activity the most dynamic and stable within the group (Antuña, 2022).

Figure 3. Metalworking occupation by subsectors in Asturias and Umbria, 1958-2010



Source: Asturias: INE, Censo Industrial de Empresas 1958 and SADEI, Input-Output tables. Umbria: ISTAT, Censimento Industria e Servizi.

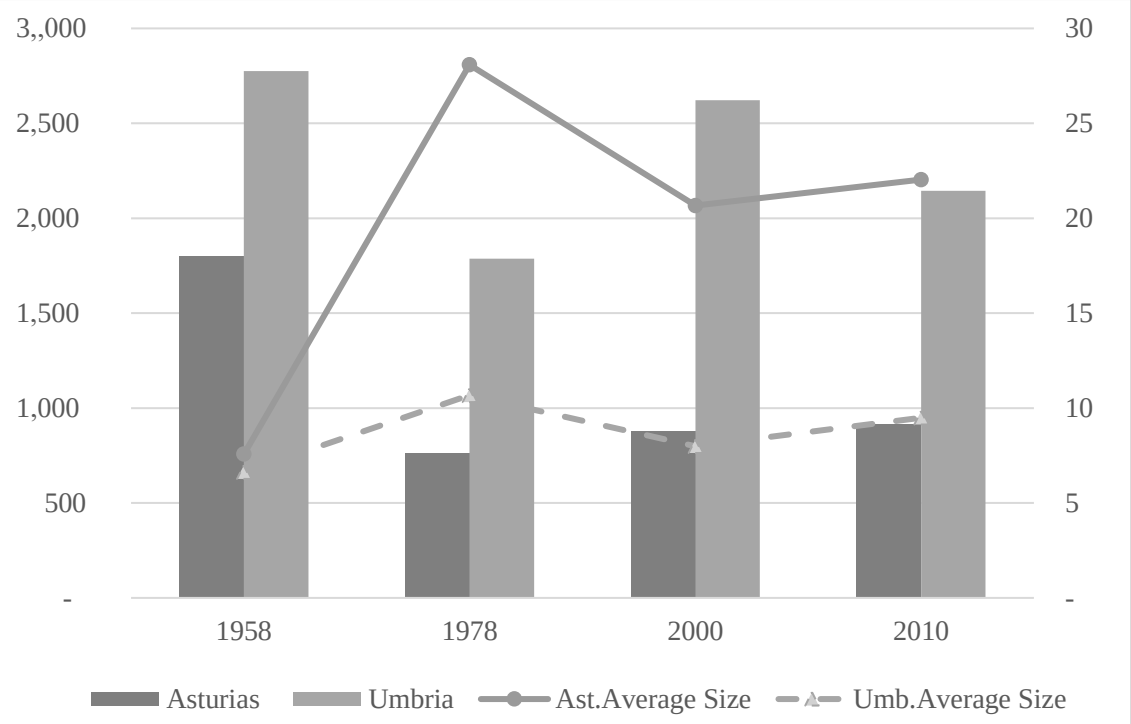
In the Umbrian case, the notable growth of Metallic Products was supported by a predominantly small business base, which gave way in the 1980s to a series of productive centers between 100 and 500 workers that will first become relevant in Terni and later in Perugia, consolidating from the turn of the millennium. These companies primarily consolidated in activities considered light within the segment, such as metal carpentry. The relevance of medium-large companies was higher in Transportation Material. After suffering severely from the consequences of the war, especially in the railway and aeronautical node of Foligno, the industry recovered and developed an important sector associated with aeronautical components.

The growth of this segment contrasts with the early development of Machinery and Equipment, which remains stable throughout the entire period built on a significant base of small, well-established 'mechanical workshops' emerging from the reconstruction period. In addition, certain medium-sized companies dedicated to manufacturing agricultural machinery and machinery for extractive industries were added, a clear sign of an economy with a significant agrarian base and still in transition. These companies will consolidate in Perugia in the 1980s and maintain their relative importance over the decades, although the clear predominance of small businesses, concentrating around 80% of the sector's employment.

In aggregate terms, these results are consistent with those obtained when analyzing the sectoral composition at the firm level in both regions (Figure 4). The number of Asturian metalworking companies peaked in 1958, then fell dramatically at the beginning of industrial restructuring, and since then, stabilized until the start of the Great Recession. This dynamic is explained by a drastic change in the sector's structure and the Asturian industry. In the 1950s, tiny workshops for repairing or manufacturing farming tools and simple utensils, often run by a single person or a family unit, predominated. The industry's rapid advancement under Francoist dirigisme professionalized the activity, resulting in the consolidation of a smaller number of larger companies. The liberalization following the transition to democracy favored the creation of companies in the subsequent decades, slightly reducing their

average size but maintaining it above 20 workers. These results confirm the consolidation of a dynamic base of medium-large enterprises operating in the Machinery and Equipment subsector, which would be the main driver of the sector during and after industrial restructuring (Antuña, 2022).

Figure 4. Asturias and Umbria metalworking firms and firms' average size, 1958-2010



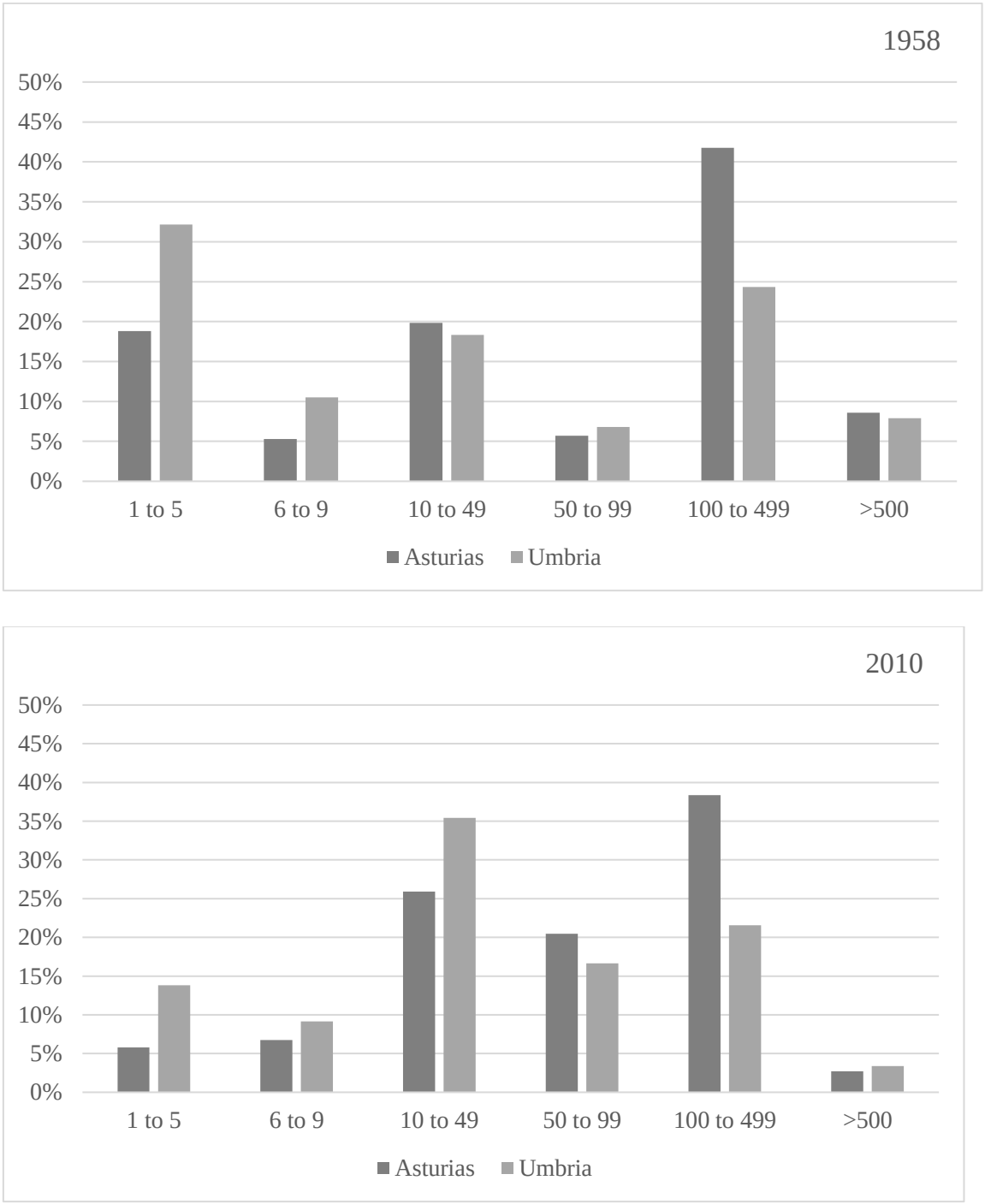
Source: Asturias: INE, Censo Industrial de Empresas 1958 and SADEI, Input-Output tables. Umbria: ISTAT, Censimento Industria e Servizi. Notes: On the right axis, the total number of companies. On the left, the average size per production establishment.

In contrast, the volatility of the Umbrian sector is characteristic of a business fabric dominated by smaller companies, with a shorter life cycle than larger ones. This business typology is less resilient to crises but also more likely to emerge during expansive economic cycles. Hence, in demographic terms, we could say that the mortality and birth rates in these ecosystems are higher than in typologies dominated by larger companies, where, however, the life expectancy of existing companies is higher. This explains the notable destruction of companies caused by the first impact of the restructuring, their significant growth after the end of the industrial crisis (especially in the second half of the 1990s), and again, the contraction resulting from the beginning of the Great Recession (Ferrucci, 2008). Throughout the entire

period, it can be observed how the average size of the metalworking company in Umbria is more stable than in the Asturian case, as it follows the same pattern but with less pronounced peaks, but it is also much smaller, around 10 employees. However, the average size of the Umbra metalworking industry is consistent with the dualism identified in the region's general productive structure. Without approaching the development patterns of the medium-large industry typical of the Northwest model, the average size of the Umbra metalworking industry also does not conform to the diffuse industrialization model typical of the NEC area, as it presents a greater importance of the medium-sized company than that characteristic of this pattern, which co-exist with big firms operating in basic sectors such as chemical or steelmaking (Cassavechia, 2013).

This dynamic is reinforced when observing the distribution of employment by company size (Figure 5). In both cases, the distribution shifts from being pronounced at the tails to becoming normal, where employment is more concentrated in medium-sized companies. However, in Asturias the preponderance of large companies, with more than 100 employees, was already significant by the late 1950s, while in Umbria, employment in companies with 1 to 9 workers is notably more prominent. Thus, by 2011, employment in Asturias was characterized by a concentration in medium-sized and, especially, medium-large companies, reinforcing the idea that capital goods producers took over from the large shipyards and the large auxiliary companies dominant before the restructuring. Although the dynamic is similar in the Umbrian case, the concentration of employment in smaller companies is more pronounced. More precisely, within the segment of medium-sized enterprises itself, it can be observed how the distribution is not uniform, with medium-large enterprises predominating in Asturias compared to the smaller-sized ones typical of Umbria.

Figure 5. Asturias and Umbria distribution of metalworking employment by company size, 1958-2010



Source: Asturias: INE, Censo Industrial de Empresas 1958 and SADEI, Input-Output tables. Umbria: ISTAT, Censimento Industria e Servizi. Note: 2010 is the last year that offers a symmetrical breakdown.

At the aggregate level, an initial look at Asturias and Umbria's metalworking sector presented a similar picture in both cases. On the one hand, both sectors employed around 20,000 workers, representing a figure close to 30% of the total industrial employment in these regions. The internal composition by subsectors also appeared to be similar. The presence of a significant steel industry promotes the development of the Metallic Products subsector, the following stage in the steel value chain, which accounted for approximately half of the metalworking employment in both cases. This was complemented by a similar weight of Machinery and Equipment and a minor presence of Transportation Material. However, the trend of Machinery and Equipment, which has the highest technological component and generates the greatest added value, differed in both regions. In Asturias, starting from a very marginal importance, this subsector grew progressively throughout the studied period, while in Umbria, starting from a very high relative weight at the beginning, it stagnated and even reduced its importance in the last decades. This trend suggests an early specialization in light mechanics in Umbria, linked to sectors demanding capital goods of relatively low specialization and technological component, which was maintained in time. Given that this segment acts as the technological articulator and innovation catalyst for the rest of the industry, this disparity in employment trends suggests the possibility that at the beginning of the Great Recession, the sector in Umbria was in a phase of potential lock-in.

4.1. The spatial dynamics of metalworking development

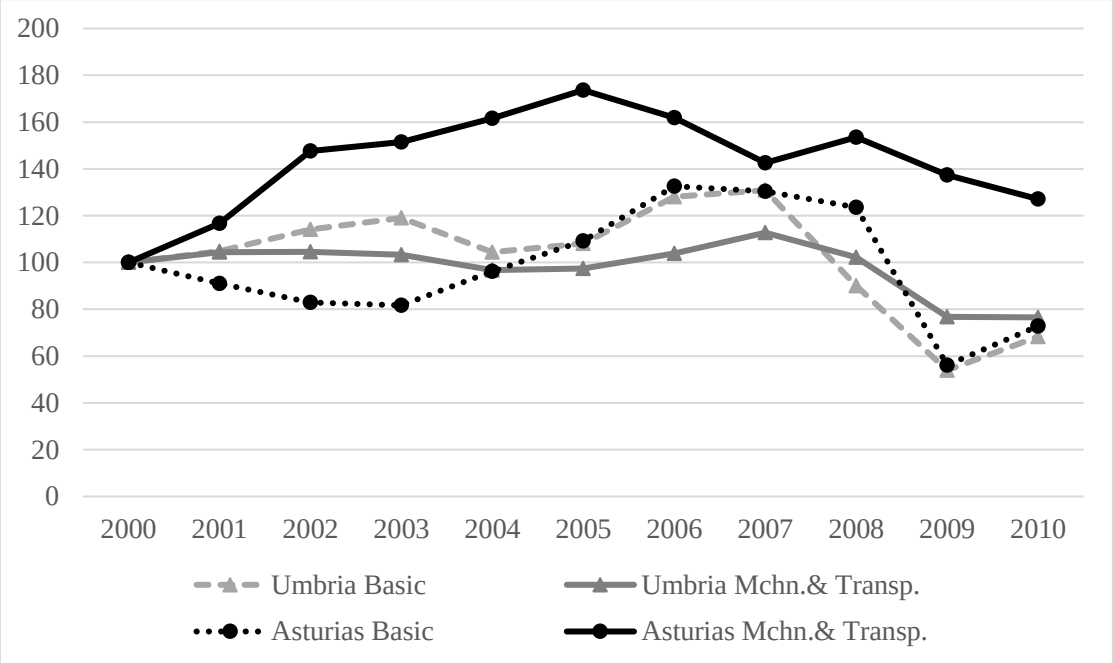
The available data from the year 2000 confirm what was anticipated by the structural evolution. By adapting the analyzed categories to the level of disaggregation offered by ISTAT and following the technological classification of Ferrucci & Picciotti (2013), we can divide the steel value chain into two major groups. 1) Basic: Metallurgy + Metallic Products, Medium-tech; 2) Machinery & Transport: Machinery and Equipment + Transportation Material, High-tech.[9] Therefore, it can be inferred that the

[9] The aggregations made in the primary sources prevent the inclusion of the metalworking sector without counting Metallurgy, which, due to its volume, would generate significant distortion in the overall evolution.

development of this second group will have a greater impact on the sector's competitiveness, acting as a key driver of its technological development. Likewise, improved performance of this segment would be linked with specialization in activities with a high technological component and progress towards more specialized segments of the value chain.

Data indicates differing trends between the Asturian and Umbrian sectors (Figure 6). While both exhibit fluctuating and declining patterns in their basic industries, high-tech sectors show distinct trajectories. In Umbria, stagnation and minor declines align with prior findings, highlighting a focus on less specialized mechanical branches. This is consistent with stagnant GVA and smaller business sizes. In contrast, Asturias shows growth, concentrating on larger firms moving towards more specialized value chain segments.

Figure 6. Metalworking Gross Value Added evolution in Asturias and Umbria by sub-aggregations, 2000-2010

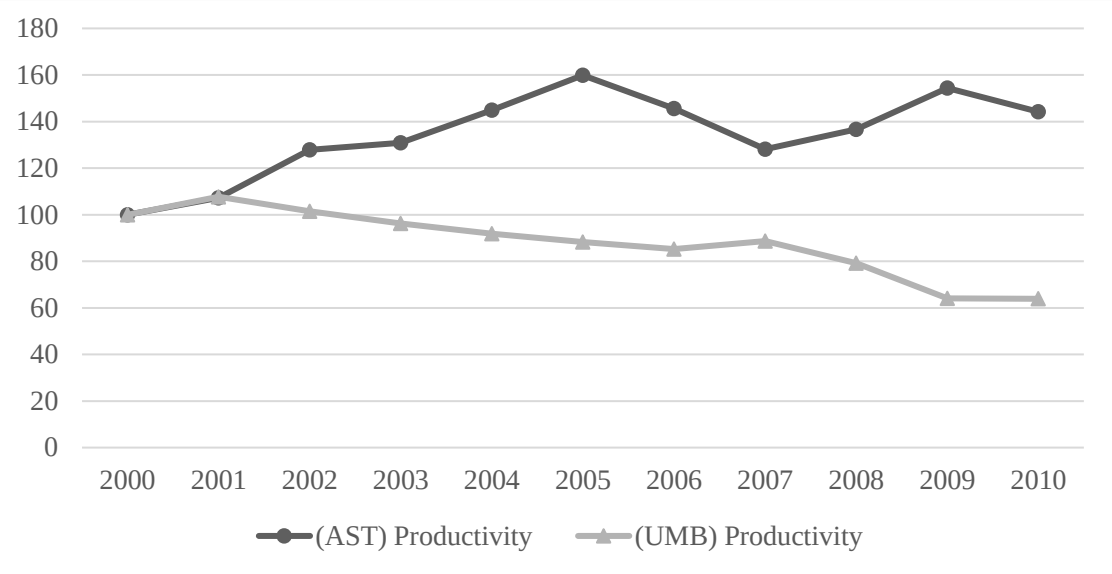


Source: ISTAT, Conti Economici Regionali and SADEI, Cuentas de la Industria Asturiana. Notes: Index numbers base 2000, constant 2010 euros.

Productivity trends further support these findings (Figure 7). In Umbria, while employment in the Machinery & Transportation sector remains stable, productivity notably declines over time. Conversely, productivity markedly improves in Asturias, where employment is also steady. These results

highlight distinct internal dynamics within these sectors in the two regions. Umbria's approach is more labor-intensive, indicating a focus on less specialized, lower-tech activities, in contrast to Asturias's direction towards specialization in higher-tech areas.

Figure 7. Machinery and Transportation labor productivity evolution in Asturias and Umbria, 2000-2010



Source: ISTAT, Conti Economici Regionali and SADEI, Cuentas de la Industria Asturiana.
Notes: Apparent labor productivity according to the Gross Value Added (GVA) per worker. Index numbers base 2000, constant 2010 euros.

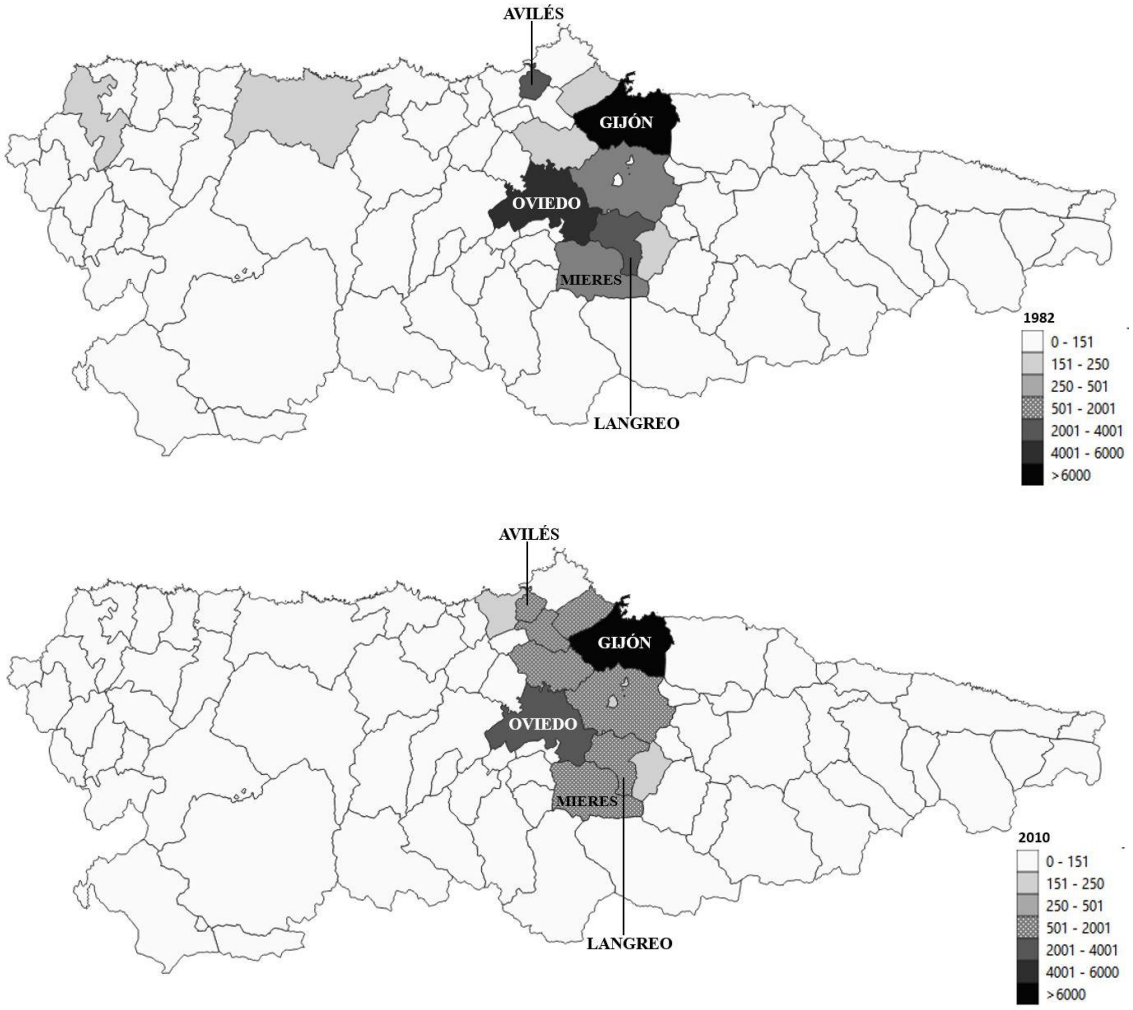
Analyzing the spatial distribution of the metalworking sector can complete the picture shown so far and reveal new insights into the reasons behind these differences in competitiveness, even though both display seemingly similar productive structures. The importance of geographical agglomeration to industrial and economic development is well-documented (Crafts & Mulatu, 2005; Kim, 1999; Klein & Crafts, 2012). The New Economic Geography (NEG) highlights how spatial concentration boosts positive externalities and economies of scale. Industrial clusters develop from backward linkages (industries' demand for inputs) and forward linkages (the supply of locally produced goods to other industries), creating sectoral ecosystems via Input-Output connections. The emergence of strategic activities is expected to lead to the clustering of related activities, generating external economies (Krugman, 1991; Tirado et al., 2002). This suggests that larger average establishment size helps drive endogenous growth through internal economies

of scale and productivity enhancements (Ciccone & Hall, 1996; Krugman & Venables, 1996). That's why, as a basic goods manufacturing industry, a large steel company might be expected to foster the development of a metalworking sector, benefiting from forward linkages in its value chain and the generation of spillovers of diverse nature.

The evolution of the geographic distribution of the metalworking industry in Asturias showed a clear trend towards concentration around the cities of Avilés and Gijón, where steelmaking activity is focused (Figure 8). Over time, there has been a distinct move towards a more homogeneous agglomeration, in which the municipalities bordering those structuring the so-called 'Asturian eight' are involved.[10] The Asturian metalworking sector has progressively organized itself following the logic of a hierarchical cluster, in which the steel industry has organized productive resources around itself and generated the necessary externalities to promote the development of the most advanced segments in the steel value chain. This evolution is consistent with the data previously shown in terms of competitiveness. In addition to establishing close supplier-customer networks, the companies within this ecosystem benefited from the infrastructural, educational, and technological development that accompanied the creation of the steel industry. The regional government continued developing these areas from the 1980s onwards, also in the form of business parks and public agencies for innovation, export, and development. (Antuña, 2022; Benito del Pozo, 2014). This has led to the evolution of the metalworking sector, also boosting the growth of other related activities, both in manufacturing and services, promoting the development of activities such as logistics and ICTs and keeping close collaboration with ArcelorMittal and other major multinationals in matters of innovation and R&D (Antuña, 2024).

[10] This poly-nuclear metropolitan system is structured around the cities shown on the map and orchestrates the regional economy by concentrating economic activity and around 70% of the Asturian population (Benito del Pozo, 1993)

Figure 8. Spatial distribution of metalworking employment in Asturias by municipalities, 1982 & 2010



Source: Own elaboration based on municipal data from SADEI.

Regarding their geographical distribution, over the decades, the mining cities in the interior have been losing relevance, and today, they mainly concentrate small and medium-sized enterprises with a level of specialization that is relatively lower than that of others clustered in more dynamic hubs. This is the case of Gijón, which, in addition to hosting the second ArcelorMittal plant in the region, aggregates more than 6,000 employees in its municipality in the metalworking sector. In the city, a virtuous circle has been fostered, consisting of medium and medium-large metalworking companies with a high level of specialization, which benefit from the existence of an important industrial port and have had a significant pulling effect on other related

agents, such as knowledge (Universidad Laboral de Gijón, which focuses on engineering degrees) and technological centers.

Avilés is the main Spanish municipality in terms of industrial employment density and a significant generator of positive externalities in its metropolitan area.[11] The city has indeed had a more traditional productive specialization, with a greater emphasis on basic activities linked to the prominence of the steel industry since 1950. However, in recent years it has become a reference in innovation, hosting numerous public and private R&D centers, many of them associated with large multinationals that collaborate within the framework of the 'Avilés City of Knowledge' project and the Island of Innovation. This effect connects with the one generated by Gijón and Oviedo, the region's capital. This has favored an agglomeration process tending towards uniformity in the territory, from which the bordering councils to these three cities, such as Siero or Llanera, have benefited. With this aim, the regional government has, since the 1990s, developed a series of public works designed to favor these territorial synergies, such as the improvement of infrastructure and significant development of business parks (Benito del Pozo, 1993, 2014). As a result, the sector's agglomeration in Asturias has led to the progressive generation of a dense network of companies and highly interconnected stakeholders. The tangible organizational result of this dynamic is the creation of the 'Asturias Steel Pole', led by ArcelorMittal in 2015, and especially of MetaIndustry4, an advanced manufacturing cluster established in 2016, composed of companies operating in very diverse activities within the steel value chain (Antuña, 2022).

In the Umbrian case, the sector's distribution throughout the region is much more dispersed and irregular, with many more municipalities represented but with lower levels of concentration and without a clear pattern of agglomeration (Figure 9). The territorial structure of the regional industrial system does not seem to be based on clear, highly specialized, and compact productive areas, indicating a clear differentiation from other spatial

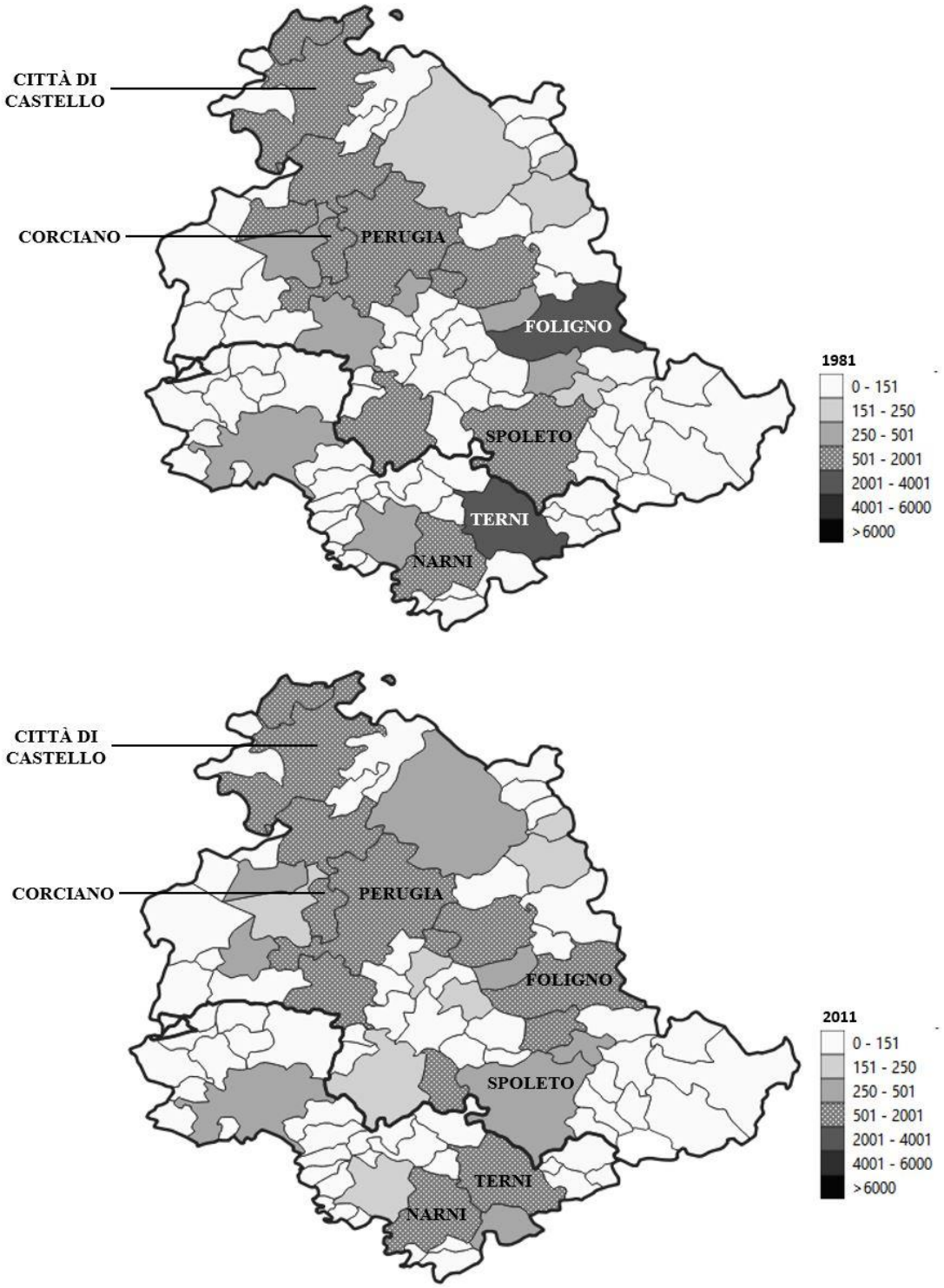
[11] INE, *Indicadores Urbanos 2021*.

organization systems typical of the NEC area (Bracalente, 1986). The Umbrian structural composition and spatial distribution prevented the transition towards development models based on larger-sized companies (Covino, 2005), reinforcing the trends shown in the previous section due to the relatively small average size of its metalworking companies. Similarly, the geographical distance of most of the metalworking sector from the steel hub of Terni suggests that the sector's development in the region did not follow the same pattern as in Asturias. Therefore, we cannot speak of a hierarchical agglomeration process similar to Asturias at the regional level.

From the metalworking perspective, it is important to highlight the relative decline in the importance of the Terni steel plant and its apparent low level of influence in generating significant forward linkages in its operational environment. The literature has emphasized two fundamental factors in this process. The first was the traditionally low level of subcontracting and demand for auxiliary services that Terni promoted among local metalworking companies, as historically, the company preferred to develop its own workshops for more specialized auxiliary functions, outsourcing only the simplest and most basic services. This resulted in a low level of interrelation among companies and poor growth and specialization of the firms related to the steel industry (Bettoni & Marmottini, 2001). The second is the company's specialization in producing special steels, which made it more difficult to establish related companies that used this material to manufacture high-value-added goods due to the high technological entry barriers of the productive processes. In the entire region, this specialization favored the intensive use of this input in less specialized processes, such as metal carpentry or in branches of low-specialized light mechanics, which also did not favor the development of a tertiary sector oriented towards business services (Ferrucci, 2009; Ferrucci & Picciotti, 2013).[12]

[12] This issue had already been identified following the steel mill's change in specialization. Once the adjustments and industrial restructurings of the Sinigaglia plan were completed, and the end of the reconstruction period was reached, the Chamber of Commerce of Terni launched initiatives aimed at creating companies capable of transforming the production of special steels from Terni. Although the plan financed the establishment of 15 new facilities, its impact on employment was relatively low, creating a

Figure 9. Spatial distribution of metalworking employment in Umbria by municipalities, 1981 & 2011



Source: ISTAT, Censimento Industria e Servizi. Dati per comune.

total of about 700 jobs, which were not concentrated in high-value-added segments (Bettoni & Marmottini, 2001).

Nevertheless, the more dispersed pattern of Umbria could have led to a development model more closely tied to diffuse industrialization patterns, with poles of specialization distributed throughout the region operating as industrial districts. However, as previously introduced, this development pattern does not fit with the productive structure found for the metalworking sector in this work, and it reinforces the findings of other studies on the overall Umbrian manufacturing economy. Following the industrial restructuring, the Umbrian manufacturing fabric evolved towards leadership by medium-sized companies, characterized either as regional champions or as subsidiaries of multinational companies established in the region (Ferrucci, 2008). This development model aligns with the concept of a fourth capitalism in clear development in the region (Castellani & Pompei, 2013). Indeed, in a recent report, Mediobanca-Unioncamere (2023) identified Umbria as the third Italian region in terms of the significance of this type of company, although it is noteworthy that, as in the case of the metalworking sector, employment was concentrated in companies with fewer than 200 employees, and nearly half of the observations occur in the range of 50-100 workers. The additional problem with the relatively small size of these companies is their dispersion and isolation. Most of these companies operated individually in specialized sectors, generating few and weak connections with local supply chains and failing to energize regional service chains (Covino, 2001; Ferrucci, 2009). This scenario resembles a vicious circle, as the lack of rootedness of these companies hampers the generation of these networks, which in turn undermines the capacity of these companies to generate spillovers over the rest of the productive fabric.

The metalworking sector has followed the general trend and, since the 1980s, has been progressively led by emergent medium or medium-small enterprises specialized in very specific activities or market niches. The issue is that, following the region's general pattern, these firms are widely scattered across the territory and hardly maintain any relationship with the local productive fabric. This hindered the appearance of districts or cluster dynamics, provoking that in those cases where signs of these dynamics begin to appear are still in very early stages of development (Bracalente et al., 1992). In

addition, the dualism characteristic of the Umbrian productive structure is also evident at the geographical level.

In the last decades, the large steel industry in Terni has relatively conditioned the development of the local work system organized around this municipality,[13] where a series of companies aimed at utilizing this production have emerged (Sacchi, 2009). Nonetheless, there was again a tendency towards such diversification of activities that increased the barriers to generating synergies, complementarities, and knowledge spillovers (Ferrucci, 2009). These companies maintained strong relationships with other national and foreign firms, acting as satellites or under subcontracting arrangements, generating few value chains at the regional level and hindering the development of R&D (Pieroni & Pompei, 2005). Since the 1990s, Umbrian institutions have promoted the development of various action plans aimed at increasing the competitiveness of companies that leverage the value chain of special steels produced by ThyssenKrupp, Such as the progress at the University Pole of Terni in research on advanced materials or the creation of the Parco Tecnologico dell'Umbria-SITECH. However, at the beginning of the Great Recession, the degree of permeability and progress of these interventions was still very incipient, with the aggravating factor that companies related to the steel and chemical industries had a low level of involvement in such projects and in promoting the generation of spillovers (Ferrucci, 2009).

The relatively limited influence of Terni's company activities on the development of the metalworking industry was also evident in establishing this sector in the province of Perugia, where almost 80% of the occupation was concentrated. From a spatial input-output logic, this suggests a growth pattern that is more closely linked forward, where the mechanics sought to relate well either with end markets associated with larger populations or sectors demanding intermediate and capital goods. In this second case, development occurred hand in hand with ‘Made in Italy’ sectors, such as

[13] It encompasses the municipalities of Terni, Narni, Amelia, Stroncone, Spoleto and Massa Martana, which belongs to the province of Perugia.

wood/paper, food, and fashion, which demand capital products and services related to light mechanics (Cassavechia, 2013).

These sectors experienced their heyday from the 1960s and initially responded to a model of diffuse industrialization, originating some productive axes such as the Tevere Valley, north of Perugia; the vicinity of Trasimeno, to the west, and the eastern corridor connecting the capital with Foligno. However, this diversity in location also occurs in productive specialization. A higher degree of diversity should lead to greater business interrelation, sowing the seeds for the emergence of districts following the NEC pattern. However, this does not occur in Umbria, where geographical dispersion replicates in activities, seemingly unrelated to each other, at least in significant terms (Bracalente, 1989). Equally, from the 1980s these industries started a reconfiguration either to be intervened by foreign capital or to reinforce patterns of isolated leadership by medium-sized companies belonging to extra-regional value chains. This explains the dispersion of the metalworking sector in Perugia, either due to its local-scale relationships with other light industries or the sporadic emergence of medium-sized companies disconnected from regional networks (Covino, 2001).

In this scenario, we can identify noteworthy exceptions. Such is the case of the Umbria Aerospace Cluster, the heir of the Umbrian aeronautical tradition dating back to the early 20th century, primarily concentrated around the legacy of SAI (Passignano) and AUSA (Foligno) in the post-war period (Covino & Gallo, 1978). Similarly, the Umbria nautical cluster has been established, comprised of companies from very diverse sectors —some metalworking among them— capable of creating synergies aimed at the manufacture of recreational boats.[14]

[14] More information: https://www.umbrianauticalcluster.com/

5. Concluding remarks

This paper presents a comparative regional analysis of the evolution of the metalworking sector in Asturias and Umbria from the late 1950s until the onset of the Great Recession. Both regions' economic and industrial trajectories have been marked by the development of a significant steel industry, which is considered strategic for national development plans and, therefore, the state's role as a fundamental factor in its development. Unlike previous studies focused on steelmaking, this work examines the metalworking industry, proposing that a large steel company's presence would boost a dynamic, competitive metalworking sector through agglomeration and diverse spillovers.

The obtained results indicate that the impact of the large steel industry in both regions was uneven, and that the studied metalworking industries, despite having an apparently similar productive structure, did not follow similar trajectories due primarily to the differing pulling capacity of the steel industry and the different patterns of sectoral location. In Asturias, the creation of the national steel champion Ensidesa in 1950 facilitated the takeoff of the metalworking sector, whose growth followed a clear pattern of spatial agglomeration around the parent industry. This agglomeration resulted in the creation of a hierarchical cluster, in which metalworking companies benefited from positive externalities caused by the impact of Ensidesa on its surroundings and the high degree of interrelation that this company maintained with its operational environment. After the adjustments suffered during industrial restructuring, the metalworking sector took over from the large basic industries, led by an emerging base of medium-large companies specialized in high-value-added segments and capable of integrating themselves into global value chains. In Umbria, however, the existence of the steel company Terni never had that dragging effect on the rest of the mechanical activity, which followed a process of dispersed growth associated with the demand for unspecialized capital goods from other traditional industries in the region, such as food and textiles. Like in Asturias, regional metalworking champions emerged in Umbria from the 1980s, but these were

smaller and highly connected with extra-regional value chains under subcontracting relationships. This caused the success of these companies to have less permeability on the rest of the productive fabric, leaving these success stories generally isolated from the development of the rest of the industry.

From a structural point of view, in both cases, an emerging base of medium-sized companies linked to the Machinery and Equipment subsector, which generates higher added value, arises. However, the average size of these companies is much larger in Asturias, favoring both the progressive increase of their internal capacities and their potential to generate environmental spillovers. The spatial agglomeration of metalworking activity in the very long term and the constant interrelation among the companies of this ecosystem were key to generating this virtuous cycle. This allowed the metalworking industry to benefit from endogenous growth processes in a cluster environment, increasing business competitiveness and enabling sustained sector growth after industrial restructuring. In the Umbrian case, the limited capacity of the Terni company to generate linkages also reflected in the spatial distribution of the metalworking industry, which was much more dispersed than in Asturias. This could have led to the emergence of various industrial districts across the territory, with areas of productive specialization in different activities highly localized within the region following the NEC pattern. However, this interrelation rarely occurred, resulting in a very dispersed ecosystem of small companies with little interrelation. This relative isolation was replicated in the leading medium-sized firms, which hardly generated positive linkages with other industries in their surroundings.

These results have important implications for the literature, as they shed light on which factors determine that long-term trajectories generate endogenous growth dynamics capable of leading certain industries to lock-in situations or, conversely, favor the accumulation of specific capacities to address delocking processes (MacKenzie & Perchard, 2022; Newey & Coenen, 2022; Zeitlin, 2003). Likewise, the findings are relevant for further deepening our understanding of the role of large companies as generators of successful and

resilient ecosystems beyond the original specialization, which also increases our knowledge about the capacity of these ecosystems and the companies that comprise them to change trajectories or generate new ones (Iammarino & McCann, 2006; Trippl & Tödtling, 2008; Valdaliso et al., 2016). Finally, for both regions' industrial historiography, these complement the extensive body of previous studies on steelmaking by connecting it with its influence on traditionally non-leading sectors (Antuña, 2022; Bonelli, 1975; Nadal & Catalan, 1994).

In the future, and starting from the limitations in the sources previously mentioned, it would be relevant to complement the results of this work with a quantitative approach that delves into the interrelationship between the development of the metalworking sector and other related activities, such as business services, ICT, or logistics. Through methodologies characteristic of New Economic Geography (NEG), it would be possible to better establish connection patterns between the steel industry, metalworking, and the rest of industrial activities. The implementation of these methodologies would allow for strengthening the results suggested here regarding the interrelationship between intersectoral supply and demand relations, industrial agglomeration, and its impact on business competitiveness.

Aknowledgments

Much of this work could be carried out thanks to a research stay at Bocconi University, Milan, between April and July 2023. This stay was made possible by the FPU mobility scholarship EST23/00184 granted by the Ministry of Science, Innovation, and Universities.

Firstly, I would like to thank Professor Andrea Colli for supervising my stay there and Professor Veronica Binda for her selfless support throughout the process, both academically and personally. I would also like to thank the help and comments from Professors Jordi Catalan, Marc Prat, Franco Amatori, Marco Doria, Ruggero Ranieri, Valeria Giacomin, Grace Balor and Emanuele Felice, who have significantly contributed to the development of this paper.

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Concluding remarks

Industry has returned to the center of the political and academic arena in recent years. In Europe, some studies have focused on the process of deindustrialization and its consequences at the regional level (Araujo et al., 2021; Di Berardino et al., 2021; Rodrik, 2016; Škuflić & Družić, 2016). Others have delved into the capabilities of these regions to develop future growth paths through different patterns of reindustrialization (Capello & Cerisola, 2023; Christopherson et al., 2014; Ganau & Kilroy, 2023; Hassink et al., 2019). Both lines of analysis agree in emphasizing the path-dependent nature of these processes, understanding that the generation of persistence trajectories and industrial path creation are accumulative processes that occur over the long term (Boschma, 2004; Djelic & Quack, 2007; Martin, 2010; Martin & Sunley, 2006; Newey & Coenen, 2022). Therefore, the introduction of historical methods in the analysis of these realities, as well as in the search for hidden potential for reindustrialization, is of utmost interest (Giacomin, 2018; Lubinski et al., 2024; MacKenzie et al., 2022; MacKenzie & Perchard, 2022). However, there is still a significant scarcity of work that investigates this line using historical analysis based on long-term case studies to establish a clear and effective dialogue between Economic and Business History and the debates opened by Evolutionary Economic Geography.

This thesis contributes to this significant gap in the literature by analyzing the case of the metalworking sector in Asturias, the main steelmaking pole of Spain, between 1939 and 2018. Through a long-term, in-depth study that combines structural, corporate, and institutional analysis, this thesis aims to analyze the determinants that have allowed this sector to become a reference for a region that, after being severely punished by industrial restructuring, undertook a drastic process of tertiarization. For this purpose, the various works composing this thesis are based on a holistic vision, starting from mixed methods to try to reconstruct the history of the studied sector and explain the different sectoral dynamics discovered throughout the process. To

this end, an exhaustive use of sources of different natures has been made, from official archival primary sources to corporate archives and oral history, in order to achieve the highest possible explanatory power. With the same objective, starting from a sectoral analytical perspective, the structural analysis has been completed with a business vision and a comparative case study.

This research nuances the views that, focusing on the study of the hegemonic industries of Asturian industrialization (steel industry, coal mining, and shipbuilding), have tended to consider Asturias as an industrial wasteland after the harsh restructuring process begun in the 1980s.The results show how the sector's current leadership at the regional level has been built on a long-term accumulative process, supported by the externalities generated by the region's hegemonic industries, mainly steelmaking, which favored the generation of a hierarchical cluster formed over almost a century of history. Thus, Chapter 1 shows that, despite having the necessary prerequisites for its emergence, it was not until the creation of the national steelmaking champion Ensidesa in 1950 that the Asturian metalworking cluster emerged in the region. There is no doubt about the role that Francoist industrial policy played in this process, as the creation of this large company was accompanied by a set of policies (e.g., infrastructure, education) that notably benefited metalworking companies and favor their agglomeration around the parent industry. However, the role of the regime must be at least nuanced. While numerous voices clamored from the state bodies for directly boosting this sector after identifying its potential, the Francoist institutions focused their support on the heavy basic industries, systematically ignoring these requests. In addition, as the rest of industries considered as 'non-strategic', the metalworking sector suffered the continued internal contradictions typical of an autarchic regime whose internal functioning was more based on arbitrariness and nepotism than on economic rationality, generating constant constraints and bottlenecks.

Despite this, the creation of Ensidesa gave rise to enough self-reinforcing dynamics for the Asturian metalworking sector to be already clustered at the

beginning of the industrial restructuring. As Paper 2 shows, the generation of this ecosystem allowed the sector to overcome the crisis and become internationally competitive from the mid-1990s. This leap was possible thanks to an emerging base of medium-large companies operating in very high value-added segments and capable of inserting themselves in advanced stages of global value chains. This would be the case of the Daniel Alonso Group, the current world leader in manufacturing wind towers and offshore structures, whose history is analyzed in Chapter 3. This company is a paradigmatic case of this emerging business base, originally very linked to traditional industries and progressively reoriented towards different activities related to advanced manufacturing and Industry 4.0. In the case of DAG, the progressive accumulation of capabilities represents the 3-stage process characteristic of the entire sector: emergence motivated by the creation of Ensidesa, endogenous growth around the steel industry, and specialization in a new activity with a high technological component and GVA.

This business case exemplifies an entire sectoral dynamic, that is, the ability to overcome a potential lock-in situation derived from facing the industrial restructuring process starting from a strong specialization in traditional activities. Within the limitations inherent in research of this nature, it would therefore be possible to open the door to trying to elucidate whether this same pattern was replicated in other European regions with similar characteristics. Chapter 4 shows, through a comparative analysis with the Italian region of Umbria, that despite steel's significant contribution to industrial growth in both cases, their metalworking sectors' development trajectories are distinct and non-replicable. This difference stems from steelmaking's varying roles in fostering agglomeration economies within each region. In Asturias, Ensidesa produced substantial positive externalities, fostering a strong interconnectedness with its surroundings and leading to a well-structured, hierarchical cluster. In contrast, the Terni steel company in Umbria failed to generate a similar economic magnetism. Consequently, the Umbrian metalworking industry is dispersed and characterized by low inter-company collaboration, undermining its competitiviness.

This thesis dialogues with recent literature on path dependence and path creation (Grillitsch et al., 2018; Hassink et al., 2019; Isaksen & Trippl, 2014; MacKinnon et al., 2019), especially with those works that seek to understand how the generation of endogenous growth processes and potential lock-in can give rise to the generation of new growth paths and delocking based on the accumulation of capabilities in the long term (Law, 2018; MacKenzie et al., 2022; Newey & Coenen, 2022). The results obtained deepen our understanding of the capacity of large firms and heavy industries to generate positive spillovers in their operating environment (Catalan et al., 2011; Chandler et al., 1997; Chandler & Hikino, 1997; Markusen, 1996).

These insights connect with the literature that delves into regional processes of deindustrialization (Chesire, 1991; Hassink, 2022; MacKinnon, 2020; Nickell et al., 2008; Raggi, 2019; Doria, 2022) as well as the search for new paths of economic growth based on industrial development (Balland & Boschma, 2021; Capello & Cerisola, 2023; Christopherson et al., 2014). The Asturian case represents a region specialized in large, labor-intensive sectors, so the industrial restructuring had severe economic, social, and political consequences, opening wounds whose scars have not yet healed. However, a closer look at the data reveals the relative preeminence of an already consolidated metalworking industry, competitive in foreign markets and highly demanding in technology and highly skilled labor. From a regional perspective, it is important to continue analyzing the sector's ability to generate positive effects in its operational environment, that is, the capacity to act as a direct and indirect stimulator of the economy, as the steel industry once did. The results obtained in these studies show a cohesive metalworking sector, which also demonstrates a significant degree of integration with the economic environment and other related activities, such as ICTs or logistics services. This is notable at the level of the predominance of medium-sized companies leading the sector but also at the capacity of the Asturian ecosystem to attract FDI and multinationals from the metalworking sector itself as well as other related activities, and ensure they position themselves as leading agents of these environments and favor the permeability of their positive dynamics.

One of these dynamics is the intensive development of collaborative R&D plans, in which business initiatives connect with public and private agents. Therefore, the results obtained in this research also have implications for the literature on clusters and their trajectories (Elola et al., 2012; Isaksen, 2016; Trippl et al., 2015; Trippl & Tödtling, 2008; Valdaliso et al., 2016) and on their typology and the competitiveness of the companies that form them (Catalan & Fernández-De-Sevilla, 2020; González-Bravo et al., 2018; Grashof, 2021; Randelli & Lombardi, 2014; Rocha, 2015). This thesis has traced the evolution of the Asturian metalworking sector since its emergence, analyzing its trajectory from various prisms (e.g. institutional, business) and interrelating the structural dynamics of the sector with the actions taken by the different actors of the analyzed environment and taking into account the bidirectional relationship established between these and their context. Therefore, agency and contingency are placed at the center of evolutionary analyses (Garretsen & Martin, 2010; Grillitsch et al., 2022; Popp & Wilson, 2007), vindicating the power of historical methods in these approaches and the need to establish tangible and effective dialogues between Economic and Business History, and others such as Evolutionary Economic Geography and Management Studies (Henning, 2018; Martin & Sunley, 2022; Perchard et al., 2017; Sydow et al., 2020).

Equally relevant is the historical approach to the analysis of public policies (Andreoni & Chang, 2017; Chang, 2002; Elola et al., 2017). This work has important implications for the literature that has revived interest in industrial policy, presenting it again as a key element for achieving sustainable economic development (Chang & Andreoni, 2020; Rodrik, 2004; Wigger, 2023). The case of the Asturian metalworking sector shows how, in the region, industrial policy has been lagging behind the dynamism of a sector that has always benefited indirectly from cross-cutting interventions or those directed at other industries, missing a direct incentive that never arrived. This paradigm highlights the need to identify sectors whose dynamism has been obscured by the decline of others much larger in volume. Their identification and greater understanding would favor implementing efficient policies and development plans aimed at enhancing the competitiveness of inherently

dynamic activities. This would increase the efficiency of industrial development policies within the framework of Smart Specialization and open a new perspective on the map of European industrial development (Balland et al., 2019; Balland & Boschma, 2021; Ganau & Kilroy, 2023; Rigby et al., 2022). From this perspective, the focus would be on emerging activities located in declining industrial regions, which could also reduce the regional gap generated by the deindustrialization process and the abandonment of industrial policy by liberal governments.

This thesis opens new avenues of research, which also stem from the limitations of a work of this nature. Firstly, it would be relevant to undertake a comprehensive long-term analysis that offers a continuous view of the global history of the sector, facilitating its replicability and research from a comparative perspective. From this possibility emerges another line of potential interest, which is the possibility of undertaking these comparative studies from very diverse perspectives, among which stands out the effect that different industrial policies could have had on the development of this sector in different regions and countries. Also connected with politics, it is possible to cross this analytical framework with other social science disciplines, such as political science, to analyze the effects of the deindustrialization process on voting and how they relate to the path of reindustrialization. Likewise, from a 'macro' perspective, there is also the possibility of delving into the impact that trajectories like that of the studied sector have on variables such as wages or educational development at the regional level. Lastly, to establish an effective dialogue with other disciplines, it is necessary to also be open to new methodologies, so the insertion of advanced statistical methods characteristic of Economic Geography appears to complement other methodologies typical of historical studies.

Overall, this work shows the need to revive interest in industrial history and the potential it offers by doing so from a multidisciplinary perspective. The in-depth analysis of long-term dynamics is crucial in deeply understanding inherently accumulative processes. Undertaking this type of research is crucial if we want to address sustainable economic development, making it

necessary to connect past trajectories with the future potential of the industrial sector.

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