Levelling up left-behind places: East Germany between 'long-neoliberalism' and state-capitalist cures

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Abstract

The intensification of regional inequality has sparked growing interest in left-behind regions, the fundamental structural drivers of subnational peripheralization and adequate forms of regional development policy. Based on a case study on East German de-/ and re-industrialisation, this paper contributes to these debates pointing to the role of regional industrial policy in nurturing agglomerating forces through regional anchor firms. After reunification, the East German economy deindustrialised at historically unprecedented speed and sectoral breadth. By 1992, the East German industrial base reduced to under 30% of its 1989 levels, while 46% of the entire East German workforce were either un- or underemployed. Using Jenks natural breaks and Getis-Ord Gi* geospatial analysis techniques, the article documents the lasting effects of the transition shock on the East German productive system, as evidenced by a persistent gap in manufacturing density and persistent peripheral position in German production structures. Limited regional resilience to the transition shock can be explained by the destruction of anchor firms in the privatisation process. There were some pockets of recovery as evidenced empirically by statistically significant hotspots in high-tech industries, namely an opto-electronics hotspot around Jena and a pharmaceutical hotspot around Halle-Leipzig-Bitterfeld. Tracing industrial recovery in the opto-electronics hotspot around Jena, the article illustrates the critical role played by the recreation of anchor firm functions under state-ownership. The findings emphasize that effective regional development policies must not only remove barriers to the spread of agglomeration economies but also nurture regional anchor firms as agglomerating forces. This case study of East Germany provides valuable insights into the structural drivers of peripheralization and the types of agency necessary to promote regional resilience and economic recovery in transition economies.

Introduction

Since the 1980s, socio-economic polarisation has increased across all geographical scales (Rodríguez-Pose, Bartalucci, et al., 2024; Fiorentino et al., 2024). At the regional scale, this trend has sparked a growing body of research on left-behind places (Pike et al., 2024), regional development traps (Diemer et al., 2022), and sub-national peripheralization (Kühn, 2015). A growing body of empirical evidence highlights the existence, persistence and significance of left-behind places (Fiorentino et al., 2024), which matter, not least because economic and political geography overlap, as exemplified by the strong correlation between being left behind and political discontent (Dijkstra et al., 2020, Rodríguez-Pose et al., 2023; Rodríguez-Pose, Dijkstra, et al., 2024).

Theoretical research suggests that regional inequality is socially constructed and structurally conditioned. In particular, the processes of regional peripheralisation are *relational*, in the sense that the growth of the core and the stagnation of the periphery are linked or even contingent on one another; *multi-dimensional* involving economic, political and sociological dimensions; *multi-scalar*, i.e. being observable at different geographical scales from global to sub-national and *temporal*, meaning that agency has the potential to alter the structural conditions which constrain peripheralized regions (Kühn, 2015). The triggers of regional peripheralisation vary considerably across different national contexts (Pike et al., 2024), including among other globalisation, skills biased technological change and austerity (Leyshon, 2021). More remains to be uncovered about the mechanisms through which such trigger events lock regions into lower growth paths or development traps. In addition, more remains to be uncovered on the type of agency that allows to alter structurally disadvantaging conditions, i.e. the policies that can support resilience to shocks (Boschma, 2015) and 'levelling-up'. *Place-sensitive* approaches to regional development emphasise tailoring policy interventions to the specific characteristics and needs of different regions (Iammarino et al., 2019; Rodríguez-Pose, Bartalucci, et al., 2024). *Place-based, people centred* approaches propose post-growth, foundational-economy centred regional policy agenda centred around community well-being and sense of belonging (MacKinnon et al., 2022; Kinossian, 2018).

This paper aims to empirically contribute to the study of peripheralisation and its cures through a case study on East Germany. Drawing on structuralist theories of cumulative causation, the paper points to the critical role of anchor firms in supporting structurally advantaging or generating disadvantaging productive conditions. Anchor firms are large, regionally embedded firms, which can act as an agglomerating force in high value-added, high wage industries and which structure productive activities of other firms. The presence as much as the nature of regional anchor firms is critical in supporting regional development economically. This point is illustrated at the example of the de-/ and re-industrialisation process unfolding in East Germany after reunification. The transition shock in East Germany was particularly severe, deindustrialisation unfolding at historically unprecedent speed and breadth after reunification. Despite equally historically unprecedented fiscal transfers, the lasting consequences of the transition shock are still measurable today. Using natural breaks and Getis-Ord Gi* geospatial analysis techniques, the paper documents a persistent if narrowing gap in manufacturing density and a persistent peripheral productive integration into West German production structures as evidenced by lower shares of value captured by East German firms and persisting gaps in technology-intensive manufacturing. Other and related dimensions of peripheralization such as demographic shrinkage (Lang, 2012; Velthuis et al., 2023), a persistent wage gap (Dickey & Widmaier, 2021) and stigmatisation (Leibert & Golinski, 2017) have been empirically documented elsewhere.

Given the persistence of dependent production structures despite unprecedented fiscal transfers, the East German case helps to identify some of the fundamental drivers of spatial polarisation. We show

that the destruction of anchor firms in the privatisation process led to a peripheral integration of the remaining East German manufacturing base into German production structures. East German manufacturing firms became extended workbenches and peripheral suppliers with consequences for linkage formation, value added and by extension wages. In the absence of regional agglomeration forces in the form of regional anchor firms, spatial polarisation unfolded through low income and job growth, outmigration and a correspondingly high concentration of deprivation and vulnerability, which is difficult to address given more limited tax revenue available for public investment.

At the same time, there were some pockets of recovery as evidenced empirically by the emergence of individual hotspots in high-tech industries – an opto-electronics hotspot around Jena and a pharmaceutical hotspot in what used to be the chemical triangle around Halle-Leipzig-Bitterfeld. Tracing industrial recovery in the opto-electronics hotspot around Jena, we illustrate the critical role played by the recreation of anchor firm functions under state-ownership. Critical in supporting regional resilience was not just the presence of regional anchor firms but also their nature, with Jena-based anchor firms operating under regional state ownership and on cooperative models. Hence, the East German case also helps to identify the types of regional industrial policy, which can help to revert structurally dependent productive positions thereby complementing foundational economy focussed measures. What is critical to the poly-centric emergence of agglomeration economies is not just the removal of barriers to agglomeration economies as emphasised by place-sensitive approaches but also the nurturing of an agglomerating force in the form of socially useful regional anchor firms in the first place. Together, these findings contribute empirically to the understanding of the structural economic drivers of peripheralisation in transition economies and the types of agency, which can alter such structurally disadvantaging conditions.

The article is structured as follows: Section 1 reviews the literature on why left-behind places exist and persist and how regional development can be supported by policy. Section 2 situates the case study of East Germany and reviews the transition shock, focussing on the dynamics of de-industrialisation and peripheral integration into West German production structures. Section 3 documents the lasting consequences of the transition shock in terms of a persisting gap in manufacturing density and a persistent peripheral position in German production structures. Section 4 reviews a pocket of resilience in the opto-electronics cluster around Jenoptik and Zeiss in Jena and surrounding regions.

1. The intensification, persistence and significance of spatially uneven development

Left-behind places exist, have intensified, persist and they matter.

The economic geography literature documented the intensification, persistence and significance of spatially uneven regional development within the EU. First, a growing body of evidence demonstrates why left-behind places matter. On the one hand, spatially uneven regional development is a problem in itself, given the challenges it poses in managing demographic dynamics, the provision of health, education, social care and infrastructure services and the need it imposes for redistribution (Fiorentino et al., 2024; Leyshon, 2021). On the other hand, economic geography and political geography overlap, manifesting as high levels of political discontent and increased support for populist parties in regions that have been left behind. In Europe, the most significant factor behind the rise of far-right populism is economic decline (Dijkstra et al., 2020; Rodríguez-Pose et al., 2023; Rodríguez-Pose, Dijkstra, et al., 2024).

Second, spatial inequalities have intensified almost everywhere within high income economies since the early to mid-1980s (Iammarino et al., 2019; Fiorentino et al., 2024; Kemeny & Storper, 2024)

informing a growing body of literature on peripheralization (Kühn et al., 2017; Kühn, 2015), regional development traps (Diemer et al., 2022; Rodríguez-Pose, Dijkstra, et al., 2024); and left-behind places (Pike et al., 2024). Increasing unevenness is observable at different geographical scales whether global, national, regional or local, and coincides with fundamental changes to global productive systems over the past forty years including the vertical disintegration of production in Global Value Chains with attendant competition in low-wage productive activities and skills-biased technological change; the growing weight of finance in and over productive activities (financialisation), and the demise of socialist production systems (Fiorentino et al., 2024; Martin et al., 2021). The impact of these global economic transformations on spatial unevenness has been intensified by shifting dominant macroeconomic policy paradigms toward neoliberalism, including varying degrees of deregulation, privatization, austerity, and the promotion of finance within productive systems (Fiorentino et al., 2024; Leyshon, 2021).

Third, spatially uneven regional development is not just *multi-dimensional* involving economic, political and sociological dimensions; *multi-scalar*, i.e. being observable at different geographical scales from global to sub-national, it is also *relational* in the sense that the growth of the core and the stagnation of the periphery are linked or even causally related (Kühn, 2015). The impact of global economic transformations and policy shocks therefore has not just been spatially uneven, favouring certain cities and regions whilst leaving others marginalized and 'left behind' from the economic progress but has also been self-reinforcing meaning that gaps in economic performance can persist and amplify. Yet, peripheralization is also *temporal*, meaning that agency has the potential to alter the structural conditions which constrain peripheralized regions (Kühn, 2015). This is understood in evolutionary economic geography in terms of varying levels of regional resilience (Di Tommaso et al., 2023; Martin & Gardiner, 2019; Martin et al., 2016). In an interplay between industry, networks and policy, such regional resilience is determined both by a region's short-term capacity to absorb shocks and by its long-term ability to establish new growth trajectories. Here, short-term and long-term aspects of regional resilience are linked in that shocks can have a permanent effect on the capacity of regional productive systems to develop new growth paths (Boschma, 2015; Pike et al., 2010).

There is ongoing debate about the types of policy which can support short- and long-term regional resilience

The dominant regional development policy approach draws on the theoretical foundations of New Economic Geography (NEG). The central premise of NEG is that the clustering of economic activity at subnational level promotes innovation and productivity growth. This occurs because concentrations of firms and skilled workers facilitate knowledge spill-overs, economies of scale and scope. Policy should therefore focus on encouraging urban and regional clusters to harness these benefits. Yet, it has been recognised that policies capitalising on agglomeration effects as suggested by NEG frameworks, have actually amplified regional economic divergence (Fiorentino et al., 2024; Rodríguez-Pose, Bartalucci, et al., 2024; MacKinnon et al., 2022; Rodríguez-Pose, 2018) sparking debates about alternatives.

So-called *place-sensitive* approach (Rodríguez-Pose, Bartalucci, et al., 2024; Iammarino et al., 2019), emphasise that such polarising effects of agglomeration enhancing regional policy framework stem from numerous market-failures in the spatial diffusion of agglomeration effects, including barriers in physical connectivity (distance decay) or barriers to labour migration among other. With that in mind, place-sensitive approaches propose growth-based frameworks, which focus on addressing the challenges faced by different 'clubs' of underperforming regional economies in Europe. Regional development policy should both be sensitive to the needs of agglomeration economies and create the

conditions for them to occur in as many places as possible. For low performing regions, it is argued that regional development policy needs to focus on removing the barriers to the spread of agglomeration economies by improving institutional quality, connectivity and labour force skills (Rodríguez-Pose, Bartalucci, et al., 2024; Iammarino et al., 2019; Rodríguez-Pose, 2018).

By contrast, *place-based, people-centred* approaches (MacKinnon et al., 2022; Kinossian, 2018) propose that political discontent, collective feelings of embitterment and exclusion go much beyond economic factors. 'Left behind' places encompass economic, social, demographic, political, and cultural dimensions. They face relative economic underperformance, lower educational qualifications, higher poverty, out-migration, demographic shrinkage, poor health, limited connectivity, reduced services, political disengagement, and a lack of civic assets and community facilities (Pike et al., 2024). The collective dissatisfaction in left-behind regions ultimately stems from a shared grievance over the decline in their economic, political, and cultural standing *relative to* more prosperous regions. The ultimate drivers of discontent being relational and multi-dimensional, place-based approaches propose a post-growth, foundational-economy centred regional policy agenda to rebuild a sense of belonging and attachment, including a focus on housing, utilities, transport and social infrastructure (MacKinnon et al., 2022; Kinossian, 2018).

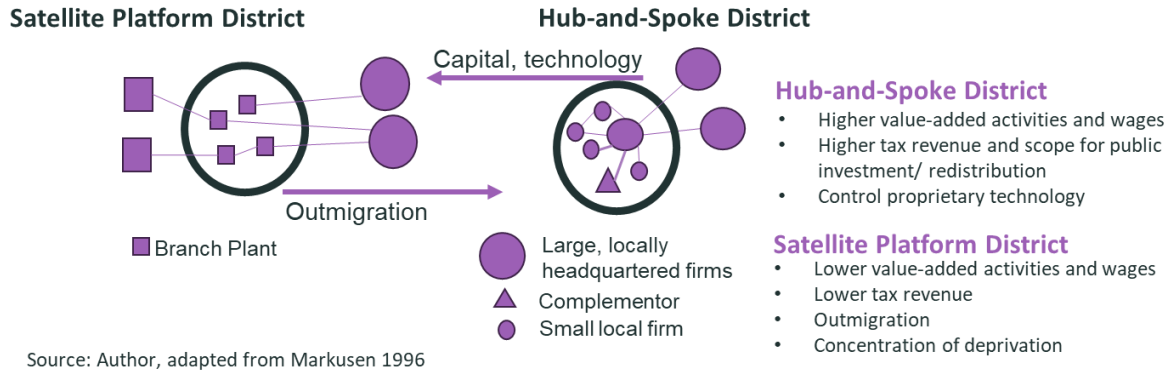
Why does left-behindness persist: the drivers of regional development traps.

Growth-oriented and foundational-economy-focussed approaches can be seen as complementary policy options. However, the effectiveness of growth-oriented measures hinges on identifying the fundamental structural drivers of subnational peripheralization. Drawing on structuralist theories of cumulative causation, we argue that supporting the poly-centric emergence of agglomeration economies hinges on nurturing a socially useful agglomeration force in the first place not just addressing barriers to the diffusion of agglomeration economies.

A critical factor in the emergence of spatial productive hierarchies relates to the role assumed by large firms in the regional productive ecosystem. In so-called Hub-and-Spoke industrial districts, large regionally headquartered core firms act as an agglomerating force attracting and structuring the activities of other, smaller firms (Markusen, 1996; Figure 1). These so-called anchor firms (Feldman 2003) generate a gravitational pull towards themselves and shape regional productive activities, supporting cumulative causation and IRS from interconnection of technologies and firms within the area. Anchor firms attract new start-ups that often specialize in similar or related fields and cater highly specialised input demand of lead firms, whether as complementors that contribute to the development of core technology, as suppliers or distributors. As the region gains a reputation for its expertise, it attracts additional companies focused on related applications or products, thereby generating a gravitational pull towards the region (Feldman 2003). Such anchor functions might be assumed by government institutions in State-anchored industrial districts (Markusen, 1996). By contrast, Satellite Platform Industrial districts are comprised chiefly of branch plants (either high-tech or low-wage/ low-tax) of externally-owned and headquartered firms (Markusen, 1996; Figure 1). The absence of regionally headquartered core firms is a driver of structural dependency in Satellite industrial districts. Multinational corporations (MNCs) retain the highest value-added activities near the headquarters (Hymer 1972). Consequently, as functions such as goal setting, planning, and research and development are concentrated near the headquarters, spatial hierarchies in value creation prevail, value creation being concentrated in certain cities and regions in advanced regions paired with a widespread diffusion of low-tier activities concentrated in lagging-behind regions (Iammarino & McCann, 2018).

Such polarising effects are self-reinforcing economically, politically and sociologically in accumulation regimes based in increasing returns to scale (IRS). The circular cumulative relationship between output and productivity growth allows first movers to accumulate resources and capabilities at an increasingly faster rate. Myrdal (1957) has conceptualised this as 'backwash' and 'spread' effects: whilst IRS in agglomeration economies can benefit peripheries through extended markets and or access to improved technologies (spread-effects), first movers in the centre can accumulate at an ever-faster rate and through their progressively dominant position also hold-back the development of the periphery (back-wash effects). 'Spread-effects' are typically not strong enough to counterbalance backwash effects. As economies of scale and scope enable core regions to achieve cost reductions and productivity gains, and as innovation generates new markets in the centre, these core areas become hubs of economic, technological, and social innovation. This accelerates the decline of peripheral regions by draining capital and labour (usually of the younger, highly qualified and better educated sections of the population) away from the periphery. The dependence of the periphery on the core reduces the ability of the periphery to pursue independent development policies thereby generating dependence upon more prosperous localities for the provision of funding and services. Indeed, Markusen (1996) finds that Satellite industrial districts are typically characterised by dependence on finance, investment, technical expertise and business services, absence of long-term commitments to local suppliers as well as high rates of in-migration of low-skilled labour and out-migration at managerial, professional, technical levels (Markusen, 1996). Additionally, this economic cumulative causation results in inequalities in non-economic aspects, such as political power (e.g. decision-making processes and control over agenda-setting), cultural dominance and social marginalisation (Friedman 1973; Kühn et al., 2017). Further, Leibert & Golinski (2017) highlight sociological exclusion mechanisms of discursive marginalisation or stigmatisation through the creation and perpetuation of negative regional images.

Figure 1. The production of spatial hierarchies through different productive ecosystems



Source: Author, adapted from Markusen 1996

Reinforced by policy: policy induced monopoly power and finance. Feldman et al. (2021) argue that the spatial polarization of prosperity through Myrdalian backwash effects has been exacerbated by institutional changes since the 1980s. These changes, favouring finance and network industries, have allowed dominant firms to strengthen their market power. This institutional environment has amplified the benefits of spatial proximity, enhancing the gravitational pull of agglomeration economies whilst also exacerbating large-firm dominance within industrial districts. Deregulated finance enables financial actors to shift resources to firms with higher earnings prospects based on expectation of market power and monopoly rents, while extended intellectual property rights protections in industries like big tech and pharma help incumbents internalise economies of scale, reinforcing winner-take-all dynamics. High-growth startups in scalable industries benefit from being close to venture capitalists and large firms, as working towards acquisition by incumbents is often the only viable strategy for SMEs, drawing successful firms away from their original locations to major economic

centres. This dynamic perpetuates localised returns and creates "superstar" cities and clusters, making it increasingly difficult for other areas to compete.

To address the spatially polarising forces of accumulation regimes based on IRS, nurturing and creating an agglomerating force is critical beyond addressing market failures to agglomeration economies. Here, anchor firms can be harnessed as a regional development tool. Given potentially rentierist tendencies and monopolisation dynamics around large-firms in industrial cluster (Feldman 2021), the nature of anchor firms matters as much as their presence. Given the unique potential for productivity increases and linkage formation in manufacturing (Thirlwall, 1983), anchor firms operating in proprietary control of technology in high-value added manufacturing sectors have strong potential to generate agglomeration forces. A mission-oriented design of innovation policy around health, green tech or agri tech could be harnessed to hold in check rentierist monopolisation dynamics around large firms (Mazzucato, 2021).

2. Regional polarisation in Germany: the neoliberal transition shock in the peripheral integration of the East German manufacturing into German production structures

This section shows that the destruction of anchor firms in the privatisation process led to a peripheral integration of the remaining East German manufacturing base into German production networks. Operated by the Treuhandanstalt (THA), the East German privatisation process unfolded against a neoliberal policy turn and unequal power relations (Priewe 1993, Carlin 1992, Carlin 1994, Roesler 1994a, Hall and Ludwig 1995; Hall & Ludwig 1993). East German firms were often in bad conditions when considering the state of their capital stock (Roesler, 1994b) and indebtedness (Priewe, 1993), and they faced structural disadvantages given the near total collapse of domestic and external markets[1] (Hall & Ludwig, 2008; Priewe, 1993; Roesler 1994b) as well as labour cost disadvantages under the unified labour market and currency union (Carlin, 1992; Carlin, 1994). The policy debate on how to deal with these structural disadvantages unfolded against a neoliberal policy moment. Liberal economists, backed by the neoclassical economic mainstream that viewed state intervention – whether the monetary union or transfer payments to East Germany - as market-distorting (e.g. Snower & Merkl, 2006), used East Germany's economic transition to advocate for reduced state involvement (Damm, 2017). At the same time, the privatisation process happened on terms of unequal power relations. East Germany was highly indebted, with most of its debt held by West Germany. The political weight of East German regional governments and representatives of industry was limited, leaving little scope to push for alternatives routes such as industrial restructuring and infant industry-type nurturing of transition enterprises (Kehrer, 2000). Several detailed proposals were rejected both by the THA and the federal government, who, instead, placed their confidence in market forces (Priewe, 1993). Power-imbalances were also evident in the governance structure of the THA, the management of which was almost exclusively West German, including West German managers who competed in the same market as the transitioning East German firms (Priewe, 1993; Carlin, 1992).

This setting of unequal power relations against the background of a neoliberal policy turn guided the nature of the privatisation process, which was distinct in terms of its speed and its method. The THA was under political pressure to privatise rapidly and without prior allegedly market-distorting rehabilitation. In fact firms under THA trusteeship were actively prevented from productivity enhancing investment prior to privatisation (Priewe, 1993; Roesler, 1994b). Privatisation was carried

[1] The overnight liberalization of markets resulted in the collapse of virtually all markets. External markets collapsed in the East bloc and in the Western market due to the removal of export subsidies. The East German internal market collapsed due to shifting consumer preferences (Hall & Ludwig, 2008; Priewe, 1993; Roesler 1994). The example of Berlin-Kosmetik underscored this, where the THA allowed modernizing investments before privatization, yet major retailers refused to stock Berlin cosmetic products (Roesler, 1994b).

out at a speed by far exceeding that in CEE economies: by 1993, 95% of publicly owned enterprises privatised (Roesler, 1994a). The THA disregarded common privatization methods used in other Eastern European economies such as public listing, voucher schemes, management or workers' buy-outs (Priewe, 1993) and instead relied on direct negotiations with West German firms operating in the same industry to privatize East Germany's assets. Together, about 90% of East German assets were transferred to West German companies (Hall & Ludwig, 1995), based on contacts established by the THA's supervisory board (Roesler, 1994b; Priewe, 1993). This approach was justified at the time by the lack of private capital and entrepreneurial skills in East Germany, as well as the need to retain managerial control in privatized enterprises (Carlin, 1992).

The privatisation process structurally altered the position and productive capabilities of East German firms. *First*, the speed of privatisation entailed an excess loss of productive capacity. 70% of firms placed under THA ownership were classified as independently viable or potentially viable by the THA prior to privatisation (Kehrer, 2000). By 1992, total industrial production in East Germany had declined to less than 30% of its 1989 levels. Within two years of reunification, over 3.2 million jobs were lost, and by 1992, 46% of the East German labour force was either unemployed or underemployed in job creation schemes (ABM) (Roesler, 1994b). The deindustrialization process was unprecedented in its depth, affecting the entire manufacturing sector rather than individual industries, and in its rapid pace, unfolding over just two years. Typically, industrial declines, such as in the Saar region, occurred gradually over a decade or more and impacted thousands rather than millions of workers (Damm, 2017). The neoliberal push for a rapid sale occurred under adverse market conditions. Given the near total collapse of domestic and external markets, the THA struggled to attract investors and was therefore forced to award contracts to bidders with speculative or even fraudulent motives and to those focussed on securing dominant positions in the East German regional market (Priewe, 1993; Schulz, 2013; Hall & Ludwig, 1995). Many THA companies, which were independently viable or could have been after restructuring, were sold to market-dominating West German investors (Priewe, 1993). Under these conditions, the sales proceeds from privatisation covered merely 38% of the THA's running costs let alone generating any surplus from the sale of East German assets (Roesler, 1994a). Regardless of market conditions, many West German investors showed limited interest in purchasing new capacity in East Germany and preferred to meet East German demand by expanding their production capacities in their established production sites, where conditions were more familiar and there was no need to deal with uncertainties surrounding the workforce and infrastructure (Roesler, 1994a).

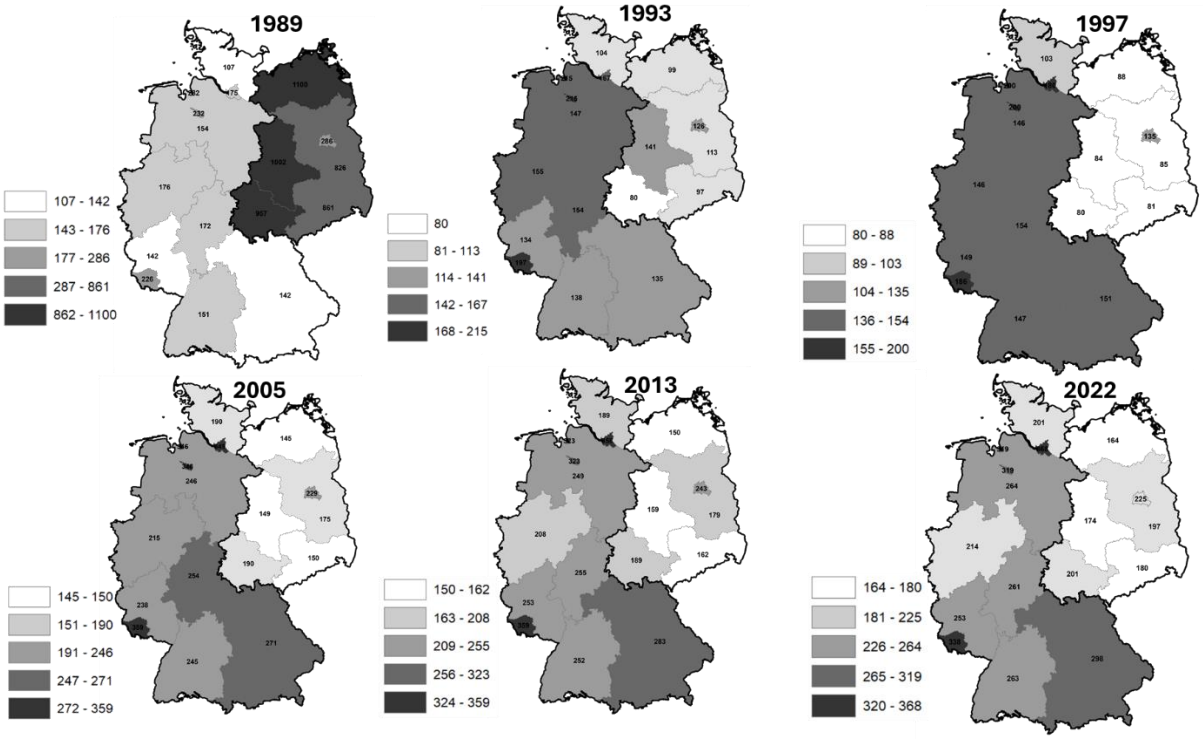
Second, the privatisation method had profound consequences for the productive ecosystem through the destruction of anchor firms. To implement the privatisation method, the size difference between East and West Germany enterprises at the time of reunification needed to be overcome. East German firms were significantly larger on average, production being dominated by large, vertically integrated combines (Kehrer, 2000). The average Kombinat employed 20,000 people. The average East German firm counted 893 employees, compared to just 190 in West Germany (Carlin, 1992). A central part of the THA's work was therefore to break up, strip down, and recombining parts of former combines into units sellable to West German SMEs (Carlin, 1992). Management buy-outs being considered as a last resort and voucher scheme favouring dispersed ownership being ruled out altogether, meant that East Germans were by design excluded or at least disfavoured in the ownership transfer (Carlin, 1992; Roesler, 1994b). As such, about 90% of the East German capital stock to individuals and firms headquartered in West Germany (Hall & Ludwig, 2009).

The destruction of large industrial firms and ownership transfer to firms headquartered in West Germany resulted in a void of regional anchor firms and transformed the remaining East German

industrial base into extended workbenches producing intermediate inputs in branch plant facilities owned by West German firms, which retained higher value added activities spatially close to the Western based headquarters (Hall & Ludwig, 2009; Hall & Ludwig, 2008). The absence of regional anchor firms hindered the development of viable SMEs (Roesler, 1994b), influencing their research-intensity, innovation capacity and the density of producer related services.

To this day, East German districts suffer from a persistent gap in local anchor firms. The break-up of the industrial combines, necessary to create sellable units for West German investors, was followed by a disproportionately large number of SMEs. Whilst in 1989, the average firm size in all East German regions clustered in the top two clusters, by 2022 average firm size in all East German regions clustered in the two lowest clusters. No West German region appeared in the lowest cluster in 2022 (Figure 2).

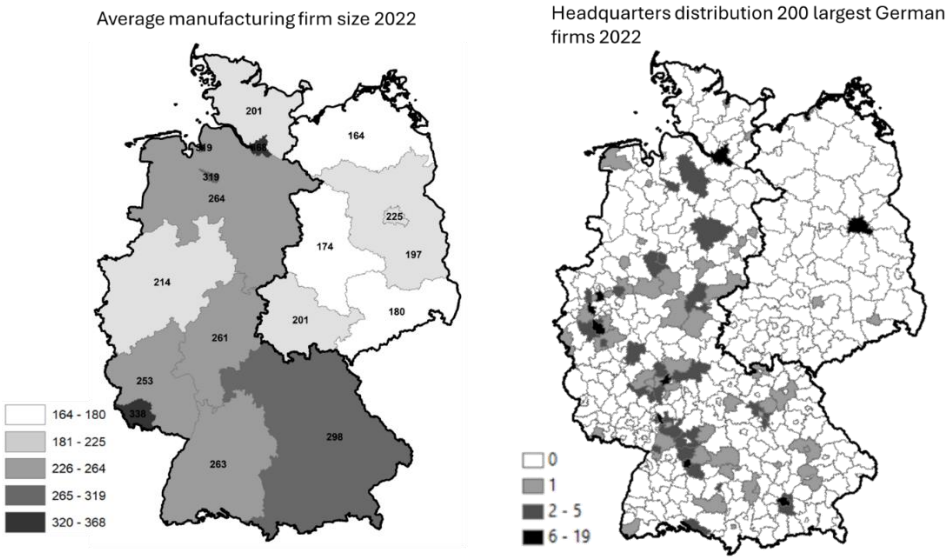
Figure 2. Average Manufacturing Firm Size (natural breaks)



Calculations based on: Statistisches Jahrbuch der DDR 1990; Statistische Jahrbucher der Bundesrepublik 1990, 1992, 1998; Volkswirtschaftliche Gesamtrechnung der Lander 2005-2022

These SMEs operate largely in the absence of large, regionally headquartered firms. By 2022, only three of Germany's largest 200 firms in industry, commerce and services were headquartered in East Germany (Figure 3).

Figure 3. Average manufacturing firm size and distribution of headquarters in 2022



Calculations based on: Volkswirtschaftliche Gesamtrechnung der Lander2022 and FAZ(2023) Die 100 Größten

3. Long-neoliberalism: the lasting consequences of neoliberal shock therapy…

This section uses geospatial analysis techniques to demonstrate the lasting effects of the transition shock on the East German productive system, documenting specifically a lasting manufacturing gap (as measured in manufacturing employment per 1,000 residents) and a lasting peripheral position of East German firms in the German productive system (as measured by value added captured by East German firms and high-tech intensity of manufacturing employment). This suggests limited long-term regional resilience (i.e. ability to carve out new growth paths). The absence of regional anchor firms that could act as an agglomerating force triggered strong Myrdalian backwash effects through low income and job growth, outmigration and limited tax revenue available for public investment.

The following section uses geospatial clustering and hotspot analysis to trace any lasting effects of the privatisation programme. *Natural breaks clustering* analysis based on the Jenks natural breaks optimisation is used to divide geospatial data into clusters that are as internally homogeneous as possible while maximising the differences between the classes. *Getis-Ord Gi* statistic*s 'hotspots' and 'coldspots' in spatial data. To evaluate whether high or low values cluster spatially, the Getis-Ord Gi* statistic determines the degree to which a value at a given location is higher or lower than expected based on the values at neighbouring locations. The Gi* statistic for a feature i is defined as:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{ij}x_j - \bar{X}\sum_{j=1}^{n} w_{ij}}{s\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{ij}^2 - \left(\sum_{j=1}^{n} w_{ij}\right)^2\right]}{n-1}}}$$

where:

- x_j is the attribute value at location j.

- w_{ij} is the spatial weight between location i and location j. w_{ij} = if locations i and j are neighbours, and w_{ij} = 0 otherwise.
- $\bar{X}$ is the mean of the attribute values.
- S is the standard deviation of the attribute values.
- n is the total number of locations.

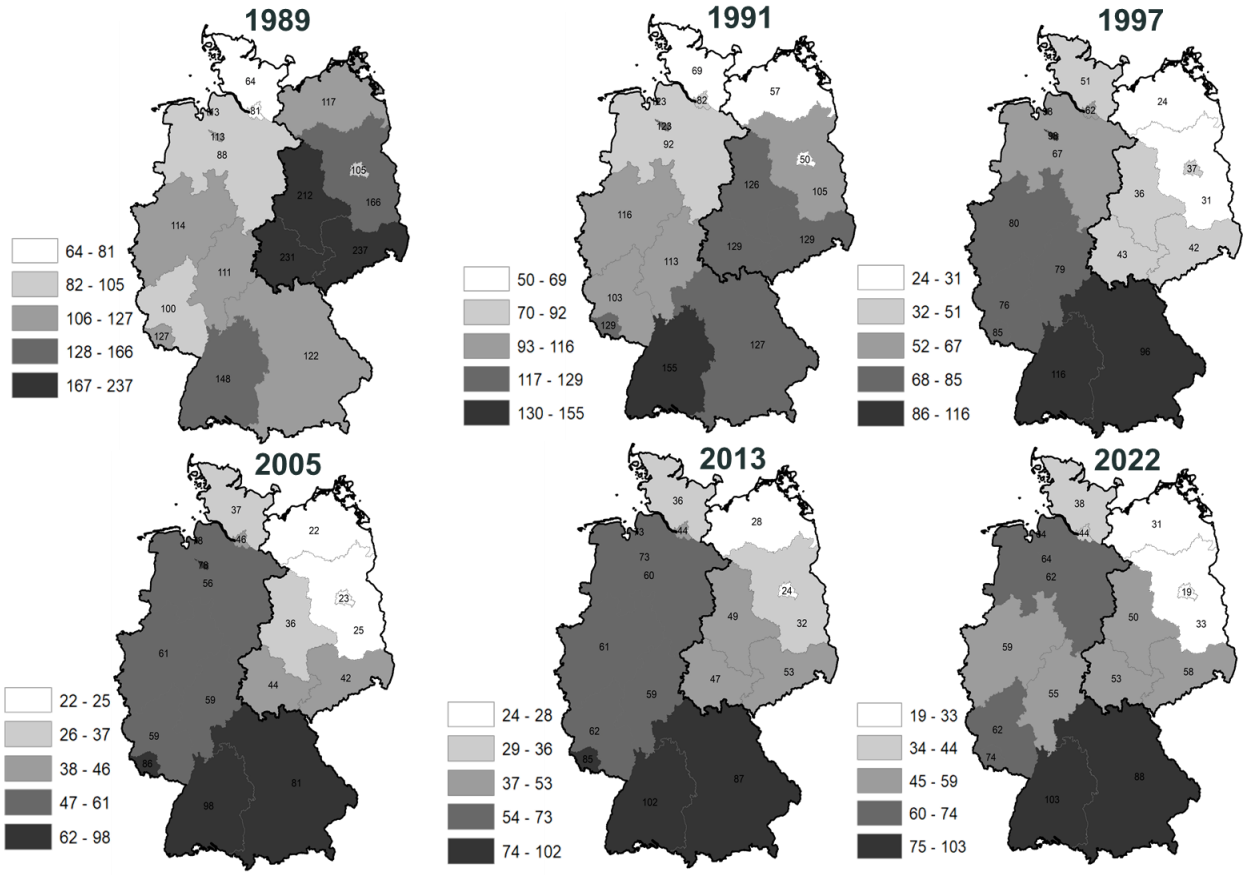
High Gi Values* indicate that a location is part of a cluster of high values (hotspot). Low Gi Values* indicate that a location is part of a cluster of low values (coldspot). Near-zero Gi Values* indicate that the location does not significantly deviate from the average spatial pattern. Statistical significance of the Gi Values* is established against critical values from a standard normal distribution.

Persistent though declining manufacturing gap

Figure 4 and Figure 5 show manufacturing density is measured as manufacturing employment per 1,000 residents at regional and district level. The advantage of measuring manufacturing density in this way is the feasibility to construct a data series including the period before reunification, which is not distorted by differences in the value accounting systems and hence comparable across East and West.

The Jenks natural breaks clustering reveals a persistent if narrowing gap in manufacturing density at regional level (Figure 4). Before reunification both parts of Germany were highly industrialised and positioned in leading roles in their respective blocs. Manufacturing density in the Southern parts of East Germany was substantially higher in 1989 that in any West German region, counting as many as 237 manufacturing workers per 1,000 residents in Saxony, 231 in Thuringia and 212 in Saxony-Anhalt. Manufacturing density declined across both parts of Germany over the period 1989 to 2022 but substantially faster in East German regions. Manufacturing density in Saxony declined to 42 in 1997, recovering to just 58 in 2022, in Mecklenburg-Vorpommern, the erstwhile East German laggard it declined from 117 in 1989 to 24 in 1997, recovering to 31 in 2022. The strongest performing East German regions (Thuringia and Saxony) only reach the medium cluster by 2022, i.e. more than three decades after reunification. Noticeable as well is that the lowest manufacturing density cluster in 2022 contains only East German regions, namely Brandenburg, Mecklenburg-Vorpommern and Berlin (Figure 4).

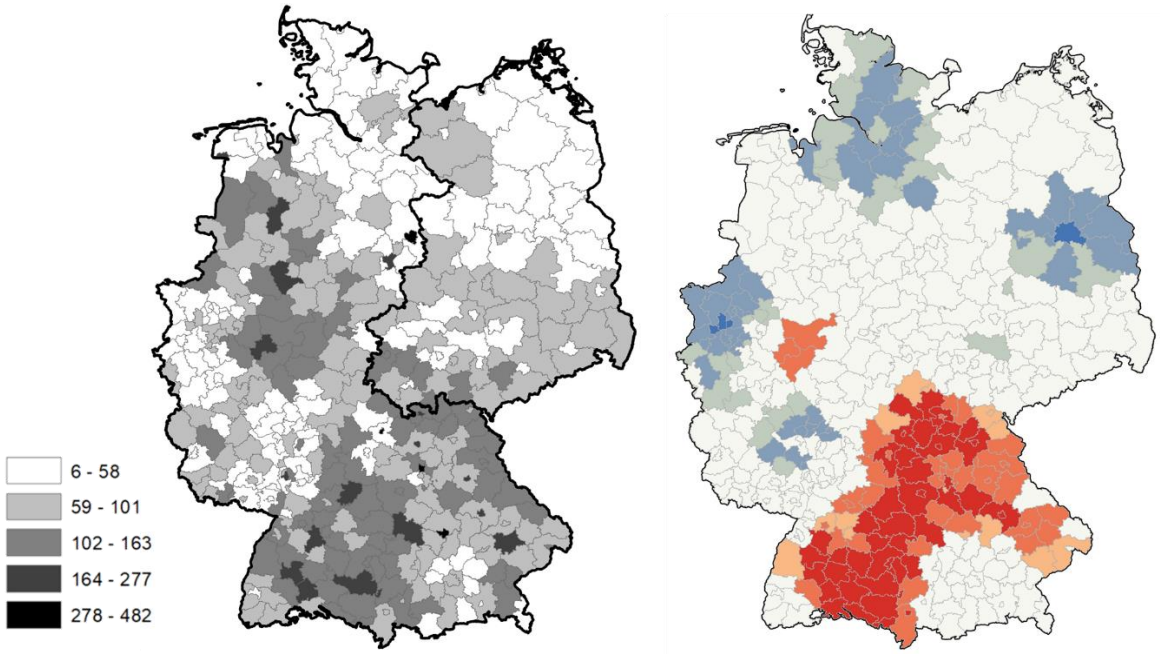
Figure 4. Manufacturing employment per 1,000 residents (natural breaks)



Calculations based on: Statistisches Jahrbuch der DDR 1990; Statistische Jahrbucher der Bundesrepublik 1990, 1992, 1998; Volkswirtschaftliche Gesamtrechnung der Lander 2005-2022

Figure 5 disaggregates manufacturing density by district for the year 2022 applying both natural break analysis and Getis-Ord Gi* hotspot/ cold spot analysis. The natural break analysis shows that East German districts are overrepresented in the lowest and second-lowest manufacturing density cluster (48% and 43% of East German districts falling into these two clusters respectively, against 35% and 35% of West German districts). Only seven East German districts (9%) have reached the middle cluster, against 24% of West German districts. None of the East German districts fall into the highest or second highest cluster (compared to 1% and 6% respectively of West German districts; **Table 1**). The hotspot analysis shows that although most East German districts do not significantly deviate from the average spatial pattern, we see significant cold-spots in East German districts (Brandenburg around Berlin) and practically no hotspots apart from three Thuringian districts (Sonneberg, Hildburghausen and Schmalkalden-Meiningen) close to the Bavarian border.

Figure 5. Manufacturing employment per 1,000 residents 2022 (natural breaks and hotspots)



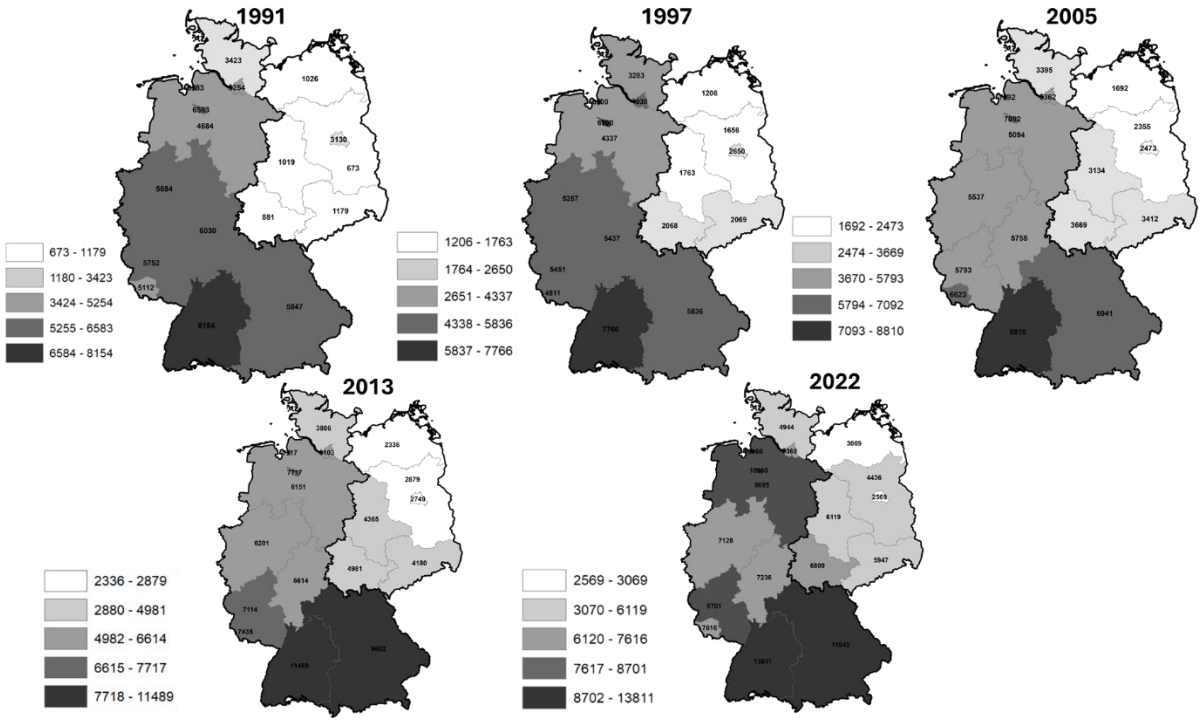
Calculations based on: Volkswirtschaftliche Gesamtrechnung der Lander2022

Table 1. Distribution of manufacturing density clusters across East and West German districts				
Manufacturing density 2022	**East German districts**		**West German districts**	
(Manufacturing employment per 1,000)	number	% of districts	number	% of districts
cluster 1 (6-58)	37	48%	112	35%
cluster 2 (59-101)	33	43%	112	35%
cluster 3 (102-163)	7	9%	78	24%
cluster 4 (164-277)	0	0%	18	6%
cluster 5 (278-482)	0	0%	4	1%

Persistent dependent manufacturing: From large industrial conglomerates to peripheral suppliers

In addition to the persisting manufacturing gap, the gap in local anchor firms correlates with a persistent peripheral position of East German firms in the German productive system, as evidenced by a persistent gap in the value added captured by East German manufacturing firms and the lower density of high-tech manufacturing sectors. The spatial concentration of headquarters (Figure 3) had persistent consequences for the location of high value-added firm activities. Persistent unequal value capture is illustrated in Figure 6 showing manufacturing value per capita over the period 1991 to 2022. Whilst the gap between East and West German regions narrows, it persists into 2022. By 2022, only one East German region (Thuringia) has reached the medium cluster whilst all other East German regions appear in the lowest two clusters.

Figure 6. Manufacturing value-added per capita (natural breaks)



Calculations based on: Statistische Jahrbucher der Bundesrepublik 1990, 1992, 1998; Volkswirtschaftliche Gesamtrechnung der Lander 2005-2022

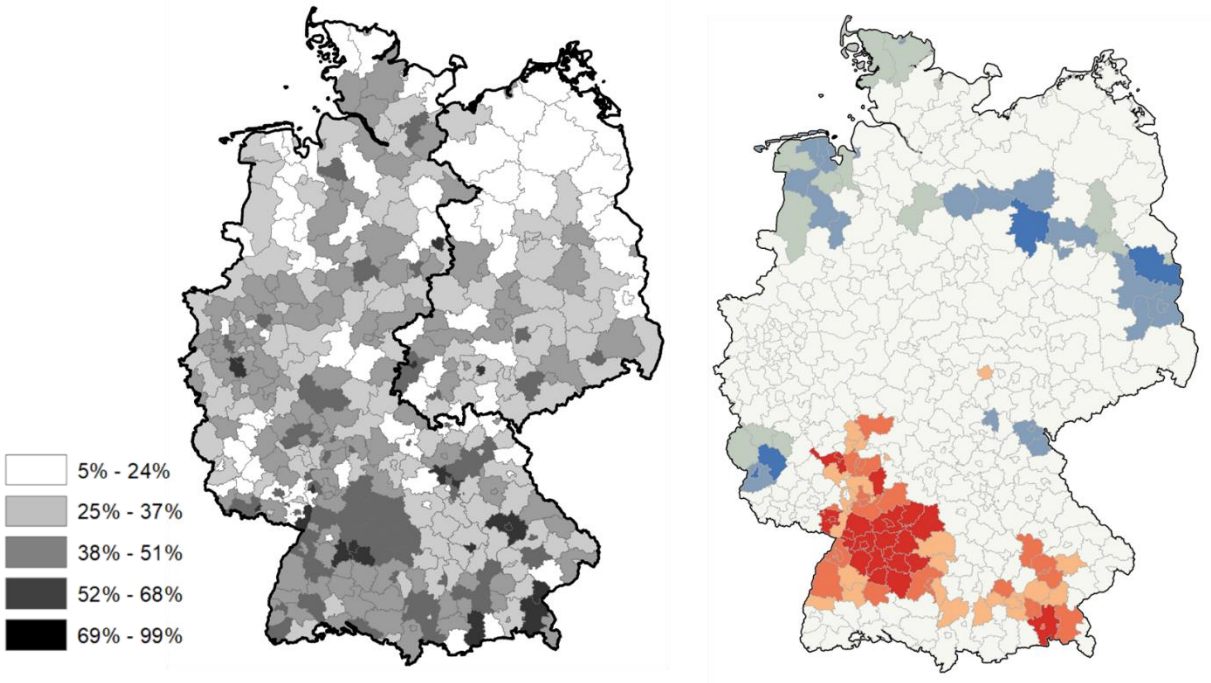
Lower value captured by East German manufacturing firms is in part driven by firm-level organisational hierarchies. For instance, R&D activities of manufacturing firms are still largely concentrated in West Germany, only 10% of private R&D employees in based in East Germany (Röhl & von Speicher 2009). Eickelpasch (2013) find that R&D employment as share of the total workforce is only 86% of the West German level, the distance being even more pronounced when looking at private firms only (48%).

Lower value capture is also driven by the sectoral decomposition of manufacturing. Figure 7 illustrates a persistent gap in technology-intensive manufacturing employment relative to total manufacturing employment at district level. Since 2008, sub-sectoral data on manufacturing published by the Statistical Offices of the Federal States (*Statistische Ämter der Länder*) follow ISIC Rev. 4 in their industry classification (WZ 2008). Of the two-digit codes, the following were classified as 'technology-intensive':

1) Manufacture of chemicals and chemical products
2) Manufacture of pharmaceuticals, medicinal chemical and botanical products
3) Manufacture of computer, electronic and optical products
4) Manufacture of electrical equipment
5) Manufacture of machinery and equipment
6) Manufacture of motor vehicles, trailers and semi-trailers

East German districts show considerably more cold spots and only a single hotspot district around Jena (Thuringia) when considering manufacturing employment in technology-intensive sectors. East German districts are overrepresented in the lowest two clusters and under-represented in the medium (23% of East German districts against 31% of West German districts) and the highest two clusters (6% and 3% of East German districts respectively against 16% and 5% of West German districts; **Table 2**).

Figure 7. Technology-intensive manufacturing employment as % total manufacturing employment 2022 (natural breaks and hotspots)



Calculations based on: Volkswirtschaftliche Gesamtrechnung der Lander 2022

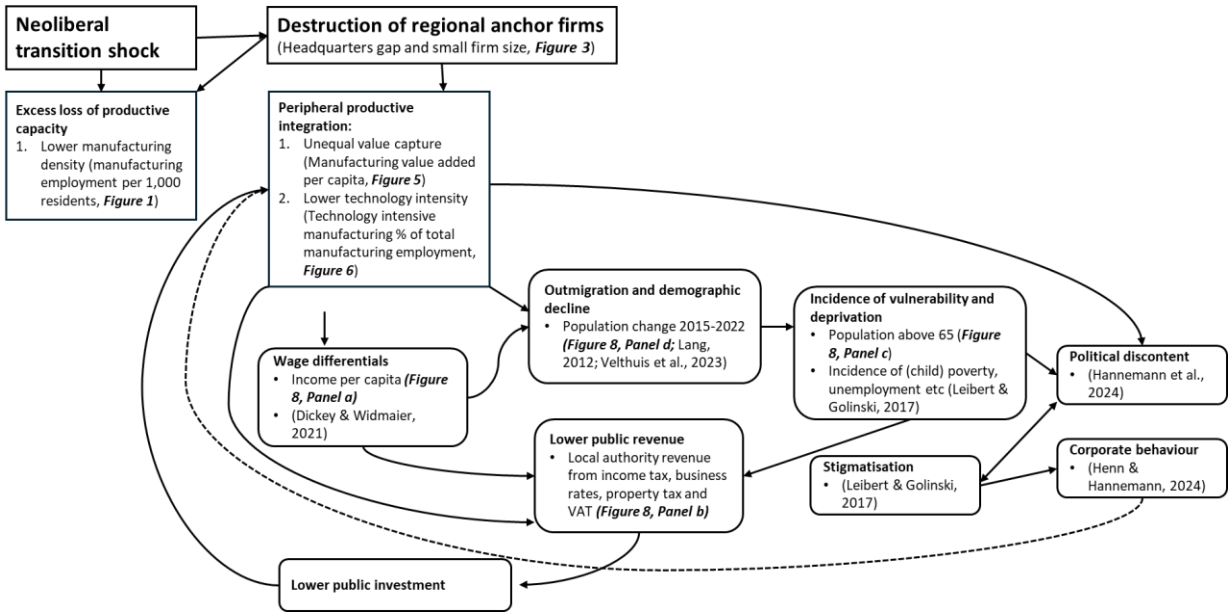
Table 2. Distribution of high-tech manufacturing intensity across East and West German districts				
High tech intensity 2022	**East German districts**		**West German districts**	
High tech manufacturing employment (% of total manufacturing)	number	% of districts	number	% of districts
cluster 1 (5-24)	25	32%	55	17%
cluster 2 (25-37)	27	35%	90	28%
cluster 3 (38-51)	18	23%	110	34%
cluster 4 (52-68)	5	6%	53	16%
cluster 5 (69-99)	2	3%	16	5%

Related dimensions of peripherality

From this peripheral productive position ensue interrelated and self-reinforcing dimensions of peripherality, traced in Figure 8 and documented in existing research on East Germany. The lower share of high-tech and high value-added manufacturing drives income (Figure 9, Panel a) and wage differentials (Dickey & Widmaier, 2021). The mass-unemployment ensuing from the transition process necessitated large transfers payments, which supported consumption but without effective support to rebuild productive capacity, unemployment remained consistently above West German regions, triggering a downward spiral of low income, poor job growth and outmigration (Hall & Ludwig, 2008; Hall & Ludwig, 2008). These, in turn, encourage outmigration, demographic decline (Lang, 2012; Velthuis et al., 2023; Figure 9, Panel d) and a concentration of older, vulnerable or deprived residents (Figure 9, Panel c) with attendant stigmatisation (Leibert & Golinski, 2017). The higher concentration

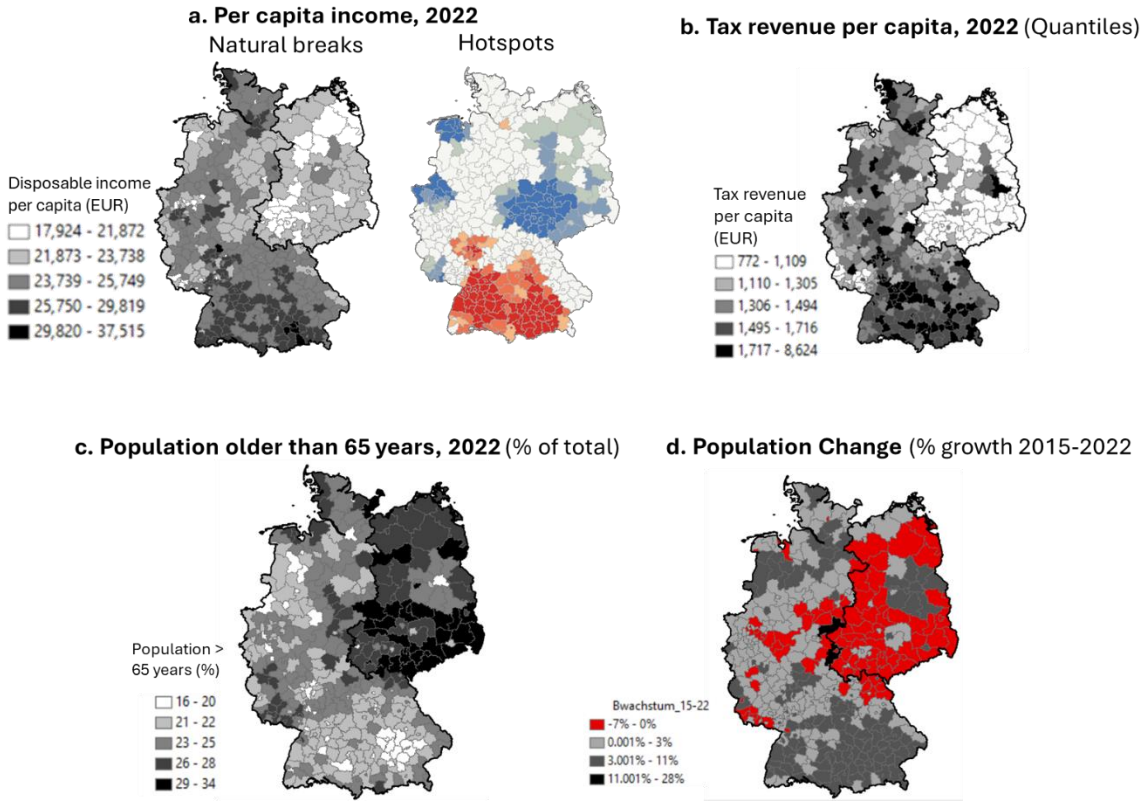
of vulnerability and deprivation increases demand on public spending, which cannot be met as the excess loss of productive capacity negatively impacts on local government funding through lower business rates and ground tax (Figure 9, Panel b). Such downward spirals have supported the emergence of collective disappointment and embitterment over the course of two generations feeding political discontent (Hannemann et al., 2024) and impacting on firm behaviour (Henn & Hannemann, 2024).

Figure 8. Lock-in mechanisms.



Source: Author

Figure 9. Related dimensions of peripherality



Similar dynamics of peripherality occurred in the EU's Southern periphery (Arestis & Paliginis 1995) and in Central and Eastern European (CEE) transition economies, which produce complex goods with cheap but highly skilled labour in a position of persistent dependency on core technology, FDI and markets (Nölke & Vliegenthart 2009; Michalski 2018; Bohle, 2018; Plank & Staritz 2013).

4. Some of its cures: the role of anchor firms in state-ownership supporting reindustrialisation in industrial cores

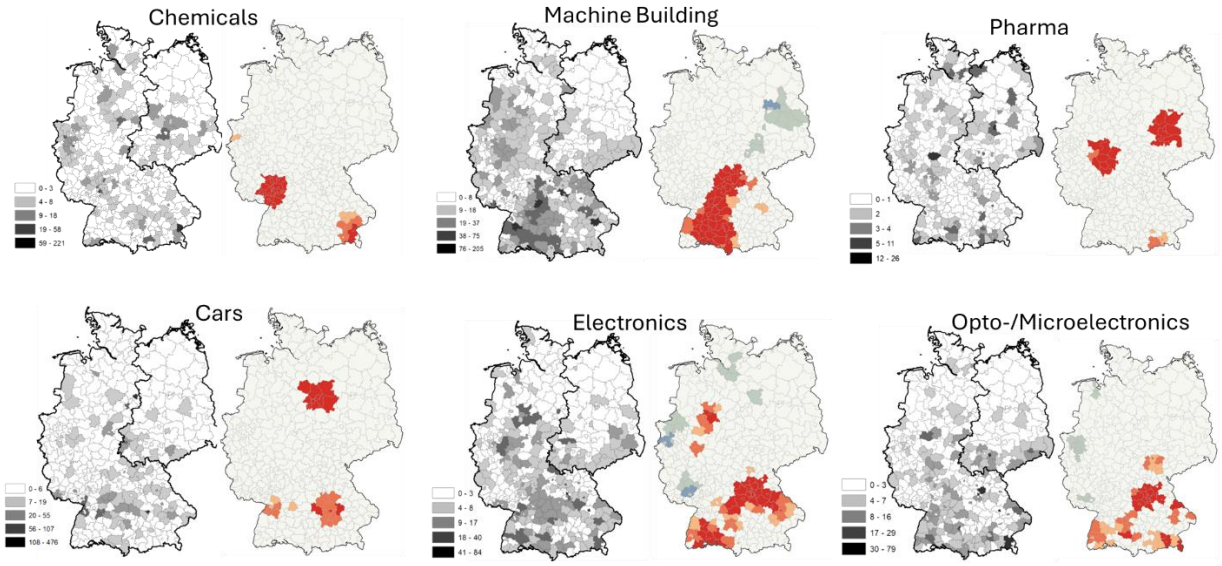
Some pockets of recovery in technology-intensive manufacturing

Though the manufacturing gap shows signs of narrowing it is still measurable in 2022 and East German manufacturing remains in a peripheral position when considering value added and the sectoral composition of manufacturing. However, two technology-intensive manufacturing sectors do show statistically significant employment hotspots in East German districts: 'pharmaceuticals, medicinal chemical and botanical products' around the former GDR 'chemical triangle' in Leipzig-Halle-Bitterfeld and 'computer, electronic and optical products' around Jena (Figure 10). This begs the question which factors supported the short-term and long-term resilience of these regions. In both cases, the recovery builds on capabilities going back to the socialist and pre-socialist era and an active regional industrial policy nurturing regional anchor firms.

Active support for productive capacity has played a subordinate role in intra-German fiscal transfers. Whilst the rapid collapse of the East German economy led to significant fiscal transfers (Roesler, 1994a), estimated at €1.5tn to €3.4tn between 1991 and 2018 (Deutscher Bundestag, 2020), the majority of these (60-70%) were transfer payments for unemployment benefit, pensions, health care etc., followed by infrastructure extension. Support for productive capacity was introduced from 1993

onwards when the disastrous consequences of the neoliberal transition model became apparent and policy efforts shifted towards the preservation of 'industrial cores' (Karlsch, 2017; Damm, 2017). Key initiatives included the "Investitionszulage" subsidising investment projects of manufacturing firms and producer-related services at a rate of 12.5% (25% for SMEs), "Gemeinschaftsaufgabe zur Verbesserung der regionalen Wirtschaftsstruktur", KfW subsidized credits, "Zentrales Innovationsprogramm für den Mittelstand" and the "EXIST" programme (Röhl & von Speicher, 2009: 22). These efforts, though beneficial (Röhl & von Speicher, 2009), were marked by conflicting interests with Western (West-German/ EU) producers (Karlsch, 2017) and took place against gravitational forces of spatial unevenness unleashed through the privatisation process traced in section 3. Where regional industrial policy was successful in counteracting such spatially polarising forces, it relied on effective mechanisms to nurture regional agglomerating forces as illustrated by the Jena optics cluster below.

Figure 10. Manufacturing employment per 1,000 residents by technology-intensive manufacturing sector (natural breaks and hotspots)



Calculations based on: Volkswirtschaftliche Gesamtrechnung der Lander 2022

The nurturing of regional anchor firms - Zeiss Meditec AG and Jenoptik AG in Jena

In 2023, Jena counted 17.7% employment in manufacturing, the vast majority of which is in research-intensive manufacturing which employs 14% of the workforce. This is significantly above German average of 11%. In addition, 28% of employees work in knowledge-intensive services, equally substantially above German average of 20%. In 2023, 266 patents were issued per 100,000, against a German average of 46 per 100,000. The city counts three related high tech clusters around opto-electronics – photonics, medical technology and precision technology, each structured by significant anchor firms, namely Jenoptik AG (1,700 employees), Zeiss Meditec AG (> 2,000 employees) and Schott AG (500 employees) (JenaWirtschaft, 2024).

All three anchor firms go back to a single company – Carl Zeiss Jena. Of the Jena-based anchor firms, Jenoptik AG and Zeiss Meditec AG as a subsidiary of the Zeiss Group are headquartered in Jena. The corporate headquarters of the Zeiss Group are in Oberkochen, the Schott AG headquarters in Mainz. The Carl Zeiss Jena company was founded in 1846 in Jena, Thuringia, producing optical precision equipment such as microscopes and lenses. From its outset, the company operated at the technological frontier building on a close collaboration with Jena-based physicist Ernst Abbe and glass

chemist Otto Schott, leading to significant advancements in optical theory and new types of optical glass essential for high-quality lenses and microscopes. In 1884, Zeiss, Schott and Abbe founded the Schott company producing optical and technical specialty glasses (Schott, 2024). After Carl Zeiss's death, the Zeiss company was transformed into a foundation-owned company (*Stiftungsunternehmen*) by Ernst Abbe in 1889. The shares of the Schott sister company were also transferred to the Carl Zeiss Foundation in 1891 (Carl Zeiss Stiftung, 2024a), which was set up to promote the company's strategic interests including the advancement of scientific research in optical precision mechanics but crucially also of productivity and innovative capabilities of the companies' workforce. Abbe understood the latter to be intricately linked to a reduction in social inequality and progressive work environments including, employee profit sharing, higher wages at reduced working hours, extensive pension and sick pay. This unique corporate model made Zeiss and Schott some of the most progressive firms in the industrial world at the beginning of the 20th century (Walter, 1999). From early on, Zeiss and Schott also structured the productive activities in the region and acted as an agglomerating force. In 1922, for instance, the annual congress of the German ophthalmological society moved from Heidelberg to Jena given advancements in ophthalmological precision equipment realised by the Zeiss medical technology segment (Donnerhacke & Fritsch, 2004).

Allied intelligence recognised Carl Zeiss Jena as a company whose technology was of strategic interest to Allied powers. Upon the liberation of Thuringia in April 1945, American forces therefore relocated Zeiss' most important intellectual property and physical assets and deported 77 of Zeiss' and 41 of Schott's leading engineers, scientists and managers from Jena to the American-occupied zone. As a result, the Zeiss Foundation companies were duplicated in East and West Germany, comprising the original company in Jena, under Soviet control since July 1945 and transferred to collective ownership in a Volkseigener Betrieb (VEB), and Zeiss West (headquartered in Oberkochen, Baden-Württemberg) as well as Schott West (headquartered in Mainz, Rhineland-Palatinate) (Schott, 2024; Zeiss, 2024).

Each Zeiss company operated within their respective political and economic systems, contributing to technological developments of their respective blocs. Zeiss West advanced to a typical West German medium size company benefitting from Marshall plan help, employing 8,278 in 1987. Zeiss East transformed into a large conglomerate employing 32,378 at the time of reunification (Mühlfriedel & Hellmuth, 1996; Steiner, 2020), playing a key role in the East German micro-electronics programme (Stokes, 2000; Augustine, 2007; Mühlhausen, 1999). Under the leadership of its notorious manager Wolfgang Biermann (Augustine, 2020), among the most significant areas of development at VEB Carl Zeiss Jena were lithography machinery for the production of semiconductors (Raab, 2020; Hahmann, 2011; Hacker, 1999) and electronic medical precision equipment a growing proportion of which was exported to the non-socialist world market throughout the 1980s (Donnerhacke & Fritsch, 2004).

At the time of reunification, the question emerged whether and under which terms to reunite the two Zeiss entities. As for other combines, the VEB Carl Zeiss Jena was split up and the core business parts around lithography and medical precision technology were acquired by Zeiss West in Oberkochen (Steiner, 2020; Mühlfriedel & Hellmuth, 1996). For this acquisition, Zeiss Oberkochen received DM 578million in subsidies from Thuringia and the THA, including debt settlement, equity and a five years coverage of financial losses (Deutscher Bundestag, 1992). Of the over 30,000 VEB Zeiss Jena employees, 2,800 were retained in 1991 following the integration into the Oberkochen based Zeiss group (Mühlfriedel & Hellmuth, 1996).

The viable non-core business parts of the VEB Carl Zeiss Jena, including laser, clean room technology and industrial measurement equipment, were retained in the newly formed 'Jenoptik Gmbh' under Thuringian state-ownership (Steiner, 2020). The state of Thuringia remains the largest shareholder holding 11% of shares in 2023 (Jenoptik, 2023). Not expected to survive reunification for very long,

Jenoptik advanced to a multinational photonics company with presence in over 80 countries, core competencies including laser technology, security and defence technology, and traffic safety systems. In the 1990s under the leadership of Lothar Späth, the former First Minister of Baden-Wurttemberg, Jenoptik advanced to an anchor firm under Thuringian state-ownership, deploying several strategies to attract related firms into the region. Doing so, Jenoptik significantly contributed to the preservation of a nucleus of industrial activities around optics and photonics, around which additional investors would settle or new businesses were founded (Heimpold, 2016).

First, Jenoptik sold most of the real estate inherited from the VEB, using the proceeds to attract investors to Jena. For instance, an investor centre was set up to provide support with bureaucratic processes and staff acquisition. By the end of 1996, these efforts attracted 47 investors to Jena, with 139 other employers leasing Jenoptik properties (Heimpold, 2016; Jenoptik, 2019).

Second, Jenoptik under Späth strategically acquired a number of West German firms, including among other Meissner und Wurst GmbH & Co. (Stuttgart) in 1994, Hagenuk Impulsphysik (Hamburg) in 1995 and ESW Extel Systems Wedel, specializing in civil and defence technology, in November 1997. These acquisitions were instrumental in building the company's and ultimately the region's short-term resilience to the transition shock because they allowed selling Jenoptik products through the established sales channels of the acquired companies, thereby stabilising demand conditions (Heimpold, 2016; Jenoptik, 2019). These strategic acquisitions were also critical in supporting long-term regional productive resilience because Späth insisted that the headquarters of the merged companies had to be in Jena (Donnerhacke & Fritsch, 2004).

Equally significant was third the support for local industry networks, supporting startups. Throughout the 1990s, Jenoptik GmbH supported the formation of industry networks, such as the Optics and Photonics Network OptoNet e.V. and the Health Technology and Medical Technology Network medways e.V., thereby further contributing to the establishment, settlement, and advancement of numerous technology-oriented companies in the city (Heimpold, 2016). In 2023, Jena counts a total of nine industry networks around its core industrial clusters in photonics, medical technology and precision technology. Moreover, Jenoptik AG collaborates with numerous partners from both academic and non-academic research institutions and industry (Heimpold, 2016). Jena counts 14 public research institutes, including among other three Max Planck Institutes, three Leibnitz Institutes, two Helmholz Institutes and one Fraunhofer Institute (JenaWirtschaft, 2024). Over 100 companies work in the field of laser manufacturing in Jena and its surroundings (JenaWirtschaft, 2015), making the region a significant photonics agglomeration in Germany after a brief stagnation following reunification (Wiederhold, 2000).

The opto-electronics hotspot in Jena and surrounding districts was further supported by the growth of a medical technology cluster, which was supported both by the growth of the reunited Zeiss and the Jenoptik Gmbh. Following a difficult start in the mid-1990s, the reunited Zeiss grew into large multinational company employing just under 43,000 workers worldwide as of 2023 (Zeiss Group, 2024), a success driven by the growth in the semiconductor technology segment. As per THA agreement, Zeiss committed itself to keep production facilities and its research centre in Jena. The reunited Zeiss entities in Jena and Oberkochen initially largely operated in competition with one another and disentangling the competencies between the East and West locations proved difficult initially, as both had a near identical portfolio (Mühlfriedel & Hellmuth, 1996; Donnerhacke & Fritsch, 2004). Though the medical technology segment was attributed to Jena, Zeiss Oberkochen initially retained the strategic management of the segment, which complicated operations. In 1995, the medical technologies segment including the strategic management was fully transferred to Jena (Donnerhacke & Fritsch, 2004). The growth of Zeiss' medical technology segment in Jena was critically

helped by the strategic acquisitions undertaken by Jenoptik, which entered in a joint venture with the medical laser producer Aesculap in 1996, later named Asclepion Meditec AG. Jenoptik CEO Späth again insisted for the headquarters of Asclepion to be moved to Jena. Zeiss Meditec later acquired Asclepion's ophthalmological laser segment in 2002 (Donnerhacke & Fritsch, 2004; Zimmermann, 2019), which account for 75.5% of Zeiss Meditec's revenue in 2023. Zeiss Meditec AG employs 4,823 workers worldwide of which more than 2,000 in Jena as of 2023 (Carl Zeiss Meditec, 2024; JenaWirtschaft, 2024). Around Zeiss Meditec, the 'medways' industry network, Jena-based public research institutes and university hospital emerged a cluster of several dozen medical engineering and technology companies (JenaWirtschaft, 2014).[2]

To note is the unique corporate model of the Jena-based anchor firms, Jenoptik AG, Zeiss Meditec AG and Schott AG. Jenoptik's largest shareholder remains the state of Thuringia holding 11% of shares. The largest shareholder of Zeiss Meditec AG is the Zeiss AG with 59.1% of shares (Carl Zeiss Meditec, 2024), which is owned entirely by the Carl Zeiss Foundation. The Carl Zeiss Foundation is also the sole owner of the Schott AG and is legally prohibited from selling its shares in Zeiss and Schott. Dividends attributed to the Carl Zeiss Foundation are used to promote science and technology in the fields of mathematics, computer science and natural science. Support is given to projects in the federal states of Baden-Württemberg, Rhineland Palatinate and Thuringia where the foundation companies are based. Among the largest private foundations committed to the promotion of science, 264 projects worth € 199.1 million have been funded by the Zeiss foundation in Thuringia since 2007, 483 projects worth €247.3 million in Baden-Württemberg and 211 projects worth € 116.5 million in Rhineland-Palatinate (Carl Zeiss Stiftung, 2024b).

Conclusions

Against the background of rising regional unevenness in high income economies, there is ongoing debate about how to support regional resilience to shocks and economic development in 'left-behind places'. Theoretical research shows that regional resilience, which has both short-term and long-term dimensions in terms of a region's ability to withstand shocks and to carve out new growth paths, is determined in the interplay between industry, networks and policy (Boschma, 2015). There are ongoing debates on the fundamental structural drivers of subnational peripheralization and effective agency against these fundamental drivers, i.e. appropriate regional development policy frameworks. *Place-sensitive* approaches to regional development emphasize tailoring policies and interventions to the specific characteristics and needs of different regions (Iammarino et al., 2019; Rodríguez-Pose, Bartalucci, et al., 2024). *Place-based, people centred* approaches propose post-growth, foundational-economy centred regional policy agenda centred around community well-being and sense of belonging (MacKinnon et al., 2022; Kinossian, 2018).

This article aimed to contribute to these questions about the drivers of spatial polarisation and its cures with a case study on East German de- and re-industrialisation after the reunification transition shock. The East German economy deindustrialised at historically unprecedented speed and sectoral breadth. By 1992, the East German industrial base reduced to under 30% of its 1989 levels, while 46% of the entire East German workforce were either un- or underemployed. Using natural breaks and Getis-Ord Gi* geospatial analysis techniques, the article documents a persistent manufacturing gap (as measured in manufacturing employment per 1,000 residents) and a lasting peripheral position of East German firms in the German productive system (as measured by value added captured by East German

[2] https://www.jenawirtschaft.de/fileadmin/user_upload/Gesundheitstechnologie_Jena-Liste.pdf

firms and high-tech intensity of manufacturing employment). This is indicative of limited long-term regional resilience despite historically unprecedented fiscal transfers. In the East German case, the neoliberal principles guiding the transition process during the early 1990s caused an excess loss of productive capacity. What caused 'long-neoliberalism' in the East German economy was the destruction of regional anchor firms following the break-up of the industrial combines, rendered necessary to create sellable units for West German investors in the privatisation process. The absence of regional anchor firms that could act as an agglomerating force triggered strong Myrdallian 'backwash effects' through low income and job growth, outmigration, high concentrations of vulnerability and deprivation and limited tax revenue available for public investment.

At the same time, there were some pockets of recovery as evidenced empirically by the emergence of individual hotspots in high-tech industries, with statistically significant hotspots forming in the former chemical triangle around Halle-Leipzig-Bitterfeld and around Jena in micro- and opto-electronics. Disaggregating the industrial history of Jena hotspot after reunification, we show that regional industrial policy recreated functions of anchor firms. Jena hosts three related high-tech opto-electronics clusters around photonics, medical technology and precision engineering, anchored by firms operating under distinct corporate models, including Jenoptik AG under regional state-ownership and the foundation-owned Carl Zeiss Meditec AG and Schott AG.

These findings contribute to the theoretical debates on the structural drivers of sub-national peripheralization processes showing that in the East German case, the destruction of anchor firms and associated loss of regional agglomerating forces was a critical factor impairing regional resilience. The article also contributes to the policy debates on the types of agency that can revert structurally disadvantaging conditions. What is critical to the poly-centric emergence of agglomeration economies is not just the removal of barriers to agglomeration such as connectivity or an adequately trained labour force but the creation and nurturing of an agglomeration force in the first instance. The Jena cluster also shows that it is not just the presence of anchor firms that appears critical but also their nature, the Jena-based anchor firms each operating on corporate models which facilitate channelling the gains from agglomeration economies into wider regional development.

This study's focus on East Germany limits the generalizability of its findings. Future research should explore whether similar dynamics are present in other Central and Eastern European transition economies. Additionally, investigating other successful regional clusters could provide further insights into the role and nature of anchor firms in fostering regional resilience and economic recovery.

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