Structural change of firms and of the workforce

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Abstract This report explores structural transformation between manufacturing and services for firms and employees in Austria. As a consequence of structural transformation from manufacturing to services, firms can go through an internal transition by increasing services components of the goods they produce. The results are sector switches, factoryless producers, or hybrid producers. First, we present evidence on the extent to which manufacturing firms increase service activities. Austrian manufacturing firms show some of the patterns typically associated with structural change in firms. While employment drops to the level of the average services firm, labor productivity—already high before the switch—further increases. Sectoral switchers have higher shares of intangible investment. Second, we analyze sector switches from the perspective of employees displaced from their employer. Sector and firm switching persons are already different before the displacement. They are younger and earn lower wages. Higher educational attainment increases the switching probability. After the switch, only persons switching within manufacturing can close the wage gap to non-switching persons. For individuals moving to non-market services, the wage gap widens further. Women and workers aged 50+ face higher probabilities of switching to part-time work after mass layoffs and of becoming unemployed or leaving the labor force. Younger displaced workers are more likely to enter knowledge-intensive service subsectors, but less likely to move into high-productivity service subsectors.

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Aim

The goal of this study is to examine structural change in Austria, focusing on structural change within firms, and sectoral transitions of employees. The results are intended to inform about the frequency of switching both of firms and employees, the characteristics of switchers, and the outcomes.

Firms undergo structural change either by expanding into services or by fully transitioning from manufacturing to services. This transformation occurs through functional change, where product-related services—such as product design or software supporting product use—gain importance, or through sectoral change, where firms shift entirely from producing goods to providing services. Intangible investments, including R&D and software, play a critical role in these transitions. This study provides evidence on Austrian firms moving from manufacturing to services and examines trends in employment, productivity, sales, and intangible investments over time.

A second part investigates workforce adaptation, examining whether employees can transition between sectors and which characteristics influence their mobility, such as age, education, and gender. The study further explores the impacts of sectoral transitions on wages, employment status, and movement from manufacturing to knowledge intensive services and high productivity services.

Main results

- Sector switching firms have higher labor productivity before the switch and increase labor productivity further after the switch. They also have higher shares of intangible investment. Their employment level drops after the switch.
- Probability of displacement is highest for the age group 15-24 and lowest for the age group 50+. For services employment, the probability increases stronger with higher educational attainment than for manufacturing.
- Displaced persons have lower wages already before displacement. Wages decrease after switches to non-market services, and increase after switches to a manufacturing firm.
- Women and older employees have higher probabilities of part time work after mass layoffs, and also for being unemployed or out of the labor force.
- Younger displaced persons are more likely to switch to knowledge intensive service subsectors, but less likely to switch to high productivity service subsectors.

Policy relevance

- Groups that more frequently experience a switch after firm's employment contraction could be preferred when considering support for sector switching. The study finds that young persons have higher probabilities of displacement after layoffs.
- Programs for adult learning can be increasingly targeted, tailored and evaluated with the goal to adjust to structural change and the new requirements it brings about. One example that may be usefully adjusted is the educational leave program.
- Programs to support displaced persons affected by structural change could focus on disadvantaged groups. In particular, women and older persons have higher probabilities of being unemployed or out of the labor force after displacement.

1   Introduction

In many advanced economies, the manufacturing sector has experienced a long-term decline in its share of both value added and employment relative to the total economy. These developments are accompanied by a corresponding rise in employment and value added in the service sector. This structural shift brings significant challenges: employees must acquire new skills, firms must adapt to technological change, and policymakers must address its implications for productivity growth. In Austria, the recent drop in manufacturing output has intensified concerns about structural change and raised the question of whether deindustrialization is underway.

Services play a critical role in driving productivity growth. Between 2013 and 2019, the three subsectors contributing most to overall productivity growth in the EU were wholesale and retail trade (G), information and communication (J), and administrative and support services (N). In the United States, the top contributors were information and communication (J), professional services (M), and finance and insurance (K). The gap in productivity contribution between the U.S. and the EU is particularly pronounced in these service subsectors, even though information and communication ranks among the top three in both regions. Information and communication is especially important because it underpins productivity improvements across other sectors as well (Draghi Report, European Commission, 2024).

Innovation capacity is another critical dimension of structural change. Traditionally, about two-thirds of business R&D spending originates from industrial firms, even though manufacturing accounts for only one-sixth of total value added (Rodrik, 2016; Lawrence and Edwards, 2013). A shift away from manufacturing could therefore reduce a country's innovation potential. Recent evidence points out how Europe already lags behind the United States in innovation performance (Fuest et al., 2024). While public R&D spending as a share of GDP is similar in both regions, corporate spending in Europe amounts to 1.2% of GDP compared to 2.3% in the U.S. Moreover, Europe's R&D focus remains concentrated in medium-tech sectors, whereas the U.S. increasingly invests in high-tech industries. For example, in 2003, two of the top three R&D-intensive firms were automotive companies in both regions. By 2023, all three leading U.S. firms were in software, while Europe's top three remained in the automotive sector. This raises concerns that Europe's growth potential may be constrained by insufficient emphasis on high-tech innovation.

The aim of this study is to examine structural change in Austria, focusing on several dimensions: structural change within firms, its relationship to R&D and other intangible investments, and its impact on employees. The first question is whether structural change occurs within firms—either through expanding service activities or by switching entirely to the service sector. Two mechanisms are central to this process: functional change, where product-related services such as design or software become increasingly important, and sectoral change, where firms move from selling goods to selling services. Intangible investments, including R&D and software, often play a pivotal role in these transitions. Section 2 provides background on structural change in Austria, highlighting the rise of services and the recent decline in manufacturing output following the energy crisis. Section 3 presents empirical evidence on Austrian firms switching from manufacturing to services and on the development of service activities within manufacturing firms, analyzing employment, productivity, sales, value added, and intangible investment over time.

The second question concerns how displaced employees adjust to structural shifts—particularly whether they transition to other sectors and which factors influence these transitions. Section 4 explores these workforce dynamics in detail.

2 Development of manufacturing

In Austria, the share of both value added and employment in manufacturing has declined over time, similar to trends observed in many other countries (Figure 1). Changes in these shares are commonly used indicators to describe structural change. Structural change refers to the shift of economic activity between sectors: from agriculture to manufacturing and then to services (Herrendorf et al., 2013). These developments are accompanied by an increase in employment and value added in the service sector.

Over time, differences have emerged between Austria and the comparison country groups. Until the financial and economic crisis, the decline in the share of value added and employment was more pronounced in the comparison groups. After the crisis and up to the COVID-19 pandemic, these trends stagnated at different levels. Since the pandemic, the share of value added has fallen in Austria, while it stagnated in the EU27 or increased in the BENESCAND group.[1] Employment share, on the other hand, stagnated in Austria and declined in the comparison groups.

Figure 1: **Share of value-added in manufacturing and market services**

Notes: Manufacturing: NACE C. Services: NACE G-N.
Source: Eurostat (nama_10_a64, nama_10_a64_e).

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[1] The BENESCAND group includes Belgium, the Netherlands, Denmark, Finland, Sweden.

The production index in manufacturing recovered in Austria after the downturn caused by the COVID-19 pandemic in 2021, following a trajectory similar to that of the EU27 (Figure 2). The decline from 2023 onward also mirrored this pattern. In the BENESCAND countries, the drop during the pandemic was less pronounced, and the subsequent decline after 2023 was only marginal. In the most recent months of 2025, the production index in Austria, as well as in the EU27 countries, returned to the level observed before the energy crisis. Unlike value added, the production index does not deduct intermediate inputs, and services provided by industrial enterprises are included only in cases of assembly, maintenance, or repair services (Bolz, 2025; Lehmann et al., 2025).

Figure 2: **Monthly manufacturing production quantity index**

Notes: Seasonally and calendar day adjusted data.
Source: Eurostat.

Table 1 shows the development of employment, gross value-added and labor productivity by broad sector. In Austria, the manufacturing share of employment (in hours worked) was 15.1% in 2023. The share decreased by 2.7 percentage points compared to 1995, which might be considered as a modest deindustrialization. Manufacturing hours worked decline stronger in BENESCAND (-6.3PP) and in the EU27 (-5,3PP) on average. Compared to BENESCAND, manufacturing in Austria had a lower share of total employment already in 1995 (Austria: 15.1%+2.7PP=17.8%; BENESCAND: 10.0%+6.3PP=16.3%). The share of value added of total GDP decreased by 2.9PP from 1995 to 2023, to 17.7% in Austria.

Labor productivity growth over the period 1995-2023 for the whole economy was 38.0% in Austria. Growth was largest in manufacturing with 102.2%. "Other industries" (NACE D-F: electricity, waste and water, and construction) experienced a decline of labor productivity. For market services (NACE G-N), increase in labor productivity was 33.5%. Labor productivity growth in manufacturing was also largest among all sectors in the group of BENESCAND (122.2%) and therefore also larger than in Austria. For the EU27, manufacturing labor productivity growth was smaller (97.7%) than in Austria.

The relatively flat trajectory of structural change in Austria conceals important developments. The first is the heterogeneity in subsectors, shown in the next Subsection 2.1. The second is regional

variation, explored in Subsection 2.2. The third development masked at the country-level is known as functional structural change. Research shows that structural change is not only visible between manufacturing and services sectors, but also within the manufacturing sector itself, including within individual firms (Bernard et al., 2017; Eickelpasch, 2014). This type of servitisation involves a shift from production-oriented to service-oriented tasks, without necessarily altering a firm's sector classification (Fort et al., 2018; Fort, 2023). It is reflected in occupational changes: traditional manufacturing roles in production decline, while service-related occupations—particularly in research, development, management, and technical services—gain importance. Grouping occupations into broader categories production, primary services, and secondary (especially knowledge-intensive) services makes this transformation observable and underscores the growing role of intellectual and organizational functions in industrial value creation. This development of a decrease in the share of production jobs will be discussed and analysed in more detail in Section 3.

Table 1: **Development of broad sectors (1995–2023)**

		Primary	Mfg.	Other industries	Market services	Non-market services
Austria						
Hours worked	share (% of total), 2023	5.1	15.1	8.6	46.0	25.2
	change (PP), 1995-2023	-6.2	-2.7	-0.2	6.0	3.1
	growth (in %), 1995-2023	-48.6	-2.8	11.8	31.3	30.4
Value added	share (% of total), 2023	1.7	17.7	10.2	49.7	20.8
	share, change (PP), 1995-2023	-1.0	-2.9	-1.5	5.4	0.0
	growth (in %), 1995-2023	27.3	96.5	-10.6	75.2	38.0
Labor prod. growth	(in %), 1995-2023	147.4	102.2	-20.0	33.5	5.8
BENESCAND						
Hours worked	share (% of total), 2023	2.8	10.0	8.6	46.8	31.7
	change (PP), 1995-2023	-2.1	-6.3	0.5	5.9	2.0
	growth (in %), 1995-2023	-25.3	-20.3	37.5	48.2	38.1
Value added	share (% of total), 2023	2.2	14.1	8.2	52.3	23.2
	share, change (PP), 1995-2023	-1.9	-5.2	0.5	6.3	0.2
	growth (in %), 1995-2023	-29.8	77.0	45.9	100.9	35.5
Labor prod. growth	(in %), 1995-2023	-6.1	122.2	6.1	35.6	-1.9
EU27						
Hours worked	share (% of total), 2023	5.2	14.4	9.0	44.4	27.0
	change (PP), 1995-2023	-6.5	-5.3	0.1	9.0	2.7
	growth (in %), 1995-2023	-50.0	-17.1	13.8	41.9	25.9
Value added	share (% of total), 2023	2.2	16.3	9.1	51.0	21.4
	share, change (PP), 1995-2023	-1.2	-3.6	0.2	4.9	-0.3
	growth (in %), 1995-2023	-7.0	64.0	-0.8	83.4	33.9
Labor prod. growth	(in %), 1995-2023	85.9	97.7	-12.9	29.3	6.4

Notes: EU27 exclude Malta and Portugal. Share of total value added in percent of nominal GDP of each year. Value-added growth and labor productivity growth in terms of chained linked volumes.
Sector definitions based on NACE:
Primary: agriculture (A) and mining (B).
Other industries: electricity (D), waste and water (E), construction (F).
Mfg.: manufacturing (C).
Market services (G-N), Non-market services (O-U).
Source: Eurostat.

2.1   Subsectoral variation

Structural change within manufacturing industries has not been uniform. While the overall share of hours worked has stagnated since 2010, employment trends across subsectors show considerable variation. Employment declined particularly in consumer goods (excluding food) and in glass and ceramics. By contrast, the largest increase in employment occurred in mechanical engineering, whereas the strongest growth in value added was recorded in the chemical and pharmaceutical industry (Figure 3, left column).

There was also considerable variation in employment trends across subsectors within the service sector (Figure 3, right column). The largest employment gains were recorded in administration, education, and health. Business services—including professional, scientific, technical, and other economic services—achieved the second-highest increase in employment and by far the largest growth in value added. In the information and communication sector, employment growth ranked fourth, while growth in value added ranked second.

Figure 3: **Change in employment and value added in manufacturing and market services**

Notes: Employment in persons. Value added in chained volumes. Classification of industries according to NACE 2008, Rev. 2. Food … C10–C12. Consumer goods (excluding food) … C13–C15, C16–C18, C31–C32. Chemical and pharmaceutical industry … C19–C22. Glass and ceramics … C23. Metal … C24–C25. Electronics … C26–C27. Vehicle manufacturing … C29–C30. Mechanical engineering … C28, C33. Trade and hospitality … G45–G47, H, I. Information & Communication … J. Financial services … K. Real estate … L. Business services … M–N. Administration and health … O–Q. Other services … R–S.
Source: Eurostat (nama_10_a64, nama_10_a64_e).

2.2 Regional variation

Regional variation in structural change is relevant because different regions experience the shift from industrial to service-oriented employment in different ways. Regions with a high share of industrial jobs often face greater employment losses, while those with more highly educated workforces are better able to adapt and recover (Gagliardi et al., 2023). Local characteristics such as education levels, export orientation, and sector specialization influence whether a region can successfully navigate structural change or struggles to compensate for industrial decline (Dauth and Südekum, 2016; Yi et al., 2024). Figure 4 illustrates the heterogeneity in the development among the federal states (NUTS-2-regions) by showing the percentage points change of employment in the manufacturing sector.

Figure 4: **Change of manufacturing share of employment (in percentage points, compared to 2010)**

Source: Eurostat (sbs_r_nuts03, sbs_r_nuts06_r2, lfst_r_lfe2emp).

One of the main characteristics of deindustrialization is the decrease of the manufacturing employment share. Gagliardi et al. (2023) examine "the world's rust belts" and find that regions (labor markets) with a high share of manufacturing employment had a larger decrease in total employment. They also found significant heterogeneity between regions and that a higher share of higher educated persons in the workforce helped to reinstitute or surpass the initial level of employment. One third of so-called manufacturing hubs have employment fully recover by 2010. The share of college graduates is found to have no effect on employment growth before manufacturing employment share peaks, but a significant effect afterwards. The effect of education is instrumented by the initial distance to a college or university.

Below we explore regional development of employment in relation to the change in manufacturing employment for Austria, with the approach from Gagliardi et al. (2023), adjusted to a shorter time period of data availability.

Figure 5 shows the development of manufacturing employment for Austrian states (NUTS2-level). NUTS2-regions are considered reasonably closed labor markets (Antón et al., 2022). Until the Great Recession, in all states the share of manufacturing employment decreases. After the Great Recession, the development shows more variation. Some states have an increasing share of employment, some decreasing, and some show stagnation over the period.

Figure 5: **Share of employment in manufacturing by federal state**

Notes: Employment in persons. Dashed line: Austria overall.
Source: Eurostat (sbs_r_nuts03, sbs_r_nuts06_r2, sbs_r_nuts2021, lfst_r_lfe2emp).

Figure 6 (left panel), shows the relationship between the change in overall employment in the region and manufacturing share of employment in the period 1999-2005. To put the regional employment change in perspective of Austria's overall employment change, the vertical axis shows the difference to employment growth for the whole country. The change is calculated between the earlier period (1999-2005) and the later period (2015-2020). The two states with the largest share of manufacturing employment, Vorarlberg and Upper Austria, also exhibit larger growth in total employment. The right panel shows the *change* in manufacturing employment share between the two periods. While the change (in percentage points) of the manufacturing share varies between close to zero and -4PP, there does not seem to be an overall pattern in relation to the change in overall employment of the region.

Figure 6: **Relationship between regional manufacturing employment and overall employment growth**

Notes: The vertical axes show the difference in overall employment growth (from 1999–2005 to 2015–2020) between the region and the entire country. Left panel: The horizontal axis shows the share of employment in manufacturing (1999-2005). Right panel: The horizontal axis shows the change in the share of employment in manufacturing in percentage points (from 1999–2005 to 2015–2020).
Source: Eurostat (sbs_r_nuts03, sbs_r_nuts06_r2, sbs_r_nuts2021, lfst_r_lfe2emp).

3 Structural change in firms

Structural change does not occur solely through the closure of firms in manufacturing and the entry of new firms in the service sector. Activities also shift within firms from manufacturing toward the service sector. This Section starts by describing structural change within firms, in particular, from manufacturing to service activities. The differentiation of how manufacturing firms can transition to service orientation either by sectoral or by functional structural change is described in Subsection 3.1. Evidence on functional structural change within the manufacturing sector is given in Subsection 3.2. The Subsection also explores structural change in manufacturing firms by looking at the frequency of switching to the service sector or the growth of service plants employment. Finally, Subsection 3.3 describes how the composition of occupations has shifted from production to service occupations, in particular those with high levels of education.

3.1 Functional and sectoral structural change

Structural change in industrial firms can occur in two main forms. Both types of transformation reflect a broader trend toward digitalization, service integration, and value creation beyond physical goods.

The first is functional structural change, where service-related activities gain importance compared to traditional production. The operations of manufacturing companies include not only production but also research and development, marketing, sales, accounting, and financing. Product-related service activities can be performed before (planning and consulting services on product specifications, configuration, design), and after (maintenance and servicing, training, repairs, material and spare parts management and ongoing optimization) the production phase (Ding et al., 2022; Lehmann et al., 2025).

Both complete transitions and hybrid firms are possible. In hybrid production models, companies combine physical products with digital services and maintenance solutions. For example, firms in climate technology, aerospace, and industrial systems increasingly integrate digital interfaces, remote monitoring, real-time data analysis, and cloud-based optimization into their offering. Some companies even shift toward selling performance or usage rather than physical products, such as airplane engine usage hours or compressed air instead of compressors (Lehmann et al., 2025; Bahrke et al., 2015; specific examples are described in the Appendix). The case of complete transitions are so-called factoryless goods-producing firms, that focus on design and development while outsourcing manufacturing. Examples are Apple, semiconductor firms like Qualcomm, or consumer goods producers like Nike (Fort et al., 2023).

The second form is sectoral structural change, where companies transition from manufacturing and sales of goods to sales of services. The services typically are primarily provided for other companies. Such services can be auxiliary activities carried out at the company's own establishments. Examples of such auxiliary activities include warehouse management or R&D, or moving away from hardware production toward data-driven solutions, consulting, and software services. Historical examples include firms that evolved from producing mainframes, cash registers, or navigation instruments to offering IT services, electronic mapping, and related customer solutions (Ding et al., 2022; Fort et al., 2018; Bernard et al., 2017).

Evidence of structural change in manufacturing firms can be obtained from the structure of employment and investment. The next subsections show evidence from firm switching, plant-level-based employment growth of manufacturing firms in the services sector, and the composition of production and services occupations in the manufacturing sector.

A particularly notable increase in the activities of industrial companies in the service sector is observed in services that serve as input factors for other companies, rather than for final consumption (Ding et al., 2022). The expanding service activities are concentrated in (technology-intensive) professional services and the wholesale sector. This corresponds to those service sectors where substantial

contributions to overall economic productivity growth are measured. In Europe, wholesale and retail trade contributed the most, whereas in the US, professional services provided the second largest share, while IT services make the largest individual contribution (Nikolov et al., 2024; 2013–2019).

3.2   Switching and two-sector firms

The adjustment of employment in manufacturing in the USA occurs less through the exit of entire companies than through the closure of individual establishments, while companies often continue to exist in another form (Fort et al., 2018). Industrial companies with service activities contributed between 16 and 32% to the growth of employment in the service sector in the USA between 1977 and 2019. Continuing firms, accounting for less than 1% of all firms, are responsible for 15-26 percentage points of that contribution (Ding et al., 2022). In Denmark, around 10% of all manufacturing companies switched to the service sector from 2002 to 2007, and their share of manufacturing employment accounted for 42% of the decline in employment in manufacturing during that period (Bernard et al., 2017).

3.2.1   Firm level sector switching

Based on firm-level data from structural business statistics, the analysis in this subsection relies on firms switching the industry code from manufacturing to services. Manufacturing is defined by NACE codes 10-33 (section C). Services are constrained to market services covering NACE codes 45-82 (sections G-N). Firms receive an assignment to a main activity according to NACE classes in the Business Register, in agreement with the firm. In case of several different NACE-activities of the firm, the assignment to a main activity is based on value-added (see the Appendix for more details). Switching firms are defined as those that switch permanently, meaning that they do not switch twice in the sample period.

Table 2 shows the number of firm switches in the period 2008-2022 for manufacturing and services. The Table also shows employment in staying and switching firms at the end of the sample period (2022). The survival rate of firms is 70% for manufacturing and 71% for market services. Employment in surviving switchers from manufacturing to services is less than half compared to switching from services to manufacturing. Measured relative to employment of the sector where the switchers came from, though, switching is more important from manufacturing to services.

Table 2: **Stayers and switchers (2008-2022)**

		Going to			
		Firms		Employment (2022)	
		Mfg.	Mkt. services	Mfg.	Mkt.services
Coming from	Mfg.	34,236	2,292	638,530	17,002
	Mkt. services	1,651	419,803	36,371	2,103,605

Notes: The table shows the number of switching and staying firms for manufacturing and services and the number of employed persons in 2022 for stayers and switchers. The year of the switch, based on NACE-codes, must lie in 2008-2022, which is the sample period. The other two groups are firms that stay in manufacturing (cells Mfg.-Mfg.) and that stay in market services (cells Mkt. services-Mkt.-services). Manufacturing: NACE C. Market services: NACE G-N.
Source: AMDC.

Firm switching as measured here is a less frequent phenomenon in Austria, compared to Bernard et al. (2017) for Denmark. The mean share of firms permanently switching from manufacturing to services from 2008 to 2022 is 0.6% per year (1.6% in Denmark).[2] In comparison, mean entry of new firms in manufacturing is 1.9% of firms. In 2022, switchers that survived account for 5.6% of manufacturing

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[2] Bernard et al. (2017) use data for the time period 1993-2007 and a deviate in their definition of a manufacturing firm, and therefore, of a switching firm. In their definition, a manufacturing firm is one that has at least one manufacturing plant and where manufacturing plant employment is at least 5% of the total firm workforce.

firms, 2.5% of manufacturing employment and 2.2% of manufacturing value-added. The switch from services to manufacturing, though, occurs for only 0.04% of services firms, which means that the relative frequency of the switch from manufacturing to services is higher by a factor of 14.6 (0.6/0.04). In 2022, 0.4% of manufacturing firms are surviving switchers from services, which account for 1.7% of employ-ment in services and 2.4% of value-added in services.

Looking at employment before switching, more than 75% of firms switch to three subsectors: real estate (35.2%, NACE 68), management (22.4%, NACE 70) and wholesale (17.9%, NACE 46) (Table 3). The top 10 subsectors (by the number of switching firms) account for 94.1% of pre-switching employment among all switchers to market services. In the year of switching, employment falls by about two thirds. The largest drops take place in management (-89.8%), real estate (-88.0%) and finance (-84.7%). At the end of the sample period, employment in surviving firms is largest in wholesale, retail and management. Only employment of management surviving switchers grows until 2022, compared to the year after switching.

Table 3: **Top 10 most frequent subsectors switching from manufacturing to services (2008-2022)**

Rank	Subsector	NACE	Firms	Employment			
				Year before switching	Share	Year after switching	Survivors 2022
1	Wholesale	46	459	11,187	17.9%	7,370	5,088
2	Retail	47	435	3,490	5.6%	3,259	2,191
3	Real estate	68	400	22,052	35.2%	2,636	916
4	Car trade	45	145	1,093	1.7%	856	705
5	Food	56	125	1,016	1.6%	927	696
6	Management	70	125	13,991	22.4%	1,428	2,010
7	Engineering	71	99	1,009	1.6%	621	520
8	Finance	64	91	3,510	5.6%	538	191
9	Programming	62	64	661	1.1%	667	508
10	Prof. activities	74	56	120	0.2%	85	46
1-33	All subsectors	45-82	2,292	62,587	100%	22,309	17,002

Notes: The table shows for the 10 most frequent NACE-2-digit industries that manufacturing firms switched to: the number of firms, the employment in the year before switching, the share of employment in the year before switching of all switching manufacturing firms, employment after switching and employment of switching manufacturing firms at the end of the sample period (2022) that survive until the end of the sample period. Detailed sector names: 46 … Wholesale trade, except of motor vehicles and motorcycles. 47 … Retail trade, except of motor vehicles and motorcycles. 68 … Real estate activities. 45 … Whole-sale and retail trade and repair of motor vehicles and motorcycles. 56 … Food and beverage service activities. 70 … Activities of head offices; management consultancy activities. 71 … Architectural and engineering activities; technical testing and analy-sis. 64 … Financial service activities, except insurance and pension funding. 62 … Computer programming, consultancy and related activities. 74 … Other professional, scientific and technical activities.
Source: AMDC.

Characteristics of internal structural change

Products sold by manufacturing firms become more hybrid through product-related services. More complex products offer more product-related services. This goes along with more digitalization in the firm and with more R&D expenses (Lehmann et al., 2025). Production can become more hybrid, too. This is the case when manufacturing firms outsource or offshore production or parts of it and focus on product services components.[3]

Hybrid production in manufacturing makes the related, but distinct question of offshored and out-sourced production a relevant issue for analysing the service activities of manufacturing firms. Domestic

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[3] Offshoring is the relocation to another country by the firm, outsourcing the relocation to another firm. Also, offshoring and out-sourcing can happen together (see Fort, 2023).

value added can shift to intellectual property like R&D output, or copyrights. In contrast to licensed manufacturing, immaterial capital (software, patents, brands, design) remains with the manufacturing firm. The effect of hybrid production on intermediate inputs is affected by the extent of possible reshoring and potentially increased competitiveness of domestic production through automation. Hybrid production can also lead to a decrease of the share of intermediate products in total production, though, when the increase of value added of services measured in production value is sufficiently large (Lehmann et al., 2025).

To address the characteristics of switchers before and after the switch and in comparison to non-switchers, we look at the development of employment, labor productivity, sales, value-added, and intangible investment. The results focus on firm switching from manufacturing to market services. Switchers are the firms as identified for Table 2, coming from manufacturing, going to market services. The comparison group consists of stayers in manufacturing and stayers in market services.

Because there is no switching, the comparison group does not have a natural post-switch time period. One can only estimate the post-effect for the group of switchers. This would miss the comparison to the average development of stayers over time. To capture the development of the characteristics (dependent variables) for stayers, we assign to each staying firm a pseudo switch at a randomly selected year during their sample presence. The sample is restricted to be balanced by requiring firms to be observed from year minus 4 before the switch until year 4 after the switch—or pseudo switch for a firm in one of the two comparison groups of stayers. The reason to balance the sample is to avoid biases through major changes in the sample composition by firms that are observed only for short periods of time, which are predominantly small firms, firms with short life spans, or both.[4] The pseudo-post effect for stayers is interpreted as the development within the sector that occurs over time without an actual switch. Because the assignment of the pseudo-switch to the non-switchers is random, the comparison groups reflect the population of firms in expectation. The estimation equation for the development of the characteristics of interest is

$$y_{it} = \beta_0 + \beta_1 * 1(Mfg.Stayer_{it}) + \beta_2 * 1(Mkt.Serv.Stayer_{it})$$
$$+ \beta_3 * 1(Switcher_{it}) * Post_{it}$$
$$+ \beta_4 * 1(Mfg.Stayer_{it}) * Post_{it}$$
$$+ \beta_5 * 1(Mkt.Serv.Stayer_{it}) * Post_{it} + u_{it}$$

1(.) indicates a dummy variable. β_1 (β_2) measures the difference of the dependent variable for the group of manufacturing (market services) stayers before the switch. β_3 measures the effect for switchers compared to before the switch ("post"-effect). β_4 (β_5) measures the difference for manufacturing (market services) stayers in their pseudo post time period.

Employment. Table 4 shows the results for the development of employment of switchers and the comparison groups. Employment is measured as the head count of total employment, both self-employed and employees. Switching manufacturing firms are not different in employment compared to staying manufacturers before the switch (Column (1), "Mfg. stayers"). Market services firms are smaller by about 20.7 persons ("Serv. stayers"). In the post period, switching manufacturers drop in size by 14.8 persons, getting closer to the size of market services stayers ("Switchers x Post"). At the same time, manufacturing stayers grow in size, by 2.3 persons ("Mfg. stayer x Post"), while market services stayers remain stable in size, with an insignificant change of 0.7 persons ("Serv. stayer x Post").

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[4] Table 9 and Table 10 in the Appendix show the results with an unrestricted, unbalanced sample of all observations available. The main results and even the magnitudes of the post-switch difference-in-differences are not strongly affected.

For a comparison to other market services firms (the target sector of the firms previously recorded in manufacturing), a combination of effects is useful, to obtain a difference-in-differences-estimate. Looking at the outcome for employment, two additional estimates must be considered. First, market services firms have lower employment already before the switch (β_2). Second, employment also changes for services firms over time (β_5). To obtain the comparable employment of services firms in the post period, we calculate β_3-β_2-β_5. This type of calculation is given for all outcomes in the last line of Table 4 ("Post-diff. for mfg. switchers to serv. stayers"). In the case of employment, switchers after the switch have a headcount of employment that is 5.2 higher than for service stayers in the comparable time period, but that difference is not statistically significant. The Table also shows the difference-in-difference estimate to manufacturing stayers in the post-period ("Post-diff. for mfg. switchers to mfg. stayers").

Labor productivity. Labor productivity is gross value added over the employment headcount. Value added is deflated to 2015 euros. Labor productivity is similar for stayers in both groups ---manufacturing and services—and lower by about 11-12 euros per employee (Column (2) of Table 4).[5] After the switch, labor productivity increases further for switchers by 8.2 euros, compared to its pre-switch value. For stayers, there is no (manufacturing) or little change (market services, -1.2 euros) after in the comparison period of the pseudo switch. Therefore, the post-switch difference gap for switchers widens to about 20 euros.

Sales. Sales are deflated to 2015 euros. Before the switch, sales are not different for manufacturing switchers to manufacturing stayers, but smaller for market services stayers. After the switch, the gap widens between manufacturing stayers and switchers. Switchers become similar to market services stayers.

Value added. Value added (gross, in 2015 euros) is higher for switchers than for manufacturing stayers, and lower for market services stayers. After the switch, it drops, which may not be surprising after the decline observed for employment in Column (1). The difference to manufacturing stayers is more negative after the switch, and the difference to market services stayers remains positive, but smaller.

Intangibles. Intangible investments are frequently discussed as important covariates of the change from manufacturing to hybrid production or factoryless production, because product-based services rely on intangibles like software, R&D, or design. Intangible investment is the sum of investment into three types of intangible capital that are available from our data source (SBS and R&D statistics of firms): (1) software, (2) concessions, industrial property rights, and similar rights as well as licenses derived from them, and (3) expenses on internal and external R&D (Crouzet et al., 2022). The share of intangible investment in total investment of switchers is similar to manufacturing stayers and smaller for market services stayers (Column(5) of Table 4).[6] After the switch, the share does not change for manufacturing stayers or switchers, but increases for market services stayers. The difference-in-differences is 1.9% for switchers compared to services stayers and similar to manufacturing stayers. Switchers carry with them the higher level of intangible investment share when they switch the sector. R&D expenditures are only available every other year. To avoid losing those observations where R&D is not available, Column (6) repeats the estimation for the share of intangibles with only considering categories (1) software and (2) concessions, industrial property rights, and similar rights as well as licenses derived from them. For this subgroup of intangibles, switchers have a higher share of total investment than stayers. After the switch, all three groups of firms increase the share by a similar amount. Therefore, after the switch, intangibles remain higher for switchers, at about 1%.

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[5] Outliers in terms of labor productivity of the highest and lowest 0.2 percentiles, relative to the observations of a year, are excluded.

[6] Firm-year observations with zero investment are dropped from the estimation sample.

Table 4: **Employment, productivity, and sales for staying and switching firms**

	(1)	(2)	(3)
		Labor	
	Employment	productivity	Sales
Mfg. stayers	1.51	-10.92**	2,057.5
	(3.66)	(1.73)	(1,093.6)
Services stayers	-20.67**	-12.20**	-4,326.6**
	(3.59)	(1.69)	(1,071.3)
Switchers from mfg. to services x post	-14.77**	8.24**	-2,840.9*
	(4.80)	(2.27)	(1,433.2)
Mfg. Stayers x post	2.33*	-0.32	1,051.0**
	(1.05)	(0.50)	(314.0)
Services stayers x post	0.652	-1.16**	172.0
	(0.362)	(0.171)	(108.0)
Constant	30.09**	57.86**	6,389.0**
	(3.58)	(1.69)	(1,068.2)
Observations	714,402	714,402	714,402
Diff. for mfg. switchers to mfg. stayers	-18.60**	19.47**	-5,949.5**
	(3.28)	(1.55)	(978.1)
Diff. for mfg. switchers to services stayers	5.25	21.60**	1,313.7
	(3.21)	(1.52)	(958.2)

Notes: Each column contains one regression output. The sample of firms is balanced by requiring that each firm must be available 4 years before and 4 years after the switching event. Switchers are selected as firms that permanently switch from manufacturing to market services sector. The year of the switch, based on NACE-codes, must lie in 2008-2022, which is the sample period. The other two groups are firms that stay in manufacturing and that stay in market services. For the non-switching firms, a pseudo switching event was randomly assigned to each firm. Each variable (first column) is a dummy variable for a specific group. The line shows the estimate of the coefficient. Standard errors are in parentheses below each estimate. The last two lines show the statistical significance and the estimate that is derived from the linear combination of the estimates of the difference of manufacturing switchers to the post-value of stayers.
The dependent variables of the regressions: *Employment*: Number of persons employed. *Labor productivity*: Deflated labor productivity (2015 euros). *Sales*: Deflated sales (2015 euros).
* indicates significance at the 5% level, ** at the 1% level.
Source: AMDC.

Table 5: **Value added and intangibles for staying and switching firms**

	(4) Value added	(5) Share intangibles Incl. R&D	(6) Excl. R&D
Mfg. stayers	702.9**	0.0031	-0.0095**
	(268.0)	(0.0069)	(0.0023)
Services stayers	-1458.0**	-0.0235**	-0.0108**
	(262.5)	(0.0068)	(0.0022)
Switchers from mfg. to services x post	-897.8*	-0.0017	0.0031
	(351.2)	(0.0082)	(0.0031)
Mfg. Stayers x post	289.3**	0.0026	0.0046**
	(76.9)	(0.0017)	(0.00066)
Services stayers x post	48.6	0.0028**	0.0035**
	(26.5)	(0.00063)	(0.00025)
Constant	1993.8**	0.0536**	0.0315**
	(261.8)	(0.0068)	(0.0022)
Observations	714,402	223,264	557,163
Diff. for mfg. switchers to mfg. stayers	-1890.0**	-0.0074	0.0080**
	(239.7)	(0.0047)	(0.0022)
Diff. for mfg. switchers to services stayers	511.79*	0.0190**	0.0104**
	(234.8)	(0.0046)	(0.0022)

Notes: Each column contains one regression output. The sample of firms is balanced by requiring that each firm must be available 4 years before and 4 years after the switching event. Switchers are selected as firms that permanently switch from manufacturing to market services sector. The year of the switch, based on NACE-codes, must lie in 2008-2022, which is the sample period. The other two groups are firms that stay in manufacturing and that stay in market services. For the non-switching firms, a pseudo switching event was randomly assigned to each firm. Each variable (first column) is a dummy variable for a specific group. The line shows the estimate of the coefficient. Standard errors are in parentheses below each estimate. The last two lines show the statistical significance and the estimate that is derived from the linear combination of the estimates of the difference of manufacturing switchers to the post-value of stayers.
The dependent variables of the regressions: *Value added*: Deflated gross value added (2015 euros). *Share intangibles incl. R&D*: Share of intangible assets, including R&D, software and immaterial property rights, divided by total investment. *Share intangibles excl. R&D*: Alternative definition of share of intangible assets, including software and immaterial property rights, divided by total investment.
* indicates significance at the 5% level, ** at the 1% level.
Source: AMDC.

The change in characteristics of firms switching from manufacturing to market services gives some evidence on the hypothesis of hybrid production. Switching firms adjust in size to the much lower average level of market services firms. Labor productivity is higher for switchers compared to stayers before the switch, and even larger afterwards. For Denmark, Bernard et al. (2017), find that switching firms are already smaller before the switch by 4.8%, and they also find a large drop in size after the switch to about -30% for the three years after the switch, relative to staying manufacturing firms. For labor productivity, both the pre- and post-switch pattern deviate, as for Austria. Labor productivity in Denmark is 5.4% higher for switchers before switching, and about 10-12% higher in the three years after switching. Intangible investment, as a share of total investment, for Austrian switchers is higher before the switch compared to services, and—when excluding R&D from intangibles—also compared to manufacturing. The higher shares of intangibles are maintained by switchers after the switch.

3.2.2 Plant level sector switching

Recent studies approach structural change within firms by measuring service sector employment within manufacturing firms. This can be done by evaluating sectoral activity of plants within firms. Ding et al.

(2022) find an increase of services activities within manufacturing plants that contributes a share of 16-32%—depending on measurement approaches—of the total growth of services employment in the US.

For a summary of structural change within firms, we define two groups of firms, in line with Ding et al. (2022). The first group consists of firms which had a manufacturing plant at any point in time during the sample period (2014-2022); these are labelled "M". The remaining firms are non-manufacturing firms ("NM"). Table 6 shows employment and its change for the two types of firms and also the results for the US from Ding et al. (2022) for comparison.[7] The top panel shows the results for Austria. Columns (2)-(4) show employment in manufacturing plants, which is per definition non-existent in non-manufacturing firms. Manufacturing employment increased between 2014 and 2022 by 44.7 thousand persons. Employment of manufacturing firms in non-manufacturing sector plants is shown in Columns (6)-(8). It increased by 13.9 thousand persons. The second line shows the development of non-manufacturing employment in non-manufacturing firms. It increased by 195.3 thousand persons. Column (9) shows that manufacturing firms contributed 6.6% of total growth in non-manufacturing employment. For the US, the corresponding contribution over the longer time period 1977-2019 is 16-32%.

Table 6: **Sectoral employees in manufacturing and non-manufacturing firms**

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AT (in thsd)	Emp. 2014 M	Emp. 2022	Diff.	Share diff.	Emp. 2014 NM	Emp. 2022	Diff.	Share diff.
M firms	548.1	592.8	44.7	100.0%	51.2	65.1	13.9	6.6%
NM firms					1,350.1	1,545.8	195.3	93.4%
Total					1,401.3	1,610.9	209.2	100.0%
US (in mill)	Emp. 1977 M	Emp. 2019	Diff.	Share diff.	Emp. 1977 NM	Emp. 2019	Diff.	Share diff.
M firms	17.7	12.1	-5.7	100.0%	12.6	23.9	11.3	16.0%
NM firms					35.4	95.9	60.5	84.0%
Total					48.0	119.8	71.7	100.0%

Notes: The table shows the number of employed persons in manufacturing firms (M) and in non-manufacturing firms (NM). Manufacturing firms are those that operate any manufacturing plant ("work address") in the sample period (2013-2022). All other firms are non-manufacturing firms. The firms' type is indicated in the first column. The next three columns (2)-(4) show the number of employed persons. In 2014 and 2022 in manufacturing plants. Columns (6)-(8) show the employed persons of the firms in non-manufacturing plants. Diff. is the difference between the columns for the years 2014 and 2022. Share diff. is the share that manufacturing firms and non-manufacturing firms employed from these differences.
Source: Austria: AMDC (LMS). US: Ding et al. (2022).

It is unclear how well the results between Ding et al. (2022) and our results can be compared. On the one hand, the share difference is relative to total growth of both sectors. So, any larger increases over longer time periods could be mirrored in both sectors and the share of services employment in manufacturing firms might be stable as well. On the other hand, the criterion to be in the sample of manufacturing firms is to have a manufacturing plant at any point in time. When firms with both manufacturing and services plants remain somewhat stable in time, increasing the number of years will put increasingly more firms into the manufacturing group and longer time periods would lead to larger services employment of manufacturing firms.

3.3 Composition of occupations in manufacturing

Production activities include processing, repairing, and operating or maintaining machinery and equipment. Primary service activities differ from production activities in that they extend the production

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[7] Data for plant level employment and sector coding are from "Register-based labor market statistics". We evaluate those firms that also appear in the SBS dataset.

process, maintain the overall economic production flow, or directly enter consumption. These include simpler activities in sales and office work as well as general services such as cleaning, catering, storage, security, and transportation. Secondary service activities are mostly intangible and intellectual, typically requiring a university degree or an equivalent high level of qualification. They include activities such as research, development, organization, management, applying and interpreting law, care, consulting, teaching, publishing, and entertainment (Helmrich and Zika, 2010; Tiemann et al., 2008).

Secondary services can be divided into two further groups. The first group, secondary services I, consists of personal services, which include specialist and assistant roles in areas such as care, medical treatment, legal, social, and cultural fields. The second group, secondary services II, comprises knowledge-intensive services, which mainly include academic professions such as research and development, mathematics, engineering, natural sciences and technical (STEM) fields, teaching, legal consulting, planning, coordination, organization, and management (Stooß and Weidig, 1990).

In Austria, there was a pronounced trend from production occupations toward service-oriented occupations in manufacturing between 2011 and 2024 (Figure 7, left panel). Manufacturing occupations decreased by 9.5 percentage points, while knowledge-intensive secondary services increased by 6.1 percentage points. Personal services played a minor role. In goods manufacturing, the share of manufacturing jobs was smaller (41.1% in 2024) than in other industries (49.5% in 2024). However, in absolute numbers, production occupations dominated in manufacturing with 280,000 employees compared to 175,000 in other industries. Between 1975 and 2017, the ratio of manufacturing employees in goods production to those in services in Germany fell from 3 to 1.3 (Boddin and Kröger, 2021).

Duernecker and Herrendorf (2022) investigate whether outsourcing contributes to structural change and find that it does not play a significant role in the measured shift from manufacturing to services. This conclusion is based on an analysis that uses manufacturing versus service occupations rather than firm-level employment data of sectors. They emphasize the relevance of structural change at the occupational level. Looking at the whole economy in Austria also shows that the production occupations lost in manufacturing are not accompanied by an increase of production occupations elsewhere (Figure 7, right panel).

Based on occupational categories for Germany, Eickelpasch (2014) documents increasing shares of services occupations for manufacturing firms. Production occupations decrease by about 3.6PP from 1999 to 2011, while the category of services occupations increases by 2.7PP.[8] Notably, the share of primary services occupations remains close to constant. Subgroups in primary services are accounting and administration; purchasing, sales, distribution, advertising and marketing; transport, logistics, and warehousing; and security, cleaning and miscellaneous. The share of secondary services increases by 2.6PP, which is an increase of about 17% for secondary services. Subgroups in secondary services are management and organization; research and development; and technical services.

For Germany, Eickelpasch (2014) also shows a relationship to the extent of export orientation. Manufacturing subsectors with export share above 50% decrease the share of production workers by 4.4PP. Intermediate export share subsectors with 33%-50% decrease production workers by 3.2PP, and subsectors with export shares below 33% by 2.2PP.

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[8] The numbers given here add up the percentage points changes of the two time periods that Eickelpasch (2014) separates because of a structural break in the classification of occupations.

Figure 7: **Manufacturing employment by type of activity (in %)**

Notes: Classification of Occupations (ISCO 08, Microcensus, Statistik Austria) based on the framework by Helmrich and Zika (2010). The subdivision of secondary services follows Stooß and Weidig (1990). Manufacturing: activities such as processing, repairing, and operating or maintaining machinery and equipment. Primary services: simpler activities in sales and office work, as well as general services like cleaning, catering, storage, security, and transportation. Secondary services I: personal services, mainly specialist and assistant roles in areas such as care, medical treatment, legal, social care, and cultural fields. Secondary services II: knowledge-intensive services, primarily academic professions; research and development, STEM occupations, teaching, legal consulting, planning, coordination, organization, and management. Details in Table 8 in the Appendix.
Source: Microcensus, Statistik Austria (2025).

Structural change within firms in the manufacturing sector is increasingly driven by a shift toward service-oriented occupations. The share of traditional production occupations is being replaced by service-oriented occupations, particularly in research and development, technical services, and management. This trend reflects functional structural change and is also linked to the growing importance of complex activities in manufacturing due to automation. Industrial value creation is becoming more knowledge-intensive and shaped by organizational functions.

4 Income and employment of workforce

With structural change comes job loss and new job opportunity. Some employed persons may have difficulties to find new employment. The central question is how displaced employees adjust to structural shifts—particularly whether they transition to other sectors, and which factors influence these transitions. Is there a large share of transitions to other firms in the same sector, or to unemployment, or out of the labor force? Do persons transition from manufacturing to services? Which characteristics are related to which transitions?

Several recent studies relate structural change to aspects of labor market development. Boddin and Kroeger (2021) examine wage dynamics following mass layoffs, highlighting how outcomes vary by both the sector of the firm—manufacturing versus services—and the occupation of the displaced worker. Their analysis includes several empirical strategies. First, an unconditional pre/post comparison for treated individuals—those employed in manufacturing firms with manufacturing occupations who switch across combinations of industry and occupation. Second, a difference-in-differences (DID) approach comparing treated groups to propensity-score matched controls from non-mass-layoff firms. Third, a DID specification using a balanced panel of the individuals. Fourth, a static pre/post comparison across four treated groups, without year-by-year differentiation. Their findings reveal that wage losses are most pronounced for workers switching from manufacturing firms and manufacturing occupations to service firms and service occupations (−12.0%). Wage declines are smaller for those transitioning to a service occupation in manufacturing (−3.8%) and even smaller for those transitioning to manufacturing occupation in services (−2.8%). Workers who switch to another firm within manufacturing and remain in both firm and occupation experience a modest wage gain (+0.7%).

Helm et al. (2023) analyze the impact of mass layoffs in manufacturing to understand wage losses and labor market transitions. Manufacturing jobs typically offer high wages across skill levels, while service sector wages vary widely depending on knowledge intensity. The research focuses on whether low-skilled workers face greater wage declines and how structural change influences these outcomes over time. Their findings show that low-wage workers suffer larger and growing wage losses—rising from 5% in the 1980s to 15% in the 2000s—and are more likely to move into low-knowledge service jobs. They conclude that structural change increasingly leads to wage polarization.

Yi et al. (2024) explore how the effects of displacement from manufacturing jobs vary depending on the absorptive capacity of local labor markets. They estimate the transferability of workers' skills from manufacturing to other sectors and use co-worker networks to account for endogenous switching patterns into specific sectors. The findings show that wage losses are greater when local markets offer fewer opportunities for skill transfer. In areas with high import exposure, wage losses over a ten-year period are significantly larger—about 12 percentage points more when comparing the 75th to the 25th percentile of import exposure.

Bloom et al. (2024) find that increased import penetration leads to a significant reallocation of jobs from the manufacturing sector to the service sector, with much of this shift occurring within firms rather than across them. Additionally, the research highlights that the level of human capital in a given area plays a crucial role in facilitating job creation within the service sector.

The goal of this Section is to examine the consequences of structural change for employees in Austria. The main question addressed is: what are the patterns of adjustment of structural change for employment? The two sub-questions are: (i) Are employees able to switch from manufacturing to services? (ii) Which factors support or impede sector switches? We focus on workers displaced from manufacturing and service firms due to mass layoffs. Mass layoffs are seen as exogenous shocks, and used for an analysis of employment transitions, wage developments, and labor market outcomes. To that end, we

look at the effects that age, education, and gender have on the transition, on wages and on employment status (unemployment, labor force participation).

The findings stress the differences of displaced workers who switch sectors before the layoff: they tend to be younger and earn lower wages. Education significantly increases the likelihood of switching, especially to knowledge-intensive services. However, wage recovery varies: only those switching within manufacturing manage to close most of the wage gap, while those moving to non-market services experience further wage losses. Women and older workers (50+) are more likely to transition to part-time work or exit the labor force. Overall, the study highlights how structural change leads to unequal outcomes depending on sector, age, gender, and education.

The next Subsection first presents the mass layoff research design used to identify exogenous job displacement and its effects. Then, we describe the data used and how the mass layoff design is implemented. The results section is grouped into analysis of the characteristics of switching employees, wage developments, and transitions to part-time work, followed by a focused examination of unemployment and labor force exit among group of switchers.

4.1   Mass layoff design

To address the question of employment transition from a structural change perspective, we look at mass layoff events. The motivation of using mass layoffs is to obtain a sample of employed persons that is plausibly exogenously separated from their employers. The mass-layoff design aims to avoid key selection effects on the individual level when analysing the effects of job loss. Employees who resign voluntarily may be better qualified or more motivated. These persons may be able to more easily find new employment compared to persons exogenously affected by structural change. Those who are laid off individually and selectively by employers might be less productive. These may be less likely to find new employment than after exogenous displacement. In contrast, job loss due to mass layoffs does not occur because of individual performance, but rather due to external shocks affecting the company (e.g., site closures, industry crises, structural change). This allows the consequences of job loss to be more causally attributed to the event itself.

At the same time, this design reveals the impact of systemic shocks on employees, showing how external economic changes (e.g., demand collapses, technological disruptions) affect workforces—independent of individual suitability. In this respect, we deviate from the usual use of the mass layoff design, which is to estimate the layoff effect on the average worker. We look at types of employees selectively displaced in a mass layoff to adjust the workforce from the sectoral perspective of structural change. This perspective is similar to the analysis of mass layoffs in Margolis and Montana (2024), who also view them as restructuring events. We address the effect of structural change on unemployment, new employment, wages, and transition to other sectors. The comparison group consists of persons that remain employed in the mass layoff firms.

4.2   Data and implementation of mass layoff design

To select mass layoff firms, we follow the approach of Halla et al. (2020), who also use Austrian data. Employment of the firm before the mass layoff must be at least 11 persons. The definition of a mass layoff depends on the size of the firm. Between 11-20 persons, the decline threshold is 3 persons, for firms with 21-100 persons, it is 5 persons, for 100-600 persons, it is 5%, and for firms above 600 persons, it is 30 persons. Our sample covers the period 2013-2022.

Alternative definitions of mass layoffs are used in different studies. Couch et al. (2010) use the definition originally used in Jacobson et al. (1993), where a mass layoff is defined when quarterly employment drops at least 30% below the maximum in several previous years. In robustness analysis to four alternative definitions, they find that results on wage effects are not sensitive to the definition. Bertheau

et al. (2023) use only firms with at least 50 employees in the year before the mass layoff. In our data, this would lead to a dramatic decrease in the sample size of mass layoffs.

We apply the rule of Bertheau et al. (2023) to not record as a mass layoff cases where more than 20 percent of employees leaving a firm jointly switch to another firm. The rule is in place to avoid confusion of mass layoffs with mergers or outsourcing. The following two other rules from Bertheau et al. (2023) are applied: persons laid off are only considered once, not in several mass layoffs; employees analyzed in a mass layoff event are not used as stayers in other years.

Only persons with full time employment in the year before and two years before the mass layoff are considered. Also, only persons which are both employed at the same firm in the two years before the mass layoff are considered. Other studies use more than two years (three, or five, are common), but the time period covered in our data source is comparably short. Persons with gross wages above 200.000 euros are excluded (about 1.5% of observations). Wages are measured as annual gross wages (in 2015 euros, deflated by the CPI) from wage tax records (Lohnsteuerstatistik, AMDC). Persons where the educational level changes from the year before the mass layoff or in the year after the mass layoff are excluded. We select white and blue collar workers, which account for around 90% of all employed persons.[9]

As analysed for example in Bernard et al. (2017), firms may also switch the sector and the workers would then switch the sector without switching the firm. There are very few cases of firms switching the sector among mass layoff firms (about 2/10 of a percent of all manufacturing stayers). The group is excluded.

Concerning the sectoral perspective, we choose layoffs of firms in manufacturing (NACE C) or market services (NACE G-N). The final sample of stayers and switchers during 2013-2022 is shown Table 7. To give a complete picture of the transition after mass layoff, we follow persons outside manufacturing and services switching, too.[10] In manufacturing, 10.3% of persons in mass layoff firms are laid off; in market services, 16.4% are laid off. Figure 8 shows where the persons switch to after the mass layoff, conditional on leaving. Switching out, but remaining in the sector, means that a person switches to another firm within the sector. Remaining in the sector happens about twice as often in market services (50.3%) than in manufacturing (26.5%). The share of unemployed is more similar, being 22.0% for manufacturing, and 18.5% for market services. In manufacturing, 9% switch out of the labor force, and 7.3% from market services.

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[9] The remaining persons are apprentices and civil servants (Beamte). The latter are primarily in postal services (NACE 53), transportation (NACE 49), repair and installation of machinery (NACE 33) and manufacture of basic metals (NACE 24).

[10] An illustration of sectoral flows from before the mass layoff until the second year after the mass layoff is shown in Figure 14 in the Appendix. The Figure ends with mass layoff year 2020 because the data end 2022.

Table 7: **Staying and switching after mass layoffs**

		Going to							Total
		Stayers	Switchers						
			Mfg.	Mkt. Serv.	Non-mkt. serv.	Other ind.	Unemployed	Out of labor force	
Coming from	Mfg.	384,006	11,671	14,038	2,279	2,394	9,692	3,954	428,034
	Mkt. Serv.	536,430	13,337	53,025	7,495	4,393	19,559	7,659	641,898

Notes: The NACE-codes of the sectors are: C (Mfg.), G-N (Market services), O-U (Non-market services), D-F (Other industry). Includes persons switching to part time work, whereas persons were employed full time in both years before switching. Excluded are persons that switch to retirement, education, compulsory military or alternative service, work outside the country, are on temporary leave (mostly paternal leave), or exit (not covered in register anymore). Also contained in other are a small share of leavers going to the primary sector (primarily to agriculture) and persons where the status is unknown. Employed persons before retirement age are excluded.
Source: AMDC.

Figure 8: **Switching after mass layoffs**

Notes: Each column contains the share of employed persons switching out from employment at a manufacturing or market services firm to another firm or sector or employment status after a mass layoff, conditional on being laid off. The left panel is for persons employed in manufacturing before the mass layoff. The right panel for persons employed in the market services sector before the mass layoff. The number of total switchers corresponds to the pooled sample from 2013-2022 of all employed persons switching out of mass layoff firms. Mass layoff firms are firms that lay off a large number of employed persons at one point in time. The sectors are: Mfg., manufacturing (NACE C). Market services (NACE G-N). Non-market services (NACE O-U). Other industry (NACE D, E, F).
Source: AMDC.

4.3 Results

4.3.1 Characteristics of switchers

The effect of characteristics of employees that switch out of the mass layoff firm into employment by another firm is estimated with the following linear probability model.

$$1(switch_i) = \beta_0 + \beta_1 * 1(female_i) + \beta_2 * 1(white\ collar_i)$$
$$+ \beta_3 * educ_i$$
$$+ \beta_4 * age_i$$
$$+ \beta_5 * wage_i + \beta_6 * wage_i * educ_i + \beta_7 * wage_i * age_i + u_{it}$$

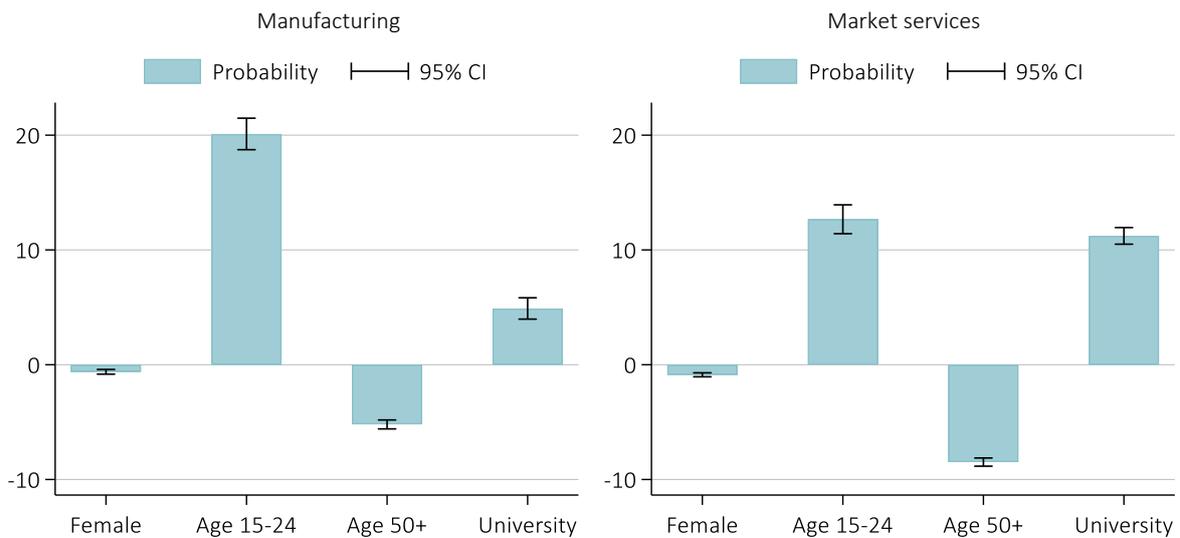The dependent variable is a dummy for switching out of the mass layoff firm. *female* and *white collar* are dummy variables. *educ* and *age* represent vectors to indicate to which group of the categorical variable a person belongs. *educ* has six categories of highest educational attainment (compulsory schooling, apprenticeship, intermediate vocational school, higher vocational school, academic school, and university). *age* is measured in three groups (15-24, 25-49, 50+). *wage* is gross wage in the year before the mass layoff (in constant 2015 euros). The estimated equation is estimated by two different, but each pooled, OLS models, one for mass layoffs in manufacturing firms, and one for market services firms. Switchers to unemployment or out of the labor force are excluded, as well as persons that switch to part time work. The analysis of those three groups is shown in Subsections 4.3.3 and 4.3.4.

Manufacturing. Figure 9 shows selected determinants of switching out of the firm (the full results are in Table 11, Column (1), in the Appendix). Women have a smaller probability of exiting from the firm, by about 0.6% for manufacturing. White collar workers have a higher probability of 1.5%. The effect for educational attainment is relative to the group of persons that only finish compulsory school. Higher vocational school (0.9%) and university (4.9%) have significantly higher probabilities of switching. The largest effect is for the age group 15-24, which have a probability of switching of 20.1%. The age group of 50+ has a probability that is 5.2% lower. Wages have a negative effect of about -7.7e-07*25,000 = -1.9% for a wage difference of 25,000 euros, which is similar in magnitude to the difference between the 25th and 75th wage percentile in the sample. Below, all wage estimates are multiplied by 25,000 for interpretation. Wages appear in the estimation equation interacted with educational level and age. For intermediate vocational school and academic secondary school, higher wages have a positive effect on switching, which is 0.6% and 0.8% at a wage differential of 25,000 euros. For the age group 15-24, wage has a negative interaction, decreasing the switching out probability by 10.5%. For the age group 50+, the wage interaction is positive, increasing the probability by 0.8%.

Market services. Several effects differ in size and/or sign for switchers in manufacturing (Table 11, Column (4)). White collar workers have a 7.1% lower probability instead of a higher probability as in manufacturing. Educational level has a stronger effect on switching probability. For a university degree, it is more than twice as high for market services (11.2%) compared to manufacturing (4.9%). Age has a 12.7% probability increase for 15-24 for market services and -8.4% for 50+. Wages interactions with educational attainment have the opposite sign for services: while the educational attainment base effects turn significantly positive, the switching probabilities become smaller with increasing wages. Wage attenuates the age effects. For 15-24, higher wages decrease the probability of switching (-1.6% for 25,000 euros). For 50+, higher wages increase the probability (1.2% for 25,000 euros).

Figure 9: **Probability to switch for selected characteristics**

Notes: Each column shows the probability of switching out from the manufacturing (left) or services firm (right) where a displaced person was employed before the mass layoff. The probabilities are from a linear probability model where the dependent variable is 0 when the employee is not displaced in the mass layoff, and 1 when she is. The comparison groups are: men; age group 25–49; at most compulsory schooling. Selected explanatory categories. For the results of the full specification, see Table 11 in the Appendix. The sample consists of stayers and switchers after mass layoff and employed after the switch. Pooled sample from 2013-2022. Manufacturing (NACE C). Market services (NACE G-N).
Source: AMDC.

4.3.2   Wages

The previous results addressed the question: who remains in the firm when a mass layoff occurs, and who typically leaves to another firm in the same or another sector. Young persons have the highest probability of leaving, except if they earn very high wages. The next set of results looks at wages after a displacement. The estimated equation for the change in wages for different switching cases is:

$$wage_{it} = \beta_0 + \beta_1 * 1(female_i) + \beta_2 * 1(white\ collar_i) + \beta_3 * educ_i + \beta_4 * age_i$$
$$+ \beta_5 * post_{it}$$
$$+ \beta_6 * post_{it} * 1(female_i) + \beta_7 * post_{it} * 1(white\ collar_i) + \beta_8 * post_{it} * educ_i + \beta_9 * post_{it} * age_i$$
$$+ \gamma_0 * target\ sector_i + \gamma_1 * post_{it} * target\ sector_i + u_{it}$$

Each person in a mass layoff firm appears before and after the mass layoff, with *t* representing time relative to the layoff year. *post* is a dummy variable that is 1 after the layoff, and 0 before. *wage* is gross wage (in constant 2015 euros). Newly introduced to the equation, in comparison to the switching equation in the previous subsection, is the categorical vector *target sector* and its interaction with *post*. Their coefficients capture the difference of the wages of employees that are laid off, compared to those that remain in the firm, before (γ_0) and after the event (γ_1). The equation is estimated by pooled OLS, first for manufacturing mass layoffs, and then for market services mass layoffs.

Manufacturing. The estimates of main interest are for the dummy variables indicating a switch to another sector, after leaving manufacturing. The estimation equation for the wage results before and after the switch shown in Figure 10 (left panel), contains dummy variables for switchers for each sector, both before and after switching (results for the full specification are in Table 11, Column (2), in the Appendix). Dummy variables for the switch sectors control for wage differences before switching. The results show that all switching persons had lower wages already before the switch—controlling for education, gender, age group, and white collar workers, as before. The wage differences range from -2571

euros to -3879 euros. This translates to a decrease of -5.7% to -8.6% relative to the median wage in the sample (approximately 45,000 2015 euros) and to -5.1% to -7.8% relative to the mean wage in the sample (approximately 50,000 2015 euros). The control group consists of persons that remain in the manufacturing firm after the mass layoff. The interactions with the variable "post" measure the wage difference after the switch, for each sector. Persons that switch to another manufacturing firm can compensate 74% of their pre-switch difference (=2023.7/2739.1). Persons switching to other industry or to market services have similar wages as before the switch. Persons switching to non-market services add another 50% to their initial difference of stayers (=1543.4/3090.8).

Market services. In contrast to manufacturing, persons switching to another manufacturing firm do not already have lower wages before the switch (Figure 10, right panel, and full results in Table 11, Column (5) of the Appendix). For the other sectors, switchers do have smaller wages before the switch. After the switch, wages increase when switching to a manufacturing firm, by 1851 euros. Wages also increase when switching to a firm in other industry, by 1167 euros. A change to another firm within the sector does not offset the pre-switch wage difference (insignificant increase of 125 euros, compared to a pre-switch difference of -3503 euros), which is also in contrast to manufacturing, where 74% of the pre-switch difference is offset by a switch to another firm within the sector. Finally, a switch from market to non-market services increases the pre-switch difference of -6815 euros by another 1031 euros.

Figure 10: **Wages before and after switching from manufacturing or market services to another firm (by target sector)**

Notes: Each column shows the wages before and after switching out from the manufacturing (left) or services firm (right) where a displaced person was employed before the mass layoff, by target sector. The dependent variable are wages in constant (2015) euros. The comparison groups are employees that remain employed in the mass layoff firm. The results of the full specification are in Table 11 in the Appendix. The sample consists of stayers and switchers after mass layoff and employed after the switch. Pooled sample from 2013-2022. Manufacturing (NACE C). Market services (NACE G-N).
Source: AMDC.

4.3.3 Part time work

Because of the increasing prevalence of part time work in Austria, the next set of results is intended to contribute to the understanding of the determinants of part time work. The sample is larger because persons switching to a new employer, but working only part time, were excluded in the estimations above, and are included now. We estimate the following linear probability model (OLS) on a dummy that is one when the person switches to part-time work in the year after the mass layoff:

$$1(part\ time_{i,post}) = \beta_0 + \beta_1 * 1(female_i) + \beta_2 * 1(white\ collar_i) + \beta_3 * educ_i + \beta_4 * age_i$$
$$+ \beta_5 * wage_{i,pre} + \beta_6 * wage_{i,pre} * educ_i + \beta_7 * wage_{i,pre} * age_i$$
$$+ \gamma_0 * target\ sector_i + u_{it}$$

The dependent variable is a dummy variable for switching to part time *after* the mass layoff. Note that only mass layoff employees that worked full time *before* the event are included in all samples. *wage* is measured before the mass layoff.

Manufacturing. Overall, 1.5% of persons—switchers and stayers together—switch to part time in the year after the mass layoff. Women have a 1.5% higher probability of switching from full time to part time (Table 11, Column (3)). White collar workers have a 0.5% higher probability. The probabilities are about 1% higher for vocational middle and higher schools, and for academic school. For university, it is 1.8% higher. For the age group 50+, the probability increases by 1.9%. Wages have a negative effect on the part time probability. The effect for a difference of 25,000 euros is an additional 0.3%. All wage effects interacted with level of education are significant and diminish the probability of part time work further. The only exception is the interaction with apprenticeship. The reference group for educational attainment is compulsory school. The magnitude of the wage--education interaction ranges from 0.25% (vocational middle school) to 0.5% (university). For age group 15-24, wage increases part time work by 0.6%, for age group 50+ it decreases by 0.3%. Remaining in manufacturing decreases part time work probability, while switching to market services increases the probability by 1.2% and by 3.6% for non-market services.

Market services. Overall, 2.3% of persons—switchers and stayers together—switch to part time in the year after the mass layoff. Women's probability of switching is about twice as large as for manufacturing (2.8%;Table 11, Column (6)). A difference to manufacturing that stands out is that age group 15-24 has a 3.7% higher probability of switching to part time (not significantly different from zero for manufacturing). The effect for age group 50+ is half as large (0.9%). For wages, the largest differences are the base effect (-1.3% per 25,000 euros) and the additional negative effect for age group 15-24 (-3.1% per 25,000 euros). A second remarkable contrast to manufacturing is that higher wages have a positive effect on part time work for higher educational attainment. The probability of switching to part time employment is smaller when switching to manufacturing (-0.9%), and larger when switching within market services (0.9%) or to non-market services (3.4%).

4.3.4 Unemployment, out of labor force

This subsection looks at the group of persons that switch to unemployment or out of the labor force. The comparison group consists of all other switchers. The following separate linear probability model (OLS) is estimated for each group of switchers:

$$1(y)_{i,post} = \beta_0 + \beta_1 * 1(female_i) + \beta_2 * educ_i + \beta_3 * age_i + u_{it}$$

where *y* is either *unemployed* or *out of the labor force* in the year after the mass layoff.

*Manufacturing.*Figure 11 (left panel; numerical results in Table 12, Column (2), in the Appendix) shows the pre-switch characteristics associated with a higher probability of unemployment in the year after the mass layoff. The probability is higher for women (3.5%) and for the age group 50+ (13.6%). Higher educational attainment levels have a lower probability, compared to the reference group of compulsory education: apprenticeship and higher vocational school are associated with a probability of unemployment that is about 7% lower, for intermediate vocational training, academic school and

university, the probability decreases by 13.6%, 15.7% and 17.1%. The determinants in terms of signs and significance are similar for being out of the labor force. The main differences are an estimate that is larger for women (3.8%) and larger and significant for age group 15-24 (-1.2%). The other determinants are similar, but smaller in magnitude.

Market services. In contrast to manufacturing, the age group 15-24 has a significantly lower probability (-2.7%) of unemployment (Figure 11, right panel, and Table 13, Column (2), in the Appendix). The other determinants are similar, but with smaller magnitudes. Being out of the labor force again has a positive estimate for women, but almost cut in half compared to manufacturing (2.1%). The effects for the other determinants, while similar in sign and relative importance, have smaller magnitudes in market services as in manufacturing.

Figure 11: **Probability of being unemployed or out of labor force after mass layoff**

Notes: Each column shows the probability of being unemployed or out of labor force after being displaced from the manufacturing (left) or services firm (right) in a mass layoff, for different characteristics of the displaced employees. The dependent variable is a dummy variable for being unemployed or out of labor force after displacement. The comparison groups are employees that are displaced, but employed in another firm after the mass layoff. The numerical results of the full specification are in Table 12 (manufacturing) and Table 13 (market services) in the Appendix. The sample consists of switchers after mass layoff. Comparison groups are: male, age 25-49, at most compulsory schooling. Pooled sample from 2013-2022. Manufacturing (NACE C). Market services (NACE G-N).
Source: AMDC.

4.3.5   Knowledge intensive services

The same specification as for unemployed in the previous section is used on a dummy that is one when the switch occurs to a subsector characterized as knowledge-intensive services (KIS). The definition of the knowledge-intensive services follows Eurostat.[11]

Manufacturing. The sample is reduced to switchers going from manufacturing to market services (Table 12, Column (4)). The probability to switch to a KIS subsector is 11.4% smaller for women. The age groups do not have an effect. Education has a large effect. The effect is negative for apprenticeship (-6.9%), compared to the reference group of compulsory schooling. For intermediate vocational school, it is also negative (-3.5%). Educational level has a positive effect for academic school (5.1%), higher vocational school (11.3%) and university (22.0%).

Market services. The sample consists of switchers within market services, from one firm to another (Table 13, Column (4)). The probability for women to switch to a KIS subsector is -7.3%. Age group 15-

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[11]   See   https://ec.europa.eu/eurostat/cache/metadata/en/htec_esms.htm,   and   Annex   3:   https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an_3.pdf. (NACE 50-51, 58-63, 64-66, 69-75, 78, 80).

24 has a higher probability of 3.0%, age group 50+ a negative effect of -7.1%. The effects of educational levels are more positive than for manufacturing. While apprenticeship has no effect now, the effect of intermediate vocational training is a 8.8% higher probability to switch to a KIS subsector, 22.1% higher for academic school, 27.5% for higher vocational school, and 42.9% for university.[12]

4.3.6 High-productivity-growth services

Consideration of subsectors with high-productivity-growth within services follows the approach in Dürnecker et al. (2024). Instead of the long post-war time period they use for categorization into high and low productivity subsector, we calculate labor productivity for the period before our estimation sample starts and where other data are available for labor productivity calculation (2008-2012). We define as high-productivity growth services those 2-digit services subsectors of market services where average labor productivity belongs to the highest 50%.[13] Again, we use the same specification as for knowledge-intensive services in the previous section.

Manufacturing. The sample is restricted to switchers from manufacturing to market services (Table 12, Column (5)). Switchers in the age group 15-24 have a lower probability (-3.4%) of going to a high-productivity-growth services subsector (HLP), compared to the reference age group 25-49. For age group 50+, the probability is higher (2.2%). Educational attainment has a strong effect: 17.4% higher probability for apprenticeship (all compared to the reference group of compulsory education), 30.8% for intermediate vocational school, 28.0% for academic school, 43.6% for higher vocational school and 48.4% for university.

Market services. The sample consists of switchers within market services, from one firm to another (Table 13, Column (5)). The signs and magnitudes are comparable to switchers from manufacturing to market services.[14]

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[12] Including a dummy variable that captures if the source subsector was a KIS leads to smaller and more similar results compared to manufacturing. The sign and significance of the estimates do not change.

[13] These are NACE-2-digit subindustries 46, 50, 51, 58, 60, 61, 62, 64, 65, 66, 68, 69, 70, 71, 75, 77.

[14] Including a dummy variable that captures if the source subsector was a high-productivity-growth subsector makes the age group 50+ insignificant. The sign and significance of the other estimates do not change, but their magnitude becomes smaller and also smaller than the results for manufacturing.

Figure 12: **Probability of switching to a knowledge-intensive (KIS) or high labor productivity (HLP) services subsector after mass layoff**

Notes: Each column shows the probability of switching to a knowledge-intensive services subsector or to a high productivity services subsector after being displaced from the manufacturing (left) or services firm (right) in a mass layoff, for different characteristics of the displaced employees. The dependent variable is a dummy variable for switching to a knowledge-intensive sector or to a high productivity sector. The numerical results of the full specification are in Table 12 (manufacturing) and Table 13 (market services) in the Appendix. The sample consists of switchers after mass layoff. Comparison groups are: male, age 25-49, at most compulsory schooling. Pooled sample from 2013-2022. Manufacturing (NACE C). Market services (NACE G-N). Source: AMDC.

4.3.7   Target subindustries

Figure 13 shows the top 10 target subsectors of firm and sector switchers. The left panel is for switchers from manufacturing to market services, the right panel for market service to manufacturing. Note that the absolute number of switchers from manufacturing to market services (14,038) is larger than from market services to manufacturing (13,337), even though the total number of mass layoffs is about 40% larger (see Table 7, 536,430/384,006).

Manufacturing. Employment activities (78) and wholesale (46) stand out as the largest two target market services subsectors (Figure 13, left panel). The next two, similar in size, are management (70) and retail (47). The top 10 of a total of 33 subsectors in market services account for 83.1% of the switchers.

Market services. Manufacturing of machinery and equipment n. e. c. (28) stands out as the largest target manufacturing subsector for switchers (Figure 13, right panel). The next two, with similar magnitude, are manufacturing of fabricated metal products, except machinery and equipment (25) and food products (10). The top 10 of a total of 22 subsectors in manufacturing account for 77.1% of the switchers.

Figure 13: **Top 10 target subsectors of firm and sector switchers**

Notes: Each column contains the share of employed persons switching out from employment at a manufacturing (market services) firm, conditional on switching to a market services (manufacturing) firm. The left (right) panel shows the 10 largest 2-digit NACE industries from market services (manufacturing) where persons employed in manufacturing (market services) before the mass layoff switch to. The number of total switchers corresponds to the pooled sample from 2013-2022 of all persons switching out of mass layoff firms to the other sector. Mass layoff firms are firms that lay off a large number of employed persons at one point in time.

Market services:
78: Employment activities,
46: Wholesale trade, except of motor vehicles and motorcycles
70: Activities of head offices; management consultancy activities
47: Retail trade, except of motor vehicles and motorcycles
72: Scientific research and development
49: Land transport and transport via pipelines
56: Food and beverage service activities
71: Architectural and engineering activities; technical testing and analysis
62: Computer programming, consultancy and related activities
81: Services to buildings and landscape activities

Manufacturing
28: machinery and equipment n.e.c.
25: fabricated metal products, except machinery and equipment
10: food products
29: motor vehicles, trailers and semi-trailers
27: electrical equipment
24: basic metals
33: Repair and installation of machinery and equipment
26: computer, electronic and optical products
23: other non-metallic mineral products
21: basic pharmaceutical products and pharmaceutical preparations

Source: AMDC.

5   Summary

Structural change affects firms and employees by exits from sectors and by adjustment to new sectors. While the share of manufacturing employment stagnated in Austria in the decade after the Great Recession, recent development since 2023 shows a decline of manufacturing production. The goal of the study is to inform about the ability and the outcomes of sector switching firms, and the ability of employees to move to other sectors.

Firms undergo structural change by expanding into services or switching sectors. This happens through functional change, where product-related services (e.g., product design, software accompanying product use) gain importance, or sectoral change, where firms shift entirely from products to services. Intangible investments like R&D and software play a key role in these transitions. The first part of the study investigates Austrian firms switching from manufacturing to services, finding that they contract in employment to the level of service firms. Labor productivity of switchers is larger before the switch and increases more than for firms staying in their sector after the switch. Intangible investments are larger for switching firms, providing some evidence for a higher relevance of product-oriented services.

The second part investigates workforce adaptation by looking at the effect of exogenous displacement from manufacturing and services firms. Young employees (15-24 years) have the highest probability of displacement, and employees age 50+ the lowest probability. Wage attenuates the age effects. For 15-24, higher wages decrease the probability of switching, for 50+, higher wages increase the probability. Higher levels of educational attainment have higher effects for leaving the firm in market services than in manufacturing firms. Switching employees have lower wages already before the switch. Moving to a manufacturing firm has a positive effect on wages, moving to non-market services employers leads to a widening of the wage gap of switcher. About 2% of employees transition to part time work after a mass layoff event. Women and older employees have higher probabilities of part time work. Higher wages reduce the probability of part time work. For higher educational attainment, wage has a negative effect on part time work after manufacturing mass layoff, but a positive effect for market services mass layoffs. Women and age group 50+ have a higher probability of being unemployed or out of the labor force, while, as expected, higher educational attainment reduces the probability. Women have a lower probability of switching to knowledge-intensive services subsectors, and intermediate levels of educational attainment are also associated with lower probabilities when the mass layoff occurred in manufacturing, but not for services. Older age groups and higher educational attainment lead to more frequent switches to service subsectors that have high labor productivity.

Persons exiting firms often have lower wages already before their exit, after controlling for age, educational attainment and gender. Women and younger persons have higher probabilities of being unemployed or out of the labor force after displacement. Programs to support displaced persons after structural change could focus more on these disadvantaged groups.

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7 Appendix

7.1 Classifications

Sector classification

Firms (legal units) are assigned to a main activity according to NACE classes in the Statistical Business Register (SBR/URS). The main activity is assigned in agreement with the firm. In case of several different NACE-activities of the firm, the assignment to a main activity takes place on the basis of firm-specific revenue shares, which are valued at the overall (SBS-data basis) value-added share of revenue (Statistik Austria, 2022a). The main activity is derived at the top-level NACE-code. While the highest-value-added activity may switch to other top-level NACE-codes, the statistical classification of the main activity on disaggregated levels always follows the higher level of aggregation ("top down method"). E.g., a firm with activities (value-added share) in 2591 (25%), 2899 (35%) and 4614 (40%) will have classification 1-digit C (60%) and 2-digit 28 (35%). If there are two activities both with a share close to 50%, then the main activity will only be replaced if it switches below 50% for two consecutive years. (Statistik Austria, 2008)

Assignment to a main activity of plants according to NACE classes is based on value-added, following the same rules as for firms (see Subsection "sector classification" in Section "Two-sector firms and switching"; Statistik Austria, 2022b).

Occupations classification

Table 8: **Mapping of occupational groups to fields of activity**

Field	Ö-ISCO-08	Occupational group
Production	61	Skilled workers in agriculture
	62	Skilled workers in forestry, fishing, and hunting
	63	Farmers, fishers, hunters, and gatherers for own consumption
	71	Construction and finishing trades and related occupations, excluding electricians
	72	Metal workers, mechanics, and related occupations
	73	Precision craft workers, printers, and artisanal trades
	74	Electricians and electronics technicians
	75	Food processing, woodworking, garment manufacturing, and related craft trades
	81	Operators of stationary plants and machinery
	82	Assembly occupations
	92	Laborers in agriculture, forestry, and fishing
	931	Laborers in mining and construction
	932	Laborers in manufacturing
Primary services	33	Non-academic business and administrative specialists
	41	General office and secretarial staff
	42	Office staff with customer contact
	43	Office staff in finance, accounting, statistics, and materials management
	44	Other office staff and related occupations
	511	Travel attendants, conductors
	512	Cooks
	513	Waiters/waitresses
	515	Caretakers, housekeepers
	52	Sales personnel
	54	Security and protective services personnel
	83	Vehicle drivers and mobile equipment operators
	91	Cleaning staff and helpers
	933	Helpers in transport and storage
	94	Helpers in food preparation
	95	Street vendors and street-based service workers
	96	Waste disposal workers and other elementary occupations
Secondary services - personal	321	Medical and pharmaceutical professionals
	323	Non-academic specialists in traditional and complementary medicine
	324	Veterinary professionals and assistants
	325	Other health care assistants
	34	Non-academic legal, social care, cultural, and related specialists
	514	Hairdressers, beauticians, and related occupations
	53	Caregiving occupations
Secondary services - knowledge intensive	1	Managers
	21	Scientists, mathematicians, and engineers
	22	Academic and related health professionals, including non-academic nurses and midwives
	23	Teachers
	24	Business professionals and comparable academic occupations
	25	Academic and comparable specialists in information and communication technology
	26	Lawyers, social scientists, and cultural professionals
	31	Engineering and comparable technical specialists
	322	Non-academic nursing and midwifery professionals (<322>)
	35	Information and communication technicians

Notes: Classification of Occupations (ISCO 08, Microcensus, Statistik Austria) based on the framework by Helmrich and Zika (2010). The subdivision of secondary services follows Stooß and Weidig (1990).

7.2 Additional results

Table 9: **Employment, productivity and sales of staying and switching firms (unbalanced panel)**

	(1)	(2)	(3)
		Labor	
	Employment	productivity	Sales
Mfg. stayers	-4.14**	-11.15**	128.4
	(1.17)	(0.72)	(395.7)
Services stayers	-19.31**	-13.8**	-3820.5**
	(1.14)	(0.71)	(386.7)
Switchers from mfg. to services x post	-16.03**	7.65**	-2493.9**
	(1.54)	(0.95)	(522.2)
Mfg. Stayers x post-switching	3.14**	-0.121	1560.7**
	(0.37)	(0.228)	(124.9)
Services stayers x post-switching	0.241*	-1.62**	54.7
	(0.115)	(0.071)	(39.0)
Constant	26.6**	53.9**	5360.9**
	(1.14)	(0.704)	(385.7)
Observations	4,099,033	4,099,033	4,099,033
Diff. for mfg. switchers to mfg. stayers	-15.0**	18.9**	-4182.9**
	(1.07)	(0.66)	(363.0)
Diff. for mfg. switchers to services stayers	3.0**	23.1**	1272.0**
	(1.04)	(0.644)	(353.2)

Notes: Each column contains one regression output. The sample of firms is not balanced, firms enter the sample for as many years as available, but must be observed at least twice to be categorized as switcher or non-switcher. Switchers are selected as firms that permanently switch from manufacturing to market services sector. The year of the switch, based on NACE-codes, must lie in 2008-2022, which is the sample period. The other two groups are firms that stay in manufacturing and that stay in market services. For the non-switching firms, a pseudo switching event was randomly assigned to each firm. Each variable (first column) is a dummy variable for a specific group. The line shows the estimate of the coefficient. Standard errors are in parentheses below each estimate. The last two lines show the statistical significance and the estimate that is derived from the linear combination of the estimates of the difference of manufacturing switchers to the post-value of stayers.
The dependent variables of the regressions: *Employment*: Number of persons employed. *Labor productivity*: Deflated labor productivity (2015 euros). *Sales*: Deflated sales (2015 euros).
* indicates significance at the 5% level, ** at the 1% level.
Source: AMDC.

Table 10: **Value added and intangibles of staying and switching firms (unbalanced panel)**

	(4)	(5)	(6)
	Value added	Share intangibles	
		Incl. R&D	Excl. R&D
Mfg. stayers	21.4	-0.021**	-0.012**
	(97.5)	(0.003)	(0.001)
Services stayers	-1327.2**	-0.046**	-0.013**
	(95.2)	(0.003)	(0.001)
Switchers from mfg. to services x post	-1005.8**	-0.014**	0.004**
	(128.6)	(0.004)	(0.001)
Mfg. Stayers x post-switching	429.5**	0.004**	0.007**
	(30.8)	(0.001)	(0.0003)
Services stayers x post-switching	28.38**	0.004**	0.006**
	(9.61)	(0.0003)	(0.0001)
Constant	1738.2**	0.075**	0.033**
	(95.0)	(0.003)	(0.001)
Observations	4,099,033	1,022,548	2,917,578
Diff. for mfg. switchers to mfg. stayers	-1456.7**	0.0038	0.009**
	(89.4)	(0.002)	(0.001)
Diff. for mfg. switchers to services stayers	293.0**	0.0278**	0.012**
	(87.0)	(0.002)	(0.001)

Notes: Each column contains one regression output. The sample of firms is not balanced, firms enter the sample for as many years as available, but must be observed at least twice to be categorized as switcher or non-switcher. Switchers are selected as firms that permanently switch from manufacturing to market services sector. The year of the switch, based on NACE-codes, must lie in 2008-2022, which is the sample period. The other two groups are firms that stay in manufacturing and that stay in market services. For the non-switching firms, a pseudo switching event was randomly assigned to each firm. Each variable (first column) is a dummy variable for a specific group. The line shows the estimate of the coefficient. Standard errors are in parentheses below each estimate. The last two lines show the statistical significance and the estimate that is derived from the linear combination of the estimates of the difference of manufacturing switchers to the post-value of stayers.
The dependent variables of the regressions: *Value added*: Deflated gross value added (2015 euros). *Share intangibles incl. R&D*: Share of intangible assets, including R&D, software and immaterial property rights, divided by total investment. *Share intangibles excl. R&D*: Alternative definition of share of intangible assets, including software and immaterial property rights, divided by total investment.
* indicates significance at the 5% level, ** at the 1% level.
Source: AMDC.

7.3   Additional figures

Figure 14: **Sectoral flows from before mass layoff until the second year after mass layoff (mass layoff years 2014–2020)**

Notes: Each entry contains the number of employed persons switching from one sector to another in year 1 (middle layer) and year 2 (right layer). The left layer shows where the persons were employed before a mass layoff. Observations are selected as employed persons working in mass layoff firms. The number of observations corresponds to the pooled sample from 2013-2022 of all employed persons in mass layoff firms. Mass layoff firms are firms that lay off a large number of employed persons at one point in time. The sectors are:

indoth: Other industry (NACE D, E, F)
mfg: Manufacturing (NACE C)
ms: Market services (NACE G-N)
nms: Non-market services (O-U)
olf: Out of labor force
unemp: Unemployed
other: Education, national service, retirement, temporary leave, exit, abroad, primary sector, or unknown.
Source: AMDC.

7.4   Examples for structural change in manufacturing firms

7.4.1   Functional structural change

Hybrid production

Companies in the *mechanical engineering* industry increasingly use remote maintenance by collecting and transmitting operational data from various machines. This approach enables the identification of causes of malfunctions without requiring on-site visits. Operators receive instructions for resolving issues directly, which significantly reduces response times and eliminates travel costs for service personnel (Dachs, Simon, 2016).

Wolf GmbH is a European manufacturer and system provider of heating, climate, and solar technology. Regulatory changes and growing environmental awareness have driven product innovations. The planning process has become more complex due to the integration of multiple heating components, while installation and maintenance by local craftsmen are increasingly demanding because of electronic components and digital interfaces. These interfaces allow remote maintenance and advance ordering

of spare parts. Wolf offers a mobile app for smartphones and tablets that enables technicians to access error messages and customers to control their systems. Device software can be updated through the digital interface. To address the higher complexity of installation and maintenance, Wolf provides seminars through its own academy, including online training sessions, and offers consulting on funding opportunities (Bahrke et al., 2015).

MTU Aero Engines manufactures and maintains engines for civil and military aviation. The company offers contract models ranging from time-and-material agreements to fully hybrid "Power-by-the-Hour" contracts, where airlines pay solely for engine usage per flight hour. Real-time analysis of operational data across all engines of a specific type using big data techniques helps identify potential weaknesses and risks early, reducing the need for costly shop visits that require complete engine disassembly (Bahrke et al., 2015).

Siemens leverages IT infrastructure to provide remote maintenance services, ensuring security and performance while offering advanced data storage and analytics technologies for customers. The company combines analytics expertise, deep understanding of customer processes, and proprietary knowledge of product design and life cycles. Its services include analysis and optimization of equipment and holistic production processes, energy consumption and demand management, safety and risk assessments, and cloud-based solutions for platform management (Bahrke et al., 2015).

Kaeser Kompressoren operates as a compressed air system provider, shifting from selling compressors to selling compressed air as a service. The company uses real-time remote monitoring to optimize material and personnel deployment and maximize machine uptime. Predictive maintenance strategies enable proactive planning with minimal effort, reducing downtime and improving efficiency (Bahrke et al., 2015).

Factoryless Goods Producing Firms

Factoryless goods producers focus on design and development while outsourcing manufacturing, yet remain "deeply involved in the production of physical goods" (Fort et al., 2023). *Apple* is one of the often-cited examples, which has shifted to device design and development and outsourced production. Similarly, semiconductor firms have often transitioned to factoryless goods producing firms, e. g. *Qualcomm*. The transition is not constrained to high-tech products, as the example of *Nike* shows, which has many manufacturing locations in many different countries.

7.4.2   Sectoral Structural Change

Sectoral structural change occurs when companies transition from manufacturing to service provision. *IBM* shifted from producing mainframes to offering data solutions. The *National Cash Register Company* moved from manufacturing cash registers, ATMs, and computers to providing professional services and software. *Unisys* evolved from mainframe production to IT and consulting services (Ding et al., 2022). Similarly, *Iver C. Weilbach & Co* transformed from producing compasses to delivering electronic nautical charts and related customer services (Bernard et al., 2017).

7.5   Regression results

Table 11: **Characteristics, wages, and part time work for switchers and stayers**

	(1)	(2)	(3)	(4)	(5)	(6)
	Manufacturing			Market services		
	Switch	Wage	Part time	Switch	Wage	Part time
Female	-0.0062**	-12,671.2**	0.01491**	-0.00879**	-12,147**	0.02760**
	(0.0010)	(74.2)	(0.00053)	(0.00089)	(63.2)	(0.00044)
White collar	0.0147**	15,489.2**	0.00546**	-0.0710**	18,106**	0.00275**
	(0.0010)	(71.3)	(.00053)	(.0011)	(73.9)	(0.00054)
Apprenticeship	-0.00049	4,982.2**	0.0014	0.0102**	3,050**	-0.0088**
	(0.00373)	(86.0)	(.0019)	(0.0030)	(93.3)	(.0015)
Intermediate	-0.0060	8,511.7**	0.0092**	0.0172**	8,712.4**	-0.0079**
vocational	(0.0044)	(111.8)	(0.0023)	(0.0037)	(120.1)	(0.0018)
Academic	0.0027	6,314.7**	0.0113**	0.0246**	13,542**	0.0087**
school	(0.0068)	(197.9)	(0.0035)	(0.0041)	(139.5)	(0.0020)
Higher	0.0095*	12,567.4**	0.0122**	0.0400**	16,660**	-0.0046*
vocational	(0.0044)	(122.89)	(0.0023)	(0.0036)	(119.1)	(0.0018)
University	0.0490**	25,563.3**	0.0184**	0.1122**	28,387**	0.0063**
	(0.0047)	(129.6)	(0.0024)	(0.0037)	(118.3)	(0.0018)
Age 15-24	0.2011**	-9,516.2**	-0.0064	0.1267**	-11,748**	0.0370**
	(.0070)	(122.9)	(0.0036)	(0.0064)	(122.6)	(0.0031)
Age 50+	-0.0520**	7,333.6**	0.0194**	-0.0848**	10,167**	0.00946**
	(0.0020)	(61.5)	(0.0010)	(0.0018)	(65.3)	(0.00090)
Wage	-7.7e-07**		-1.3e-07**	-4.6e-07**		-5.3e-07**
	(9.1-08)		(4.6e-08)	(7.5e-08)		(3.7e-08)
Apprenticeship	1.7e-07		5.2e-08	-5.6e-08		2.3e-07**
x wage	(9.5e-08)		(4.9e-08)	(8.0e-08)		(3.9e-08)
Intermed. voc.	2.5e-07*		-1.0e-07*	-1.6e-07		3.0e-07**
x wage	(1.0e-07)		(5.2e-08)	(8.6e-08)		(4.3e-08)
Academic sch.	3.0e-07*		-1.6e-07*	-1.7e-07*		1.2e-07**
x wage	(1.4e-07)		(7.2e-08)	(8.8e-08)		(4.3e-08)
Higher voc.	1.8e-07		-1.6e-07**	-3.8e-07**		2.9e-07**
x wage	(9. 8e-08)		(5.0e-08)	(8.2e-08)		(4.1e-08)
University	6.4e-08		-2.0e-07**	-6.7e-07**		1.2e-07**
x wage	(9.7e-08)		(5.0e-08)	(8.0e-08)		(3.9e-08)
Age 15-24	-4.2e-06**		2.2e-07*	-6.5e-07**		-1.2e-06**
x wage	(1.9e-07)		(9.6e-08)	(2.1e-07)		(1.0e-07)
Age 50+	3.2e-07**		-1.2e-07**	4.9e-07**		8.4e-09
x wage	(3.4e-08)		(1.8e-08)	(3.0e-08)		(1.5e-08)

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Table 11 *continued*: **Characteristics, wages, and part time work for switchers and stayers**

	(1)	(2)	(3)	(4)	(5)	(6)
		Manufacturing			Market services	
	Switch	Wage	Part time	Switch	Wage	Part time
Post		-72.87			30.42	
		(114.0)			(123.6)	
Female		299.6**			259**	
x post		(104.9)			(89.9)	
White collar		646.9**			620.25**	
x post		(100.8)			(104.5)	
Other industry		-3,879.1**	0.0047		-3,347.4**	-0.0023
		(408.8)	(0.0028)		(384.0)	(0.0026)
Manufacturing		-2,739.1**	-0.0058**		80.91	-0.0090**
		(176.6)	(0.0012)		(206.6)	(0.0014)
Market services		-2,571**	0.0120**		-3,502.6**	0.0085**
		(174.1)	(0.0012)		(116.0)	(0.00078)
Non-market services		-3,090.8**	0.0359**		-6,816.2**	.0336**
		(447.1)	(0.0030)		(308.8)	(.0020)
Other industry		130.6			1,166.7*	
x post		(578.2)			(543.0)	
Manufacturing		2,023.7**			1,851.1**	
x post		(249.8)			(292.2)	
Market services		-75.31			125.32	
x post		(246.2)			(164.1)	
Non-market services		-1,543.4*			-1,030.9*	
x post		(632.3)			(436.8)	
Apprenticeship		-55.89			-4.346	
x post		(121.7)			(132.0)	
Intermed. voc.		-121.1			63.71	
x post		(158.1)			(169.8)	
Academic sch.		304.8			165.5	
x post		(279.8)			(197.3)	
Higher voc.		5.230			372.3*	
x post		(173.8)			(168.4)	
University		539.2**			688.1**	
x post		(183.3)			(167.3)	
Age 15-24		489.2**			300.9	
x post		(173.9)			(173.3)	
Age 50+		-480.4**			-866.4**	
x post		(87.0)			(92.4)	
Constant	0.0866**	36,585**	0.0092**	0.1708**	28,117**	.0276**
	(0.0035)	(80.582)	(.0018)	(.0027)	(87.4)	(.0013)
Observations	400,101	800,202	428,034	576,821	1,153,642	641,898

Notes to Table 11: Each column contains one regression output. Columns (1)-(3) are for persons employed in the manufacturing sector, Columns (4)-(6) for persons employed in the market services sector before the displacement. Observations are selected as employed persons working in mass layoff firms. The number of observations corresponds to the pooled sample from 2013-2022 of all employed persons in all mass layoff firms. Mass layoff firms are firms that lay off a large number of employed persons at one point in time. Each variable (first column) is a dummy variable for a specific characteristic. Standard errors are below the estimates in parentheses.
The dependent variables of the regressions:
(1) and (4): Dummy variable for persons leaving the manufacturing or services firm after mass layoff (0: stay despite mass layoff).
(2) and (5): Wage gross (real 2015 euros) for persons in year after mass layoff (stayers and switchers pooled).
(3) and (6): Dummy variable for persons working part-time after mass layoff (0: person works full-time). (Part time employees are excluded in the other estimations.)
* indicates significance at the 5% level, ** at the 1% level.
Source: AMDC.

Table 12: **Probability of being in specific groups after switching out from manufacturing**

(1)	(2)	(3)	(4)	(5)
	Unemployed	Out of labor force	Knowledge intensive	High productivity
Female	0.0345**	0.0381**	-0.1143**	0.0124
	(0.0048)	(0.0033)	(0.0098)	(0.0093)
Age 15-24	-0.0117	-0.0121**	-0.0167	-0.0338**
	(0.0066)	(0.0045)	(0.0138)	(0.0130)
Age 50+	0.1355**	0.0854**	0.0049	0.0224*
	(0.0050)	(0.0035)	(0.0116)	(0.0110)
Apprenticeship	-0.0741**	-0.0430**	-0.0687**	0.1741**
	(0.0056)	(0.0039)	(0.0122)	(0.0115)
Intermediate vocational	-0.1138**	-0.0625**	-0.0354*	0.3078**
	(0.0076)	(0.0053)	(0.0165)	(0.0157)
Academic school	-0.0713**	-0.0539**	0.0511*	0.2797**
	(0.0127)	(0.0088)	(0.0255)	(0.0242)
Higher vocational	-0.1567**	-0.0782**	0.1130**	0.4364**
	(0.0074)	(0.0051)	(0.0152)	(0.0144)
University	-0.1708**	-0.0738**	0.2203**	0.4837**
	(0.0073)	(0.0051)	(0.0147)	(0.0139)
Const.	0.2743**	0.1119**	0.5210**	0.1434**
	(0.0051)	(0.0035)	(0.0109)	(0.0103)
Observations	44,028	44,028	14,038	14,038

Notes: The table is for employees working in the manufacturing sector. Each column contains one regression output. Observations are selected as employed persons working in mass layoff firms, conditional on switching out of the firm. Mass layoff firms are firms that lay off a large number of employed persons at one point in time. The persons laid off are then pooled over all firms and all years. Each variable (first column) is a dummy variable for a specific characteristic. The line shows the estimate of the coefficient. Standard errors of the estimates are in parentheses below.
The dependent variables of the regressions:
Unemployed: Dummy variable for persons unemployed in year 1 of the mass layoff.
Out of labor force: Dummy variable for persons out of labor force in year 1 of the mass layoff.
Knowledge intensive: Dummy variable for persons working in a "knowledge intensive sector" according to the Eurostat definition of such sectors.
High productivity: Dummy variable for persons working in a "high productivity sector" according to average NACE-2 labor productivity from 2008-2012.
* indicates significance at the 5% level, ** at the 1% level.
Source: AMDC.

Table 13: **Probability of being in specific groups switching out from market services**

(1)	(2)	(3) Out of labor force	(4) Knowledge intensive	(5) High productivity
	Unemployed			
Female	0.0320**	0.0211**	-0.0734**	-0.0033
	(0.0025)	(0.0017)	(0.0042)	(0.0042)
Age 15-24	-0.0270**	-0.0144**	0.0296**	-0.0489**
	(0.0037)	(0.0025)	(0.0063)	(0.0062)
Age 50+	0.0937**	0.0547**	-0.0712**	0.0135*
	(0.0032)	(0.0022)	(0.0057)	(0.0056)
Apprenticeship	-0.0590**	-0.0201**	0.0103	0.1244**
	(0.0033)	(0.0022)	(0.0058)	(0.0057)
Intermediate vocational	-0.0657**	-0.0244**	0.0875**	0.2464**
	(0.0047)	(0.0031)	(0.0080)	(0.0079)
Academic school	-0.0414**	-0.0183**	0.2211**	0.3029**
	(0.0056)	(0.0037)	(0.0092)	(0.0091)
Higher vocational	-0.0992**	-0.0326**	0.2753**	0.4413**
	(0.0046)	(0.0031)	(0.0077)	(0.0076)
University	-0.1145**	-0.0378**	0.4287**	0.5234**
	(0.0041)	(0.0028)	(0.0068)	(0.0067)
Const.	0.2215**	0.0783**	0.2895**	0.1616**
	(0.0029)	(0.0020)	(0.0051)	(0.0050)
Observations	105,468	105,468	53,025	53,025

Notes: The table is for employees working in the market services sector. Each column contains one regression output. Observations are selected as employed persons working in mass layoff firms, conditional on switching out of the firm. Mass layoff firms are firms that lay off a large number of employed persons at one point in time. The persons laid off are then pooled over all firms and all years. Each variable (first column) is a dummy variable for a specific characteristic. The line shows the estimate of the coefficient. Standard errors of the estimates are in parentheses below.

The dependent variables of the regressions:

Unemployed: Dummy variable for persons unemployed in year 1 of the mass layoff.

Out of labor force: Dummy variable for persons out of labor force in year 1 of the mass layoff.

Knowledge intensive: Dummy variable for persons working in a "knowledge intensive sector" according to the Eurostat definition of such sectors.

High productivity: Dummy variable for persons working in a "high productivity sector" according to average NACE-2 labor productivity from 2008-2012.

* indicates significance at the 5% level, ** at the 1% level.

Source: AMDC.