How Firms Adjust to Demand Shocks: Evidence from Germany and Italy in the Great Recession*

Francesco D'Amuri† Salvatore Lattanzio‡ Benjamin Smith§

September 2025

Abstract

We examine how German and Italian manufacturing firms with more than 20 employees adjust labor costs in response to demand shocks. Using matched employer-employee-balance sheet data and an exogenous sector-level demand shifter based on the collapse in world trade during the Great Recession, we find that a 1% exogenous decrease in sales leads the average German firm to reduce wages by 0.20% – twice the response observed in Italian firms. In contrast, employment adjustment is more pronounced in Italy, driven by a decline in hiring rate. These differences are not driven by variations in hours worked per employee, labor supply conditions, or firm exposure to the concurrent credit shock. Finally, we find that producer prices in both countries follow similar dynamics in response to the shock.

Keywords: Labor demand, wage and employment flexibility.
JEL codes: E32, F16, J23, J31

*We thank Fabrizio Balassone, Matteo Bugamelli, Francesca Carta, Federico Cingano, Domenico Depalo, Marta De Philippis, Marco Francesconi, Andrew Garin, Luigi Guiso, Jennifer Hunt, Simon Jaeger, Andrea Ichino, Francis Kramarz, Andrea Linarello, Kai Liu, Hamish Low, Marco Manacorda, Claudio Michelacci, Ludovic Panon, Matteo Paradisi, Fabiano Schivardi, Paolo Sestito, Alexandra Spitz-Oener, Roberto Torrini, Eliana Viviano, Till von Wachter and seminar participants at the Bank of Italy, LMU Munich, the Brucchi Luchino Labor market workshop, EALE, EIEF, the Royal Economic Society annual congress and the University of Cambridge for useful comments and suggestions. The views expressed in this article are those of the authors and are not the responsibility of the Bank of Italy or the Eurosystem.

†Bank of Italy, Directorate General for Economics, Statistics and Research. *E-mail address*: francesco.damuri@bancaditalia.it.

‡Bank of Italy, Directorate General for Economics, Statistics and Research. *E-mail address*: salvatore.lattanzio@bancaditalia.it.

§United States Federal Trade Commission. *E-mail address*: bsmith3@ftc.gov.

1 Introduction

The degree of wage rigidity and its implications for employment and firm's outcomes are central issues in macroeconomics (Abraham and Haltiwanger, 1995; Brandolini, 1995; Elsby and Solon, 2019). They become particularly salient within a currency area, where wage flexibility facilitates relative price adjustments—an essential way to achieve a terms-of-trade depreciation in response to country-specific shocks (Mundell, 1961; Krugman, 2013; Schmitt-Grohé and Uribe, 2013).[1] Even in the case of a common shock, adjustment is generally expected to occur more swiftly in countries with more flexible wages.

In this paper, we use matched employed-employee balance sheet administrative data and an instrumental variable strategy to quantify the degree of wage and employment adjustment in the two largest manufacturing economies of the euro area: Germany and Italy.

Labor market institutions in the two countries differ across several dimensions, including bargaining regimes.[2] In particular, in Italy, national agreements between unions and employers set wage floors for occupations within narrowly defined industry classifications, which firms can undercut only in rare circumstances. By contrast, in Germany, firms can either establish stand-alone plant-level contracts or incorporate 'opening clauses', which allow for bargaining below the national industry wage (Jäger et al., 2022).

Despite these institutional differences, both countries were severely affected by the Great Recession, experiencing a 28% decline in exports during the initial phase of the crisis (2008-2009).[3] We exploit within-country, between-sector variation from this event to construct an exogenous demand shock based on the predicted decline in export volumes for manufacturing industries. This approach leverages the fact that industries tend to establish stable trading relationships with specific countries over time, and switching trading partners in the short run is costly. Consequently, demand shocks disproportionately affecting an industry's key trading partners will also disproportionately impact its product demand, while remaining uncorrelated with local supply and demand conditions. We use this variation as an instrument for the firm-level changes in sales within each country to estimate the causal effect of

[1] Galí and Monacelli (2016) highlight the risks associated with wage declines following a negative demand shock in a currency area, as the common monetary policy cannot respond to the resulting country-specific deflationary pressures; similarly, Eggertsson et al. (2014) emphasize the challenges posed by positive supply shocks induced by structural reforms.

[2] Differences also exist in employment protection, which was lower in Germany than in Italy during the period analyzed. According to the OECD employment protection index (where higher indicate stricter regulations), protection for permanent contracts stood at 2.6 in Germany and 4 in Italy, while for fixed-term contracts, it was 1 and 2, respectively. Additionally, expenditures on labor market policies (both passive and active) were higher in Germany than in Italy, amounting to €4,500 and €4,300 in PPS per person seeking employment in 2011.

[3] See Figure A.1 for import and export dynamics over time in both countries.

a decline in product demand on labor market outcomes, such as wages and employment.

We find different wage responses to demand shocks among relatively large firms (20+ employees) in Germany and Italy. A 1% exogenous decline in sales leads to a 0.21% reduction in full-time equivalent daily wages in Germany—more than three times the effect observed in Italy. This suggests that German wages have greater cyclical flexibility, not just spatial variation, as documented by Boeri et al. (2021). The stronger wage adjustment in Germany occurs despite the fact that, in the years leading up to the Great Recession, the sectors most affected by the shock had experienced higher wage growth relative to others.

Turning to labor input, the intensive margin (hours per worker) responds similarly in both countries, indicating that our findings are unlikely to be driven by differences in the use of subsidized work-hour reductions, such as *Cassa Integrazione* or *Kurzarbeit*. Regarding employment, we find a muted contemporaneous response (2008-09) in Germany, with adjustments occurring primarily in the following years (especially by 2011) and driven largely by separations. By contrast, Italy experienced a more pronounced and immediate employment contraction. Overall, the elasticity of total labor costs to sales volumes is higher in Italy than in Germany.

Further analysis shows that average wage adjustments in both countries are primarily driven by a decline in wage dynamics ampong stayers, rather than by changes in hiring wages.[4]

Examining differences by worker age, we find that German firms adjusted wages more than their Italian counterparts due to a more pronounced correction among young (aged 35 or below) and middle-aged (35-54) workers.

Our results could be biased if firms in sectors experiencing larger demand shocks were also more likely to face tighter credit constraints or greater changes in sector-specific labor supply—for example, due to shifts in labor shortages in sectors more severely affected by the demand shock. We show that these factors do not drive our main results, which remain robust across firms regardless of their location in more or less developed areas (West versus East in Germany and Centre-North versus South in Italy). However, we find that employment responses are larger in smaller firms in Italy.

Additional differences emerge when comparing firms with varying ex-ante margins of adjustment. In Italy, the employment response is concentrated among firms paying the

[4]This result may partly reflect the use of short-time work compensation schemes, which subsidize wage reductions in response to temporary demand drops. While greater wage flexibility among new hires has been documented in the literature (Pissarides, 2009, among others), recent studies accounting for composition effects—particularly the cyclicality of job-to-job transitions—have questioned this view (Gertler et al., 2020). Similarly, Kline et al., 2019 find no evidence that entry wages respond to patent-induced shocks in labor productivity, whereas wages of stayers—especially those already employed at the time of patent application—do adjust.

collectively agreed minimum, which are more constrained by the wage floor. In Germany, by contrast, the relatively muted employment response is observed across all firms, regardless of whether they pay above the sectoral minimum. However, firms paying above the wage floor have a more pronounced wage adjustment, though this effect is not statistically significant due to the smaller sample size.[5]

In contrast, the degree of downward nominal wage rigidity in Italy appears to differ only marginally between firms that apply national sectoral contracts and those that also implement firm-level agreements. This finding reinforces the idea that Italy's bargaining institutions allow for less wage adjustment compared to Germany.[6]

Finally, we complement our micro-level analysis with national accounts data (NACE, 2-digit level). In particular, we use information on hours and producer prices, which show similar responses in both countries.

Related literature and contribution This paper is closely related to two recent studies examining the effect of the Great Recession on labor market outcomes in Portugal and Italy. First, Garin and Silvério (2022) analyze how product demand shocks influenced labor market outcomes in Portugal by leveraging firm-specific export shocks from the initial phase of the Great Recession. While their approach identifies both firm-specific and common industry shocks, whereas ours focuses only on common industry shocks, we apply a similar identification strategy by using pre-recession export shares and country-specific demand responses to the recession. Garin and Silvério (2022) find that common industry export shocks affect both wages and employment, with most of the adjustment occurring through employment. Firm-specific idiosyncratic shocks also matter, and their impact is amplified in thin and less competitive labor markets. Second, Lucifora and Origo (2022) examine the effects of demand shocks during the Great Recession on labor market outcomes in the Italian metalworking industry. Instead of identifying demand shocks through exports, they instrument for revenues directly using pre-recession firm-specific market shares, multiplied by the realized change in industry revenues between 2009 and 2015. Despite differences in identification strategy and sectoral focus, their findings for Italy align with ours, showing non-significant effects on wages and significant employment responses. Compared with previous studies, the strength of our analysis lies in applying a common identification strategy to compare labor cost flexibility across the two largest manufacturing economies in Europe,

[5]This analysis does not account for potential distributional effects of sectoral wage floors across worker subgroups. In this regard, Adamopoulou et al. (2022) show that minimum wages influence the transmission of firm shocks to workers' wages by generating spillover effects on high-wage workers in firms with a high share of minimum-wage workers.

[6]This result is consistent with the descriptive analysis in D'Amuri and Giorgiantonio (2015), which highlights the high persistence of the wage component determined by firm-level (second-tier) bargaining.

which differ in their labor market institutions.

The literature has also relied on administrative data to quantify and characterize wage flexibility within *individual* countries. Studies include Bauer et al. (2007) and Stüber (2017) for Germany, Devicienti et al. (2007) and Adamopoulou et al. (2016) for Italy, and Martins et al. (2012) for Portugal. Carluccio et al. (2015) use firm-level data to assess the impact of trade and offshoring on wages, while Lucifora and Origo (2022) analyze a panel survey of Italian manufacturing firms to estimate how labor costs respond to an exogenous change in sales. In contrast, only a few studies compare wage and employment flexibility across countries using comparable data and empirical methods. Several of these analyses have been produced by the European System of Central Banks,[7] drawing on ad-hoc cross-sectional business surveys conducted through the Wage Dynamics Network (Babecký et al., 2010, 2012; Bertola et al., 2012; Druant et al., 2009; Fabiani et al., 2010). These descriptive studies find that nominal wage rigidity is higher in countries with greater collective bargaining coverage and stronger employment protection of permanent contracts. They also show that the pass-through of labor costs to prices varies depending on market structure and the share of labor costs in total production costs. For Germany, research suggests that a shift away from industry-level bargaining toward firm-level agreements has strengthened the link between wages and productivity, improving firm competitiveness (Dustmann et al., 2014). Consistent with this, Boeri et al. (2021) find that productivity and wages are more closely linked at the regional level in Germany than in Italy, using labor force survey data. Our paper contributes to this literature by providing a comparative analysis of two large euro ares economies, using reliable administrative data and a causal identification strategy to assess differences in labor cost flexibility.

The rest of the paper is structured as follows. Section 2 describes the labor market institutions in Germany and Italy. Section 3 introduces the data and provides descriptive statistics. Section 4 outlines the empirical strategy. Section 5 presents the main results and robustness checks, while Section 6 discusses heterogeneity analyses. Section 7 concludes.

[7] Outside of Europe, Elsby et al. (2016) compare wage rigidity in the United States and the United Kingdom using survey and administrative data, respectively. They find significant flexibility in both countries and conclude that "wage rigidity may be less binding and have lesser allocative consequences than is often supposed". Similarly, Verdugo (2016), using harmonized worker surveys, downplays the role of downward nominal wage rigidity once composition effects are fully considered. Recent studies for the US include Daly and Hobijn (2017), based on survey data, and Gu et al. (2020), using payroll data. Elsby and Solon (2019) provide a review of the evidence.

2 Institutional setting

Germany Wages in Germany are generally determined though sectoral and regional bargaining, typically conducted every two years, with informal coordination at the national level (Jäger et al., 2022). A collective agreement is usually first negotiated in a "pilot" region, which then serves as a reference for agreements in other areas, subject to adjustments that account for local conditions. Wage tariffs establish a scale of minimum wages, though employers commonly pay 10-20% above the minimum. Employers must adhere to the agreement set by the association with which they are registered. Additionally, the Ministry of Labor has the authority to extend a collective contract to all firms operating within the relevant industry-region scope, regardless of their affiliation with an employer federation. Firms may either implement the contract negotiated by their employer federation or negotiate a firm-level agreement, though exceptions exist. Plant-level contracts can be established even within sectoral or regional collective agreements. Furthermore, opening clauses may allow firms to set wages below the negotiated minimum, often in exchange for employment guarantees, such as commitments to retain workers.

Turning to employment protection, firms dismissing more than ten workers are required to establish a social plan, demonstrating the necessity of the dismissals while also providing training and severance payments to affected employees. Fixed-term contracts of up to eighteen months[8]—which do not entail firing costs upon expiration—were introduced in 1985 with the Employment Promotion Act, replacing previous maximum duration of six months. At the end of a fixed-term contract, firms could rehire workers only on a permanent basis. In the short run, unemployment benefits are relatively modest by international standards but become more generous over longer durations. Short-time work schemes (*Kurzarbeit*) play a significant role in mitigating employment losses during periods of negative labor demand shocks. Under these schemes, the government subsidizes approximately 60% of a worker's forgone earnings due to reduced working hours. The maximum duration of short-time work was temporarily extended from 12 to 18 months in November 2008 and further to 24 months in May 2009, though this latter extension applied only to short-time work arrangements initiated in 2009 (Arpaia et al., 2010; Brenke et al., 2013). Virtually all firms are covered by the scheme, which is funded through a fixed rate on total labor costs paid by employers, also contributing to the unemployment benefit fund. The widespread use of short-time work schemes during the Great Recession substantially mitigated employment losses, with labor market adjustments occurring primarily along the intensive margin (hours per worker) rather

[8]Extendable to twenty-four months under certain conditions.

than through reductions in employment levels.[9]

Italy The bargaining system in Italy is characterized by collectively negotiated contracts at both the national and sectoral levels, regulating all aspects of employment, including a minimum national wage for each occupation within a worker's category. Prior to 2009, the economic provisions of these contracts had a duration of two years, while other provisions remained in effect for four years. Since 2009, both sections have been standardized to a three-year duration. In addition to national-level agreements, firm-level contracts may exist, provided they align with national regulations. These contracts can modify work arrangements if explicitly authorized by the national agreements and may raise, but not lower, wages at the local level.

Regarding employment protection, agency work was prohibited in the early 1990s, while temporary work was allowed only for seasonal or occasional jobs or to replace an employee on leave. During this period, employment protection for open-ended contracts was among the strongest in the European Union, following Spain and Portugal (Grubb and Wells, 1993). The 1997 reform package (*Pacchetto Treu*) introduced greater flexibility by expanding the use of part-time, atypical, and agency contracts. Subsequent reforms further deregulated temporary and atypical contracts (Daruich et al., 2023; Depalo and Lattanzio, 2025).

Income stabilization mechanisms were highly fragmented and primarily aimed at preserving existing employment relationships, particularly through short-time work schemes, rather than providing universal protection to all unemployed individuals. Under the short-time work scheme (CIG, *Cassa Integrazione Guadagni*), the government subsidizes partial or full-hour reductions, compensating workers for approximately 80% of lost earnings.[10] Participation in the scheme requires firms to contribute a fixed percentage of each worker's wage, with sectoral variations. Additionally, firms co-finance the benefits when activating such programs. The standard duration of the scheme is up to 12 months, with limited extension possibilities (Arpaia et al., 2010; Giupponi and Landais, 2022). Throughout the period analyzed, all firms in the sample were covered by the scheme, which applied to manufacturing establishments with at least 15 employees. During the Great Recession, authorities expanded short-time work programs to mitigate the labor market impact of the of the 2008-09 crisis.

By contrast, ordinary unemployment benefits played a minimal role, offering low replacement rates (30%, increased to 40% in 2001) and a highly restricted duration (six months, extended to nine in 2001, see Rosolia and Sestito, 2012).

[9] See Burda and Hunt (2011) and Dustmann et al. (2014).

[10] Caps on benefits result in lower replacement rates for above-average wages.

3 Data and Descriptive Statistics

3.1 Data

Both for Germany and Italy, we use matched employer-employee-balance sheet data for the manufacturing sector,[11] which was directly exposed to the trade shock (Autor et al., 2013).

Germany We use labor market data from the German Social Security administration provided by the Institute for Employment Research (IAB) based on the Integrated Employment Biographies (IEB) datafile. Specifically, we use the Linked Employer-Employee Data from the IAB (LIAB) Longitudinal Model 1993-2014. The LIAB is based on the IAB establishment panel, a survey which draws a stratified sample of establishments, and follows them over time. Participation to the survey is voluntary, but the response rate is around 80% (Baumgarten, 2013). The LIAB is obtained by merging IAB establishments with employment biographies from IEB. Information (including gender and age) is available on all employees who worked at least one day at an establishment included in the survey. The LIAB further collects their full employment biographies between 1993 and 2014. Since we focus on the period 2006-2011, we have the universe of employees working at these establishments over this period. The dataset contains information on the work and pay history of employees, such as job duration in days and earnings of each employment spell. Hours of work are not recorded, but employees are classified as part-time when working less than 30 hours per week. One shortcoming of IAB earnings data is that they are censored at the highest level of earnings subject to social security contributions. To overcome this problem, we apply a Tobit wage imputation procedure following Card et al. (2013) and Dustmann et al. (2009). Besides that, we compute full-time equivalent (FTE) daily wages by halving the days worked by part-time employees; using the CPI, we convert all nominal variables in 2010 euros. We collapse relevant worker-level variables at the establishment level and retain only establishments with more than 20 employees, in order to be consistent with the sampling strategy in the Italian data, described below. Larger firms also tend to be more connected to international trade (di Giovanni et al., 2020) and thus more exposed to foreign demand fluctuations that we exploit in order to construct our instrument.

Finally, we complement this information with variables drawn from the establishment survey: industry, district, revenues – measured as the annual business volume, which coincides with sales for firms in manufacturing – and a binary indicator equal to one if the

[11] Mergers and acquisitions in the automotive sector in Germany determine outliers in wage and employment variations in the small number of firms sampled in that sector (40); as we do not have access to single observations for confidentiality reasons, we dropped this sector from the analysis both in Germany and in Italy.

establishment pays wages above the collectively agreed scale.

Italy We use data from the INVIND survey,[12] which comprises a representative sample of firms with more than 20 employees over the period 2006-2011 in both industry and services (see, for example, Daruich et al., 2023). This survey is conducted annually by the Bank of Italy and contains self-reported information on average wages, employment and firm outcomes. We match these data with official balance sheet data collected by Cerved[13] on an annual basis: from these archives we use revenues, which equal total sales in any given year. From social security records, we have information on the work histories of the universe of workers ever employed in one of the firms surveyed in INVIND. On top of main socio-demographic characteristics, these data comprise information on gross annual compensation of workers, net of employer's social security contributions, the number of days worked in a given year, the type of contract (full- or part-time, permanent or temporary), tenure, and the dates of beginning and end of the employment spell. We average relevant worker-level variables at the firm level. We do not have information on hours worked, hence we use daily wages, converted to FTE units[14] and expressed in 2010 real terms (throughout the paper, 'wages' refers to FTE daily wages).

Trade data In order to construct the instrument presented in section 4, for both Germany and Italy we use the data of the United Nations Commodity Trade Statistics Database (Comtrade) on bilateral export/import *volumes* for 170 countries by 2-digit NACE Rev. 1.1 sector. Specifically, we use data on trade volumes in 2007 and 2009 from each trading partner of Germany and Italy.

Other data sources For robustness and validation, we conduct some analyses on sector-level National Accounts data.[15] In particular, we use information on producer prices, hours worked per employee, and output. We also use data from the Business and consumer survey

[12] *Indagine sulle imprese industriali e dei servizi.*

[13] Cerved is a private company that collects balance sheet data on the universe of incorporated businesses.

[14] We have information, directly provided in social security archives, on the number of FTE days worked for part-time workers, which we exploit to compute FTE daily wages. For both countries, our measure of daily wages is equivalent to the hourly wage rate for workers with regular hours, as we are able to adjust days worked for part-time employees (for this reason, in a slight abuse of terminology, we refer to "daily wages" and not "daily earnings"). Workers with extra-time hours will have systematically lower daily wages, but taking firm averages should reduce the measurement error (unless some firms systematically require all their employees to work extra-time: an unlikely scenario given we are focusing on medium-large firms)

[15] We focus exclusively on manufacturing, whereas National Accounts data cover all firms, not just the large, surviving ones in our main data source. As a result, we trade off some comparability between the two datasets in order to leverage variables unavailable in the administrative records for Germany or Italy.

of the European Commission on the share of firms declaring that financing conditions or labor shortages are a limit to production (European Commission, 2021).

3.2 Descriptive statistics

Analysis sample From both samples we take only firms with at least 20 employees (as this is the size threshold for Italian data) and we focus on a balanced panel including all firms that were present in the sample in the time interval of the analysis 2006-2011.[16] We are thus left with 2544 firm-year observations (424 firms) for Germany and 5106 (851 firms) for Italy. With respect to the original data, we lose around 4900 firms in Germany and 1300 firms in Italy when restricting to manufacturing only. In Germany we further drop around 600 firms with less than 20 employees, on which the Italian data lack information. Finally, we drop around 70 firms in Germany and 800 in Italy that are either not present in all years or with missing values in the outcomes/controls in one of the years.[17] Table 1 reports descriptive statistics for all years in both German and Italian data, whereas Figures A.2-A.5 report averages of the main outcomes by year, either in levels or normalized with respect to a reference year. The drop in revenues faced by firms in both countries is strong and confined to the years between 2008 and 2009 (Figure A.2): by 2011 firms are back to the 2007 sales levels in both Germany and Italy. German and Italian firms have similar size (Figure A.3a of the appendix), while German firms pay about 10% higher average FTE daily wages throughout the period (Figure A.3b of the appendix); nominal wages increase in both countries, and slightly more in Italy, while in Germany a slight fall is detected around year 2009. Looking at labor market flows by age class, hiring rates show similar dynamics over time (Figures A.4a, A.4b and A.4c of the appendix); separation rates increase more in response to the negative shock in Germany in all age classes except mature workers (55+, Figures A.5a, A.5b and A.5c of the appendix).[18]

Short-time work We lack comprehensive data on the use of short-time work compensation schemes in both countries, as detailed records are available only for Italy through social security archives. Using aggregate statistics from INPS and IAB, Figure A.6a presents the number of workers in *Kurzarbeit* and the number of hours authorized for CIG on a monthly basis. The data indicate that the increase in short-time work only began in the last quarter

[16] We do not go beyond 2011 in order to avoid possible confounding effects related to the sovereign debt crisis in Italy. We carried out the analysis also on the unbalanced sample, obtaining similar results.

[17] For more information on the data we refer to Ruf et al. (2019) for Germany and to Leandro and Giuseppina (2019) for Italy.

[18] Hiring and separation rates are computed as the number of hires and separations (total and by age group) at time t divided by total employment at time $t-1$.

of 2008 and became more pronounced in 2009. In Germany, around 1.5 million workers were enrolled in short-time work at its peak, but this number declined sharply in the second half of 2010. In Italy, the number of authorized hours fluctuated between 50 and 100 million throughout 2010 and 2011. Figure A.6b illustrates that at the height of the Great Recession in 2009, the share of workers receiving partial unemployment benefits (primarily short-time work) was nearly twice as high in Germany as in Italy. However, this trend reversed in 2010. The figure also highlights that, based on annual statistics, little activity occurred in 2008, when the share of workers in short-time work remained comparable to that of the previous two years. Over the period 2006–2011, Italy spent a larger share of its GDP on financing partial unemployment benefits than Germany (Figure A.6c).

4 Identification and Empirical Specification

We estimate the following first difference equation separately for each country k and for each year from 2006 to 2011:[19]

$$\frac{\triangle y_{jkt}}{y_{jk2007}} = \alpha_{kt} + \beta_{kt}\left(\frac{\triangle R_{jk2009}}{R_{jk2007}}\right) + \delta_{kt}X_{jk} + \epsilon_{jkt} \tag{1}$$

where y_{jk2007} represents a labor market outcome for firm j, country k, and year 2007, and $\triangle y_{jkt}$ represents the change in labor market outcome from year 2007 to year t. R_{jk2007} is revenue of firm j in country k in 2007 while $\triangle R_{jk2009}$ is the change in revenue at firm j from 2007 to 2009. Note that the change in revenue is constant across equations while we estimate the effect on the change in outcomes both before and after the initial trade shock from the Great Recession. X_{jk} includes time-invariant pre-determined control variables:[20] average firm daily wages in 2007, sales net of intermediate input costs (a proxy for firm's value added) per worker in 2007, firm size dummies (less than 50, 50-99, 100-499, 500 or more employees) and four macro-sector dummies (food products, beverages and tobacco; consumer products; industrial goods; capital goods).[21]

A perennial challenge in using changes in revenue as a proxy for demand shifts is that supply shocks will also directly affect equilibrium price and quantity. Below we devise an

[19] For a similar event-study type empirical strategy where the outcome is expressed in differences relative to a base year, see Harasztosi and Lindner (2019).

[20] The inclusion of controls mainly affects the precision of the first stage relationship, but neither the first nor the second stage point estimates are substantially affected by their inclusion. Results with unconditional regressions are available upon request.

[21] We group sectors according to the following Ateco 2002 codes (equivalent of NACE Rev. 1.1): 15-16 (food products, beverages and tobacco); 17-19, 22 and 36 (consumer products); 20-21 and 23-28 (industrial goods); 29-35 (capital goods); identification thus leverages within macro-sector variation.

instrument to alleviate such concerns.

4.1 Instrument

The Great Recession induced a sharp drop in consumer demand with heterogeneous effects across countries and industries. In this context, we rely on the fact that industries establish consistent trading partners in particular countries over time and that it is costly to switch partners in the short run. As a result, demand shocks that disproportionately affect a given industry's trading partners will disproportionately affect product demand. For example, suppose the wood and rubber industries initially have a similar level of export volumes, yet have different trading partners. Suppose a recession reduces demand overall, but weakens demand in countries that buy wood (as opposed to rubber) more. Wood firms will not be able to instantaneously redirect trade to new markets and hence the wood industry will suffer a greater reduction in demand than the rubber industry, simply as a result of the composition of their trading partners.

We propose a shift-share instrument, leveraging sector-level exposure to shocks to foreign demand induced by the Great Recession between 2007 and 2009, and focusing on 2-digit sectors in manufacturing.[22] The instrument is constructed at the country-sector level for both Germany and Italy. For each sector in Germany (Italy) it is defined as the sum of the demand shocks taking place in any foreign trading partner country l – equal to the change in export volumes to l from the rest of the world (i.e., excluding Germany or Italy) – weighted by the shares of pre-recession export trade between Germany (Italy) and country l.[23] More formally, let E denote export volume, s denote industry (or *sector*), and t denote year. Then, let $E_s^{k\to l}$ represent the volume of exports shipped from origin country k to destination country l in sector s in 2007 and $\triangle E_s^{k\to l}$ represent the change in export volumes from 2007 to 2009. Also, in a slight abuse of notation, let $\tilde{K}$ represent the set of all countries except country k. Our measure of predicted percentage change in export volumes is defined as:

$$\underbrace{\frac{\triangle \hat{E}_{ks}}{E_{ks}}}_{\substack{\text{predicted percentage}\\ \text{change in exports}}} \equiv \sum_{l\in\tilde{K}} \underbrace{\frac{E_s^{k\to l}}{E_{ks}}}_{\substack{\text{inital share of}\\ \text{exports to } l \text{ from } k}} \underbrace{\left(\frac{\sum_{q\in\tilde{K}} \triangle E_s^{q\to l}}{\sum_{q\in\tilde{K}} E_s^{q\to l}}\right)}_{\substack{\%\text{ change in exports}\\ \text{to } l \text{ from world excluding } k}}, \tag{2}$$

where E_{ks} are total export volumes in country k and sector s; $\frac{E_s^{k\to l}}{E_{ks}}$ is the share of export volumes from country k to country l in 2007 and $\frac{\sum_{q\in\tilde{K}} \triangle E_s^{q\to l}}{\sum_{q\in\tilde{K}} E_s^{q\to l}}$ is the percentage change in

[22] Specifically, we exploit variation in sectors 15 to 36 of NACE Rev. 1.1.

[23] This approach was employed, among others, by Autor et al. (2013); also Garin and Silvério (2022), a paper closely related to ours, adopts a similar identification strategy.

export volumes to each country l from all countries excluding country k.

Figure 1 reports a scatter plot of the predicted change in export volumes in Italy versus Germany by sector. The points cluster around the 45 degrees line and display larger values for capital and industrial goods, and lower values for food products, beverages and tobacco, for both countries. We exploit this variation across sectors to instrument the firm-level change in sales. Our exclusion restriction is that $\frac{\triangle \hat{E}_{ks}}{E_{ks}}$ affects labor market outcomes in industry s through product demand and not through other channels such as credit or labor supply.

4.2 First stage

We estimate the following first stage equation separately for both German and Italian firms j, which measures the effect of the exogenous change in export volumes on total firm-level revenue:

$$\frac{\triangle R_{jk2009}}{R_{jk2007}} = \tilde{\alpha}_k + \gamma_k \left(\frac{\triangle \hat{E}_{s(j)k2009}}{E_{s(j)k2007}} \right) + \tilde{\delta}_k X_{jk} + \tilde{\epsilon}_{jk}. \quad (3)$$

In Table 2 we report the estimate of equation 3 in which the firm-level two-year change in sales in 2009 is regressed on the predicted export shock in volumes for the same period. We report the effects for a 1% *decline* in predicted export volumes.[24] The instrument is strong and has the expected negative sign; the point estimates are higher in absolute value for Italy and entail an elasticity equal to -0.54 between predicted change in exports volumes and sales; the impact is smaller in Germany (-0.25 but the two estimates are not statistically different from each other. The F-test is sufficiently high for both countries, respectively at 19.6 and 20.2 for Germany and Italy. In principle, a reduction in export demand may lead to import substitution to offset the loss in revenue. However, the strong first stage coefficients suggest that firms were unable to increase domestic sales in response to the fall in export demand.

In Figure 2, we further assess the instrument in terms of exogeneity and validity, by regressing up to two lags (2007, 2006 changes) and up to four leads of the instrumented variable (2008-2011 changes in sales) on the IV. In our empirical setting, we are leveraging the 2009 change in predicted exports as an exogenous shock for firm-level demand; for a given country, the turnover pattern should be independent of the size of the shock in the years preceding or following it. Consistently, we find that in both countries the coefficient in 2006 is not statistically significant. Moreover, the coefficients have similar evolutions in

[24] In other terms, we multiply the predicted export series by negative one.

Germany and Italy, except for 2008 when they have opposite signs in the two countries. This means that relative dynamics in different sectors were comparable before and after the shock took place. This is a welcome result, given that we want to study not only the contemporaneous effect of the shock on labor input and labor costs but also the subsequent short-term adjustment; we could not consistently do so if the shock would have led to a divergence in sales in the following years. Figure A.7 in the Appendix shows that the first stage relationship between the change in revenues and the instrument is monotonic. The figure displays the average drop in revenues against the quartiles of the drop in export volumes between 2007 and 2009 (more positive values indicate larger negative changes). In both countries higher absolute drops in revenues correspond to higher absolute drops in export volumes.

We verify in Figure A.8 that the first stage relationship is also present in National Accounts data. We therefore regress the change in output between any given year and 2007 on the change in exports between 2009 and 2007. We find similar responses to those found in the firm-level analysis, especially in 2009, which is the baseline year we use in the instrumental variable analyses.[25]

Finally, we investigate whether the shock we use as an instrument simply reflects different historical volatility across sectors. To do so, we compare a measure of output volatility by sector with the change in predicted export volumes. Specifically, we measure output volatility as the coefficient of variation of gross value added, measured in 2005 chain linked volumes from annual National Accounts, over the period 1995-2007. We report in Figure A.10 in the Appendix the relationship between this variable and the instrument across both Italian and German sectors. The relationship is either negative in both countries, slightly more pronounced in Italy, indicating that, if anything, sectors with larger changes in predicted export volumes during the Great Recession are those with lower output volatility in the preceding years. The relationship is, however, not statistically significant. We therefore conclude that the instrument does not simply capture higher historical volatility of some sectors relative to others.

4.3 Structural Equation

Most of the results of the paper will be based on the estimates of the following structural equation, separately for Germany and Italy (denoted as country k) for each year from 2006

[25] Point estimates are reported in Table A.2.

to 2011:

$$\frac{\triangle y_{jkt}}{y_{jk2007}} = \alpha_{kt} + \beta_{kt}\left(\frac{\widehat{\triangle R_{jk2009}}}{R_{jk2007}}\right) + \delta_{kt}X_{jk} + \epsilon_{jkt}. \tag{4}$$

All the variables are defined as above and $\left(\frac{\widehat{\triangle R_{jk2009}}}{R_{jk2007}}\right)$ are the prediced values from equation (3). As highlighted in Cameron and Miller (2015), clustered standard errors may be downward-biased in the presence of few clusters. For this reason, we rely on a wild bootstrap procedure to compute the standard errors (Cameron et al., 2008).[26]

Note that even if the explanatory variable in the second stage equation – the change in revenues $\left(\frac{\triangle R_{jk2009}}{R_{jk2007}}\right)$ – varies at the firm level, the predicted change in revenues $\left(\frac{\widehat{\triangle R_{jk2009}}}{R_{jk2007}}\right)$ obtained using the change in exports as an instrument varies at the *sector* level in an unconditional regression (i.e., when $\delta_{kt} = 0$). We use the firm-level specification primarily because it allows us to flexibly control for the vector of covariates X_{jk}, which makes the residualized predicted change in exports a quantity varying at the firm-level.[27] In addition, the 2SLS approach is better suited than a reduced-form regression to compare responses in the two countries as the first stage relationship between the predicted change in exports and the change in revenues differs somewhat between Italy and Germany (Table 2.)

In the next section we will further discuss the main threats to identification in this empirical setting.

4.4 Threats to identification and measurement issues

Credit and labor supply shocks Given the formulation of our instrument, the exclusion restriction would fail if those industries whose trading partners experienced a greater change in demand for exported goods from 2007 to 2009 were also more likely to face greater credit restrictions. A widespread reduction in credit supply affecting one country relatively more than the other would not have an impact on our estimates, since we are comparing firms between sectors but within the same country. Such credit restrictions increase the cost and reduce the availability of liquidity and can result in a reduction in investment and/or employment, as documented in a number of papers focusing on the Great Recession (Adamopoulou et al., 2021; Amiti and Weinstein, 2018; Benmelech et al., 2019; Bentolila

[26] When we use National Accounts data on a more aggregate dataset at the sector-level, we compute heteroskedasticity-robust standard errors.

[27] As a matter of fact, we would obtain very similar results if we residualize the changes in revenues and in predicted exports with the vector of covariates X_{jk}, then collapse the data and estimate the regressions at the sector-level, using weights equal to the shares of each sector in the data. Results with such sector-level approach are available upon request.

et al., 2017; Berton et al., 2018; Caggese et al., 2019; Cingano et al., 2016; Chodorow-Reich, 2013; Barrot et al., 2020). Our exclusion restriction would also fail if those industries whose trading partners experienced a greater change in demand also witnessed greater changes in sector-specific labor supply. A reduction in the number of unemployed looking for a job in a sector hardest hit by the exogenous fall in demand would – if anything – entail a downward bias in our estimates of its effect on wages. On the contrary, hiring rates would tend to be lower if the pool of candidates for a position decreases over time due to reduced job-seekers availability.[28]

In order to check whether falls in demand and credit restrictions are uncorrelated at the 2-digit NACE level, we create a dataset based on European Commission (2021), in which each observation is equal to the share of firms declaring that financing conditions represented a limit to production, in triplets defined by country, year[29] and 2-digit sector of economic activity. Given the few available observations, we estimate a reduced form model, in which we regress the change in percentage points in the dependent variable on the shock measure interacted by a post-2007 dummy, controlling for year and sector dummies.[30] Table 3, columns (1) and (3), shows that – in both countries – sectors that were more exposed to the exogenous fall in demand were only marginally hit harder by credit restrictions: both interacted coefficients are positive, but not statistically significant in Italy and only marginally significant at 10% level in Germany. Using the same data, we run a similar regression using as dependent variable the incidence of firms declaring that labor shortages were restricting production in any given year. We find no link between the first difference in the dependent variable and the shock both in Germany and in Italy (columns (2) and (4)).

Exit Going back to the matched employer-employee data for both countries, we also verify that the shock is uncorrelated with firm exit from the sample. If firms in sectors that are more exposed to the shock are more likely to exit the market, our results could be biased also in the *balanced* panel we use in our main estimates. We therefore regress a binary indicator equal to one if we observe the firm in a given year and not observe it in the next

[28] Also in this case, a widespread reduction in labor supply would not affect our estimates as we are comparing firms across sectors but within country.

[29] We mean collapse European Commission (2021) quarterly data into yearly data.

[30] Specifically, we build a longitudinal dataset at the sector-year level and estimate, separately for each country the following OLS regression:

$$\triangle y_{st} = \alpha + \eta_t + \beta_{x(s)} + \gamma_0 \left(\frac{\triangle \hat{E}_{s2009}}{E_{s2007}} \right) + \gamma_1 \left(\frac{\triangle \hat{E}_{s2009}}{E_{s2007}} \right) \times Post_t + \varepsilon_{st}, \tag{5}$$

where $x(s)$ indexes manufacturing macro-sector dummies, t indexes years from 2006 to 2011, and $Post_t$ is a dummy equal to 1 for years 2208, 2009, 2010 and 2011. Table A.2 reports the coefficients γ_0 and γ_1.

one on the predicted change in exports in each year 2006-2011. The estimates from such regressions, reported in Figure A.9, are not statistically significant for both Germany and Italy, indicating little evidence of higher exit probability for firms in sectors more exposed to the 2009 trade shock.

Intensive margin adjustment The dataset at hand covers virtually all information about the work relationship, with the exception of hours worked; this is a limitation that becomes more relevant once we consider that both countries have established short-time work programs that subsidize temporary reductions in the number of hours worked (Carta et al., 2022).

Between 2008 and 2009, the scheme had similar characteristics in the two countries (see Section 2). Unfortunately, comparable data on short-time use are not available for the two countries at the NACE 2-digit level. Nevertheless, we can check whether the variation in the intensive margin was similar in Germany and Italy for a given exogenous fall in sales. To this aim, we estimate the structural equation (4) using hours worked per employee taken from the National Accounts (NACE 2-digit level) as the dependent variable (Figure 3). Specifically, we regress the percentage point variation in hours worked per employee on the change in output (as a proxy for sales) instrumented with the predicted change in exports in each year. We find that the elasticity of the intensive margin to an exogenous reduction in sales is remarkably similar and not statistically significant in both countries. In 2009 we find the largest point estimates in absolute values to be around a 0.21-0.43% reduction for each 1% exogenous reduction in sales; in the years preceding and following 2009 we do not find any relationship between the variation in the intensive margin and the 2009 shock (see Table A.2 for the detailed point estimates).

5 Results

Adjustment in average full-time equivalent wages and employment Moving to the core results of the paper,[31] we present here the effects of the shock in predicted export volumes on firm-level FTE daily wages (expressed in 2010 euros) and employment changes (Figure 4 and 5, respectively). We find that, before 2008 and in both countries, wages were on a slight upward trend in sectors more exposed to the the exogenous fall in export volumes, though the effect is only statistically significant in Germany. In the years following the shock, we find a significant negative effect in 2009, which amounts to -0.21% in Germany, more than

[31] Table A.1 reports all the detailed point estimates and standard errors for each outcome from equation (4).

three times larger then in Italy (-0.06%) for a 1% fall in sales, with the two coefficients being significantly different at conventional levels. The effect persists up to 2011 in Germany, while it has a U-shape in Italy, with worsening wage dynamics in 2010 and a small recovery in 2011 (when the effect is no longer significant at 5% level). Wage dynamics by age and for new hires, stayers and leavers are analyzed in the next paragraph. Higher and more persistent wage elasticities to demand in Germany than in Italy could be determined by a variety of factors, such as different employment protection, unemployment benefits and bargaining institutions; our empirical analysis is not suited to distinguish the relative importance of each of these elements.

Moving to employment, we find evidence that – in both countries – firms in sectors that were hardest hit by the collapse in world trade were on similar employment trends relative to other sectors in the run up to the Great Recession (2006-7). In Italy, we observe a drop in employment that begins in 2008 (-0.16%), and then cumulates to approximately half of a percentage point by 2011, in response to a 1% exogenous fall in sales. In Germany, employment remains flat in the immediate aftermath of the Great Recession, but the dynamics worsen in 2010 and reach -0.26% at the end of our observation period. When focusing on the adjustment taking place in 2010 and 2011, it is worth keeping in mind that in those years – if anything – a very mild recovery was taking place in sectors most hit by the collapse in world trade (Figure 2). As a consequence, negative developments in wages and employment taking place after 2009 likely reflect a delayed adjustment to the negative shock occurring in that year and not to the presence of additional falls in sales.

Overall, our results suggest that the employment response in Germany is similar to that observed for wages, though with different dynamics across years: a marked short-run contraction in wages and a more swift employment response. In Italy, the downward wage dynamics are instead more muted, while employment respond considerably more. Although our data do not allow to inspect in more detail the reasons behind these differences, the more flexible bargaining institutions in Germany may have played a role in preserving employment relatively more.

For Italy, we can rule out that our findings reflect the use of short-time work compensation (CIG), since the linked employer-employee data include a binary indicator for workers in CIG. First, we estimate equation (4) using the change in the share of CIG workers (relative to 2007 employment) as outcome. Figure A.11 reports the estimates and shows a 1 percentage point increase in the share of CIG workers in 2009 and 2010 (coherently with the descriptive evidence in Figure A.6a) in response to the shock. Is this increase sufficient to explain the findings on labor costs? To answer this question, we additionally re-estimate equation (4) adding the firm-level annual share of CIG workers as a control. Figure A.12 compares the

wage and employment responses from this specification (panels a and b) with our baseline results. The patterns are virtually identical, except that the 2009 daily-wage coefficient loses statistical significance. Otherwise, our empirical conclusions remain fully robust.

Wages and employment by age group Bils (1985) and Solon et al. (1994) document that that the cyclical behavior of average wages is distorted by composition bias. For this reason, we further analyze the patterns of wage adjustment by looking at average wage changes by worker subgroups, beginning by age class (15-34, 35-54 and 55+ workers; Figure A.13). In Italy, wage downward dynamics are driven by young (15-34) and middle-aged workers (35-54), while – if anything – older workers experience mild, though not significant, wage gains (especially in 2009), probably due to higher firm-specific human capital and bagaining power. In Germany, negative wage effects are found in all age groups, but do not happen on impact among older employees..

Results on employment are more mixed. In Figure A.14 we report the evolution in the employment shares by age class in the considered interval. In Italy we observe a polarization of employment patterns by age, with upward trends in both younger and older age groups (until 2010 for the latter) that are compensated by negative dynamics in the age group 35-54. In Germany, we estimate negative point estimates for young workers in 2010 and for older workers in 2008, but the effects are not statistically significant.

Hiring and separation flows We gain additional insights on employment dynamics by looking separately at changes in total hirings and separations (Figure 6). We find different margins of adjustment in the two countries. In Italy, the negative employment dynamics are mostly driven by a reduction in hirings, which are down by 0.18% in 2011 relative to the employment levels in 2007. Separations move, instead, little in reaction to the drop in sales, except for a significant 0.11% drop in 2010. In Germany, on the contrary, separations show a clear spike in 2009-2010, when they increase by 0.24% for a 1% exogenous drop in sales relative to 2007. The point estimate remains positive (0.10%) also in 2011, though remarkably lower and not statistically different from zero. The lower inflows in Italy are concentrated among middle-aged workers, who benefit however from a decline in separation rates. (Figures A.15 and A.16). The increase in separations in Germany is driven by young (15-34) workers, while the hiring rates are relatively flat across all age groups.

Wage dynamics for new hires, stayers Higher wage cylicality among new hires (Pissarides, 2009, among others) has been recently put into question by analyses that take into account composition effects, and in particular the high cyclicality of job to job moves (Gertler

et al., 2020). We find that the moderate wage adjustment taking place in both countries is fully accounted for by the reduction in stayers' wages (Figure 7a), while wages for new hires (Figure 7b) do not show a clear pattern in response to the 2009 negative demand shock.[32] The result on stayers' wage needs to be interpreted with caution, as the fall certainly reflects also the extended use of short-time work schemes; nevertheless we have shown in paragraph 4.4 that the impact of the exogenous change in exports on the intensive margin (hours per worker) was very similar in Germany and Italy. As a consequence, relative wage dynamics in the two countries should not be affected.

Total labor costs Finally, we analyze the evolution of total labor costs. Before 2008, no trends are present in either country (Figure 8). In 2009, a large correction takes place in Italy – mostly driven by employment as argued before –, with the main coefficient estimate that goes from -0.30%. The fall continues up to 2011, when it reaches -0.74%. In Germany, the change is less pronounced and more driven by wage adjustments relative to Italy reaching -0.38% bvy the end of the observation window.

One may wonder whether the higher labor cost elasticity to sales in Italy determines an improvement in relative prices compared to Germany. We provide suggestive evidence against this hypothesis using National Accounts data. Figure 9 shows that, in both countries, producer prices are not significantly affected in sectors relatively more exposed to the global trade collapse. Based on this evidence, we can conclude that – in the short run – the higher labor cost elasticity to sales in Italy does not translates into different output price dynamics with respect to Germany. Ceteris paribus, it rather contains the decrease in profits. Controlling for short-time work use does not change the results in Italy (Figure A.12, panel c).

6 Heterogeneity

In this section, we explore whether the patterns of adjustment are different in specific sub-groups of firms. In particular, we differentiate the analysis between: i) smaller and larger firms (below and above 100 employees), ii) firms adopting a collective contract featuring more or less downward nominal wage rigidity, iii) firms belonging to more/less developed areas (West vs East in Germany; Center-North vs South in Italy).[33]

[32] Using worker-level administrative data similar to those employed in this paper between 2005-13, also Adamopoulou and Villanueva (2022) find that "all changes in the wage structure along the business cycle happen among job stayers".

[33] Table A.3 reports the detailed estimates, standard errors and number of observations.

Firm size Looking at the main results by firm size, no particular diverging pattern emerges in terms of wages or employment (Figure A.17) in Germany, confirming average results. In Italy, we observe some statistically significant short-run larger drops in wages and more pronounced employment responses in the medium run among smaller firms. These firms may have faced more difficulties in changing trading partners in response to the global trade collapse and therefore endured larger losses in their labor market outcomes.

Area Another dimension we look at is the area, as West in Germany and Centre-North in Italy clearly have an advantage in terms of productivity compared to East and South, respectively (Boeri et al., 2021). Results on both wages and employment remain very similar to the average ones in all of the four different areas (Figure A.18). We lose however some power, especially in East Germany, where the lower sample size produces much larger confidence bands.

Collective agreement Finally, we look at the collective agreement applied at the firm level and, exploiting a specific question present in both German and Italian survey data, we differentiate between firms that pay wages exactly in line with the collectively bargained minima or firms that pay above the minimum pay scale defined by such contract. Specifically, we exploit a question present in surveys for both countries (INVIND and IAB) that asks firms whether employees are paid a wage that is equal to or higher than the minimum pay scale, set at the sector level. In Italy, the variable generated from this question is continuous (how far average wages are from the minimum). In Germany, the variable is binary (at or above the minimum). Hence, we convert the variable in the Italian data to be binary as well.[34] Firms paying above the wage floor could cut wages in case of demand shocks without going below the collectively set level and, as such, face lower downward nominal wage rigidity. In Germany, we find evidence for the fact that firms paying above the wage floor are able to decrease wages more when hit by the shock (Figure A.19) while at the same time showing more favorable employment dynamics, although the estimates are not statistically significant due to low power. In Italy, firms paying the wage floor show slightly worse wage dynamics, though in some years only (2008 and 2010).[35] However, they display a remarkably stronger employment adjustment (-2.0% against -0.4% for firms paying more than the wage floor). This evidence, while suggestive, aligns with the notion that downward wage

[34]We classify 66% of firms in Italy and 28% of firms in Germany as being above the wage floor in 2008 (however, due to missing data, we are unable to classify 50% of German firms). In both countries firms paying more than the wage floor are larger, are less likely to be in the food and beverage macro-sector, and have higher wages and sales.

[35]The fall in wage growth in Germany takes place at the expenses of incumbent workers and is not a simple product of workforce composition adjustment. Additional results are available upon request.

rigidity constrains firms' ability to adjust to demand shocks, ultimately harming workers' employment prospects.

7 Conclusions

Using matched employer-employee-balance sheet data and an exogenous demand shifter based on the collapse in world trade during the Great Recession, we quantify labor cost adjustments in Germany and Italy, the two largest manufacturing economies in Europe with distinct labor market institutions.

Wages in Germany respond more to demand shocks than in Italy, reflecting greater cyclical flexibility. In contrast, employment adjustment is more pronounced in Italy and occurs mainly through subdued hiring when demand declines. In Germany, firms instead increase separation rates, particularly among younger workers. These differences explain why, for a given drop in demand, total payroll contracts more in Italy than in Germany.

The higher elasticity of labor costs to demand in Italy may be linked to differences in employment protection, unemployment benefits, and bargaining structures, though our analysis does not isolate their individual effects. At a more aggregate level, we find no evidence that greater labor cost flexibility in Italy translates into improved relative prices compared to Germany, suggesting that lower payroll expenditures limit the decline in profits rather strengthening price competitiveness.

References

Abraham, K. G. and J. C. Haltiwanger (1995). Real wages and the business cycle. *Journal of Economic Literature 33*(3), 1215–1264.

Adamopoulou, E., E. Bobbio, M. De Philippis, and F. Giorgi (2016). Wage rigidities and business cycle fluctuations: a linked employer-employee analysis. *IZA Journal of Labor Policy 5*(22).

Adamopoulou, E., M. De Philippis, E. Sette, and E. Viviano (2021). The Long Run Earnings Effects of a Credit Market Disruption. *Bank of Italy, mimeo*.

Adamopoulou, E., F. Manaresi, O. Rachedi, and E. Yurdagul (2022). Minimum Wages and Insurance Within the Firm. CRC TR 224 Discussion Paper Series 326, University of Bonn and University of Mannheim, Germany.

Adamopoulou, E. and E. Villanueva (2022). Wage determination and the bite of collective contracts in Italy and Spain. *Labour Economics 76*, 102147.

Amiti, M. and E. Weinstein (2018). How Much Do Idiosyncratic Bank Shocks Affect Investment? Evidence from Matched Bank-Firm Loan Data. *Journal of Political Economy 126*(2), 525–587.

Arpaia, A., N. Curci, E. Meyermans, J. Peschner, and F. Pierini (2010). Short time working arrangements as response to cyclical fluctuations. Occasional papers n. 64, European Commission, Economic and Financial Affairs.

Autor, D. H., D. Dorn, and G. H. Hanson (2013). The China Syndrome: Local Labor Market Effects of Import Competition in the United States. *American Economic Review 103*(6), 2121–68.

Babecký, J., P. D. Caju, T. Kosma, M. Lawless, J. Messina, and T. Rõõm (2010). Downward Nominal and Real Wage Rigidity: Survey Evidence from European Firms. *The Scandinavian Journal of Economics 112*(4), 884–910.

Babecký, J., P. Du Caju, T. Kosma, M. Lawless, J. Messina, and T. Rõõm (2012). How do European firms adjust their labour costs when nominal wages are rigid? *Labour Economics 19*(5), 792–801.

Barrot, J.-N., T. Martin, J. Sauvagnat, and B. Vallée (2020). Employment effects of alleviating financing frictions: Worker-level evidence from a loan guarantee program. Working paper.

Bauer, T., H. Bonin, L. Goette, and U. Sunde (2007). Real and nominal wage rigidities and the rate of inflation: Evidence from west german micro data. *The Economic Journal 117*(524), F508–F529.

Baumgarten, D. (2013). Exporters and the rise in wage inequality: Evidence from German linked employer–employee data. *Journal of International Economics 90*(1), 201–217.

Benmelech, E., C. Frydman, and D. Papanikolaou (2019). Financial frictions and employment during the Great Depression. *Journal of Financial Economics 133*(3), 541–563.

Bentolila, S., M. Jansen, and G. Jiménez (2017). When Credit Dries Up: Job Losses in the Great Recession. *Journal of the European Economic Association 16*(3), 650–695.

Bertola, G., A. Dabusinskas, M. Hoeberichts, M. Izquierdo, C. Kwapil, J. Montornès, and D. Radowski (2012). Price, wage and employment response to shocks: evidence from the WDN survey. *Labour Economics 19*(5), 783–791.

Berton, F., S. Mocetti, A. F. Presbitero, and M. Richiardi (2018). Banks, Firms, and Jobs. *The Review of Financial Studies 31*(6), 2113–2156.

Bils, M. J. (1985). Real wages over the business cycle: Evidence from panel data. *Journal of Political Economy 93*(4), 666–689.

Boeri, T., A. Ichino, E. Moretti, and J. Posch (2021). Wage Equalization and Regional Misallocation: Evidence from Italian and German Provinces. *Journal of the European Economic Association 19*(6), 3249–3292.

Brandolini, A. (1995). In Search of a Stylised Fact: Do Real Wages Exhibit a Consistent Pattern of Cyclical Variability? *Journal of Economic Surveys 9*(2), 103–163.

Brenke, K., U. Rinne, and K. F. Zimmermann (2013). Short-time work: The German answer to the Great Recession. *International Labour Review 152*(2), 287–305.

Burda, M. and J. Hunt (2011). What Explains the German Labor Market Miracle in the Great Recession? *Brookings Papers on Economic Activity*, 273–335.

Caggese, A., V. Cuñat, and D. Metzger (2019). Firing the wrong workers: Financing constraints and labor misallocation. *Journal of Financial Economics 133*(3), 589–607.

Cameron, A. C., J. B. Gelbach, and D. L. Miller (2008). Bootstrap-Based Improvements for Inference with Clustered Errors. *The Review of Economics and Statistics 90*(3), 414–427.

Cameron, A. C. and D. L. Miller (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources 50*(2), 317–372.

Card, D., J. Heining, and P. Kline (2013). Workplace Heterogeneity and the Rise of West German Wage Inequality. *The Quarterly Journal of Economics 128*(3), 967–1015.

Carluccio, J., D. Fougère, and E. Gautier (2015). Trade, Wages and Collective Bargaining: Evidence from France. *The Economic Journal 125*(584), 803–837.

Carta, F., A. Dalla Zuanna, S. Lattanzio, and S. Lo Bello (2022). Social shock absorbers in Italy: a comparison with the main European countries. Questioni di Economia e Finanza (Occasional Papers) 698, Bank of Italy, Economic Research and International Relations Area.

Chodorow-Reich, G. (2013). The Employment Effects of Credit Market Disruptions: Firm-level Evidence from the 2008–9 Financial Crisis. *The Quarterly Journal of Economics 129*(1), 1–59.

Cingano, F., F. Manaresi, and E. Sette (2016). Does Credit Crunch Investment Down? New Evidence on the Real Effects of the Bank-Lending Channel. *The Review of Financial Studies 29*(10), 2737–2773.

Daly, M. C. and B. Hobijn (2017). Composition and aggregate real wage growth. *American Economic Review 107*(5), 349–52.

D'Amuri, F. and C. Giorgiantonio (2015). Diffusione e prospettive della contrattazione collettiva aziendale in Italia. *Diritto delle Relazioni Industriali*.

Daruich, D., S. Di Addario, and R. Saggio (2023). The Effects of Partial Employment Protection Reforms: Evidence from Italy. *The Review of Economic Studies*. rdad012.

Depalo, D. and S. Lattanzio (2025). The increase in earnings inequality in Italy: The role and persistence of atypical contracts. *Review of Income and Wealth 71*(1), e12709.

Devicienti, F., A. Maida, and P. Sestito (2007). Downward Wage Rigidity in Italy: Micro-Based Measures and Implications. *The Economic Journal 117*(524), F530–F552.

di Giovanni, J., A. A. Levchenko, and I. Mejean (2020). Foreign Shocks as Granular Fluctuations. Working Paper 28123, National Bureau of Economic Research.

Druant, M., F. Martins, S. Fabiani, G. Kezdi, A. Lamo, and R. Sabbatini (2009). How are Firms' Wages and Prices Linked: Survey Evidence in Europe. Working papers 1084, European Central Bank.

Dustmann, C., B. Fitzenberger, U. Schönberg, and A. Spitz-Oener (2014). From Sick Man of Europe to Economic Superstar: Germany's Resurgent Economy. *Journal of Economic Perspectives 28*(1), 167–88.

Dustmann, C., J. Ludsteck, and U. Schönberg (2009). Revisiting the German Wage Structure. *The Quarterly Journal of Economics 124*(2), 843–881.

Eggertsson, G., A. Ferrero, and A. Raffo (2014). Can structural reforms help Europe? *Journal of Monetary Economics 61*, 2–22.

Elsby, M. W. L., D. Shin, and G. Solon (2016). Wage Adjustment in the Great Recession and Other Downturns: Evidence from the United States and Great Britain. *Journal of Labor Economics 34*(S1), S249–S291.

Elsby, M. W. L. and G. Solon (2019). How Prevalent Is Downward Rigidity in Nominal Wages? International Evidence from Payroll Records and Pay Slips. *Journal of Economic Perspectives 33*(3), 185–201.

European Commission (2021). Business and consumer survey data. Technical report.

Fabiani, S., C. Kwapil, T. Rõõm, K. Galuscak, and A. Lamo (2010). Wage Rigidities and Labor Market Adjustment in Europe. *Journal of the European Economic Association 8*(2-3), 497–505.

Galí, J. and T. Monacelli (2016). Understanding the Gains from Wage Flexibility: The Exchange Rate Connection. *American Economic Review 106*(12), 3829–68.

Garin, A. and F. Silvério (2022). How Responsive are Wages to Demand within the Firm? Evidence from Idiosyncratic Export Demand Shocks. *The Review of Economic Studies* (forthcoming).

Gertler, M., C. Huckfeldt, and A. Trigari (2020). Unemployment Fluctuations, Match Quality, and the Wage Cyclicality of New Hires. *The Review of Economic Studies 87*(4), 1876–1914.

Giupponi, G. and C. Landais (2022). Subsidizing Labour Hoarding in Recessions: The Employment and Welfare Effects of Short-time Work. *The Review of Economic Studies*. rdac069.

Grubb, D. and W. Wells (1993). Employment regulations and patterns of work in OECD countries. *OECD Employment Studies 21*(24).

Gu, G. W., E. Prasad, and T. Moehrle (2020). New Evidence on Cyclical Variation in Average Labor Costs in the United States. *The Review of Economics and Statistics 102*(5), 966–979.

Harasztosi, P. and A. Lindner (2019, August). Who pays for the minimum wage? *American Economic Review 109*(8), 2693–2727.

Jäger, S., S. Noy, and B. Schoefer (2022). The german model of industrial relations: Balancing flexibility and collective action. *Journal of Economic Perspectives 36*(4), 53–80.

Kline, P., N. Petkova, H. Williams, and O. Zidar (2019). Who Profits from Patents? Rent-Sharing at Innovative Firms*. *The Quarterly Journal of Economics*.

Krugman, P. (2013). Revenge of the optimum currency area. *NBER Macroeconomics Annual 27*, 439–448.

Leandro, D. and P. Giuseppina (2019). Using Administrative Data to Evaluate Sampling Bias in a Business Panel Survey. *Journal of Official Statistics 35*(1), 67–92.

Lucifora, C. and F. Origo (2022). Firms' margins of adjustment to demand shocks in regulated labour markets. Working papers n. 10, Università degli Studi di Bergamo.

Martins, P. S., G. Solon, and J. P. Thomas (2012). Measuring What Employers Do about Entry Wages over the Business Cycle: A New Approach. *American Economic Journal: Macroeconomics 4*(4), 36–55.

Mundell, R. A. (1961). A Theory of Optimum Currency Areas. *American Economic Review 51*(4), 657–665.

Pissarides, C. A. (2009). The Unemployment Volatility Puzzle: Is Wage Stickiness the Answer? *Econometrica 77*(5), 1339–1369.

Rosolia, A. and P. Sestito (2012). The effects of unemployment benefits in Italy: evidence from an institutional change. Working Papers 7, Department of the Treasury, Ministry of the Economy and of Finance.

Ruf, K., L. Schmidtlein, S. Seth, H. Stüber, and M. Umkehrer (2019). Linked Employer-Employee Data from the IAB: LIAB Longitudinal Model (LIAB LM) 1975–2019. *FDZ-datenreport 6-21*.

Schmitt-Grohé, S. and M. Uribe (2013). Downward Nominal Wage Rigidity and the Case for Temporary Inflation in the Eurozone. *Journal of Economic Perspectives 27*(3), 193–212.

Solon, G., R. Barsky, and J. A. Parker (1994). Measuring the cyclicality of real wages: How important is composition bias. *The Quarterly Journal of Economics 109*(1), 1–25.

Stüber, H. (2017). The Real Wage Cyclicality of Newly Hired and Incumbent Workers in Germany. *The Economic Journal 127*(600), 522–546.

Verdugo, G. (2016). Real wage cyclicality in the eurozone before and during the great recession: Evidence from micro data. *European Economic Review 82*, 46–69.

Table 1: Descriptive statistics

	Mean	SD	P10	P50	P90	Obs
	Panel A: Italy					
Employment	232.10	445.98	29.00	92.50	509.00	5106
Daily wage	97.05	24.04	69.77	93.13	128.09	5106
Daily wage, 15-34	80.66	15.71	61.84	78.96	101.44	5076
Daily wage, 35-54	100.03	25.36	71.50	95.90	133.38	5104
Daily wage, 55+	124.41	52.67	69.26	113.83	187.30	4962
Total labor costs	8511.43	19179.57	693.67	2489.64	18340.78	5106
Hiring rate	0.13	0.22	0.00	0.07	0.27	5106
Hiring rate, 15-34	0.07	0.11	0.00	0.03	0.16	5106
Hiring rate, 35-54	0.06	0.11	0.00	0.02	0.12	5106
Hiring rate, 55+	0.01	0.02	0.00	0.00	0.02	5106
Separation rate	0.13	0.20	0.02	0.07	0.26	5106
Separation rate, 15-34	0.05	0.09	0.00	0.02	0.12	5106
Separation rate, 35-54	0.06	0.11	0.00	0.03	0.12	5106
Separation rate, 55+	0.02	0.03	0.00	0.02	0.05	5106
	Panel B: Germany					
Employment	196.84	315.92	30.00	92.00	442.00	2544
Daily wage	114.91	39.04	67.87	110.67	167.11	2544
Daily wage, 15-34	85.78	27.62	52.60	83.17	122.46	2529
Daily wage, 35-54	125.90	40.68	75.07	121.61	180.99	2544
Daily wage, 55+	126.94	53.72	64.09	118.77	203.71	2528
Total labor costs	7110.61	13643.76	634.91	2609.93	16771.88	2544
Hiring rate	0.11	0.09	0.03	0.09	0.22	2544
Hiring rate, 15-34	0.06	0.05	0.01	0.05	0.13	2544
Hiring rate, 35-54	0.04	0.04	0.00	0.03	0.09	2544
Hiring rate, 55+	0.01	0.01	0.00	0.00	0.03	2544
Separation rate	0.10	0.06	0.04	0.08	0.18	2544
Separation rate, 15-34	0.04	0.04	0.00	0.03	0.09	2544
Separation rate, 35-54	0.03	0.03	0.00	0.03	0.08	2544
Separation rate, 55+	0.02	0.02	0.00	0.02	0.05	2544

Notes. IAB data for Germany and Invind-INPS-Cerved for Italy. See text, section 3, for details.

Table 2: First stage estimates

	(1) Germany	(2) Italy
Predicted change in exports volumes	-0.245**	-0.544***
	(0.100)	(0.122)
Kleibergen-Paap F-stat	19.558	20.241
Obs.	424	851

Notes. The table reports first stage estimates of the relationship between the firm-level change in sales and sector-level change in predicted export volumes between 2009 and 2007 (equation 3). See text for details on the construction of variables. Standard errors are computed with a wild bootstrap procedure at the sector level. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Credit and labor limiting production

	Italy		Germany	
	Credit limiting production	Labor limiting production	Credit limiting production	Labor limiting production
Predicted export change	-0.041**	0.005	-0.003	-0.004
	(0.008)	(0.004)	(0.008)	(0.006)
Predicted export change × Post	0.017	-0.011	0.024*	-0.005
	(0.008)	(0.006)	(0.007)	(0.006)
R^2	0.09	0.28	0.55	0.60
Observations	90	90	84	84

Notes. The table reports the estimates of OLS regressions of variables identifying limits to credit access and labor shortages on the predicted export change and its interaction with a post-2007 dummy. The regressions also include year and sector dummies. The dependent variables are in differences with respect to 2007. Robust standard errors are reported in parentheses. Source: Business and Consumer Survey, European Commission.

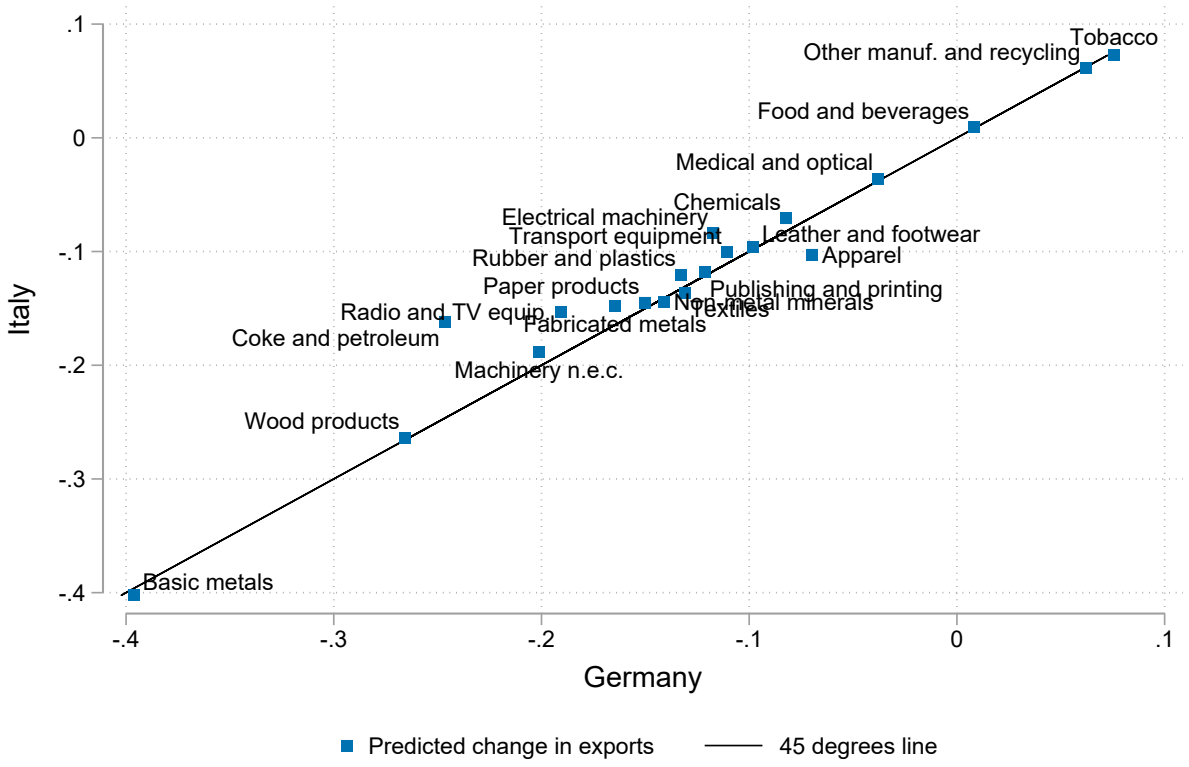


Figure 1: Predicted change in exports

Notes: The figure reports a scatter of the predicted change in exports by NACE Rev. 1.1 activity, computed as in equation (2), in Germany and Italy.

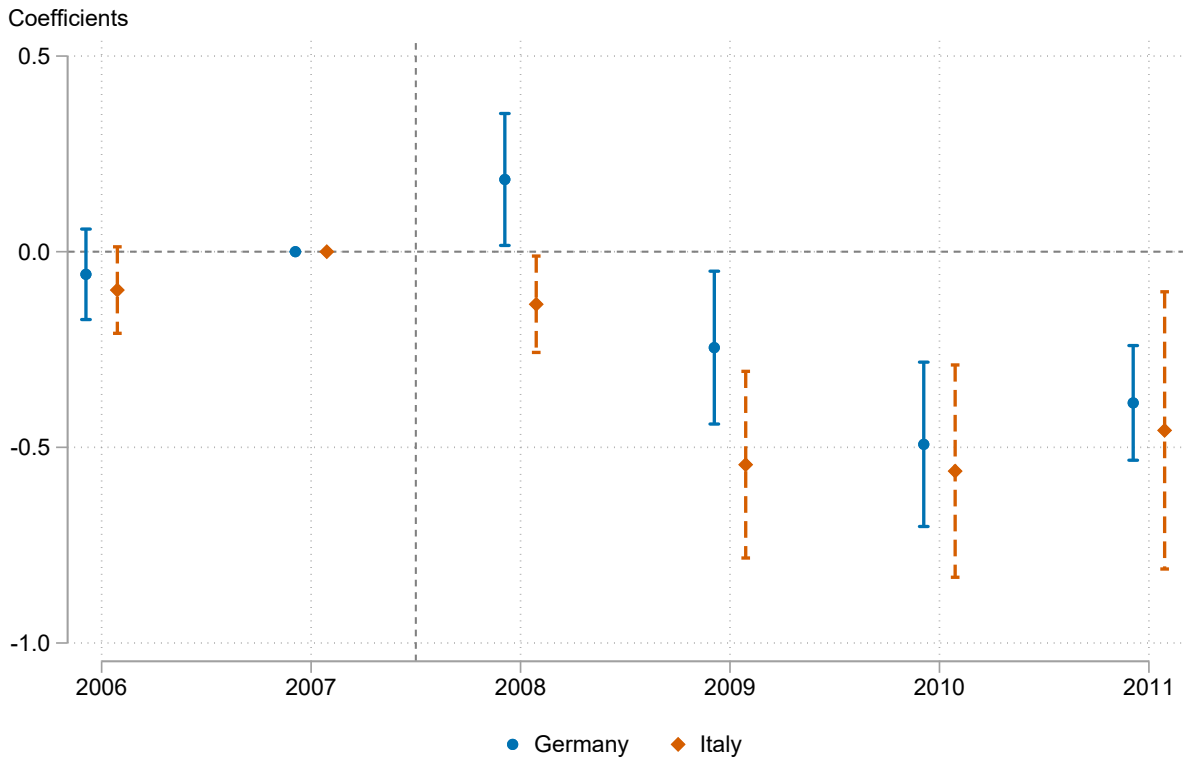


Figure 2: First stage

Notes: The figure reports point estimates for the first stage regression in which the firm-level change in sales between each year and 2007 is regressed on the predicted export *decline* between 2009 and 2007 (equation 3; see Table 2 for details on the first stage regression). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals.

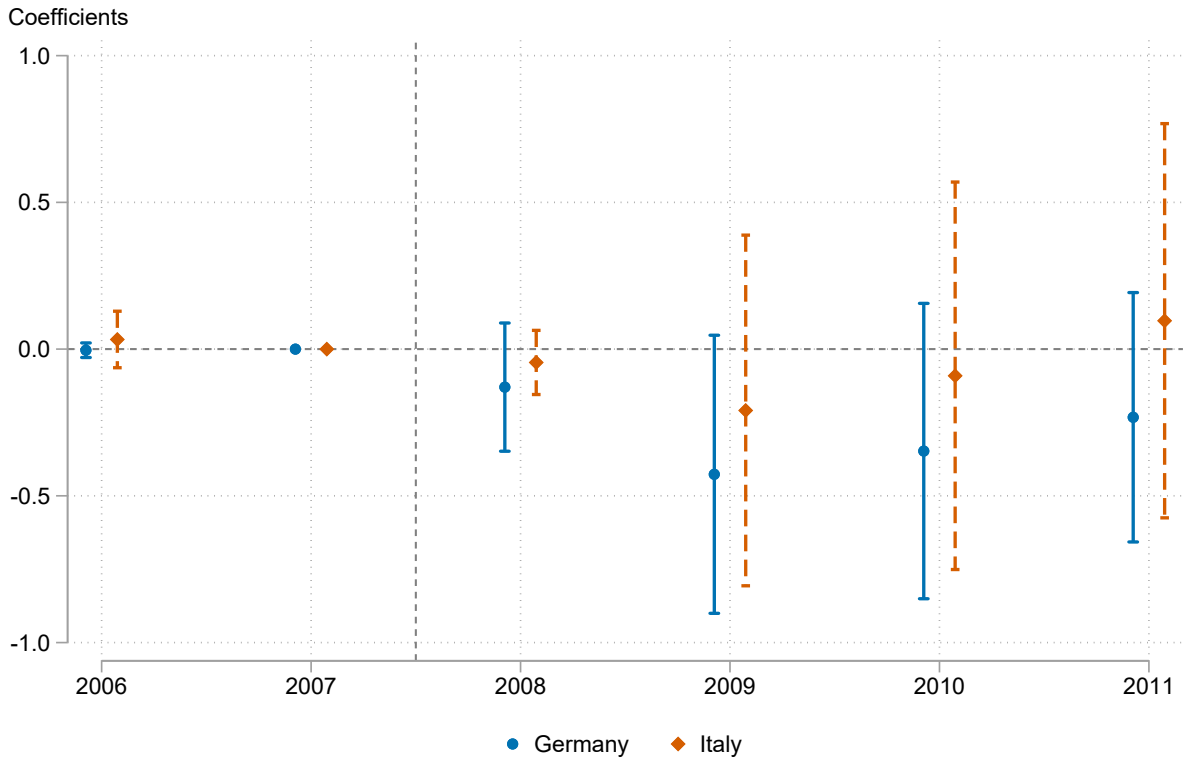


Figure 3: Hours worked per employee (National Accounts data)

Notes: The figure reports estimates for a dynamic 2SLS regression of the percentage variation in hours worked per employee between each year and 2007 on output instrumented with the predicted change in exports. Vertical bars identify 95% confidence intervals, from robust standard errors. Source: National Accounts.

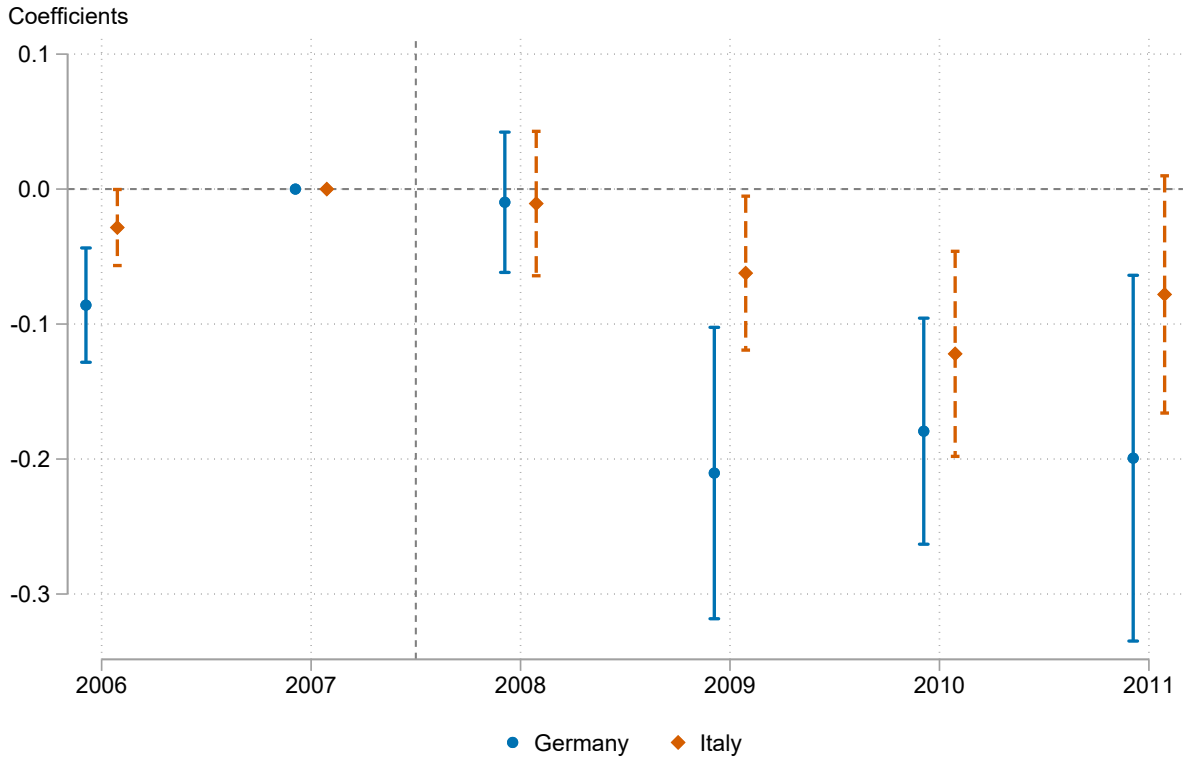


Figure 4: Daily wage

Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in firm-level average FTE daily wages on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.

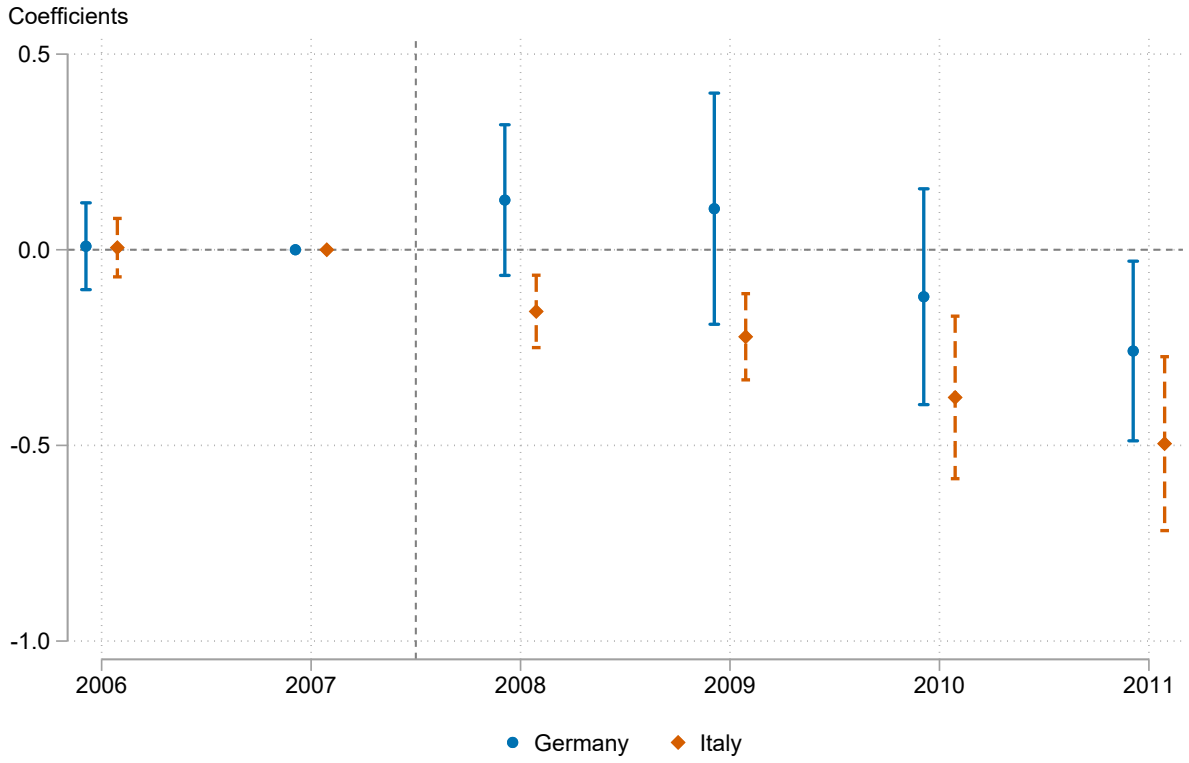
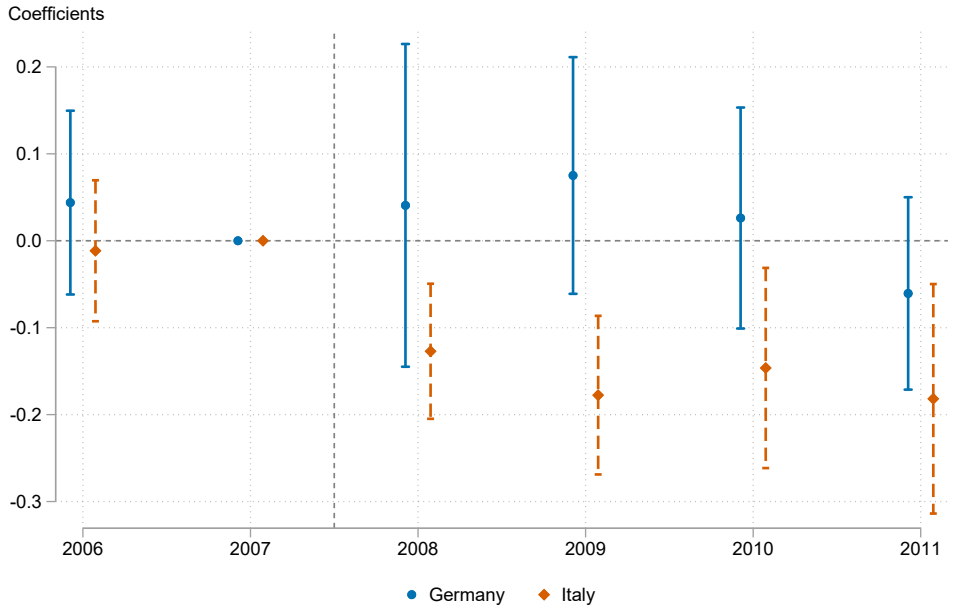
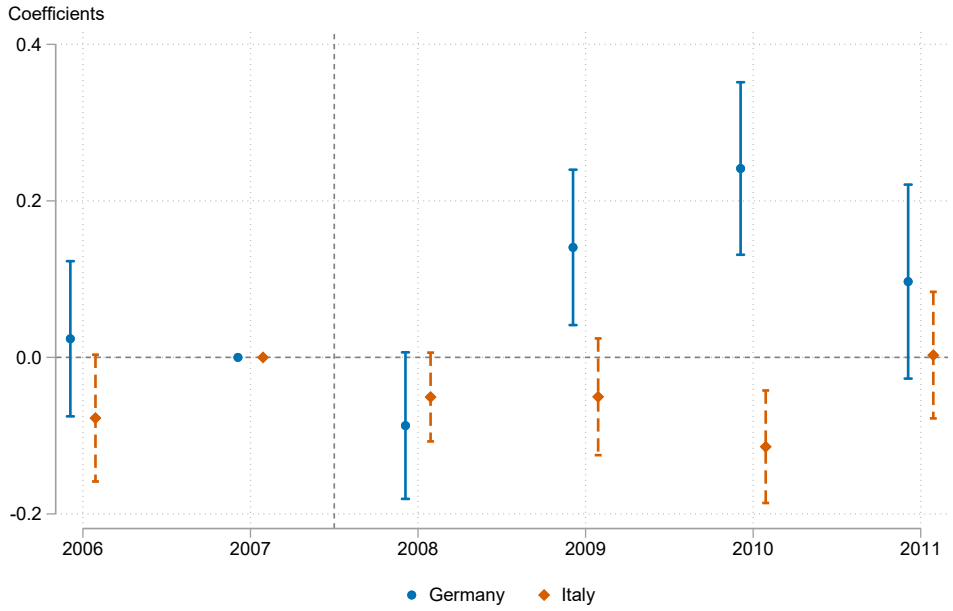


Figure 5: Employment

Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in firm-level average employment on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



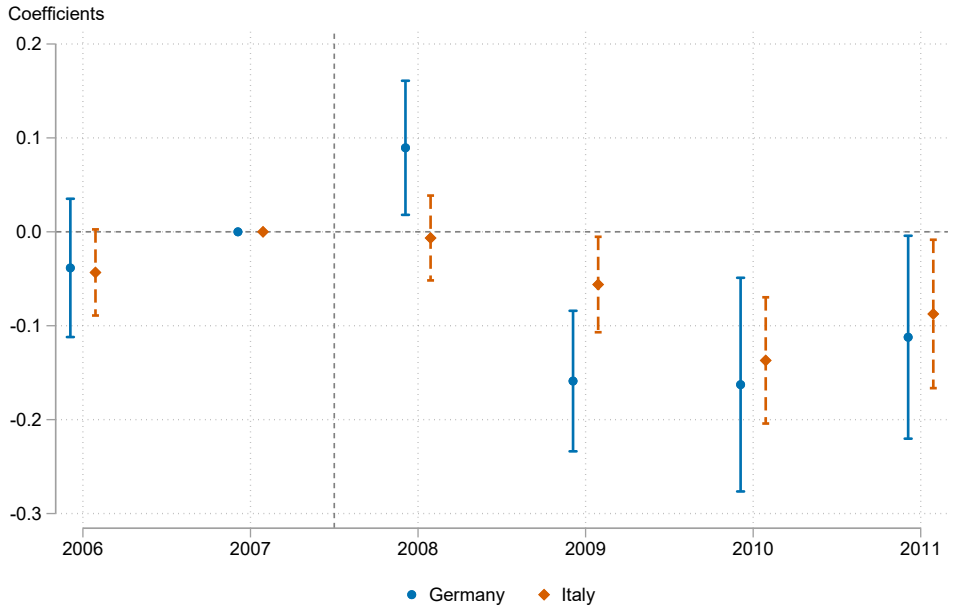
(a) Hiring



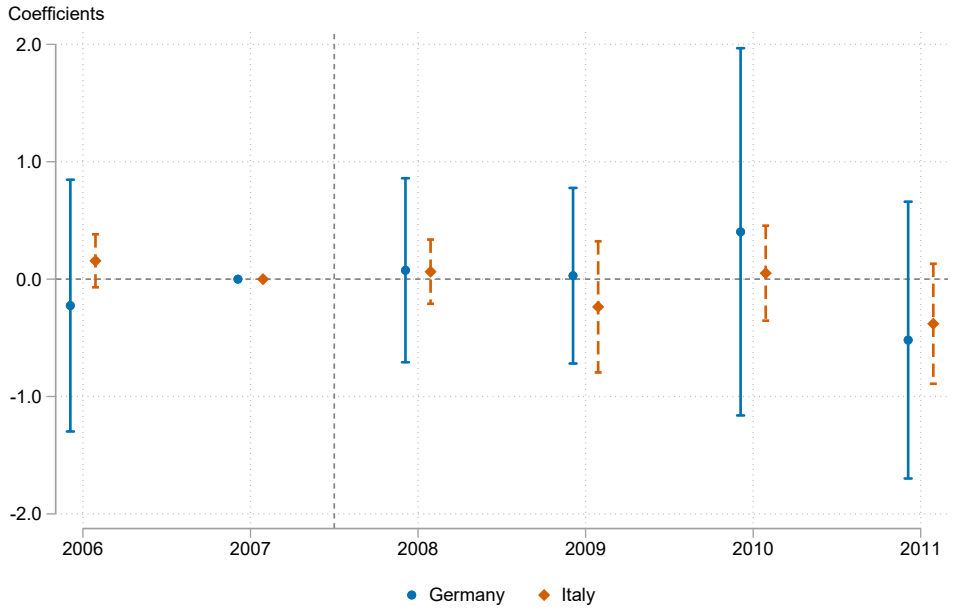
(b) Separations

Figure 6: Change in hiring and separations

Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percentage point change relative 2007 in the firm-level hiring and separation rates on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



(a) Stayers



(b) New hires

Figure 7: Daily wage of stayers and new hires

Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in the firm-level average daily wages of stayers and new hires on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.

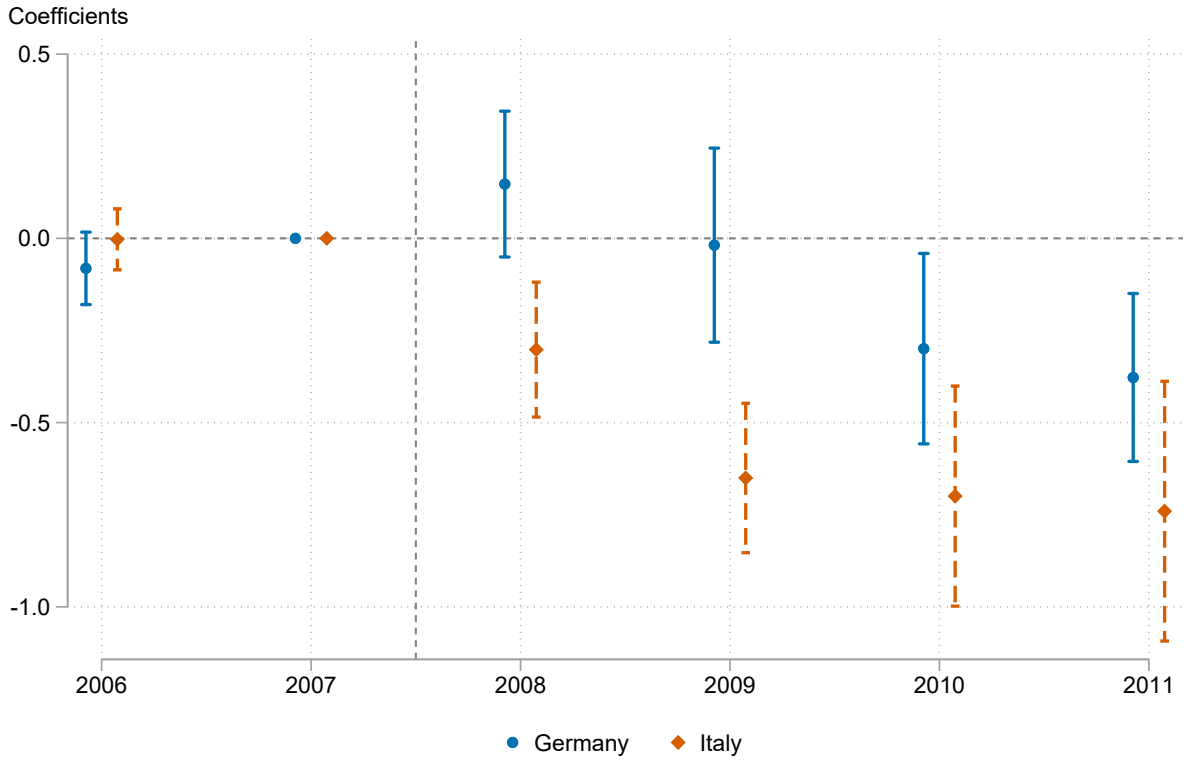


Figure 8: Total labor costs

Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in firm-level labor costs on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.

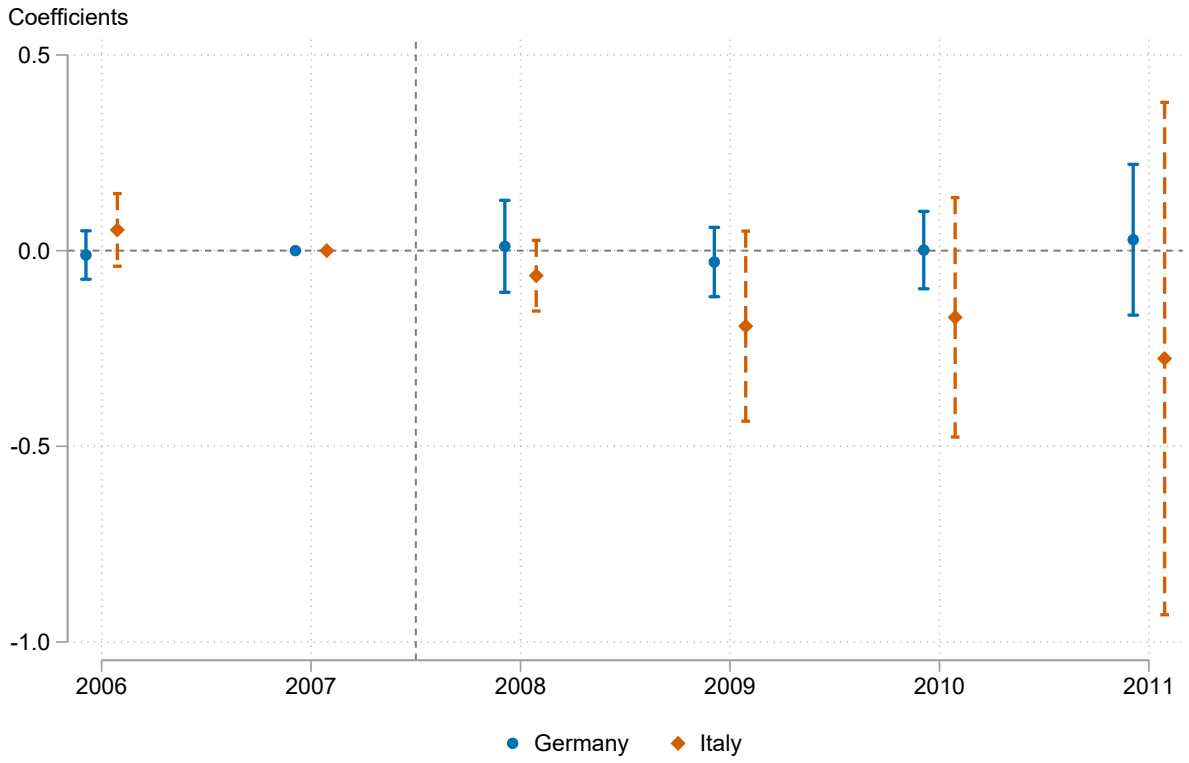


Figure 9: Producer prices

Notes: The figure reports estimates for a dynamic 2SLS regression of the percentage variation in producer prices between each year and 2007 on the 2009-2007 change in output, instrumented with the predicted change in exports. Vertical bars identify 95% confidence intervals. Source: National Accounts.

A Additional Figures and Tables

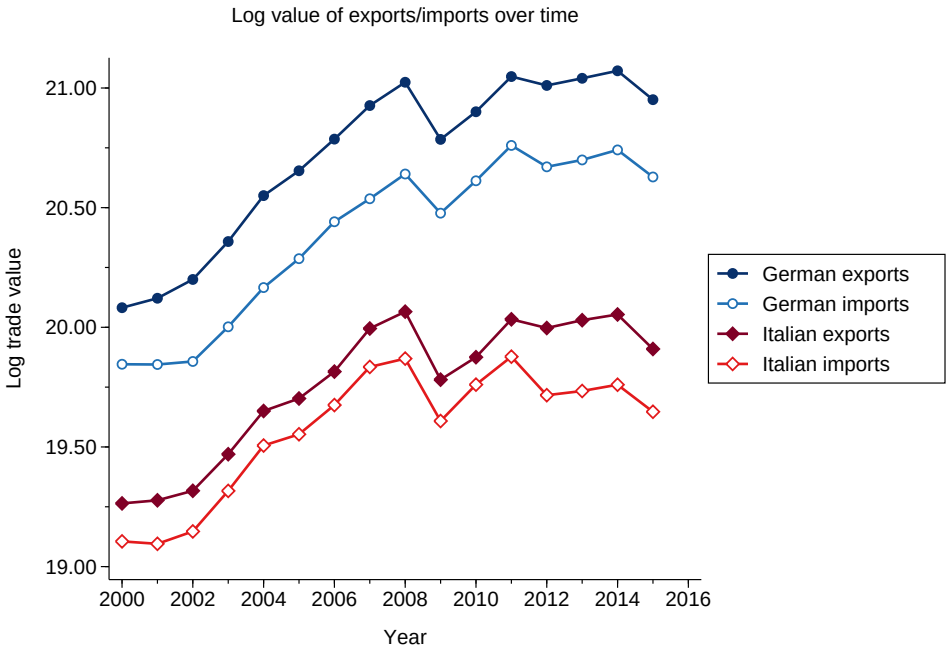


Figure A.1: Trade flows

Notes: The figure reports export and import volumes over time in Italy and Germany. Source: UN COMTRADE.

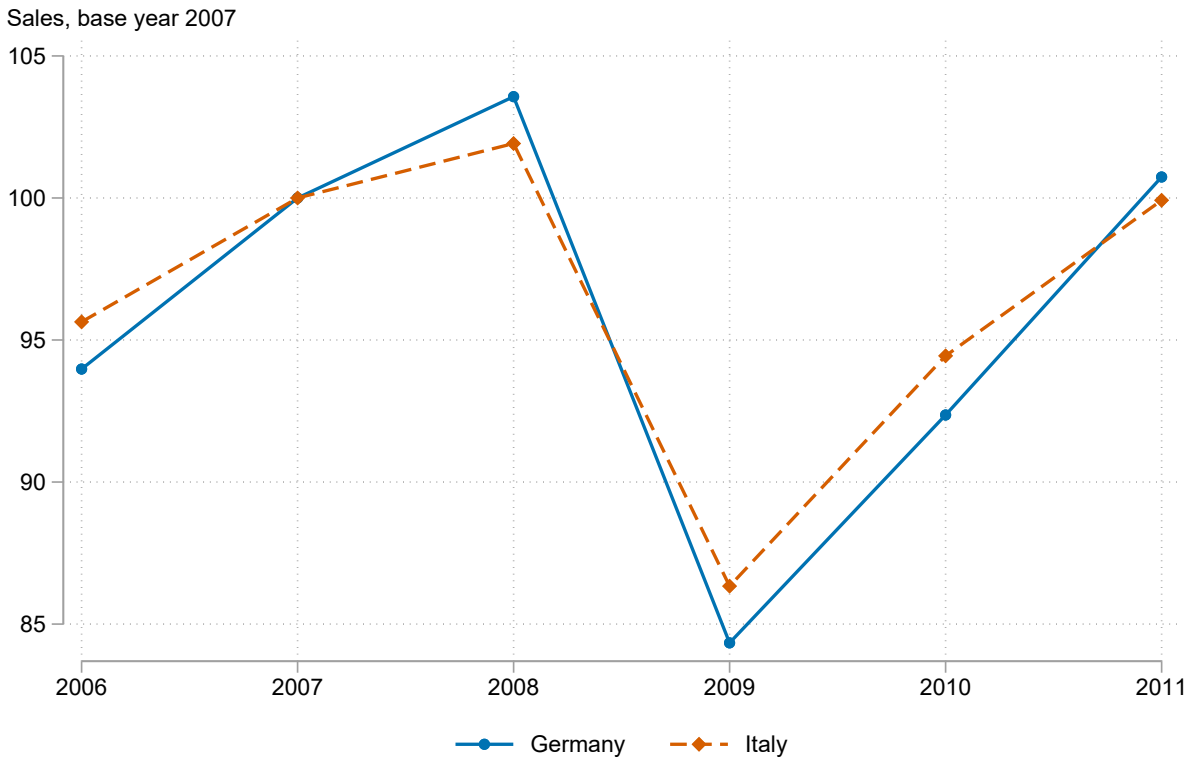
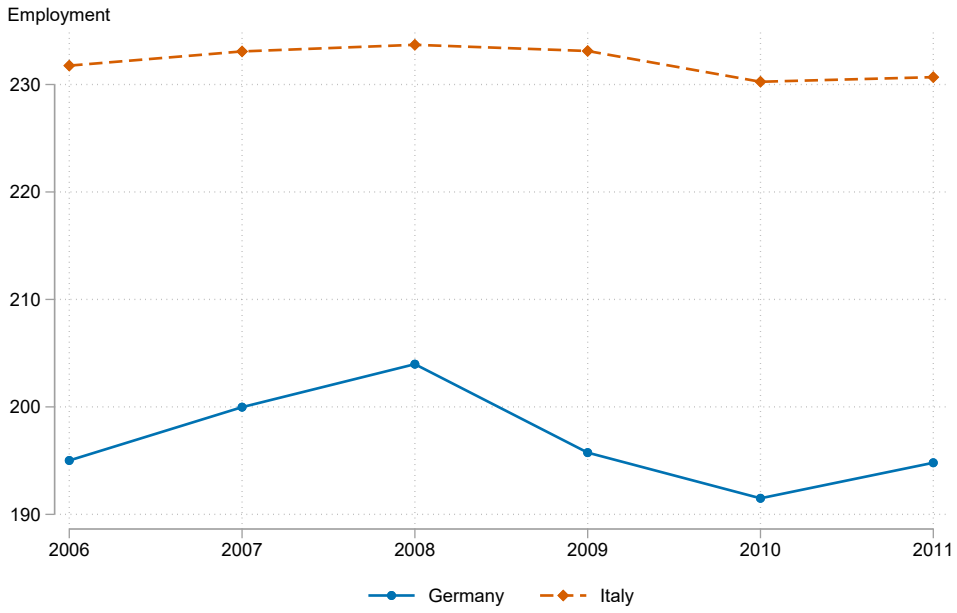
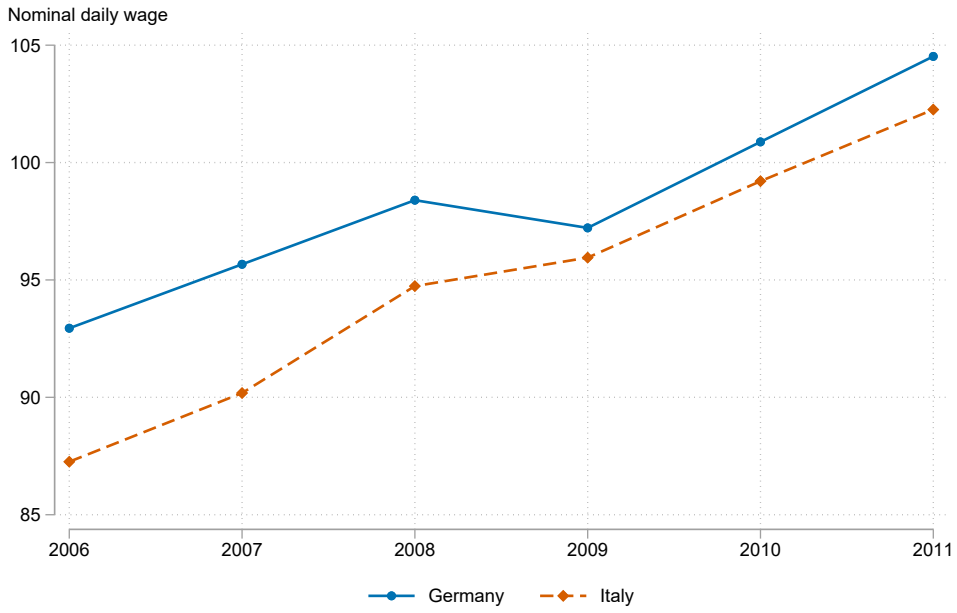


Figure A.2: Sales, base year 2007

Notes: The figure reports the evolution of average sales in Italy and Germany, using 2007 as a base year. Source: INPS-INVIND, LIAB.



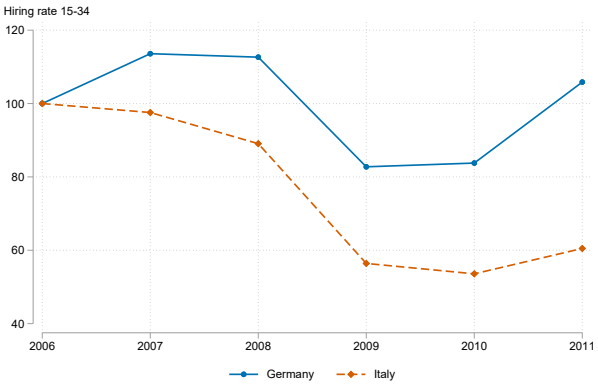
(a) Employment dynamics



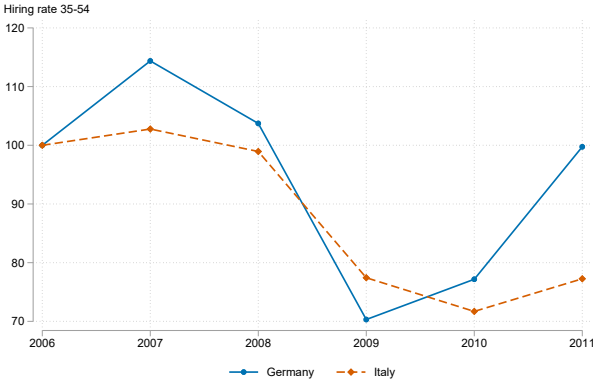
(b) Nominal wage dynamics

Figure A.3: Employment and wages

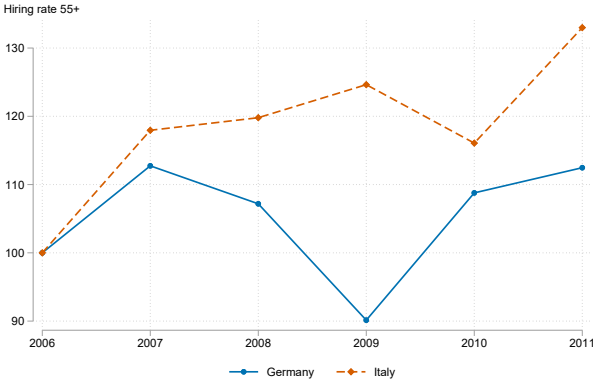
Notes: The figure reports the evolution of average employment and nominal daily wages in Italy and Germany. Source: INPS-INVIND, LIAB.



(a) Hiring rate 15-34



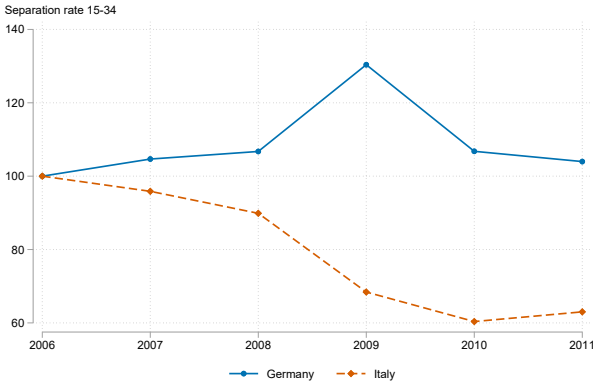
(b) Hiring rate 35-54



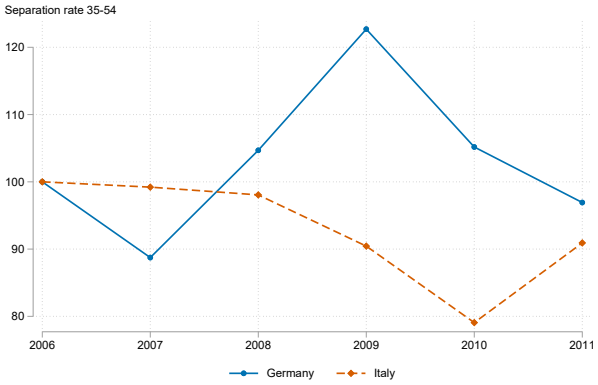
(c) Hiring rate 55+

Figure A.4: Hiring rate

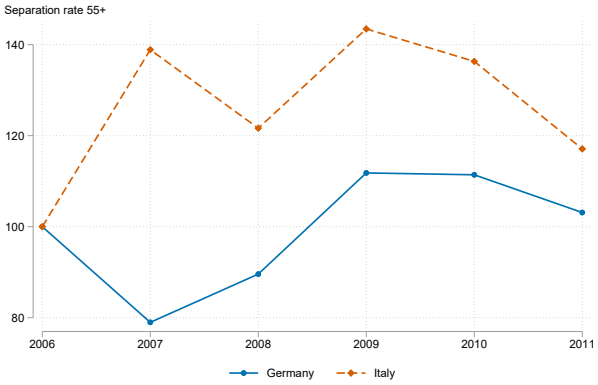
Notes: The figure reports the evolution of the average firm-level hiring rate by age group (15-34, 35-54, 55+) in Italy and Germany. Source: INPS-INVIND, LIAB.



(a) Separation rate 15-34



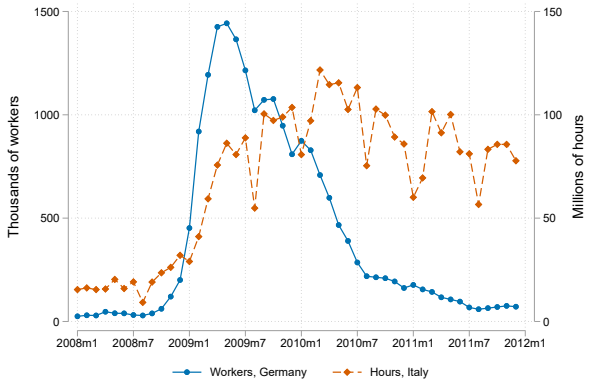
(b) Separation rate 35-54



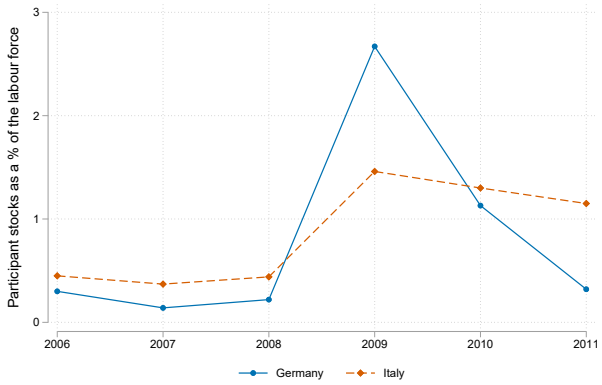
(c) Separation rate 55+

Figure A.5: Separation rate

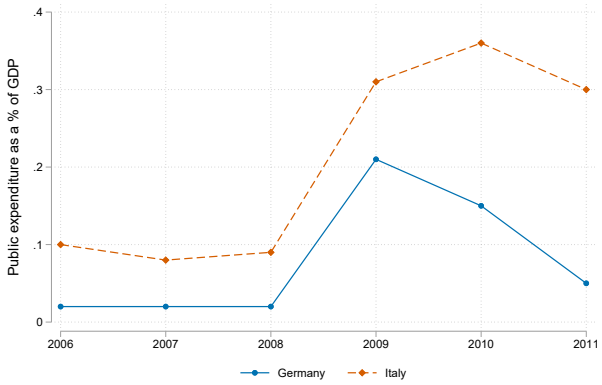
Notes: The figure reports the evolution of the average firm-level separation rate by age group (15-34, 35-54, 55+) in Italy and Germany. Source: INPS-INVIND, LIAB.



(a) Hours and heads, aggregate administrative data



(b) Participants as a percentage of labor force



(c) Public expenditure as a percentage of GDP

Figure A.6: Short-time work compensation schemes

Notes: The figure reports the total number of employees and hours in short-time work compensation schemes in Germany (*Kurzarbeit*) and Italy (*Cassa Integrazione Guadagni, CIG*) in panel a. Panels b and c report the participant stock as a percentage of labor force and the public expenditure as a percentage of GDP in partial unemployment benefits. Source: INPS Observatory on CIG and IAB for panel a; Labor Market Policy database, European Commission, for panels b and c.

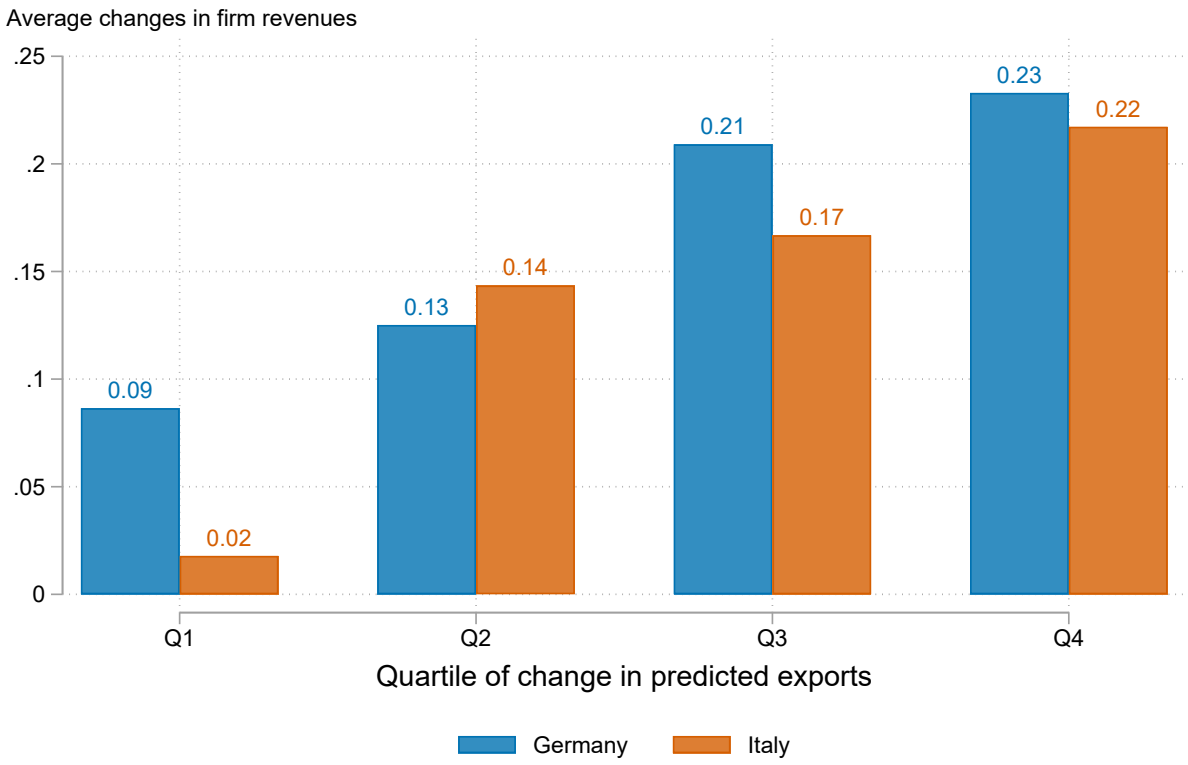


Figure A.7: Average absolute change in revenues by quartile of change in export volume

Notes. The figure reports the average change in revenues between 2007 and 2009 at the firm-level (in absolute values) by quartiles of the change in predicted export volume at the sector-level. A higher quartile indicates a stronger drop in exports between 2007 and 2009.

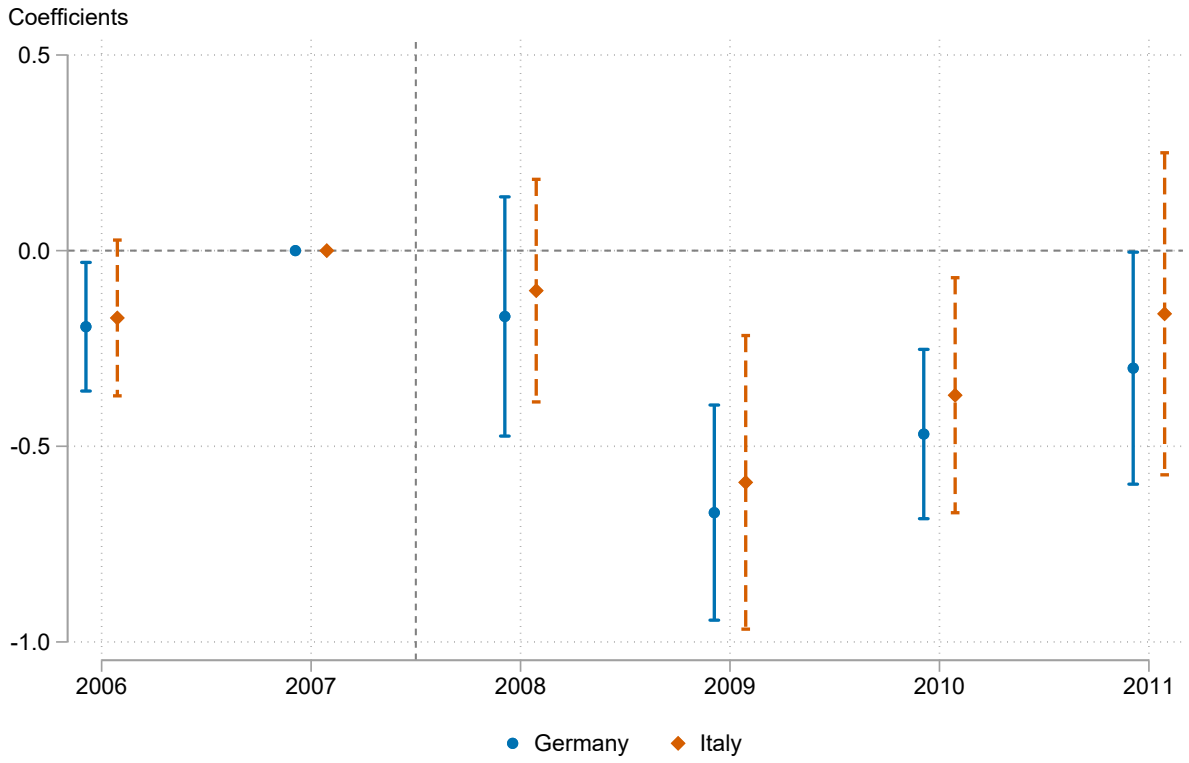


Figure A.8: Output (National Accounts)

Notes: The figure reports estimates for a dynamic OLS regression of the percentage variation in output between each year anbd 2007 on the predicted change in exports between 2009 and 2007. Vertical bars identify 95% confidence intervals. Source: National Accounts.

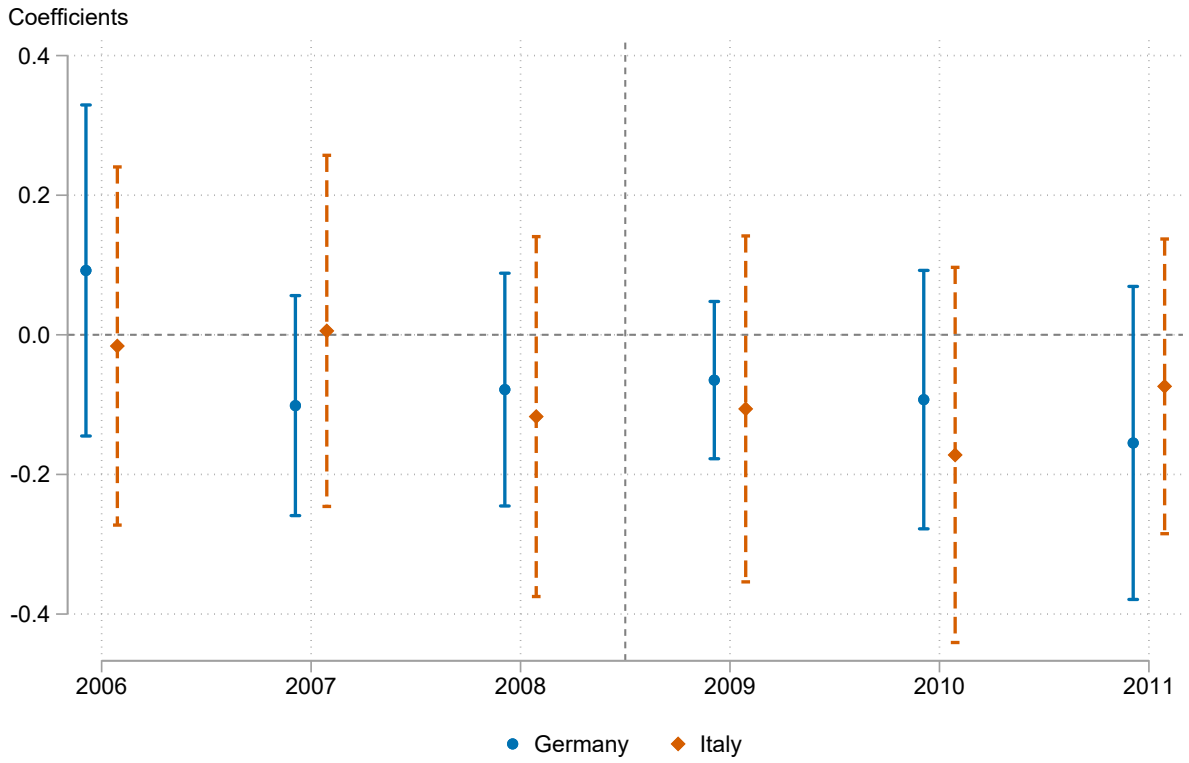


Figure A.9: Exit rate

Notes. The figure reports the coefficient of the exit probability on the predicted change in exports. The dependent variable is a dummy equal to one if the firm is observed in a given year and not observed in the next one.

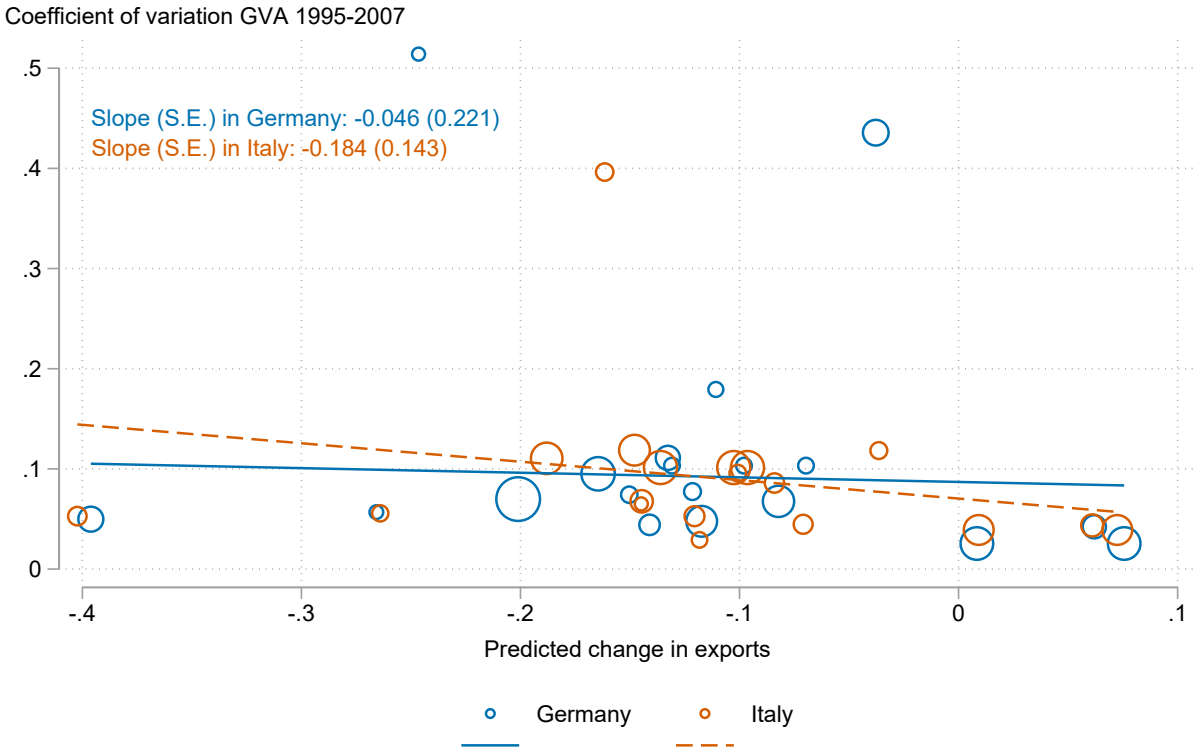


Figure A.10: Sector-level volatility and change in predicted exports

Notes. The figure reports a scatter plot of the relationship between the coefficient of variation of gross value added between 1995 and 2007 and the predicted change in exports between 2007 and 2009 at the sector-level in Italy and Germany. Gross value added is measured in 2005 chain linked volumes from annual National Accounts. The size of each marker is proportional to the sector-specific share of gross value added over total gross value added.

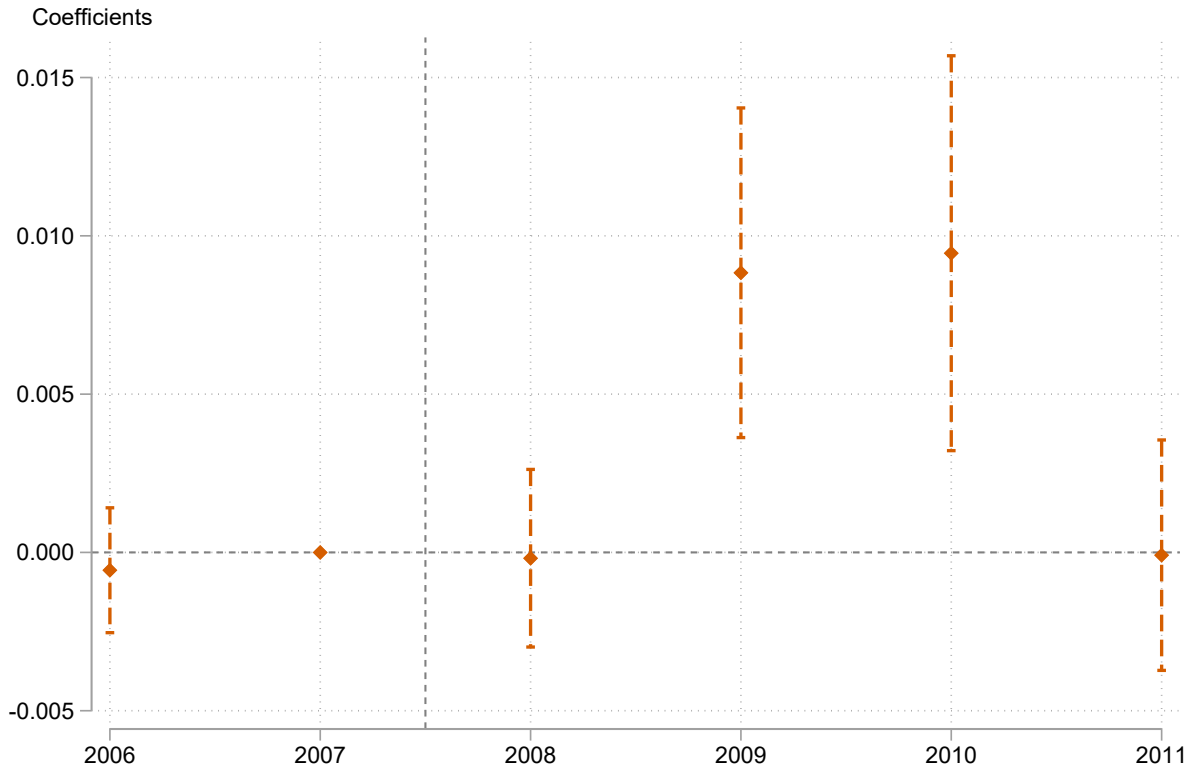
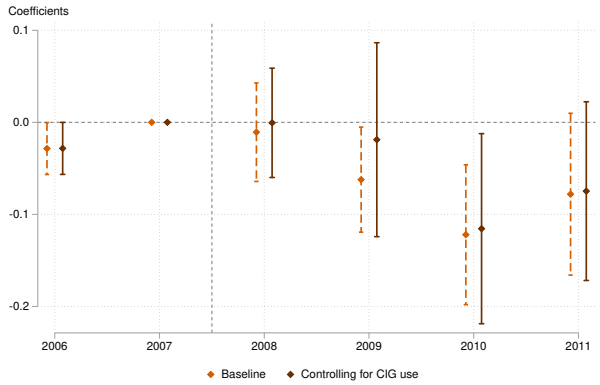
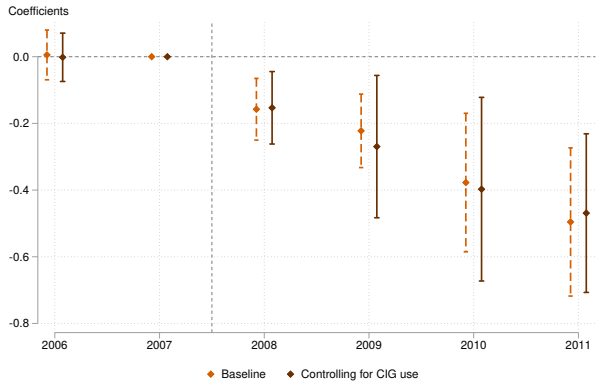


Figure A.11: Share of workers in short-time work compensation (CIG), Italy

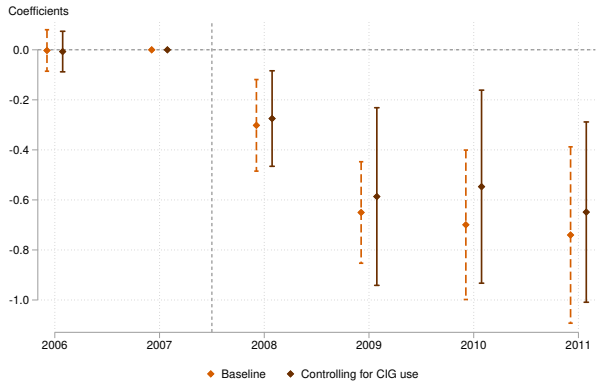
Notes. The figure reports estimates for Italy of a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in the dependent variable (the share of workers in short-time work compensation scheme, CIG, relative to 2007 employment) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND.



(a) Daily wage



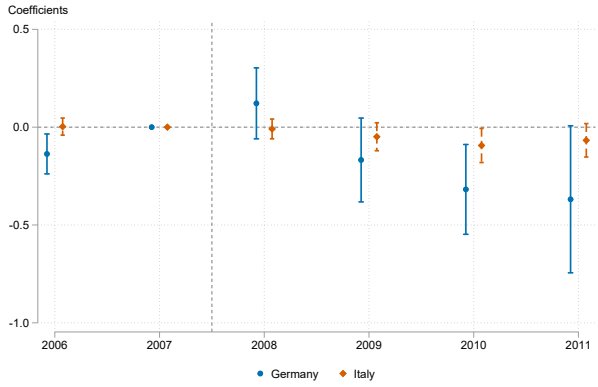
(b) Employment



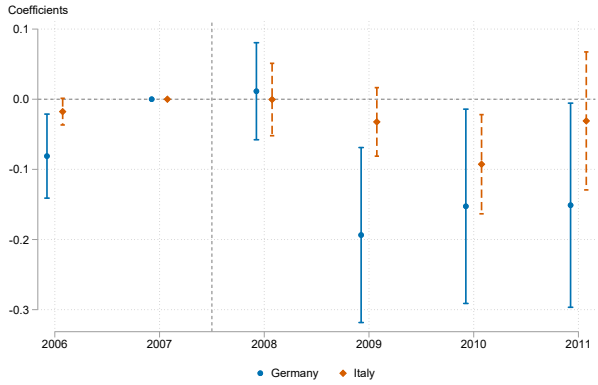
(c) Total labor costs

Figure A.12: Wages, employment and total labor costs without and with controls for use of short-time work compensation schemes (Italy)

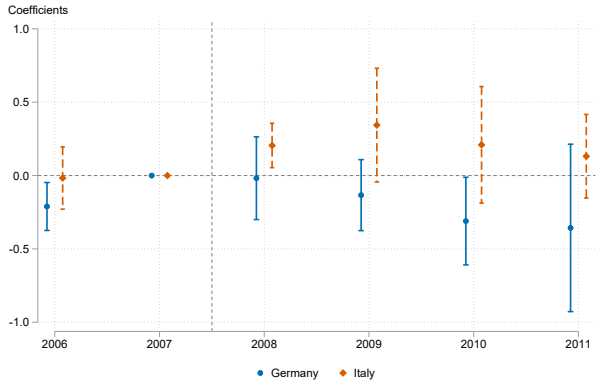
Notes: The figure reports estimates for Italy of a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in the dependent variables (daily wages, employment, labor costs) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). The "Baseline" estimates replicate coefficients from the main text. The estimates "Controlling for CIG use" include among the regressors the year-specific share of workers in short-time work compensation schemes (CIG). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND.



(a) 15-34



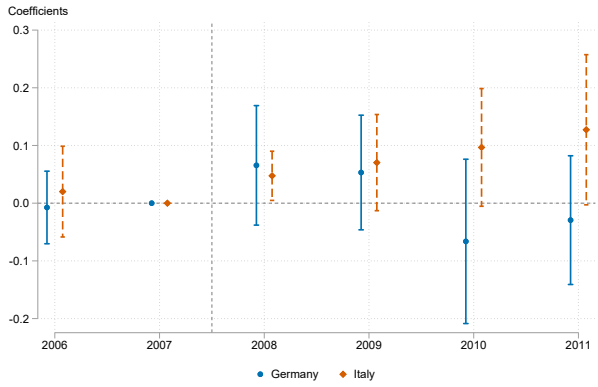
(b) 35-54



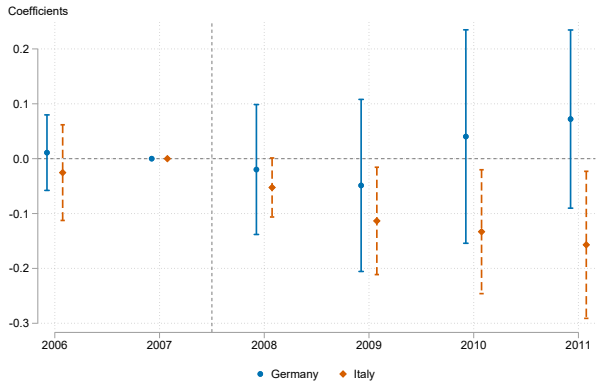
(c) 55+

Figure A.13: Daily wage, by age

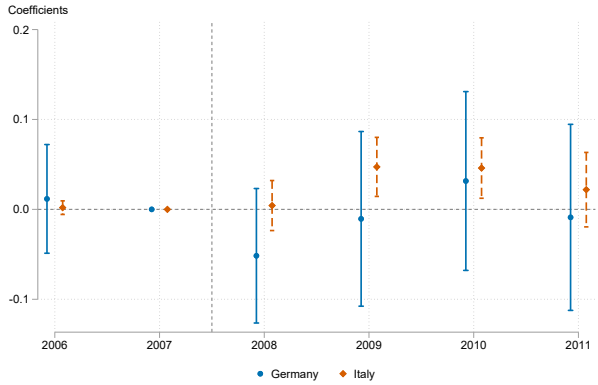
Notes: The figure reports estimates for a dynamic 2SLS regression from equation (4) of the percent change relative to 2007 in firm-level average daily wages by age group (15-34, 35-54, 55+) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



(a) 15-34



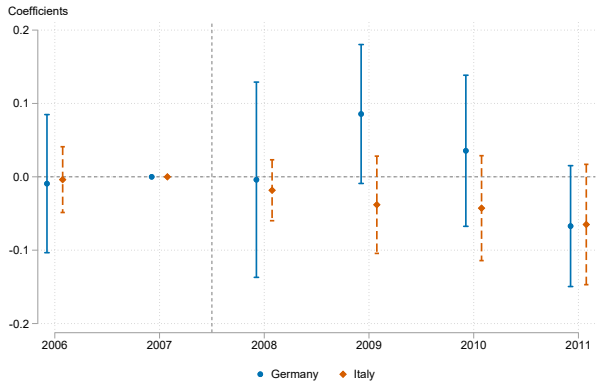
(b) 35-54



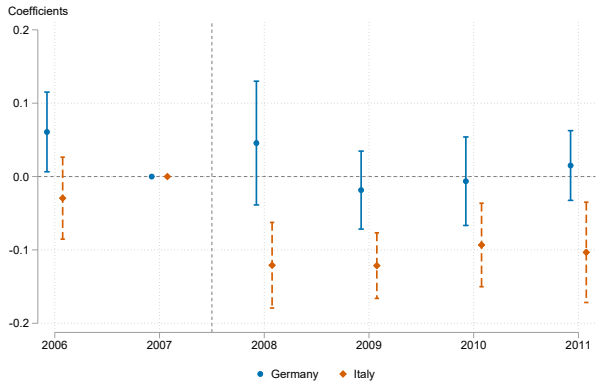
(c) 55+

Figure A.14: Employment shares by age

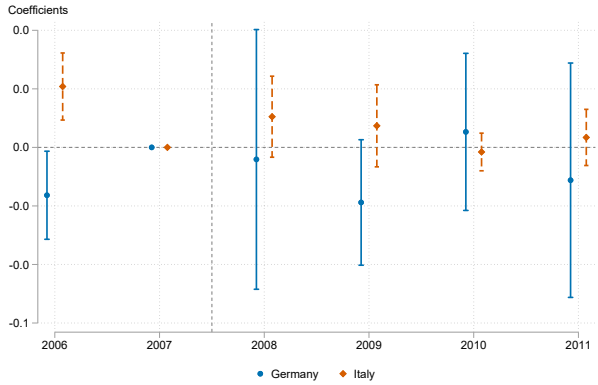
Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percentage point change relative to 2007 in firm-level shares by age group (15-34, 35-54, 55+) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



(a) 15-34



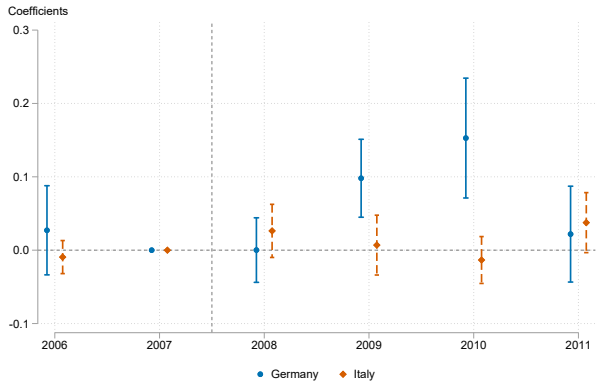
(b) 35-54



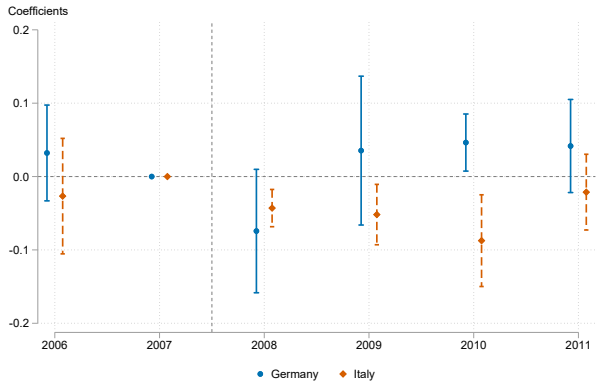
(c) 55+

Figure A.15: Change in hirings by age

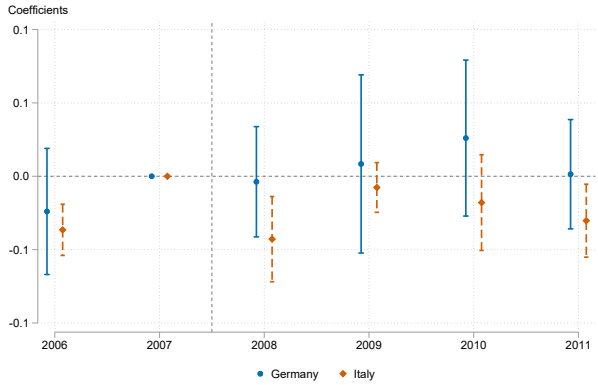
Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percentage point change relative to 2007 in firm-level hiring rates by age group (15-34, 35-54, 55+) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



(a) 15-34



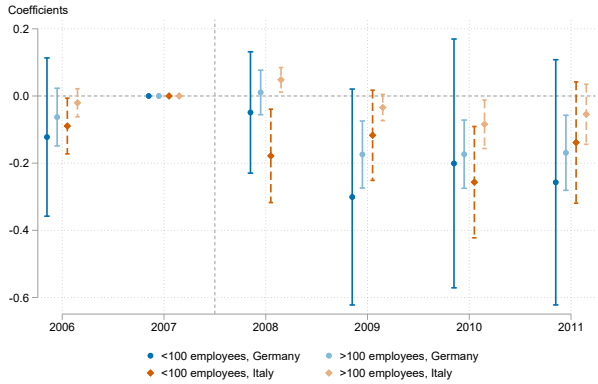
(b) 35-54



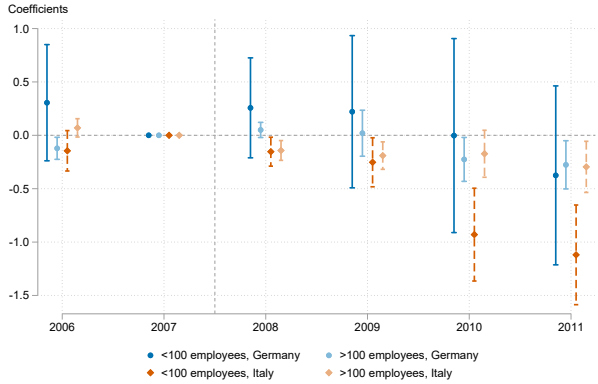
(c) 55+

Figure A.16: Change in separations by age

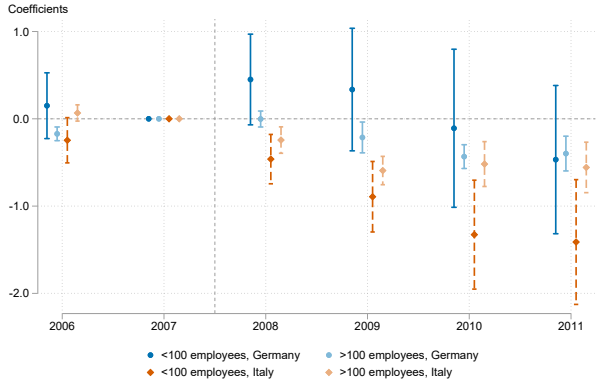
Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percentage point change relative to 2007 in firm-level separation rates by age group (15-34, 35-54, 55+) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



(a) Daily wage



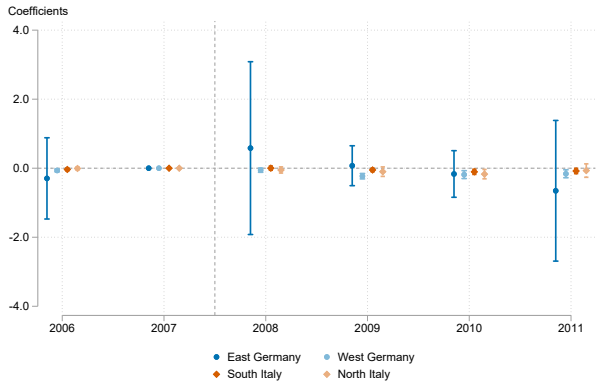
(b) Employment



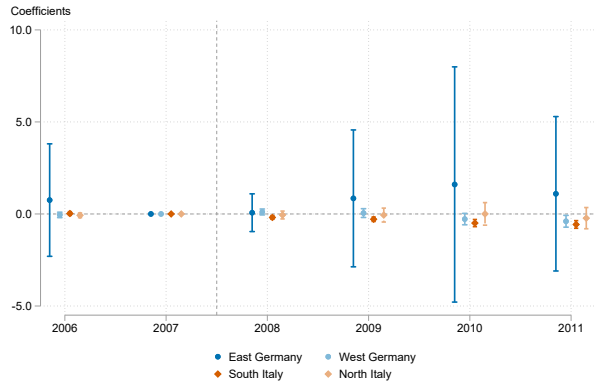
(c) Total labor costs

Figure A.17: Wages, employment and total labor costs by firm size

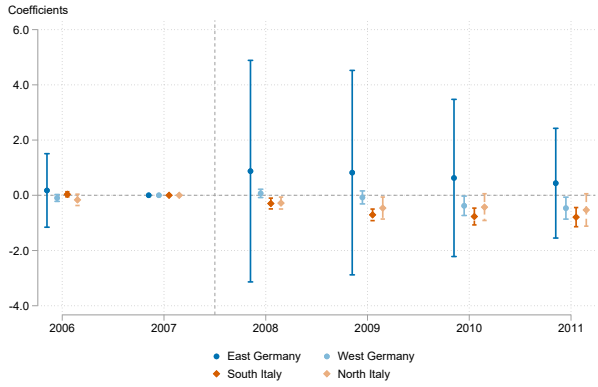
Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in the dependent variables (daily wages, employment, labor costs) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). The regressions are separately estimated for firms that in 2007 have more or less than 100 employees. Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



(a) Daily wage



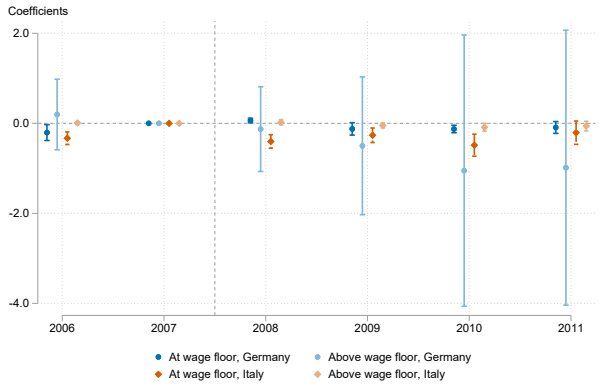
(b) Employment



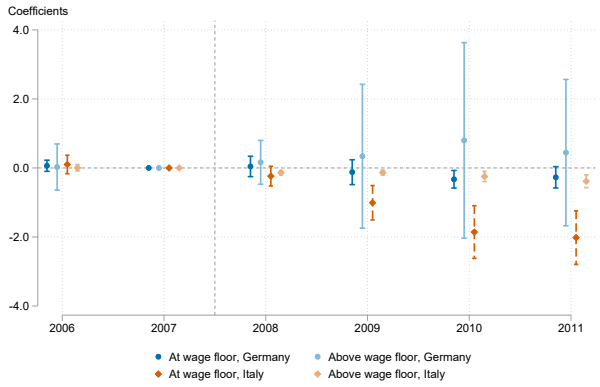
(c) Total labor costs

Figure A.18: Wages, employment and total labor costs by area

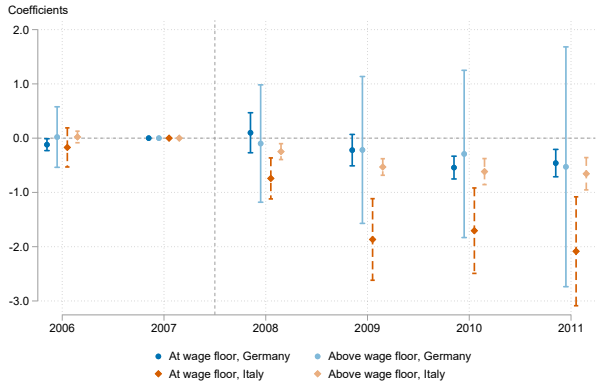
Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in the dependent variables (daily wages, employment, labor costs) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). The regressions are separately estimated for firms in the North (West) or South (East) of Italy (Germany). Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.



(a) Daily wage



(b) Employment



(c) Total labor costs

Figure A.19: Wages, employment and total labor costs by collective agreement

Notes: The figure reports estimates for a dynamic 2SLS regression from equation 4 of the percent change relative to 2007 in the dependent variables (daily wages, employment, labor costs) on the 2009-2007 change in sales, which is instrumented with the predicted change in exports (see equation 3 for the first stage specification). The regressions are separately estimated for firms that in 2007 we paying wages at or above the wage floor, defined by the collective agreements. Standard errors are computed with a wild bootstrap procedure at the sector level, vertical bars identify 95% confidence intervals. Source: INPS-INVIND, LIAB.

Table A.1: Dynamic 2SLS coefficients

	Daily wage	Daily wage, stay-ers	Daily wage, new hires	Daily wage 15-34	Daily wage 35-54	Daily wage 55+	Total labor costs	Employment	Hiring rate	Hiring rate 15-34	Hiring rate 35-54	Hiring rate 55+	Separation rate	Separation rate 15-34	Separation rate 35-54	Separation rate 55+	Share 15-34	Share 35-54	Share 55+
Panel A: Italy																			
2006	-0.028	-0.043	0.156	0.003	-0.018	-0.017	-0.003	0.005	-0.012	-0.004	-0.029	0.021	-0.078	-0.009	-0.027	-0.037	0.020	-0.025	0.002
	(0.014)	(0.023)	(0.115)	(0.022)	(0.010)	(0.108)	(0.042)	(0.038)	(0.041)	(0.023)	(0.029)	(0.006)	(0.041)	(0.011)	(0.040)	(0.009)	(0.040)	(0.044)	(0.004)
	[851]	[851]	[754]	[845]	[851]	[803]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]
2008	-0.011	-0.007	0.064	-0.009	-0.000	0.205	-0.302	-0.158	-0.127	-0.018	-0.121	0.010	-0.051	0.026	-0.043	-0.043	0.047	-0.053	0.004
	(0.027)	(0.023)	(0.140)	(0.026)	(0.026)	(0.077)	(0.093)	(0.047)	(0.040)	(0.021)	(0.030)	(0.007)	(0.029)	(0.018)	(0.013)	(0.015)	(0.022)	(0.027)	(0.014)
	[851]	[851]	[766]	[844]	[851]	[813]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]
2009	-0.062	-0.056	-0.236	-0.049	-0.032	0.344	-0.650	-0.222	-0.178	-0.038	-0.121	0.007	-0.050	0.007	-0.052	-0.008	0.070	-0.113	0.047
	(0.029)	(0.026)	(0.285)	(0.036)	(0.025)	(0.198)	(0.103)	(0.056)	(0.047)	(0.034)	(0.023)	(0.007)	(0.038)	(0.021)	(0.021)	(0.009)	(0.043)	(0.050)	(0.017)
	[851]	[851]	[689]	[844]	[851]	[809]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]
2010	-0.122	-0.137	0.051	-0.094	-0.093	0.209	-0.699	-0.377	-0.146	-0.043	-0.093	-0.002	-0.114	-0.013	-0.087	-0.018	0.097	-0.133	0.046
	(0.039)	(0.034)	(0.206)	(0.045)	(0.036)	(0.203)	(0.152)	(0.106)	(0.059)	(0.036)	(0.029)	(0.003)	(0.037)	(0.016)	(0.032)	(0.017)	(0.052)	(0.058)	(0.017)
	[851]	[851]	[683]	[842]	[850]	[810]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]
2011	-0.078	-0.087	-0.380	-0.067	-0.031	0.131	-0.740	-0.496	-0.182	-0.065	-0.103	0.003	0.003	0.038	-0.021	-0.030	0.127	-0.157	0.022
	(0.045)	(0.040)	(0.261)	(0.044)	(0.050)	(0.145)	(0.180)	(0.113)	(0.067)	(0.042)	(0.035)	(0.005)	(0.041)	(0.021)	(0.026)	(0.013)	(0.066)	(0.068)	(0.021)
	[851]	[851]	[697]	[836]	[850]	[807]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]	[851]
Panel B: Germany																			
2006	-0.086	-0.038	-0.226	-0.137	-0.081	-0.211	-0.081	0.009	0.044	-0.009	0.061	-0.016	0.024	0.027	0.032	-0.024	-0.007	0.011	0.012
	(0.022)	(0.038)	(0.547)	(0.052)	(0.031)	(0.083)	(0.050)	(0.057)	(0.054)	(0.048)	(0.028)	(0.008)	(0.051)	(0.031)	(0.033)	(0.022)	(0.032)	(0.035)	(0.031)
	[424]	[424]	[397]	[423]	[424]	[419]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]
2008	-0.010	0.089	0.076	0.122	0.011	-0.018	0.147	0.127	0.041	-0.004	0.046	-0.004	-0.087	0.000	-0.074	-0.004	0.066	-0.020	-0.052
	(0.027)	(0.036)	(0.400)	(0.093)	(0.035)	(0.144)	(0.101)	(0.098)	(0.095)	(0.068)	(0.043)	(0.023)	(0.048)	(0.022)	(0.043)	(0.019)	(0.053)	(0.060)	(0.038)
	[424]	[424]	[398]	[423]	[424]	[421]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]
2009	-0.210	-0.159	0.029	-0.168	-0.194	-0.134	-0.018	0.105	0.075	0.086	-0.018	-0.019	0.141	0.098	0.035	0.008	0.053	-0.049	-0.011
	(0.055)	(0.038)	(0.382)	(0.109)	(0.064)	(0.123)	(0.134)	(0.151)	(0.069)	(0.048)	(0.027)	(0.011)	(0.051)	(0.027)	(0.052)	(0.031)	(0.051)	(0.080)	(0.050)
	[424]	[424]	[374]	[421]	[424]	[420]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]
2010	-0.179	-0.163	0.403	-0.318	-0.153	-0.310	-0.299	-0.120	0.026	0.035	-0.006	0.005	0.241	0.153	0.046	0.026	-0.066	0.040	0.032
	(0.043)	(0.058)	(0.798)	(0.117)	(0.071)	(0.152)	(0.132)	(0.141)	(0.065)	(0.053)	(0.031)	(0.014)	(0.056)	(0.042)	(0.020)	(0.027)	(0.073)	(0.099)	(0.051)
	[424]	[424]	[386]	[419]	[424]	[421]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]
2011	-0.199	-0.112	-0.519	-0.369	-0.151	-0.357	-0.378	-0.259	-0.061	-0.067	0.015	-0.011	0.097	0.022	0.042	0.001	-0.029	0.072	-0.009
	(0.069)	(0.055)	(0.602)	(0.192)	(0.074)	(0.291)	(0.116)	(0.117)	(0.056)	(0.042)	(0.024)	(0.020)	(0.063)	(0.033)	(0.032)	(0.019)	(0.057)	(0.083)	(0.053)
	[424]	[424]	[398]	[420]	[424]	[422]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]	[424]

Notes. The table reports the estimates from equation (4) for Italy in panel A and Germany in panel B. Standard errors are computed with a wild bootstrap procedure at the sector level, and are reported in parentheses. The number of observations is reported in square brackets. Source: INPS-INVID, LIAB.

Table A.2: Regression coefficients, National Accounts variables

	First stage	*2SLS*	
	Output	Hours worked per employee	Producer prices
		Panel A: Italy	
2006	-0.290	0.033	0.053
	(0.126)	(0.049)	(0.047)
2008	-0.173	-0.045	-0.064
	(0.240)	(0.056)	(0.046)
2009	-1.000	-0.209	-0.193
	(0.000)	(0.305)	(0.124)
2010	-0.624	-0.091	-0.170
	(0.192)	(0.337)	(0.156)
2011	-0.273	0.097	-0.276
	(0.336)	(0.343)	(0.334)
Observations	90	42	84
		Panel B: Germany	
2006	-0.290	-0.004	-0.011
	(0.076)	(0.013)	(0.032)
2008	-0.251	-0.130	0.011
	(0.216)	(0.111)	(0.060)
2009	-1.000	-0.427	-0.029
	(0.000)	(0.242)	(0.045)
2010	-0.700	-0.347	0.001
	(0.078)	(0.257)	(0.050)
2011	-0.449	-0.232	0.028
	(0.208)	(0.217)	(0.098)
Observations	90	42	90

Notes. The table reports the estimates from equation (4) for Italy in panel A and Germany in panel B. Robust standard errors in parentheses. Source: National Accounts.

Table A.3: Dynamic 2SLS coefficients, heterogeneity analysis

	Heterogeneity by firm size						Heterogeneity by area						Heterogeneity by collective agreement					
	Daily wage		Employment		Total labor costs		Daily wage		Employment		Total labor costs		Daily wage		Employment		Total labor costs	
	¡100 employees	> 100 employees	< 100 employees	> 100 employees	< 100 employees	> 100 employees	East/ South	West/ North	East/ South	West/ North	East/ South	West/ North	At wage floor	Above wage floor	At wage floor	Above wage floor	At wage floor	Above wage floor
Panel A: Italy																		
2006	-0.089	-0.020	-0.145	0.070	-0.246	0.067	-0.036	-0.007	0.025	-0.073	0.036	-0.165	-0.331	0.008	0.101	0.005	-0.171	0.022
	(0.042)	(0.021)	(0.097)	(0.044)	(0.132)	(0.048)	(0.020)	(0.023)	(0.051)	(0.064)	(0.047)	(0.105)	(0.071)	(0.012)	(0.136)	(0.047)	(0.184)	(0.054)
	[446]	[405]	[446]	[405]	[446]	[405]	[641]	[210]	[641]	[210]	[641]	[210]	[273]	[578]	[273]	[578]	[273]	[578]
2008	-0.178	0.048	-0.153	-0.142	-0.462	-0.243	0.002	-0.051	-0.189	-0.056	-0.298	-0.282	-0.403	0.024	-0.238	-0.138	-0.742	-0.248
	(0.071)	(0.019)	(0.069)	(0.047)	(0.144)	(0.077)	(0.031)	(0.045)	(0.049)	(0.109)	(0.099)	(0.110)	(0.076)	(0.029)	(0.145)	(0.030)	(0.193)	(0.075)
	[446]	[405]	[446]	[405]	[446]	[405]	[641]	[210]	[641]	[210]	[641]	[210]	[273]	[578]	[273]	[578]	[273]	[578]
2009	-0.117	-0.034	-0.253	-0.190	-0.893	-0.593	-0.051	-0.100	-0.286	-0.060	-0.708	-0.462	-0.265	-0.045	-1.008	-0.135	-1.867	-0.531
	(0.069)	(0.020)	(0.117)	(0.066)	(0.206)	(0.083)	(0.026)	(0.070)	(0.060)	(0.193)	(0.107)	(0.203)	(0.083)	(0.028)	(0.254)	(0.034)	(0.383)	(0.078)
	[446]	[405]	[446]	[405]	[446]	[405]	[641]	[210]	[641]	[210]	[641]	[210]	[273]	[578]	[273]	[578]	[273]	[578]
2010	-0.257	-0.084	-0.930	-0.173	-1.327	-0.518	-0.105	-0.171	-0.494	0.004	-0.769	-0.428	-0.486	-0.087	-1.858	-0.247	-1.705	-0.616
	(0.085)	(0.037)	(0.222)	(0.112)	(0.318)	(0.131)	(0.038)	(0.070)	(0.099)	(0.312)	(0.155)	(0.247)	(0.125)	(0.044)	(0.389)	(0.075)	(0.402)	(0.122)
	[446]	[405]	[446]	[405]	[446]	[405]	[641]	[210]	[641]	[210]	[641]	[210]	[273]	[578]	[273]	[578]	[273]	[578]
2011	-0.139	-0.054	-1.120	-0.296	-1.412	-0.557	-0.080	-0.069	-0.570	-0.228	-0.791	-0.531	-0.208	-0.061	-2.018	-0.386	-2.085	-0.656
	(0.092)	(0.046)	(0.238)	(0.122)	(0.365)	(0.147)	(0.039)	(0.099)	(0.106)	(0.294)	(0.177)	(0.299)	(0.132)	(0.054)	(0.396)	(0.094)	(0.512)	(0.152)
	[446]	[405]	[446]	[405]	[446]	[405]	[641]	[210]	[641]	[210]	[641]	[210]	[273]	[578]	[273]	[578]	[273]	[578]
Panel B: Germany																		
2006	-0.122	-0.063	0.305	-0.122	0.150	-0.172	-0.295	-0.065	0.754	-0.052	0.175	-0.097	-0.206	0.196	0.063	0.026	-0.120	0.020
	(0.120)	(0.044)	(0.278)	(0.053)	(0.192)	(0.040)	(0.601)	(0.021)	(1.559)	(0.075)	(0.679)	(0.064)	(0.090)	(0.400)	(0.082)	(0.341)	(0.056)	(0.285)
	[220]	[204]	[220]	[204]	[220]	[204]	[215]	[209]	[215]	[209]	[215]	[209]	[90]	[115]	[90]	[115]	[90]	[115]
2008	-0.049	0.011	0.257	0.050	0.450	-0.002	0.582	-0.058	0.068	0.108	0.875	0.069	0.063	-0.129	0.043	0.163	0.100	-0.099
	(0.092)	(0.034)	(0.239)	(0.036)	(0.265)	(0.047)	(1.277)	(0.031)	(0.523)	(0.082)	(2.047)	(0.077)	(0.026)	(0.480)	(0.151)	(0.324)	(0.188)	(0.552)
	[220]	[204]	[220]	[204]	[220]	[204]	[215]	[209]	[215]	[209]	[215]	[209]	[90]	[115]	[90]	[115]	[90]	[115]
2009	-0.301	-0.174	0.221	0.020	0.335	-0.214	0.072	-0.231	0.847	0.048	0.820	-0.077	-0.124	-0.500	-0.123	0.338	-0.221	-0.217
	(0.164)	(0.051)	(0.364)	(0.110)	(0.358)	(0.090)	(0.295)	(0.040)	(1.897)	(0.122)	(1.889)	(0.120)	(0.071)	(0.781)	(0.183)	(1.063)	(0.148)	(0.690)
	[220]	[204]	[220]	[204]	[220]	[204]	[215]	[209]	[215]	[209]	[215]	[209]	[90]	[115]	[90]	[115]	[90]	[115]
2010	-0.201	-0.173	-0.003	-0.226	-0.108	-0.433	-0.167	-0.186	1.602	-0.278	0.628	-0.381	-0.126	-1.051	-0.328	0.797	-0.542	-0.291
	(0.189)	(0.052)	(0.464)	(0.105)	(0.462)	(0.069)	(0.344)	(0.058)	(3.260)	(0.158)	(1.452)	(0.179)	(0.042)	(1.537)	(0.130)	(1.445)	(0.107)	(0.786)
	[220]	[204]	[220]	[204]	[220]	[204]	[215]	[209]	[215]	[209]	[215]	[209]	[90]	[115]	[90]	[115]	[90]	[115]
2011	-0.257	-0.169	-0.375	-0.277	-0.468	-0.398	-0.654	-0.161	1.096	-0.397	0.438	-0.466	-0.092	-0.984	-0.271	0.444	-0.460	-0.528
	(0.186)	(0.057)	(0.428)	(0.115)	(0.433)	(0.102)	(1.040)	(0.059)	(2.140)	(0.163)	(1.014)	(0.203)	(0.067)	(1.558)	(0.158)	(1.081)	(0.129)	(1.127)
	[220]	[204]	[220]	[204]	[220]	[204]	[215]	[209]	[215]	[209]	[215]	[209]	[90]	[115]	[90]	[115]	[90]	[115]

Notes. The table reports the estimates from equation (4) for Italy in panel A and Germany in panel B separately for different subgroups defined by firm size, area, and wages relative to the floor. Standard errors are computed with a wild bootstrap procedure at the sector level, and are reported in parentheses. The number of observations is reported in square brackets. Source: INPS-INVID, LIAB.