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Staggered wages, unanticipated shocks and firms' adjustments

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ABSTRACT

This paper empirically investigates the employment and wage effects of contract staggering, i.e., the asynchronous and infrequent way in which wages adjust to changes in the economic environment. Using an identification strategy based on exogenous start dates of collective agreements around the Great Recession, we estimate the effect of increases in base wages on firms' labor cost adjustments. Our analysis is based on a large employers-employees dataset merged to collective agreements in the Netherlands, a country in which collective bargaining is dominant and contract staggering is relatively pervasive. The main result is that staggered wage setting has no real effect on employment. We find significant employment losses only in sectors covered by contracts with much longer durations than those normally assumed in macroeconomic models featuring staggered wages. Instead, we show that firms adjust labor costs by curbing other pay components such as bonuses and benefits and incidental pay. The overall result supports the idea that wage rigidities are not the main source of employment fluctuations.

1. Introduction

This paper empirically investigates the effect of a particular source of nominal rigidity in labor markets, namely the staggered way in which wages adjust to changes in the economic environment. Wages are staggered when contract decisions are taken at different points in time and these decisions are valid for a certain number of periods (Taylor, 1979).[1] At any point in time, only some industries reset their wages, and during the bargaining process employers and unions are likely to respond to events which happened in the previous period. Also, as the bargained wage is valid for a number of periods, unions form inflation expectations for the contract period in order to insure workers against real wage losses. Expectations on productivity and profitability are likely to be relevant as well, as unions would make sure that wages grow in line with industry profits. Sudden changes in expectations can therefore induce wage differentials across sectors bargaining in nearby months.

Staggered wages, also known as Taylor contracts, have been used in macroeconomics to understand the persistence of inflation

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[1] This wage rigidity is different from downward nominal wage rigidity (DNWR), which refers to the absence of nominal wage cuts. Downward nominal wage rigidity has been studied in Altonji and Devereux (2000), Elsby (2009), Schmitt-Grohé and Uribe (2016).

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dynamics and the transmission of monetary policy (Olivei and Tenreyro (2007, 2010), Björklund et al. (2019).[2] In the most recent macroeconomic literature, staggered wages are the most common method of incorporating labor market rigidities in quantitative macroeconomic models (Taylor, 2016), and represent a nominal friction that helps these models in reproducing the inflation and output dynamics observed in the data (Christiano et al., 2005; Hall, 2005; Smets and Wouters, 2007; Gertler and Trigari, 2009). Models for the labor market have instead questioned whether wage rigidities are ultimately responsible for the fluctuation of unemployment (Shimer 2005; Pissarides, 2009; Kudlyak, 2014).

Empirical studies have well documented that wages are indeed reset infrequently. On the basis of a large-scale survey among European firms, it has been documented that in the majority of firms wage resets take place only once a year or even less frequently (Fabiani et al., 2010). On the basis of the same survey, it has also been documented that firms adjust their wage bill through other means, e.g. by slowing promotions, cutting bonuses, adjusting working hours or choosing cheaper hires to replace workers who leave the firm (Babecký et al., 2012, 2019). Recent research has also confirmed that base wage cuts are rare in Great Britain (Schaefer and Singleton, 2022) and the United States (Grigsby et al., 2021), while the adjustment of flexible pay is more pervasive. Likewise, in case firms offer worker insurance within the firm, they can forego profits to absorb shocks (Guisoet al., 2005). If the scope of such adjustments is large enough, the employment response to staggered wage setting may be more muted.

Differently from most of the existing literature, this paper takes a microeconomic perspective to empirically assess how wage rigidities due to contract staggering affect firms' wage versus employment labor cost adjustments. The analysis focuses on the Netherlands, where wage resets are established in collective labor agreements (*collectieve arbeidsovereenkomst*, CAO hereafter) that apply at the sector level, but also at the company level for larger firms. The case of the Netherlands is particularly interesting because nominal rigidities due to contract staggering are very pervasive, due to the large coverage of collective agreements and the relatively long duration of contracts. We use detailed data on professional forecasts specific to the Dutch economy to identify the timing of a big unanticipated macroeconomic shock that created a substantial differential in wage growth among CAOs negotiated in nearby months. We identify this shock in October 2008, after which average wage growth agreed upon in CAOs fell from 3.5 percent to 1 percent in two quarters. We then use a large matched employers-employees dataset obtained from the combination of several administrative data sources to show the effect of contract staggering on a battery of firm-level labor market outcomes. In particular, we consider firms' responses on total and flexible (i.e. with a temporary contract) employment levels and the number of new hires in each firm and adjustments to various pay components (the base wage, bonuses, non-wage benefits, and overtime hours paid to the workers), to understand which adjustment margins firms use the most.

Identifying the effect of rigidities arising from collective bargaining systems in micro-econometric analysis is challenging. One particular concern is that the period in which the parties bargain over wage resets may be endogenous, as uncertainty may cause both parties to delay the renegotiation process (Danziger and Neuman, 2005). To address this, we exploit a particular feature of the Dutch context to generate plausible exogenous variation around the timing of the shock: in each sector or company in our data, the start date of the subsequent CAO always coincides with the expiry date of the previous CAO. By exploiting variation in the staggered and pre-determined start dates around the aggregate shock, our identification strategy ensures that the start date of each CAO is independent on the uncertainty generated by the shock. This allows us to estimate the causal effect of the wage rigidities created by contract staggering on the firms and the workers who signed their CAO before the shock and did not anticipate it.

The paper closest to our own research is Díez-Catalán and Villanueva (2014) who study the effect of widespread nominal wage rigidity in Spain, where contract staggering is caused by the presence of province-sector level agreements with a duration of typically two years or even longer. They examine workers' total wage growth and transition to unemployment after the Lehman Brothers default, which was an external shock to the Spanish economy, and find that this nominal rigidity increases the probability of transition to unemployment, especially among minimum wage workers. Differently from them, in this paper we investigate firms' labor cost adjustments after the start of the 2009 recession in the Netherlands. We improve on this study along two main dimensions: first, using data on collective agreements in place in the Netherlands in the period 2006–2012, we provide evidence on how bargaining has changed during the crisis period. Then, using an identification strategy based on CAOs pre-determined start dates (instead of the endogenous agreement dates), we identify the causal effect of nominal rigidities on firms' labor market outcomes.

Our main result is a precisely estimated zero effect of contract staggering on employment. Firms that agreed on high wage growth before the recession did not cut employment levels more than those firms that were able to witness the shock and were able to agree on lower contractual wage growth. Instead, we show that non-anticipating firms have been able to adjust their wage bill by cutting bonuses and benefits and that they seem to have been able to curb the so-called incidental pay component, that we do not observe directly.[3]

This result contrasts with macroeconomic models such as those of Hall (2005) and Gertler and Trigari (2009), in which staggered wage bargaining leads to more volatile responses to an aggregate shock of all labor market indicators, including employment. Our results support the idea that unemployment fluctuations are not the result of wage rigidities (Pissarides, 2009). More precisely, our results are in line with Björklund et al. (2019) who show that, despite persistent real effects on inflation and output, the (un) employment response to monetary policy shocks is not significant in Sweden, a country with a similar degree of employment protection, contract durations and frequencies of wage adjustments. In line with their results, we find significant employment losses only

[2] See Friedman (1977), Fischer (1977), Calvo (1983) and Roberts (1995).

[3] Incidental pay is the residual of the total wage growth minus contractual wage growth, and is typically estimated at the macro-level. It comprises the pay increases that workers receive due to e.g. promotions and performance ratings as well as compositional changes in the workforce (e.g. replacing workers who leave with cheaper hires).

in sectors covered by contracts with duration larger than thirty months, although this effect is not large enough to affect our overall results. Such durations are much higher than what is normally assumed in macroeconomic models for the U.S. economy, such as Christiano et al. (2005), Smets and Wouters (2007), Gertler and Trigari (2009), where wage resets often occur every three to four quarters. Also, our results contribute to the literature of wage rigidities by providing evidence of forms of flexibility in the wage of existing employees, and complements the existing evidence of substantial sensitivity of the wage of new hires to macroeconomic fluctuations (Haefke et al., 2013).

Our results have important implications for the role of collective bargaining. Out of concern for job losses, international organizations have often advocated to reduce nominal rigidities in wage setting, for instance by moving bargaining to the firm level. Yet, such reforms have proven contentious and have raised concerns about the overreliance on wage moderation, the erosion of collective bargaining and the consequences on wage inequality (see Dustmann et al., 2009; Blanchard et al., 2014; Boeri and Jimeno, 2015; Addison et al., 2017). Our analysis shows that the nominal rigidities that often result from collective bargaining do not necessarily come at the cost of employment, and suggests that building more room for discretionary pay components in collective agreements may be a way to alleviate such rigidities.

The paper proceeds as follows. Section 2 discusses the institutional framework. Section 3 describes the data and the descriptive statistics. Section 4 presents the identification strategy being used and the results of the empirical analysis. In Section 5 we present robustness checks and examine heterogeneity in contract duration. Section 6 concludes.

2. Institutional framework

Wage setting in the Netherlands is characterized by a dominant role for collective bargaining. According to the OECD, almost 80 percent of all wage earners in the Netherlands are covered by a collective agreement (CAO), as compared to an average of 32 percent across OECD countries.[4] The high coverage is due to the presence of the so-called *erga omnes* provisions, i.e. agreements that automatically apply to all workers within firms that are members in a signing employer association, as well as government-issued extensions of collective agreements to all firms and workers in a sector (Visser, 2016b; Hijzen et al., 2019). Four aspects of the Dutch system of collective bargaining are worth mentioning in more detail for the purpose of this paper, i.e., the level of bargaining, the duration of contracts, their timing and the content of collective agreements. In addition, we briefly discuss employment protection legislation (EPL), which influences the relative ease with which employers can terminate permanent as well as temporary employment contracts.

First, the great majority of workers are covered by a CAO that applies to the whole sector, although especially large firms can have their own firm-level agreements. As in many other countries, in the Netherlands there has been a shift towards a more decentralized wage setting. The main route to decentralization has been the increasing scope for customization within sectoral agreements. Examples include the use of minimum standards that can be topped up at the firm level and the so-called *à la carte* provisions which allow the bargaining parties of each firm to select and include the wage and non-wage components they prefer. Wage bargaining in the Netherlands is furthermore set in a corporatist setting, where various coordination mechanisms are in place to sustain collective bargaining: to ensure that confederations have a mandate, unions and employers' confederations participate to an annual discussion aimed at setting the guidelines for the next wage increases (i.e. the rate of growth of the base wage) and other bargaining priorities. This internal coordination is quite strong, especially for sectoral unions that often agree on a minimum or maximum wage increase and can possibly team up with employers against dissident unions. At the same time, since the severe wage-price spiral of the 70′s ended, unions have come to adhere to a 'jobs before wages' strategy which has been credited for a sustained decrease in unemployment levels over the 1980s and 1990s (Visser, 1998).

Second, while collective agreements in Japan or the U.S. typically have a duration of 12 months, CAOs in the Netherlands can have longer as well as shorter durations. On average, the duration of a collective agreement is about 20 months (Visser, 2019), while the average duration of wages among the 17.000 European firms surveyed for the ECB Wage Dynamic Network initiative was about 15 months (Lamo and Smets, 2009).

Third, it is important to mention some details on the timing and the degree of synchronization of Dutch collective agreements. In theory, wages are bargained according to a specific calendar: based on the forecasts published by the Netherlands Bureau for Economic Policy Analysis (CPB) in September, parties define their wage demands for the following year and set bilateral guidelines for wage increases and other bargaining priorities.[5] In practice, as we will document in the next section, bargaining takes place throughout the year. This is different from Japan or the US where wage bargaining is synchronized across sectors (Olivei and Tenreyro, 2010).

The low synchronization and the long duration of contracts together imply that the Dutch labor market is characterized by a relatively strong degree of contract staggering. Furthermore, it is important to mention that there can be a substantial difference between the start date (date at which wage increases start) and the signature date of collective agreements. Like in other countries, the Dutch practice is that if there is no new agreement the old agreement remains valid after expiration. This implies that the wage level stays the same, i.e. there is no wage increase. Yet, in case a new contract is agreed upon after the start date, the resulting wage increase can apply retrospectively (retro-activity) (Hijzen et al., 2019).

Fourth, it is worth mentioning that collective agreements typically govern most components of workers' wage bill, such as the base wage, other pay components (e.g. the thirteenth month), contribution to pension funds and benefits (e.g. travel costs). However, firms

[4] See https://stats.oecd.org/Index.aspx?DataSetCode=CBC

[5] CAOs in the Netherlands typically do not contain clauses to index wage growth to inflation.

Table 1
Summary statistics (CAO Data).

	2007	2008	2009	2010	2011
	By CAO start date				
Contract duration (months)	19.4	21.4	18.6	18.6	21.7
Agreement delay (months)	2.3	2.0	4.8	2.4	2.9
Wage growth (%)	2.9	3.0	1.3	1.2	1.7
N° agreements	88	71	74	73	60
	By CAO agreement date				
Contract duration (months)	19.7	21.0	18.0	18.7	21.2
Agreement delay (months)	2.3	2.2	2.8	3.8	3.2
Wage growth (%)	2.9	3.1	1.3	1.1	1.8
N° agreements	95	70	56	80	60

Notes: The table reports means and the number of collective agreements by CAO start date (first lines) and by CAO agreement date (last lines). The percentage wage growth is annualized (to normalize over contract duration) and also includes other structural pay increases (e.g. 13th month).

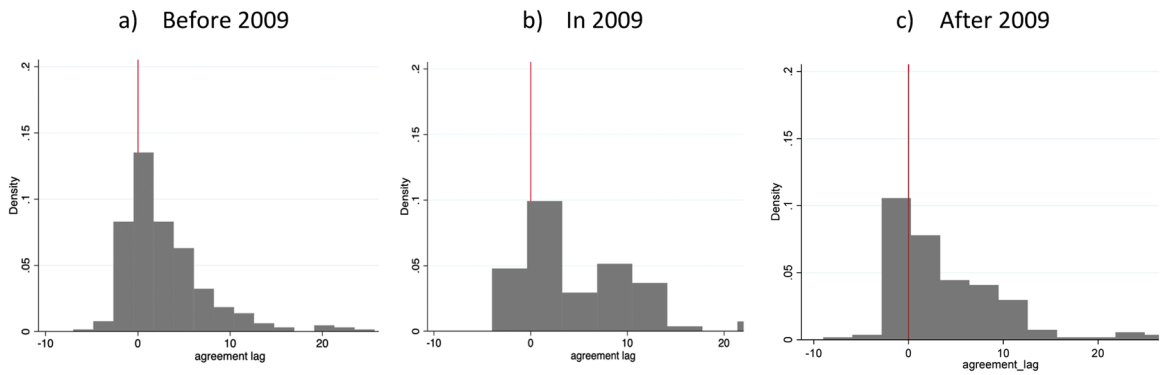

Fig. 1. Agreement delay.
Notes: The figure shows the distribution of the agreement delay of contracts started before 2009 (panel (a)), in 2009 (panel (b)) and after 2009 (panel (c)). The agreement delay is expressed in months.

may have also some room for discretion, such as pay components that depend on performance or the granting of promotions.

Finally, we note that the Netherlands – now and at the time of the period we study – has relatively strict employment protection legislation (EPL), which also influences the level of dismissals in response to a shock. According to indicators constructed by the OECD,[6] the Netherlands has one of the highest levels of employment protection for permanent contracts (especially due to strict regulation of individual dismissals in contrast to collective dismissals). At the same time, termination of temporary contracts is relatively easy in the Netherlands (while temporary contracts are relatively pervasive). Hence, this warrants the need to assess not just the effect of the shock on permanent contracts, but on total employment also comprising temporary contracts and new hires.

3. Data and descriptive statistics

3.1. Collective agreements data

Our dataset on collective labor agreements (CAOs) is obtained from the Ministry of Social Affairs (MinSZW). The dataset covers the most important CAOs in terms over worker coverage that were in place in the 2006–2012 period, and contains information on the agreement, the start and the expiration dates of agreements, the contractual wage increase as well as incidental and structural adjustments in other pay components. Also, it contains the Standard Business Classification (SBI) code that identifies the sector of the economic activity of each firm and is used to merge the CAO information with the companies and workers information available in the Matched Employers Employees Data.

Table 1 reports descriptive statistics regarding contract durations, agreement delays and contractual wage growth, and shows how the main bargaining characteristics evolved. The duration of collective agreements is the characteristic that has remained most stable. This is due to the fact that in many sectors social partners tend to stick with the same contract duration. Instead, contractual wage growth is more volatile and is closely related to the business cycle: the annualized wage increase and the total annual wage growth

[6] The OECD indicators on Strictness of employment protection can be accessed through: https://stats.oecd.org/.

(that includes incidental and structural adjustments in other pay components) were around 3 percent in the pre-crisis period, then fell to 1.3 percent during the 2009 crisis and slightly recovered to 1.8 percent in 2011. More importantly, the table shows that collective agreements are signed with a delay of, on average, several months.

Fig. 1 shows the distribution of the agreement delay before, during and after the 2009 recession. The figure shows that social partners typically reach an agreement in the months around the expiry date of the previous contract (which corresponds to the start date of the new agreement). Around 25% of contracts are agreed exactly on time, while in many other cases agreements are reached either a few months before the start date, or with a delay of one to several months.

For the purpose of this paper, it is interesting to notice that agreement delays have increased, on average, during the crisis period: in 2009 (middle panel) the share of contracts agreed on time has dropped by more than 5% and the overall distribution is more skewed to the right than the distributions before and after 2009. Instead, the distribution of the agreement delays before and after 2009 are very similar to each other. This descriptive evidence supports the idea that agreement dates are endogenous. The parties involved in the bargaining process may have decided to delay their decisions or postpone the whole negotiation process when the shock hit the economy. For this reason, in the robustness section we also perform our analysis using agreement dates instead of start dates.

To study the consequences of the rigidities induced by contract staggering in the recession period, the empirical analysis focuses on the analysis of 'reference CAOs'. We define the reference CAO as the collective labor agreement that was in place during the 2009 recession in each company and sector.[7] Table 2 reports the list of all reference CAOs and shows the agreed percentage wage increase and the validity period of each reference CAO.

The table shows that about 25% of all collective labor agreements in place during the recession consist of company-specific CAOs (as they cover relatively few employees, the coverage of the workforce by company-specific CAOs is much lower). Also, it shows that the agreed percentage wage increases in these reference CAOs range from 0 to 3.5 percent. Furthermore, the table shows that collective agreements can enter into force in various months of the year, although the first half of the year is more common than the second half. When looking at agreement dates (not reported), these are even more spread throughout the year. Finally, the table shows that contracts can have various durations, where around two thirds of them have a duration of 1 year, 18 months, 2 years or 3 years.

3.2. Matched employers employees data

The data that we use to analyze employment and wage adjustments is a matched employers employees dataset obtained by combining different administrative sources available from Statistics Netherlands. For the employers part, we combine information available in the General Firm Registry on the size, the municipality and the sector in which the firms operate with balance sheet information coming from the corporate income tax data of the tax authority. For the employees part, we combine contract spells and monthly wage bills from the tax authority with workers characteristics available from the Employee Insurance Agency (UWV) and the General Civil Registry. The Matched Employers Employees Dataset is then obtained by merging employers and employees data via the firms and workers identifiers. Eventually, the final dataset is obtained by further merging the data on collective labor agreements via the SBI codes.[8]

Table 3 provides descriptive statistics of the most important employers' and employees' attributes in the Matched Employers Employees Data (MEED). Panel (a) reports summary statistics of some firm-level attributes, while panel (b) provides summary statistics for the main worker-level attributes. Data for employers refer to a total of 90.688 firms that have at least five employees and that have been successfully matched with their corresponding employees data.[9] These firms are also observed in the whole sample period which spans from 2007 to 2009. For all these firms we observe sector-level profitability indicators and aggregate financial statistics linked via the sector codes, while for a subset of 20% of the firms in the manufacturing sector we observe the actual balance sheet data merged via the employer identifier. For listed companies, that typically have a company-specific collective agreement, we obtain the corresponding balance sheet information from Bloomberg.

For all workers of the selected 90.688 firms, we observe employees' contract spells and monthly wages of employees. Thanks to the available employer identifiers, contract spells data allows us to observe, at any point in time, total employment levels of all companies included in the sample. The total number of workers employed in our sample of firms is more than 6 million. The monthly wage bills data allows us to observe the whole structure of workers' wages, and to obtain a decomposition of their remuneration into the following components: the base wage, bonuses (e.g., performance pay), benefits (e.g., travel costs), compensation for overtime hours

[7] In case of two CAOs in place during this period, the reference contract has been defined on the basis of the number of months in 2009 in which each of them was in place or on the basis of information availability.

[8] In case of company-specific CAOs, the match between collective-agreement information and firm-level information is done on the basis of a statistical match based on the SBI code, the municipality where the company is headquartered, and the total number of employees.

[9] The General Firm Registry unfortunately contains two different and non-overlapping identifiers, namely the encrypted fiscal number and the firm identifier, and it is possible to match the employers with the employee data only on the basis of the firm identifier. For this reason, our data for employers do not contain the population of firms in the Netherlands. The share of successfully matched companies is about 75% of the total number of firms with at least five employees.

Table 2
CAO data.

CAO name	Wage increase %	Validity Period	CAO name	Wage increase %	Validity Period	CAO name	Wage increase %	Validity period
ABN-AMRO	3.50	Jan-09 Mar-10	Gemeentelijk vervoersbedrijf (GVB)	–	Jan-09 Jan-10	Postkantoren	1.00	Apr-09 Jan-10
AGF	0.00	Apr-09 Apr-10	Gemengde- en speelgoedbranche	1.25	Jan-09 Jan-11	Praxis group	0.29	Feb-09 Feb-11
ANWB	3.25	Apr-08 Apr-10	Getronics Nederland	0.00	Jan-09 Jan-10	Primair Onderwijs	0.84	Jan-09 Jan-10
Achmea	3.25	Jan-08 Jun-09	Glastuinbouw	2.5	Jul-07 Jul-10	Provinciepersoneel	0.70	Jun-07 Jun-09
Afbouw	2.00	Jan-08 Jan-10	Goederenvervoer Nederland (KNV)	3.50	Oct-08 Jan-10	RABO-bank	3.00	May-07 May-09
Akzo Nobel Pharma bv	3.00	Apr-07 Apr-09	Grafi-media	2.75	Feb-07 Feb-10	Recreatie	3.50	Jul-08 Jul-09
Albert Heijn (distributie org.)	3.50	Oct-08 Oct-09	Heineken Nederland Beheer BV	2.50	Jul-08 Oct-09	Reisbranche	1.00	Apr-09 Apr-11
Algemene Banken	3.00	Jan-08 Apr-10	Hema	0.75	Feb-09 Feb-10	Rijkspersoneel	2.30	Jan-07 Jan-11
Apotheken	3.25	Apr-08 Apr-10	Hoger beroepsonderwijs (HBO)	1.30	Aug-07 Aug-10	SNS Reaal	3.25	Jun-08 Jun-09
Arbo Unie Nederland	1.00	Jul-08 Jul-11	Holland Casino	0.00	Apr-09 Jan-11	SNT Nederland	1.13	Jul-08 May-10
Architectenbureaus	1.00	Apr-09 Apr-10	Horeca- en aanverwant bedrijf	2.76	Apr-08 Apr-10	Schilders- en glaszetbedrijf	1.50	Mar-09 Mar-11
Atos Origin	4.00	Jan-08 Jan-09	Hoveniersbedrijf	0.60	Mar-09 Mar-10	Schoonmaak	3.50	Apr-08 Jan-10
Bakkersbedrijf	3.50	Jun-08 Aug-09	Huisartsenzorg	1.50	Jan-09 Apr-10	Selektvracht B.V.	1.50	Apr-09 Jan-11
Beroepsgoederenvervoer	3.50	Oct-08 Jan-10	IKEA Nederland b.v.	3.25	Oct-08 Oct-09	Slagersbedrijf	1.00	Apr-09 Apr-11
Beroepsonderwijs	0.07	Feb-09 Apr-11	ING	3.00	Jul-08 Jan-12	Sociale Verzekeringsbank	3.25	Apr-08 Apr-10
Betonproduktenindustrie	1.00	Mar-09 Apr-11	Informatie & communicatie	3.00	Jan-08 Jan-10	Sociale werkvoorziening	3.00	Nov-07 Mar-10
Beveiligingsorganisaties	3.25	Aug-08 Jul-11	Jeugdzorg	3.50	May-08 May-10	TNT N.V.	0.70	Apr-09 Jan-12
Bloemen en planten (groothandel)	3.00	Jan-08 Jul-09	KLM-grondpersoneel	1.25	Apr-09 Apr-10	TNT Post B.V.	2.86	Apr-08 Apr-09
Bloemen- en Plantendetailhandel	1.40	Jan-09 Apr-11	KPN Contact	2.00	Jul-08 Jan-10	Tankstations en wasbedrijven	0.00	Jan-09 Jan-10
Boekhandel en Kantoorvakhandel	1.75	Jan-09 Feb-10	KPN N.V.	0.00	Jan-08 Jan-10	Taxivervoer	1.50	Mar-09 Jan-14
Bouwnijverheid	1.75	Apr-07 Jul-09	Kappersbedrijf	1.00	Jan-09 Jul-10	Technische groothandel	3.25	Jan-08 Apr-10
Canon	3.50	Apr-08 Jul-09	Kinderopvang	2.00	May-08 May-09	Technische installatiebedrijven	3.50	Feb-08 Dec-09
Carrosseriebedrijf (metaal)	3.50	Feb-08 Dec-09	Landbouwwerktuigen exploiterende	2.00	Apr-07 Apr-09	Timmerindustrie	1.25	Jan-09 Jul-09
Contract-cateringbedrijf	3.50	Apr-08 Apr-10	Levensmiddelen (groot.)	3.25	Apr-08 Apr-10	UWV (Uitvoeringsorgaan	2.60	May-07 May-10
Corus Staal B.V.	0.50	Apr-09 Apr-10	Levensmiddelen en/of zoetwaren	2.00	Jul-07 Jul-09	Uitzendbureaus	1.00	Jan-09 Apr-11
DHL Express Nederland	1.50	Apr-09 Jan-11	Levensmiddelenbedrijf	3.25	Apr-08 Apr-10	Unilever	2.00	Mar-09 May-10
DSM Limburg B.V.	3.50	Jun-08 Jun-09	Metaalbewerking (metaal)	3.50	Feb-08 Dec-09	Universitair Medische Centra	2.10	Jan-08 Mar-11
Defensie-personeel	1.00	Mar-09 Mar-10	Metalektro	3.00	Nov-07 Feb-10	Vroom Dreesman	2.05	Feb-08 Feb-10
Delta Lloyd n.v.	3.00	Jun-07 Jun-09	Meubileringsbedrijven	1.15	Jul-08 Jul-10	VVT	3.25	Jan-08 Mar-10
Dierhouderij	2.50	Jul-07 Jan-10	Mode- en sportdetailhandel	2.00	Jan-08 Jul-10	Verzekeringsbedrijf (binnendienst)	3.00	Jun-07 Dec-09
Doe het zelf branche	2.34	Jan-07 Jul-09	Mode-; interieur-; tapijt- en	3.50	May-08 Jul-10	Vleessector	1.00	Apr-09 Apr-11
Drogisterijbranche	1.00	Apr-09 Oct-10	Motorvoertuigen	3.50	Feb-08 Jan-10	Voortgezet Onderwijs	3.00	Jul-08 Aug-10
Electrotechnische detailhandel	1.58	Jan-09 Jan-12	Nederlandse Spoorwegen (nieuw)	3.00	Apr-07 May-09	Vroom en Dreesmann Food	1.92	Feb-08 Feb-10

(*continued on next page*)

Table 2 (*continued*)

CAO name	Wage increase %	Validity Period	CAO name	Wage increase %	Validity Period	CAO name	Wage increase %	Validity period
Energie	2.80	Jan-08 Jul-09	Oce Nederland B.V.	3.50	Apr-08 Jul-09	Welzijn en maatschappelijke dienst	2.50	May-08 Jan-12
Facilitaire Contactcenters	2.25	May-08 May-10	Ons Middelbaar Onderwijs	3.00	Jul-08 Aug-10	Wonen	2.75	Jan-08 Jan-10
Fortis-bank	3.50	Jan-09 Mar-10	Open Teelten	1.00	Jan-09 Jul-10	Woondiensten	1.50	Jan-09 Jan-11
Geestelijke Gezondheidszorg	1.00	Apr-09 Mar-11	Openbaar Vervoer	3.50	Jan-08 Jul-09	Ziekenhuizen	1.00	Mar-09 Mar-11
Gehandicaptenzorg	1.50	Jan-09 Mar-11	Philips (nieuw)	–	Jan-09 Jan-10	Zoetwarenindustrie	3.00	Jul-07 Jul-09
Gemeente-ambtenaren	2.20	Jun-07 Jun-09	Politie-personeel	3.50	Jan-08 Jan-12	Zorgverzekeraars	3.00	Jun-07 Jun-09

Notes: The table shows the list of all reference collective labor agreements (reference CAOs) in our sample and reports the agreed percentage wage increase and the validity period stated in the agreement.

Table 3
Summary statistics (MEED).

	a) Employers 2007	2008	2009		b) Employees 2007	2008	2009
Sales (in '000s)	5768.7	5448.4	4561.5				
				Net Annual Wage	21,271.1	22,074.4	23,164.3
	(142,448.1)	(129,001.9)	(104,524.4)		(31,001.1)	(24,827.5)	(24,440.0)
Total Assets (in '000s)	5497.3	6292.5	5890.9	N° hours worked	23.4	23.6	23.8
	(325,994.5)	(322,626.7)	(312,336.7)		(14.1)	(14.2)	(14.0)
Net Profits (in '000s)	652.2	455.8	255.2	Bonus	2.120.2	2.003.1	1.525.1
	(63,938.7)	(55,102.7)	(21,648.2)		(15,105.0)	(10,813.9)	(9963.0)
Wages (in '000s)	805.9	794.2	730.4	Bonus share (%)	13.8	13.7	13.2
	(12,943.6)	(14,320.3)	(12,962.7)				
N° of Employees	38.7	39.8	38.8				
	(572.8)	(634.5)	(582.0)				
New workers (Inflows)	18.8	16.9	14.1				
	(57.1)	(60.0)	(43.8)				

Notes: The table shows descriptive statistics of the Matched Employers Employees Dataset. Descriptive statistics of the data for employers are reported in the left panel, while descriptive statistics of the data for employees are reported in the right panel. The table reports the mean and standard deviation (in parentheses) of each reported variable.

and taxes and contributions.[10] The definition of all outcome variables used in the paper is provided in Table A1 of the Appendix. In this analysis, we focus on the components on which firms have some discretion. While firms have to take the contractual wage growth set in CAOs as given, they are able to adjust the base wage of their workforce through other means (the so-called 'incidental pay' increases, see footnote 4). In particular, they can delay promotions and reduce or delay performance-related pay increases. In addition, firms can look for cheaper hires to replace workers who leave the firm, which will lower employers' base wage costs through a composition effect. Furthermore, we will assess to what extent employers cut bonuses, benefits and overtime hours. Eventually, we set the data at the firm level and quarterly frequency.

4. Empirical strategy

This section describes our empirical strategy to assess how the 2009 aggregate shock has affected firms' adjustments in the wage bill. Before presenting our identification strategy, we first show that the shock was unanticipated, leading to exogenous variation in wage growth due to staggering in the renewal dates of collective agreements.

[10] To be precise, bonuses include the holiday allowance (this is mandatory for all workers) and, if applicable, the 'thirteenth month', individual and collective performance pay, gratifications and profit sharing. Benefits include travel cost reimbursements, the rental value of a car provided by the employer, the rental value of a service-house provided by the employer, and bonuses in the form of real goods (e.g., holidays or event tickets). Taxes and contributions include health insurance, disability insurance and contributions a pension fund.

Table 4
Consensus forecasts.

Forecast Horizon	Industrial Production				Forecast Horizon	Consumer Prices			
	Current year	1 year ahead	2 years ahead	mid-term (5 years)		Current year	1 year ahead	2 years ahead	mid-term (5 years)
October 2007	3.6	2.0	2.0	0.8	October 2007	1.7	2.2	2.3	2.0
April 2008	3.8	1.6	1.7	2.6	April 2008	2.4	2.5	2.0	1.9
October 2008	0.6	0.1	1.0	3.3	October 2008	2.6	2.0	1.7	2.3
April 2009	−9.9	1.0	2.8	5.0	April 2009	1.0	1.0	1.0	2.1
October 2009	−9.1	1.6	2.3	3.1	October 2009	0.9	1.0	1.3	1.6
April 2010	3.7	2.0	0.3	−0.5	April 2010	1.1	2.3	1.7	1.6
Forecast Horizon	Real Gross Investments				Forecast Horizon	Private Consumption			
	Current year	1 year ahead	2 years ahead	mid-term (5 years)		Current year	1 year ahead	2 years ahead	mid-term (5 years)
October 2007	4.4	3.4	2.9	1.4	October 2007	2.0	1.9	1.9	1.7
April 2008	3.6	2.0	2.7	2.6	April 2008	2.0	1.7	2.1	1.9
October 2008	5.7	0.0	2.6	3.1	October 2008	1.9	0.7	1.5	2.1
April 2009	−9.3	−2.7	2.0	3.9	April 2009	−0.7	−0.4	1.0	2.1
October 2009	−11.2	−2.8	1.8	2.5	October 2009	−2.7	−0.1	0.7	1.6
April 2010	−3.5	2.4	1.4	2.0	April 2010	−0.1	1.1	1.1	1.4

Notes: The table reports, for each date and forecast horizon, the annual expected growth rate (in percentages) of Industrial Production, Consumer Prices, Real Gross Investments and Private Consumption. Each column and row refer to a different forecast horizon and survey date, respectively. *Source:* Consensus data.

Table 5
Wage differential (test).

	Annualized wage increase (%) (a)	(b)	Total annualized wage increase (%) (c)	(d)
CAO started before 2008Q4	2.78*** (0.156)	2.45*** (0.168)	2.85*** (0.160)	2.35*** (0.163)
Controls	X	C	X	C
N	101	101	101	101

Notes: The table reports the average (unweighted) differential in the wage increase in CAOs (both the base wage and the total wage) bargained before and after the crisis (difference in means). Columns (a) and (c) report the unconditional difference in wage growth, column (b) and (d) control for differences in sectoral Return on Assets (ROA) and Return on Equity (ROE) and profit margin. The symbols *, ** and *** denote conventional significance levels. *Source*: Collective agreements data.

4.1. Unanticipated shock

The shock that we exploit is the 2009 recession. In terms of GDP, it was the strongest shock to the Dutch economy since World War II (up to 2020) which led to a substantial change in expectations.[11] To identify the timing of the shock in such a way that it was unanticipated, we use professional forecasts data on expectations about consumer prices, industrial production, investments and private consumption.[12] Table 4 shows that as of October 2008, professional forecasters were still expecting consumption, inflation and investment to increase, and their one-year ahead forecasts were stable. On the contrary, the recession scenario was already included in their April 2009 forecasts: industrial production and real investments were expected to fall by almost 10%, private consumption was also expected to drop and inflation expectations had been substantially cut.

These forecasts are perfectly in line with those published by the Netherlands Bureau for Economic Policy Analysis (CPB) that form

[11] A change in expectations is a necessary condition to produce wage dispersion in a staggered wage setting, given that unions and employers associations bargain wages also on the basis of their expectations for the time horizon of the collective agreement. Gertler and Trigari (2009) show that when contracts are staggered, the bargained wage not only depends on relative bargaining power, but also on expected future economic conditions. Similarly, Hall (2005) shows that changes in the economic environment shift the boundaries of the bargaining set and changes the employers' incentives to recruit.

[12] Consensus data consists of forecasts data at semi-annual frequency, specific for individual countries, obtained by surveying and combining opinions of professional forecasters such as advisors, institutional investors and rating agencies. For more details, see ttps://www.consensuseconomics.com

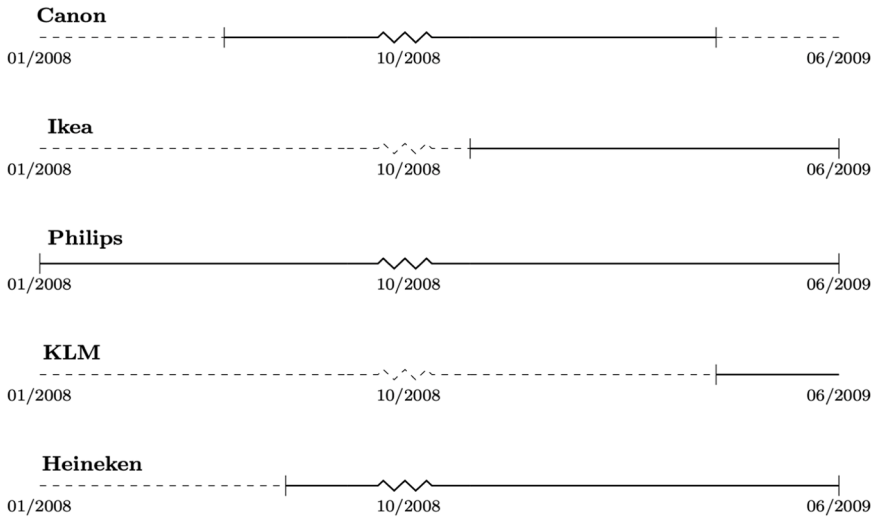

Fig. 2. Identification strategy.
Notes: Graphical example of the identification strategy used in the empirical analysis. The figure shows, in a time line, the validity period in which the reference CAO in five well-known companies. The solid segment denotes the validity period of the Reference CAO and the *zigzag* line denotes the timing of the shock. The treatment (control) group consist of firms covered by a CAO that started before (after) October 2008. In this example, Canon, Philips and Heineken are in the treatment group, Ikea and KLM are in the control group. The treatment period is the period between the (common) shock and the (specific) end date of the reference CAO. In this example, Canon early-exits from treatment.

the basis in the bargaining process.[13] As the change in expectations took place between October 2008 and April 2009, we set the timing of the shock in October 2008 to make sure that the shock was unanticipated.

4.2. Exogenous variation in wage growth

The exogenous variation that we exploit is the variation in the start dates of collective agreements that were in place during the 2009 recession ('reference CAOs'). In fact, in our data the start date of a CAO always coincides with the end date of the previous CAO. This means that once a collective agreement is signed, in principle the start date of the next collective agreement is known. This in turn implies that the contract period of all CAOs was entirely pre-determined when the 2009 recession hit the Dutch economy, and this gives us plausible exogenous variation in the CAO start dates around the timing of the shock. In practice, there can be delays, which is why in the robustness section we test whether our results are robust to the use of agreement dates instead of the (retrospective) start dates.

To test whether the 2009 recession was sudden and strong enough to create a significant wage differential, we regress the contractual wage increases in CAOs in our CAO dataset (as reported in Table 2, but then annualized to correct for contract duration) on a constant and dummy variable equal to one if the start date of the CAO is before October 2008. The associated coefficient identifies the differential in the annualized wage increase of CAOs that were signed before and after the shock. Table 5 shows that the unconditional difference in the increase of the base wage is 2.79% (column a). Controlling for differences in profitability across sectors only slightly attenuates the difference to 2.45% (column b). Considering the total annualized wage increase (that includes increases in structural pay allowances) does not change the result (column c and d).

4.3. Identification strategy

This observed wage differential across sectors, and firms resetting wages around the start of the recession, is the key of our identification strategy. The channel is the following: firms covered by a CAO that started before the 2009 recession did not anticipate the shock and committed to pay a high wage increase in a period of a substantial economic contraction. Therefore, they may have incentives to adjust labor cost using the available adjustment margins (employment or pay components over which employers have some discretion).

As our empirical strategy, we employ a quasi-natural experiment approach, in which our treatment group consists of firms that were covered by CAOs that were renegotiated before the shock and hence could not adjust wages to the crisis scenario ($T_s = 1$[CAO started before 2008Q4). Our control group consists of firms that were covered by CAOs that were renegotiated after the shock. Our total sample period lasts from 2007Q1 to 2009Q4, yet, we can evaluate our treatment effect for the period after the shock has taken

[13] These can be found in the Macroeconomic Outlook (MEV) published in 2008 and in the Central Economic Plan (CEP) published in March 2009. Both publications are available on the CEP website.

Table 6
Adjustment of employment.

	Employment		Flexible Employment		N° of New hires	
	(a)	(b)	(a)	(b)	(a)	(b)
started before ×	0.000		0.004		0.008	
after shock (2008Q-2009Q4)	(0.010)		(0.017)		(0.029)	
started before × 2007Q1		−0.006		−0.017		−0.048
		(0.015)		(0.024)		(0.031)
started before × 2007Q2		−0.006		−0.010		−0.013
		(0.012)		(0.017)		(0.029)
started before × 2007Q3		0.003		0.005		0.003
		(0.009)		(0.012)		(0.013)
started before × 2007Q4		0.014		0.024		0.011
		(0.010)		(0.019)		(0.031)
started before × 2008Q1		−0.002		−0.002		−0.037*
		(0.012)		(0.017)		(0.020)
started before × 2008Q2		−0.007		−0.011		−0.019
		(0.004)		(0.008)		(0.022)
started before × 2008Q4 (ATT)		0.002		0.001		0.000
		(0.009)		(0.014)		(0.030)
started before × 2009Q1 (ATT)		0.020		0.041* (0.024)		−0.033*
		(0.008)				(0.017)
started before × 2009Q2 (ATT)		−0.002		0.007		−0.050*
		(0.009)		(0.020)		(0.028)
started before × 2009Q3 (ATT)		−0.009		−0.012		−0.023
		(0.009)		(0.013)		(0.023)
started before × 2009Q4 (ATT)		−0.016		−0.022		−0.003
		(0.016)		(0.028)		(0.040)
N° of observations (*Nt*)	1043,162	1043,162	1043,162	1043,162	1043,162	1043,162
N° of firms (*N*)	90,688	90,688	90,688	90,688	90,688	90,688
N° of CAOs	101	101	101	101	101	101

Notes: The table reports the results of the firm-level analysis based on Eq. (1) (columns a) and Eq. (2) (columns b). All outcome variables are expressed in logarithm. The control variables are: dummy variables for small and big enterprises, the agreed percentage wage increase and the length of the CAO, the sectoral return-on-equity (ROE), return-on-assets (ROA) operating profit margin and value added. Clustered robust standard errors (at the sectoral level) are in parentheses. *, ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

place (i.e., 2008Q4 to 2009Q4). We use two alternative specifications to evaluate the effect of treatment. First, we apply a classical Difference-in-Differences estimator that estimates the treatment effect over the entire treatment period (2008Q4–2009Q4). Second, we apply a two-way-fixed-effects estimator that estimates the treatment effect per quarter. To be precise, we estimate the following equations:

$$y_{j,s,t} = \lambda_t + c_j + \beta\ (T_s * after_t) + \theta\ newCAO_{s,\ t} + Z'_{s,t}\ \gamma + \varepsilon_{j,\ s,t} \tag{1}$$

$$y_{j,s,t} = \lambda_t + c_j + \sum_t \beta_t (T_s * \vartheta_t) + \theta\ newCAO_{s,\ t} + Z'_{s,t}\ \gamma + \varepsilon_{j,\ s,t} \tag{2}$$

where $y_{j,s,t}$ is the labor market outcome of interest (e.g., employment, total wage bill) of firm j in sector s in quarter t, c_j and λ_t are firm and time fixed effects and $Z_{s,t}$ is a set of control variables. For the time fixed effects, we use the quarters and year fixed effects to further account for possible cyclicality in the data related to the outcome variable. A definition of all outcome variables used is reported in Table A1 in the Appendix. The effect of interest is captured by the coefficient β. In Eq. (1), β identifies the Average Treatment effect on the Treated (ATT) over the entire treatment period (2008Q4 to 2009Q4). In Eq. (2), the vector β_t, identifies the time-specific ATT over both the treatment and pre-treatment period.[14] Differently from Eq. (1), Eq. (2) quantifies how the intensity of the treatment effect varies over time and allows to assess the validity of the parallel trend assumption by showing the pre-treatment trend in the outcome variables across the T and C group. Eventually, the variable $newCAO_{s,\ t}$ equals one in all periods in which the reference CAO is replaced by a new collective agreement. This takes into accounts the fact that some short-term CAOs signed in 2008 were already renegotiated in 2009. Thus, it accounts for possible firms' labor cost adjustments that are not the result of nominal rigidities in the labor market but rather result from a new renegotiation of the collective agreement, that give firms the opportunity to adjust the contractual wage growth to the new economic reality.

Fig. 2 shows a graphic example of the identification strategy we use. In words, our identification strategy divides T and C sectors based on the start date of collective labor agreements around the start of the Great Financial Crisis. Hence, the treatment proxies cyclical exposure of certain sectors to the crisis due to contract staggering, as CAO started before the crisis committed to wage growths

[14] In fact, the ATT coefficient in Eq. (1) is associated to the interaction between the treatment indicator and the variable r_t , a dummy equal to 1 for all quarter in the treatment period (2008Q4-2009Q4). In Eq. (2), the ATT coefficient is associated to the interaction between the treatment indicator and ϑ_t , a vector of dummy variables equal to 1 for each quarter of the analysis period (2007Q1-2009Q4).

Table 7
Adjustment of different pay components.

	Base wage		Bonuses		Benefits		Overtime	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
started before × after shock (2008Q-2009Q4) (ATT)	0.004		−0.149***		−0.023		−0.008	
	(0.013)		(0.057)		(0.018)		(0.033)	
started before × 2008Q4		−0.009		0.136		−0.051		0.085
		(0.019)		(0.196)		(0.038)		(0.059)
started before × 2008Q4		−0.015		−0.057		−0.052		0.036
		(0.015)		(0.183)		(0.032)		(0.046)
started before × 2008Q4		−0.002		−0.002		−0.002		0.029
		(0.012)		(0.029)		(0.021)		(0.033)
started before × 2008Q4		−0.015		−0.155		−0.049		0.010
		(0.014)		(0.136)		(0.042)		(0.070)
started before × 2008Q4		0.001		−0.186		−0.034		0.120*
		(0.014)		(0.160)		(0.033)		(0.072)
started before × 2008Q4		−0.009		0.019		−0.043		0.053
		(0.006)		(0.170)		(0.027)		(0.034)
started before × 2008Q4 (ATT)		0.002		−0.139		−0.050		0.036
		(0.011)		(0.131)		(0.039)		(0.046)
started before × 2009Q1 (ATT)		0.036		−0.135		−0.027		0.090
		(0.023)		(0.171)		(0.036)		(0.057)
started before × 2009Q2 (ATT)		−0.004		−0.166**		−0.054*		−0.008
		(0.013)		(0.078)		(0.030)		(0.048)
started before × 2009Q3 (ATT)		−0.006		−0.144***		−0.079***		−0.034
		(0.013)		(0.060)		(0.009)		(0.047)
started before × 2009Q4 (ATT)		−0.027		−0.291***		−0.078**		−0.078
		(0.020)		(0.125)		(0.032)		(0.064)
N° of observations (*Nt*)	1042,830	1042,830	681,663	681,663	649,466	649,466	260,093	260,093
N° of firms (*N*)	90,634	90,634	56,805	56,805	54,122	54,122	21,674	21,674
N° of CAOs	101	101	101	101	101	101	101	101

Notes: The table reports the results of the firm-level analysis based on Eq. (1) (columns a) and Eq. (2) (columns b). The control variables are: dummy variables for small and big enterprises, the agreed percentage wage increase and the length of the CAO, the sector-level return-on-equity (ROE), return-on-assets (ROA) operating profit margin and value added. Clustered robust standard errors (at the sectoral level) are in brackets. The symbols. * , ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

about 2.5% larger. As such, our identification strategy tracks the employment and wage responses of T and C firms over the short-medium term (during the economic crisis), even after new CAOs are signed and possible adjustments occur.

Fig. 2 shows a graphic example of the identification strategy we use. The variable $newCAO_{s,\ t}$ accounts for the fact that, as evident from the figure, some CAOs signed in 2008 were already renegotiated in 2009. Thus, it accounts for the fact that once a new collective agreement has been signed, the contractual wage growth is adjusted to the new economic reality. As a result, the treatment period consists of the crisis period, up to the time in which the reference CAO is still in place. Again, the treatment assignment is based on the start date of the reference CAO, which is already established when the previous CAO was agreed upon, and is thus independent of the uncertainty caused by the crisis.

5. Main results

Table 6 reports the result of the analysis of firms' adjustments in employment in response to the unanticipated shock. It reports the estimated ATTs and standard errors which are clustered at the three-digit sector level to account for possible latent correlation between firms in the same sector (Cameron and Miller, 2015). For each outcome variable, column (a) reports the results based on a classical two-groups-two-periods Difference-in-Differences approach (Eq. (1)) and column (b) shows the results by quarter based on Eq. (2). The outcome variables are expressed in logs and include employment, the number of flexible workers and the number of new hires.[15]

Results show that, on average, the positive wage differential paid by non-anticipating firms did not induce them to (differentially) adjust labor costs by changes in the workforce. The coefficient in column (a) indicates a point estimate of the ATT equal to 0.0%. The statistically insignificant coefficients of the interaction between the treatment indicator and the pre-treatment period shows that the pre-treatment trends in the employment outcomes did not differ across the T and C group, thus supporting the validity of the parallel trend assumption. Especially in the context of employment protection legislation, flexible contracts and new hires are usually the drivers of changes in unemployment (Mortensen and Pissarides, 1994), as firms typically stop posting vacancies and do not renew

[15] Note that new hires can be seen as a proxy of the number of vacancies posted by each firm (see Table A1 for the definition of new hires). The number of new hires equals the number of vacancies if and only if all vacancies posted by the firms find a match in the labour market. This, despite being a strong assumption in general, is a relatively weaker assumption in crisis periods, when the number of vacancies is typically low and the number of unemployed workers is instead high. The same argument is used in Mortensen and Pissarides (1994) for their assumption of frictional labour market and the functional form given to the assumed matching function.

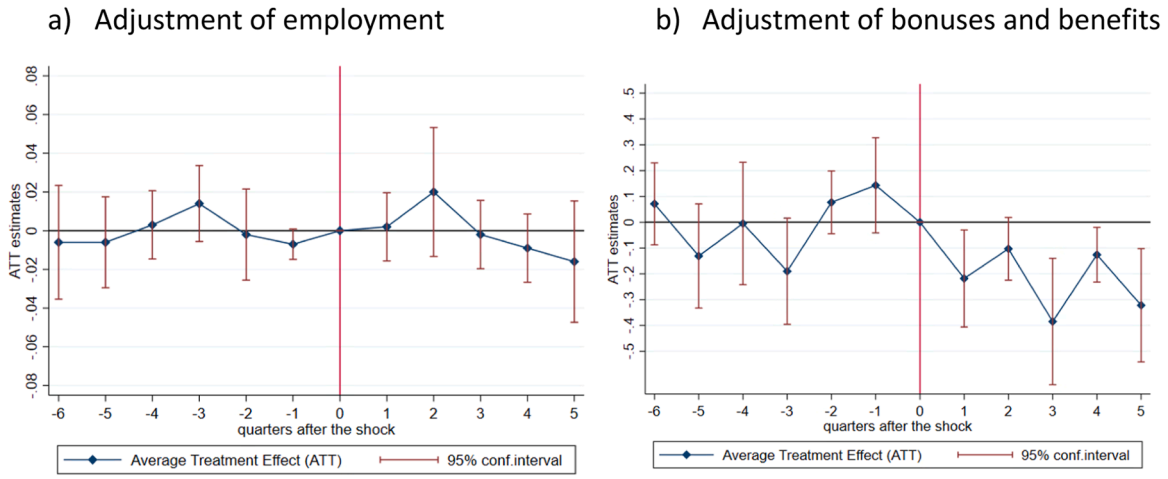

Fig. 3. Comparison of adjustment margins.
Notes: The figure shows the estimated Average Treatment Effects on the Treated (ATTs) of contract staggering on total employment (a) and on bonuses and benefits (b).

flexible contracts when they plan to cut total employment levels. Yet, the effects on flexible employment (0.4%) and new hires (0.8%) are also not statistically different from zero.

Table 7 reports the results of the analysis of firms' adjustment of four different pay components, obtained again from the estimation of a DiD regression (Eq. (1)) (column a) and of Eq. (2) (column b). To be precise, it distinguishes the wage growth attributable to increases in the base wage (a sum of the contractual wage growth mandated by CAOs and incidental pay increases), bonuses, benefits and overtime hours.[16]

Starting with the base wage, Table 7 shows that non-anticipating firms that were compelled by CAOs to grant their workers a substantial wage increase, did not pay their workers a significantly higher base wage over the entire period we study (2008Q4–2009Q4). The period-specific ATTs in column (b) show that in the first quarter of 2009, firms did pay higher base wages, yet, in the quarters thereafter there is no significant differential. Apparently, these firms have been able to offset the contractual wage increase by curbing incidental pay increases (e.g., slowing of promotions, delays of performance-related pay increases and replacing workers that leave with cheaper hires). In Section 7 we repeat this regression at the worker-level, whereby we can filter out composition effects (e.g., cheaper hires).

Furthermore, firms have also been able to adjust to contract staggering by cutting bonuses. Over the entire period, bonuses in non-anticipated firms were 14.9% lower than in firms that had been able to negotiate lower wages. In addition, firms were able to cut benefits in the last half of 2009; yet, this effect is not significant when evaluated over the entire period (2008Q4–2009Q4). Last, we find no difference in the compensation for overtime hours. Fig. 3 provides a graphical representation of the effect on employment and bonuses plus benefits by plotting the ATTs around the timing of the shock.

Summing up, in sectors where wage resets were agreed upon before the 2009 recession started, firms committed to pay, on average, 2.5% higher contractual wage growth. Unlike what is predicted in macroeconomic models, this rigidity did not result in employment losses (permanent contracts but also not temporary jobs nor new hires). As an explanation, our results demonstrate that these firms were able to offset this higher contractual wage growth with cuts in bonuses and incidental pay. Unfortunately, from this analysis we cannot derive exactly what incidental pay elements were cut as we only observe the aggregate base wage. In Section 7, we perform the analysis at the worker-level, allowing us to distinguish between cuts to the wage of the existing workforce (e.g., slowing of promotions and delays of performance-related pay increases) and cuts that arise from changes in the composition of the workforce (e.g., cheaper hires).

6. Heterogeneity in contract duration

In this section, we perform a heterogeneity analysis to shed more light on the role of contract staggering as a nominal rigidity. The definition of contract staggering not only requires that contract periods of the various CAOs are not completely in sync (that we exploit in our identification strategy) but also requires that the agreed wage increase remains valid for a certain period (wage stickiness).

Here, we look at the size of the ATTs as a function of contract duration to examine whether firms' labor adjustment cost depend on

[16] Please note that not all firms in the Netherlands use bonuses, benefits and, especially, overtime hours. For this reason, the number of observations differs from that in Table 6, as the log transformation gets rid of all firms that do not pay these compensations. While firms are compelled to pay a holiday allowances, which is counted as a bonus, if the holiday allowance is the sole bonus components we cannot use these observations in a panel set-up.

Table 8
Adjustment of employment and flexible pay by contract duration.

	Employment			Bonuses and benefits		
	(≤ 18 m)	(18–30 m)	(≥ 30 m)	(≤ 18 m)	(18–30 m)	(≥ 30 m)
started before × 2008Q4	−0.000	0.004	−0.037***	0.201	−0.197	−0.139*
(ATT)	(0.023)	(0.008)	(0.006)	(0.035)	(0.157)	(0.079)
started before × 2009Q1	0.044	0.021	−0.065	−0.027	−0.054	−0.237***
(ATT)	(0.036)	(0.022)	(0.043)	(0.112)	(0.041)	(0.062)
started before × 2009Q2	0.004	−0.003	−0.037***	0.192	−0.366	−0.436***
(ATT)	(0.022)	(0.012)	(0.011)	(0.330)	(0.226)	(0.091)
started before × 2009Q3	−0.206	−0.019	−0.029**	0.724***	−0.157**	0.227***
(ATT)	(0.129)	(0.020)	(0.012)	(0.122)	(0.063)	(0.039)
started before × 2009Q4	−0.092*	−0.019	−0.077**	0.158	−0.247	−0.289***
(ATT)	(0.036)	(0.020)	(0.036)	(0.164)	(0.188)	(0.110)
N° of observations (*Nt*)	231,307	670,112	141,743	194,191	560,797	106,690
N° of firms (*N*)	22,239	53,781	14,668	16,051	42,999	9064
N° of CAOs	31	51	19	31	51	19

Notes: The table reports the ATT of the heterogeneity analysis based on Eq. (2) for various durations of CAOs separately. All outcome variables are expressed in logarithm. For each specification, the first column refers to the subsample with CAOs lasting at most 18 months, the second column to the subsample with CAOs that last more than 18 and less than 30 months. The third column refers to the subsample with CAOs lasting at least 30 months. The firm-level control variables are the same used in the main specification. The control variables are the same used for the specifications reported in Table 6 and 7. Clustered robust standard errors (at the sectoral level) are in parentheses. The symbols.
*, ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

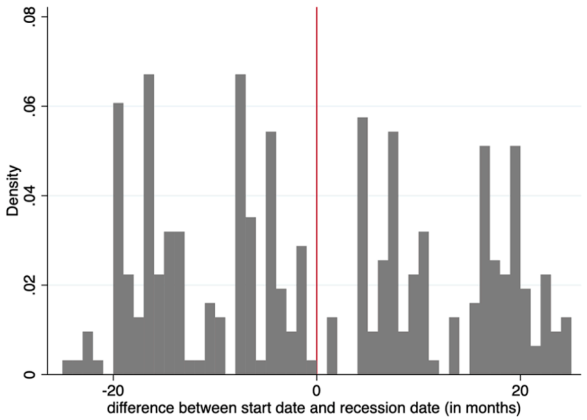

Fig. 4. Graphical test for independence of start dates.
Notes: The figure shows the distribution of the difference (in months) between the start date of each CAO and the start of the recession (October 2008), for all contracts signed within two years before or after the recession.

the degree of the wage rigidity. In sectors where collective agreements last longer, firms commit to a certain wage increase for a longer period, and they therefore have higher incentives to cut labor costs through other means. On the contrary, firms covered by short-lasting CAOs can wait for the next bargaining round to reduce their wage offer in the CAO. As already shown in Table 2, the heterogeneity in contract duration is high in the Netherlands, and varies from six months to about three years.

Table 8 reports the estimates of the specification in Eq. (2) on the subsamples of firms covered by CAOs lasting less than 18 months, between 18 and 30 months, and more than 30 months, respectively. So, the table shows a differential effect of labor market rigidities on firms' labor cost adjustments, based on the relative rigidity of the contract (exemplified by their length). We find a negative and significant effect on employment throughout the treatment period for firms covered by CAOs lasting more than 30 months (for short contracts only in the last quarter). For bonuses and benefits, we find a similar pattern, but also evidence of earlier effects and for contracts with shorter duration.

The results of this heterogeneity analysis confirm the presence of relevant rigidities in staggered wage setting. The non-synchronicity of the contract periods of collective agreements induces a wage differential across sectors negotiating wage resets around the time of an aggregate shock. We showed that the wage increase paid by firms that did not anticipate the 2009 recession was about 2.5% higher than those of firms that reset their wages during the recession. However, the most relevant rigidity is due to the presence of very long contract durations, which imply a commitment to the agreed-upon wage increases. In fact, wages are sticky for the entire contract period of the CAO. We showed firms that did not anticipate the crisis and that were covered by CAOs with the longest durations have also the strongest labor cost adjustments.

At the same time, this effect is not large enough to affect the overall result on employment (Table 6). Our main result that contract

Table 9
Agreement dates versus start dates.

N° of collective agreements		Agreed after 2008Q4	before 2008Q4
Started	after 2008Q4	41	0
	before 2008Q4	10	50

Notes: The table reports the number of collective labor agreements started and agreed before or after 2008Q4.
.

staggering does not have, on average, effects on employment contrasts with the results of macroeconomic models such as that of Gertler and Trigari (2009). In their model calibration for the U.S. economy, these authors pick a value of the wage reset frequency parameter that implies that firms, on average, reset wages every three quarters. We provide evidence of significant causal effects of an economic shock on employment only in sectors in which wage resets occur less than once every 10 quarters. Our results suggest that the absence of an overall employment effect depends on the possibility to adjust variable pay components, in particular incidental pay and bonuses (see Table 7).

7. Robustness analysis

7.1. Start dates independence from recession

Our identification strategy relies on the fact that CAOs start dates, being pre-determined from the moment the previous contract was signed, are independent of the uncertainty caused by the crisis and thus exogenous. Here, we perform a statistical test to provide further evidence of the exogeneity conditions of start dates. In detail, using the data on all collective agreements, we plot the difference, in months, between the start date of each collective agreement and the identified start date of the recession period (October 2008). Fig. 4 shows no particular spike in the few months around the recession period. This excludes the possibility that, knowing about the recession, some employers or employees associations could have agreed on start dates scheduled right after or right before the recession to obtain the best conditions for the parties they represent.

7.2. Agreement versus start dates

The robustness check in Fig. 4 provides further statistical evidence of the independence of start dates of collective agreements, with respect to the timing of the recession. However, start dates typically differ from agreement dates that are instead endogenous and, during a crisis period, possibly dependent on the uncertainty surrounding it. In the Netherlands, wage resets can be agreed upon by social partners months after the start date of the collective agreement, and the resulting wage increase can thus apply retroactively (Hijzen et al., 2019). In Fig. 1, we already showed that the agreement delay has increased during the 2009 recession, as compared to the previous and following period, and this somehow supports the argument of Danziger and Neumann (2005) on the endogeneity of agreement dates.

This issue can potentially affect the causal interpretation of our estimated effects to the extent that firms whose CAO was supposed to start before the crisis, actually agreed the wage increase after the crisis started because of a delay. Once social partners realize that the economy is hit by a recession, they could delay the negotiation process to gather more information or, given the new scenario, even change their wage offer and demand. In this case, considering start dates instead of agreement dates can cause the treatment group to include firms that, because of a delay, managed to anticipate the crisis.

Table 9 shows that out of the 60 sectors whose CAO started before 2008Q4, 10 of them reached an agreement after the crisis because of a delay.[17] This means that social partners might have agreed the wage increase in these sectors under a very different information set. To exclude this possibility, in this section, we switch from an identification based on start dates to an identification based on both starting and agreement dates. The crucial difference between the two is that while start dates are pre-determined and thus exogenous, they do not capture firms not anticipating the recession in case of delays in the negotiation process. On the other hand, agreement dates are endogenous but they better reflect the information set under which social parties signed the agreement. Here, we drop the firms covered by the 10 CAOs that started before the crisis but were agreed upon during the crisis and we re-estimate Eq. (1). In this way, we make sure that the treatment group consists of truly non-anticipating firms and, at the same time, we rule out possible issues of selection into treatment.

Note that, thanks to the availability of information on both the starting and agreement dates, the use of the endogenous agreement dates does not bias our result: by excluding the firms that delayed their wage resets, the new treatment group only consists of the firms whose CAO started *and* was agreed upon prior to October 2008. In such a way, we make sure that the treatment group only consists of non-anticipating firms. Table 10 shows that re-estimating Eqs. (1) and (2) on the basis of the new agreement dates does not modify our main results, i.e., there is no overall effect on employment, base wages are significantly higher in 2009Q1 higher but not when

[17] The average annual wage increase established in this group is equal to 2.35%, and is mostly in line with those started and agreed before the crisis. Out of these 10 CAOs, only two agreed on wage growth close to zero.

Table 10
Identification based on agreement dates.

	Employment		Base wages		Bonuses		Benefits	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
agreed before × after shock (2008Q-2009Q4) (ATT)	0.004		0.008		−0.142**		−0.023	
	(0.010)		(0.013)		(0.060)		(0.019)	
agreed before × 2008Q4		0.002		−0.002		−0.198		−0.050
		(0.015)		(0.019)		(0.189)		(0.035)
agreed before × 2008Q4		−0.005		0.010		−0.040		−0.049
		(0.006)		(0.014)		(0.179)		(0.030)
agreed before × 2008Q4		0.001		−0.008		0.000		−0.004
		(0.009)		(0.012)		(0.028)		(0.021)
agreed before × 2008Q4		0.020*		0.021		−0.075		−0.050
		(0.010)		(0.013)		(0.158)		(0.038)
agreed before × 2008Q4		0.009		0.014		−0.115		−0.032
		(0.012)		(0.001)		(0.151)		(0.029)
agreed before × 2008Q4		−0.005		0.001		−0.039		−0.038
		(0.004)		(0.007)		(0.169)		(0.024)
agreed before × 2008Q4 (ATT)		0.010		0.013		−0.049		−0.049
		(0.009)		(0.007)		(0.150)		(0.036)
agreed before × 2009Q1 (ATT)		0.031*		0.005		−0.175		0.021
		(0.016)		(0.021)		(0.163)		(0.033)
agreed before × 2009Q2 (ATT)		0.002		0.008		−0.130 (0.205)		−0.047**
		(0.008)		(0.013)				(0.020)
agreed before × 2009Q3 (ATT)		−0.009		−0.006		−0.139**		−0.075***
		(0.010)		(0.013)		(0.066)		(0.010)
agreed before × 2009Q4 (ATT)		−0.008		−0.016		−0.166**		−0.076**
		(0.015)		(0.019)		(0.076)		(0.029)
N° of observations (*Nt*)	976,294	976,294	976,016	976,016	642,563	642,563	617,178	617,178
N° of firms (*N*)	85,050	85,050	85,002	85,002	51,718	51,718	51,159	51,159
N° of CAOs	91	91	91	91	91	91	91	91

Notes: The table reports the results of the firm-level analysis based on Eq. (1) (columns a) and Eq. (2) (columns b). All outcome variables are expressed in logarithm. The control variables are: dummy variables for small and big enterprises, the agreed percentage wage increase and the length of the CAO, the sector-level return-on-equity (ROE), return-on-assets (ROA) operating profit margin and value added. Clustered robust standard errors (at the sectoral level) are in brackets. The symbols *, ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

evaluated over the entire period. Furthermore, bonuses were cut with a similar magnitude.

7.3. Worker-level evidence

The main result of the firm-level analysis is that firms that agreed on high wage growth before the recession did not cut employment levels more than those firms that were able to observe the shock and agree on lower contractual wage growth. Instead, we show that non-anticipating firms have been able to adjust their wage bill by cutting bonuses and benefits and they seem to have been able to curb the so-called incidental pay component, that we do not observe directly. In this section, we switch to the most granular level of our MEED data linking firms to employment spells, thus a worker-level analysis to test whether workers employed in treated firms eventually enjoyed a pay increase due to contract staggering. This allows us to disentangle cuts in incidental pay enacted at the worker-level (e.g., slowing of promotions and cuts of performance-related wage increases) form wage cuts that are simply due to changes in the composition of the workforce (e.g., cheap hires). To this end, we use the employees part of the MEED and look at the wage bills of all workers that were continuously employed throughout the whole sample period (2007–2009) by the 90.688 firms in our sample. Monthly wage bills have been collapsed at quarterly frequency too, so that an analogous specification to that of the firm analysis in Section 5 can be obtained at the workers level. The estimated Difference-in-Differences equation is as follows:

$$y_{i,j,s,t} = \lambda_t + c_i + \beta\ (T_s * after)\ + \theta\ newCAO_{s,\ t} + Z'_{s,\ t}\gamma + X'_{i,j,s,\ t}\delta + u_{i,j,\ s,t} \tag{3}$$

where $y_{i,j,s,t}$ is the wage of worker i in firm j of sector s at time t, and $X'_{i,j,s,\ t}$ are workers characteristics and *after* is a dummy equal to 1 for all quarter in the entire treatment period (2008Q4–2009Q4). The outcomes we consider are the workers' ordinary and total net hourly wage. The former is equal to the base wage divided by the number of contractual hours, while the latter includes all non-base wage components such as benefits, bonuses and income from overtime hours.[18]

Table 11 reports the results of the estimates of Eq. (3), for both the cases in which the treatment group indicator T_s is determined using the start dates and the agreement dates of CAOs.

[18] We divide the total net wage in a quarter with the total number of hours worked. In this way, an increase in wage can only be due to an increase in wage, but not to an increase in hours worked.

Table 11
Workers' individual wages.

	Dependent variable:			
	Base hourly wage		Total hourly wage	
	(a)	(b)	(c)	(d)
Started before ×	0.014***		0.0032	
after shock (2008Q3–2009Q4)	(0.003)		(0.0041)	
Agreed before ×		0.008***		−0.007***
after shock (2008Q3–2009Q4)		(0.003)		(0.004)
new CAO	0.022**	0.022**	0.0150*	0.0150*
	(0.009)	(0.009)	(0.0082)	(0.0082)
Age	0.057***	0.057***	0.0566***	0.0566***
	(0.001)	(0.001)	(0.0010)	(0.0010)
age squared	−0.001 **	−0.001***	−0.0005***	−0.0005***
	(0.000)	(0.000)	(0.0000)	(0.0000)
Experience	0.003***	0.003***	0.0026***	0.0026***
	(0.000)	(0.000)	(0.0003)	(0.0003)
maternity leave	−0.0000	−0.0000	−0.0127***	0.0127***
	(0.003)	(0.003)	(0.0035)	(0.0035)
sickness leave	−0.035***	−0.035***	−0.0393***	0.0393***
	(0.004)	(0.004)	(0.0037)	(0.0037)
permanent contract	0.107***	0.108***	0.1111***	0.1111***
	(0.008)	(0.008)	(0.008)	(0.008)
N° of observations (*Nt*)	24.690.219	24.690.219	24.690.219	24.690.219
N° of workers (*N*)	1.541.430	1.541.430	1.541.430	1.541.430
N° of firms	90.688	90.688	90.688	90.688
N° of CAOs	101	101	101	101

Notes: The table reports the results of the worker-level analysis based on Eq. (3). All outcome variables are expressed in logarithm. The control variables are the sector- and firm- level characteristics used in the main specification, together with following worker-level characteristics: age and its square, a dummy variable for maternity leave and sickness leave, experience within the company (in years), a dummy for nationality (Dutch vs non-Dutch), dummies for the level of education, dummies for contract status (temporary vs indeterminate). Cluster robust standard errors (at the sectoral level) are in parentheses. The symbols *, ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

Results based on the former show that workers employed in non-anticipating firms enjoyed a 1.4% average higher base wage during the crisis, relatively to their control group counterparts.[19] However, it also shows that the total wage paid to treated group workers (that includes bonuses and benefits) is not statistically higher than those of control group workers. Hence, the bonuses and benefits components have further allowed firms to adjust their wage bill. Results based on agreement dates show that after the cut in the discretionary part of the wage bill, the total wage of workers in the treatment group is slightly lower (−0.7%) than that of workers in the control group.

We conclude that employees of non-anticipating firms did not eventually earn more as a result of contract staggering and the time of the signature date of their CAO, and we ensure that the results of the firm-level analysis are not driven or confounded by compositional effects. The fact that individual employers have room for discretion on part of the increase of base wages (e.g. promotions and performance-related pay increases) and on the bonus and benefit components gives firms flexibility to adjust labor cost without changing the workforce.

7.4. Other robustness checks

We performed four additional robustness checks. First, we re-estimate Eq. (1) excluding the banking, insurance and financial sector, as firms in these sectors typically pay higher bonuses as a share of total wage. In such a way, we exclude the possibility that results might be driven by specific sectors. Second, we check whether results are robust to a later or earlier timing of the shock by shifting the treatment period back and forth by one quarter, i.e. from the 2008Q4–2009Q4 to the 2009Q1–2010Q1 and the 2008Q2–2009Q3. Third, we re-estimate the results of Tables 6 and 7 after excluding the main outcome of the negotiation (wage increase and length of the CAO) from the control variables, as these outcomes may reflect the cyclical exposure of the firm during the recession (dates are not interesting per se) and, as such, they may directly explain the employment response of the firm. Fourth, we test that results are not driven by different cyclical exposures to the crisis of treated firms (relatively to control firms) by testing for pre-crisis differences in solvability, profitability and indebtedness. The results, available in the appendix, show that all estimates are robust to these changes.

[19] This is lower than the 2.5% average contractual wage increase in CAOs, which is consistent with firms slowing promotions and/or curbing performance-related increases in the base wage. Yet, note that the 2.5% differential in contractual wage increases concerns an ordinary arithmetic mean, i.e., it has not been weighted by the numbers of employees covered by the respective CAO. This can lead to differences with the estimated base wage in the worker-level analysis.

8. Summary and conclusion

This paper has investigated the consequences of the wage rigidities induced by contract staggering in collective labor agreements in the Netherlands. Contract staggering is a labor market rigidity that arises from the combination of wage stickiness and unsynchronized collective labor agreements. The analysis confirms that the random non-synchronicity of collective agreements can create a considerable wage differential across sectors and firms that reset wages in nearby periods, especially in times characterized by widespread uncertainty and/or sudden changes in expectations, such as the 2009 recession. The descriptive analysis shows that the average wage growth stipulated in CAOs that started before the crisis was 2.5% higher than the wage growth of CAOs starting during the crisis.

In the empirical analysis, our central question was whether and how labor market rigidities induce firms to adjust labor cost at the onset of the 2009 recession. To answer this question, we exploit the exogenous and staggered start dates of collective agreements to set up a quasi-natural experiment that allows us to identify the causal effect of labor market rigidities. The main finding of this paper is that, unlike what is predicted by most macroeconomic models, the pervasive contract staggering in the Dutch labor market did not result in employment losses, even in the aftermath of an unprecedented shock such as the Great Recession. In contrast, we provide evidence that firms were able to offset this higher contractual wage increases with cuts in bonuses and benefits and, apparently, by curbing incidental wage growth. We find that employment cuts have been significant only among firms covered by very rigid collective agreements lasting more than thirty months, although this effect is not large enough to affect the overall result. Our results are robust to several sensitivity tests. First and foremost, to the use of agreement dates instead of official start dates of CAOs, to exclude the possibility that our results are biased due to strategic delays in the bargaining process.

Overall, our results suggest that despite widespread rigidity, the Dutch wage setting was flexible enough not to cause employment reductions in the year after the 2008 shock. Hence, this study underscores the importance of taking into account the wider institutional setting in which wage setting takes place. We conclude that the fact that firms, despite being covered by a collective agreement that prescribes rigid wages, still have discretion over part of the base wage as well as over bonuses and benefits allows them to their wage bill without employment losses. This is consistent with the evidence from the Wage Dynamic Network initiative (Babecký et al., 2012, 2019) showing that slowing promotions, using cheaper hires and cutting bonuses were a common wage adjustment used by European firms in the aftermath of the Great Recession. While Grigsby et al. (2021) find that bonus compensation does not much to increase the responsive of wages to shocks, in our study higher contractual wage growth is largely offset by adjustments of bonuses and incidental pay components. The fact that this effect was so large, could be due to the increased flexibility within Dutch CAOs and the fact that bargaining takes place in a corporatist setting in which unions have come to adhere to a 'jobs before wages' strategy.

At the same time, of course, this does not mean that more flexible wage setting could not further alleviate the risk of employment losses in response to a shock. Although the 2009 shock was the largest economic shock that hit the Netherlands since World War II, it was small compared to the deep economic recession that ensued in the wake of the COVID-19 outbreak. In the context of an even larger shock such as the current one, the scope for cuts in incidental pay and bonuses and benefits may be too limited to curb employment losses and a further adjustment of base wages could be preferred in order to preserve jobs.

Unfortunately, our data does not allow us to identify the precise mechanisms that firms were able to use to adjust incidental pay increases (e.g. the slowing of promotions) and to what elements of CAOs these can be linked to.[20] Further research is needed to understand which details are more important in enhancing the flexibility of collective agreements. Also, due to data unavailability this study is silent on other important margins of adjustment that may have played a role. One is firms' pricing, as previous evidence has highlighted that firms use price-setting as an important adjustment margin to a labor market shock, especially when competition is lower (Bertola et al., 2012). Another interesting possibility is the effect on workers' transition to unemployment (in line with the findings of Diez-Catalan and Villanueva, 2014) and, especially for the Netherlands, workers' transition to self-employment. We leave these questions for future research.

CRediT authorship contribution statement

Francesco G. Caloia: Data curation, Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Jante Parlevliet:** Conceptualization, Writing – original draft, Resources, Project administration, Writing – review & editing. **Mauro Mastrogiacomo:** Data curation, Supervision, Methodology, Writing – review & editing, Writing – original draft.

Data availability

The authors do not have permission to share data.

Appendix

Table A1,A2,A3,A4,A5

[20] Coding the content of collective agreements is notoriously difficult, as such agreements are often extensive and look very differently. For a subsample of our CAO dataset, the Ministry of Social Affairs has gathered information on CAOs that make reference to profit sharing, result agreements and performance pay. For this subsample of CAOs, we constructed dummies for these three various pay components. However, when adding these dummies to our analyses of the adjustment of bonuses, they did not yield significant results.

Table A1
definitions (outcome variables).

Employment	The level of employment in a firm is the sum of all workers employed within that firm in a given year.
Flexible employment	The level of flexible employment in a firm is the sum of all workers employed on a temporary basis within that firm in a given year.
New hires	The number of new hires in a firm is the sum of all new hires within that firm in a given year. A worker is defined as a new hire (inflow) if he/she is employed in the observed firm in period t but wasn't employed in the same firm in period $t-1$.
Base wage	The base wage paid by a firm to its workers is the sum of the base wage of all employees of the firm.
Bonus	The bonuses paid by a firm to its workers is the sum of the extraordinary-wage components of all employees of the firm. Extraordinary wage components include the holiday allowance (mandatory for all workers) and, if applicable, the 'thirteenth month', the individual and collective performance pay, plus any gratification and profit sharing.
Benefits	The benefits paid by a firm to its workers is the sum of the non-wage benefits of all employees of the firm. Benefits include travel cost reimbursements, the rental value of a car provided by the employer, the rental value of a service-house provided by the employer, and bonuses in the form of real goods (e.g., holidays or event tickets).
Overtime hours	Overtime hours are the sum of all the overtime hours paid to employees of a firm in a given year.
Base hourly wage	The base hourly wage of a worker is the base monthly wage (total wage excluding bonuses and benefits) divided by the number of monthly contractual hours worked.
Total hourly wage	The total hourly wage of a worker is the monthly wage (total wage including bonuses and benefits) divided by the number of monthly contractual hours worked.

Notes: The table contains the definition of all outcome variables used in the paper.

Table A2
Sensitivity analysis (crisis date).

	Shock (t) in 2008Q2				Shock (t) in 2008Q4			
	Employment		Bonus & Benefits		Employment		Bonus & Benefits	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
agreed before $t\times$	−0.001		−0.075***		−0.001		−0.11***	
after shock ($t+1$; $t+5$)	(0.007)		(0.028)		(0.006)		(0.019)	
agreed before $t\times(t+1)$		−0.001		0.019		0.018		0.018
		(0.005)		(0.063)		(0.014)		(0.041)
agreed before $t\times(t+2)$		0.004 (0.004)		−0.103*		−0.004 (0.010)		0.137**
				(0.062)				(0.070)
agreed before $t\times(t+3)$		0.027*		−0.094*		−0.017*		−0.101**
		(0.013)		(0.055)		(0.010)		(0.049)
agreed before $t\times(t+4)$		−0.005		−0.059		−0.025*		−0.19***
		(0.007)		(0.081)		(0.013)		(0.076)
agreed before $t\times(t+5)$		−0.008		−0.017		−0.000		−0.06 (0.096)
		(0.007)		(0.070)		(0.026)		
N° of observations (Nt)	1.043.138	1.043.138	861.604	861.604	1.129.962	1.129.962	928.337	928.337

Notes: The table reports the results of the firm-level sensitivity analysis based on Eq. (1) (columns a) and Eq. (2) (columns b). All outcome variables are expressed in logarithm. The first four columns present the result based on a earlier shock (crisis date set in 2008Q2). The last four columns present the result based on a later shock (crisis date set in 2008Q4). The control variables are: dummy variables for small and big enterprises, the agreed percentage wage increase and the length of the CAO, the sector-level return-on-equity (ROE), return-on-assets (ROA) operating profit margin and value added. Clustered robust standard errors are in brackets. The symbols *, ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

Table A3
Sensitivity analysis – ATTs without CAO controls (length and wage increase).

	Base wage	Bonuses	Benefits	Overtime
started before $\times$	0.004	−0.149***	−0.023	−0.008
after shock (2008Q-2009Q4)	(0.013)	(0.057)	(0.018)	(0.033)
	Employment	Flexible employment	N. of new hires	
started before $\times$	0.000	0.004	0.008	
after shock (2008Q-2009Q4)	(0.010)	(0.017)	(0.029)	

Notes: The table reports the results of the firm-level sensitivity analysis based on Eq. (1) after excluding the CAO wage increase and contract length among the control variables. All outcome variables are expressed in logarithm. The table reports the average ATT over the entire crisis period. The control variables are: dummy variables for small and big enterprises, the sector-level return-on-equity (ROE), return-on-assets (ROA) operating profit margin and value added. Clustered robust standard errors are in brackets. The symbols *, ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

Table A4
Sensitivity analysis – ATTs without banking, insurance & financial sector.

	Bonuses		Bonuses	
	(a)	(b)	(a)	(b)
Started before × after shock (2008Q-2009Q4)	−0.148** (0.059)			
Agreed before × after shock (2008Q3–2009Q4)			−0.113** (0.062)	
Started before × 2008Q4		−0.088 (0.111)		
Started before × 2009Q1		−0.033 (0.074)		
Started before × 2009Q2		−0.159* (0.079)		
Started before × 2009Q3		−0.170*** (0.064)		
Started before × 2009Q4		−0.189*** (0.088)		
Agreed before × 2008Q4				−0.133 (0.100)
Agreed before × 2009Q1				−0.056 (0.066)
Agreed before × 2009Q2				−0.168** (0.079)
Agreed before × 2009Q3				−0.156** (0.061)
Agreed before × 2009Q4				−0.265** (0.129)

Notes: The table reports the results of the firm-level sensitivity analysis based on Eq. (1) (columns a) and Eq. (2) (columns b), after excluding all firms in the insurance, banking and financial sector. The outcome variable are the amount of bonuses paid out by each firm to its employees, as expressed in logarithm. The control variables are: dummy variables for small and big enterprises, the agreed percentage wage increase and the length of the CAO, the sector-level return-on-equity (ROE), return-on-assets (ROA) operating profit margin and value added. Clustered robust standard errors are in brackets. The symbols.
*, ** and *** denote significance at the 10, 5 and 1 percent confidence level, respectively.

Table A5
Robustness check – differences in cyclical exposures of T and C firms.

	C-T difference	*t*-test (degrees of freedom)	p-value
Profitability	0.029 (0.031)	0.93	0.348
Indebtedness	−0.216 (0.229)	−0.94	0.347
Solvability	1.348 (0.826)	1.63	0.103
Labor Intensity	1.492 (0.849)	1.75	0.078

Notes: The table reports test values, t-statistics and p-values of a *t*-test for the difference in two means used to test for pre-crisis differences in the cyclical exposures of treated firms as compared to control firms. The cyclical exposures is measured before the crisis (from the 2007 end-of-year balance sheet) and proxied by the following indicators: Profitability (measured as Net Profit to Sales), Indebtedness (measured by Total debts to Total assets) and Solvability (measured as Total Debt to Equity valu.

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