Online Appendix
Labor Reallocation Effects of Furlough Schemes: Evidence from Two Recessions in Spain

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A Sector-Specific Shocks

A.1 Employment changes

Table A.1 displays the exposure of different sectors to the Great Recession. The first column displays the raw percentage employment change between the end of the boom (2006m6) and the trough of the recession (2013m2). To give a more comprehensive picture of employment changes during the entire recession, we additionally regress (logged) employment levels in each sector during 2006m6-2013m12 on a set of time dummies that control for common shocks, sector dummies, and the interaction of the dummies with a Great Recession indicator variable. The second column of Table A.1 presents the resulting estimates of the interaction term, which can be interpreted as the average sector-specific employment changes during the recession.

Using either measure of sector-specific shocks provides a very similar picture that agrees with the common narrative of this downturn: The burst of a housing bubble led to a severe contraction of employment related to construction, manufacturing, mining, and real estate activities.[1] Construction was the worst hit sector, with an astonishing average employment drop of 0.59 log points more than the least affected sector, followed by manufacturing B (0.34 log points), which includes ancillary manufactures to construction (listed in Table A.2, Appendix A), such as wood, furniture, rubber/plastic, apparel, etc.

Section 3 uses heterogeneity in sectoral exposure across provinces i to study the effects of the Great Recession as a sectoral shock. We use a Bartik-type instrument to address that the sectorial composition across provinces may not be orthogonal to other regional features related to the business cycle. In particular, we combine sector-level employment changes ΔE_j during the Great Recession with geographical differences in the shares of each sector j in each province i at the beginning of the recession $\bar{w}_{ij}$. That is, the Bartik variable is $B_i = \sum_j \bar{w}_{ij}(-\Delta E_j)$. The initial period of the recession corresponds to June 2008, and we compute the employment changes for each sector j between June 2008 and February 2013. To get a sense of this geographical distribution, Figure A.1(a) shows a map of the most affected provinces during the Great Recession. The most affected provinces are located in the northern and eastern parts of the country, while provinces in the west and south were relatively less exposed because of their specialization in the primary sector and tourism.

[1] The two measures somewhat differ regarding the severity of the employment decline in Real Estate Activities. The sector had partially recovered by the end of 2014, yet, it was one of the most severely hit early in the recession.

Table A.1: Sectorial exposure in the Great Recession

Sector	Emp. change	Regression	Emp. Share June 2008
Highly Exposed			**27.3**
Construction	-0.65	-0.54	11.9
Manufacturing (B)	-0.38	-0.29	7.9
Mining	-0.42	-0.27	0.3
Real estate activities	-0.09	-0.19	0.5
Manufacturing (A)	-0.17	-0.13	6.7
Weakly Exposed			**72.7**
Transporting and storage	-0.16	-0.12	4.6
Administrative and support service	-0.14	-0.11	7.8
Wholesale and retail trade	-0.14	-0.11	16.1
Financial activities	-0.12	-0.07	2.6
Professional activities	-0.11	-0.06	4.4
Information and communication	-0.05	-0.04	2.5
Arts, entertainment and recreation	-0.01	-0.02	1.3
Accommodation and food service	-0.01	-0.02	6.8
Water supply	-0.05	-0.02	0.9
Education	0.05	-0.01	3.8
Public admin. and defence	-0.07	0.00	6.9
Other services	0.13	0.00	4.3
Agriculture	-0.05	0.00	2.6
Energy supply	0.04	0.02	0.2
Human health and social work	0.06	0.05	7.7

Source: Own elaboration based on affiliation data from MCVL.
Note: The first column of the table reports the employment change between the beginning of the recession (2008m6) and the trough of the recession (2013m2). The second column of the table reports the estimates of the coefficients on the interaction term between sectors and a recession dummy in a regression that relates log employment at the sector level to time-fixed effects, sector dummies, and the aforementioned interaction term (sample: 2006m1- 2013m12). All estimates are significant at a 5 percent level except eight (from Arts to Energy Supply). The second column reports the employment shares of the sectors in June 2008. The employment shares in bold characters refer to the weighted average across highly exposed and weakly exposed sectors. The coefficient of correlation between the economy-wide sector employment changes and the regression coefficient is 0.95.

Table A.2: Cumulative change in manufacturing employment (2008-2013)

	Emp. change	Manuf. emp. share June 2008
Highly exposed		
Manufacture of wood	-51.60	3.48
Manufacture of furniture	-56.66	4.26
Manufacture of rubber/plastic	-26.34	4.77
Manufacture of non-metallic	-52.79	7.55
Manufacture of basic metals	-29.93	4.37
Manufacture of fabricated metals	-40.14	13.37
Manufacture of electronic	-25.57	1.63
Manufacture of electrical	-34.94	2.90
Manufacture of wearing apparel	-47.30	2.96
Manufacture of vehicles	-22.08	7.82
Weakly exposed		
Manufacture of food products	-8.52	13.77
Manufacture of beverages	-13.41	2.24
Manufacture of tobacco	-36.93	0.22
Manufacture of textiles	-37.51	2.37
Manufacture of leather	-13.37	1.70
Manufacture of paper	-17.32	2.11
Printing and media	-36.87	3.68
Manufacture of refined petroleum	-2.98	0.42
Manufacture of chemicals	-14.20	4.05
Manufacture of pharmaceutics	-3.18	2.01
Manufacture of machinery	-31.69	6.22
Manufacture of other transport	-18.81	2.57
Other manufacturing	-22.44	1.32
Repair and instal of machinery	-5.56	2.42

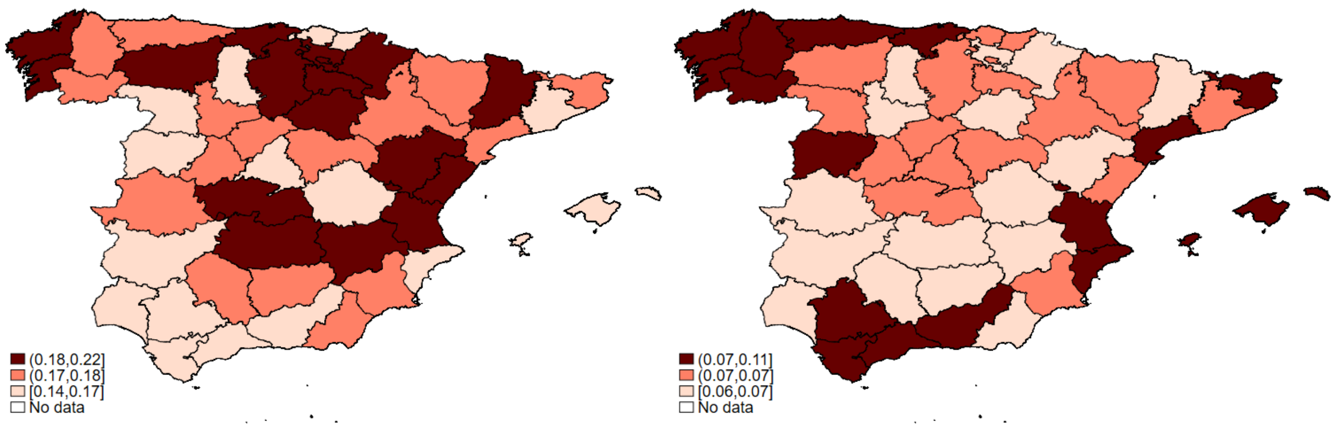
Source: Own elaboration based on affiliation data from the Spanish Social Security (MCVL).
Note: The table reports the effect of percentage change in employment between June 2008 and February 2013 and the employment share in June 2008 across different manufacturing industries with 2-digit NACE codes.

One may worry that regions with high employment shares in the most affected sectors could have grown particularly quickly before the recession, making it debatable whether the employment decline during the recession represents partially mean-reversion. To address this concern, we follow the idea of Goldsmith-Pinkham et al. (2020) and ask whether the Bartik instrument predicts employment change before the recession (January 2006 to June 2008).[2] That is, we regress the pre-recession employment change for each province on the Bartik instrument. We estimate a reduced form effect of 0.58 with a corresponding p-value of 0.16. That is, the effect of the Bartik instrument on pre-recession employment changes is not significant at standard confidence values.

[2]The analogy to a standard differences-in-differences analysis is that the initial industry shares in the Great Recession proxy the exposure to the policy change and the growth rates in employment during the Great Recession proxy the size of the policy change.

Table A.3 shows that, similar to the Great Recession, the Great Contagion (2020q1-2021q1) also displays large variation in employment growth rates across sectors.[3] Accommodation and Food Services, Arts and Entertainment, Other Services, Real Estate Activities, and Education were the sectors with the biggest employment contractions.[4] Figure A.1(b) shows that regional heterogeneity in exposure rates is again substantial. The spatial differences with the Great Recession are noteworthy. In effect, whereas the central and northern provinces were the ones with the highest employment concentration in those sectors subsequently hit by the bursting of the housing bubble, the most exposed provinces during the Great Contagion are the ones in the South, East, and Northwest of Spain. All these locations are traditionally large destinations of tourism which suffered a big collapse as a result of the pandemic and the lockdown.

Figure A.1: Map of sectoral exposure across provinces



(a) Great Recession

(b) Great Contagion

Source: Own elaboration based on affiliation data from the Spanish Social Security (MCVL) and Maps from the Spanish National Center of Geographic Information (CNIG).
Note: The map displays the share of employment in highly exposed sectors in June 2008 (Great Recession) and 2019Q4 (COVID Recession) in the Spanish mainland and the Balearic Islands.

So far, our discussion has focused on a continuous exposure measure to sector-specific shocks. For the structural model, we require a binary measure. To that end, we classify sectors into highly exposed (top quartile of pre-recession employment) and weakly exposed using the time-series regression model explained above. Table 3 uses this measure to compare the Great Recession experience in the model and data. To be specific, in the data, we predict changes in employment, job-finding rates, and job-loss rates by the share of employment in the highly-exposed sector using

[3]The government-mandated lockdown in the whole Spanish territory started on March 15 2020, and lasted 99 days. Later, a milder lockdown was established in October 25, lasting 196 days

[4]De la Fuente (2021) also highlights the regional differences arising from this shock.

Table A.3: Sectorial exposure in the Great Contagion

Sector	**Emp. change**	**Regression**	**Emp. share 2019Q4**
Highly exposed			**25.9**
Accommodation and food service	-0.26	-0.24	8.5
Arts, entertainment and recreation	-0.22	-0.15	9.8
Other services	-0.14	-0.10	1.6
Real estate activities	-0.12	-0.09	0.6
Education	-0.07	-0.07	5.4
Weakly exposed			**74.1**
Transporting and storage	-0.08	-0.06	4.9
Administrative and support service	-0.07	-0.06	8.7
Water supply	-0.05	-0.05	0.9
Agriculture	0.01	-0.05	3.4
Wholesale and retail trade	-0.07	-0.04	15.9
Manufacturing (A)	-0.03	-0.04	9.1
Manufacturing (B)	-0.10	-0.04	3.0
Construction	-0.15	-0.03	5.7
Information and communication	0.03	-0.03	3.3
Energy supply	-0.07	-0.03	0.2
Professional activities	-0.04	-0.03	4.9
Public administration and defence	-0.02	-0.02	7.1
Financial and insurance activities	-0.03	-0.02	2.1
Mining	0.06	-0.02	0.1
Human health and social work	0.01	0.00	4.7

Source: Own elaboration based on affiliation data from MCVL and EPA.
Note: The first column of the table reports the employment change between the beginning of the recession (2019q4) and the trough of the recession (2020q2). The second column of the table reports the estimates of the coefficients on the interaction term between sectors and a recession dummy from a regression that relates log employment at the industry level to time-fixed effects, sector dummies, and the aforementioned interaction term between 2018q1 and 2022q4. All estimates of the highly exposed sectors are highly significant, while only a few are significant among weakly exposed ones. The second column reports the employment share of the sectors in 2019Q4. The employment shares in bold characters refer to the weighted average across highly exposed and weakly exposed sectors. The coefficient of correlation between the economy-wide sector employment changes and the regression coefficient is 0.83.

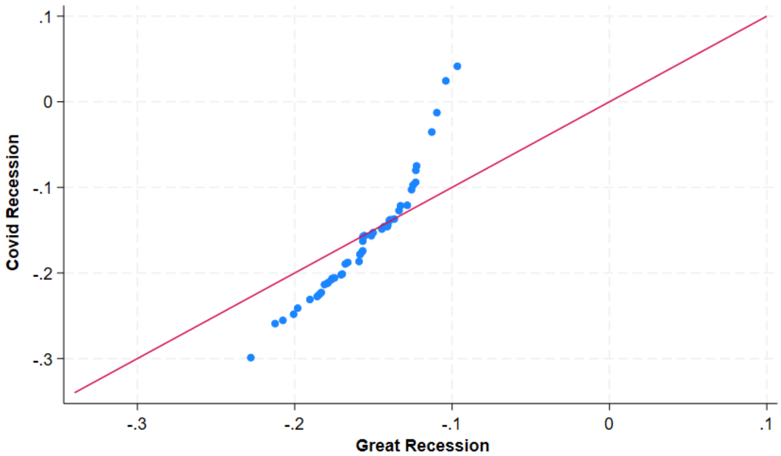
a linear regression model where the regressor is:

$$B_i = \sum_j \bar{w}_{ij} \mathbb{I}_j, \quad \mathbb{I}_j = 1 \text{ if } j = H.$$

A.2 Output changes

Section 3.2 documents that the employment decline during the Great Contagion is significantly lower than one would expect from the experience of the Great Recession. Figure A.2 shows that the lower employment decline during the pandemic occurs in spite of comparable GDP contractions in both recessions. The figure plots the GDP growth between the pre-recession national peak and trough of each recession across provinces during the Great Contagion and the Great Recession. Each point corresponds to a pair of provinces, each belonging to the same rank in the severity of GDP growth of the respective recession. We find that the average province experiences a decrease in the GDP of about 16 percent in both recessions, suggesting that the size of the initial shock is similar. Moreover, except for a handful of the least affected provinces, a province ranked in a given percentile of GDP growth during the Great Recession experienced a similar contraction in GDP as its counterpart during the Great Contagion. Overall, these results suggest that the smaller employment decline during the Great Contagion arises from factors other than the magnitude of the initial GDP shock.

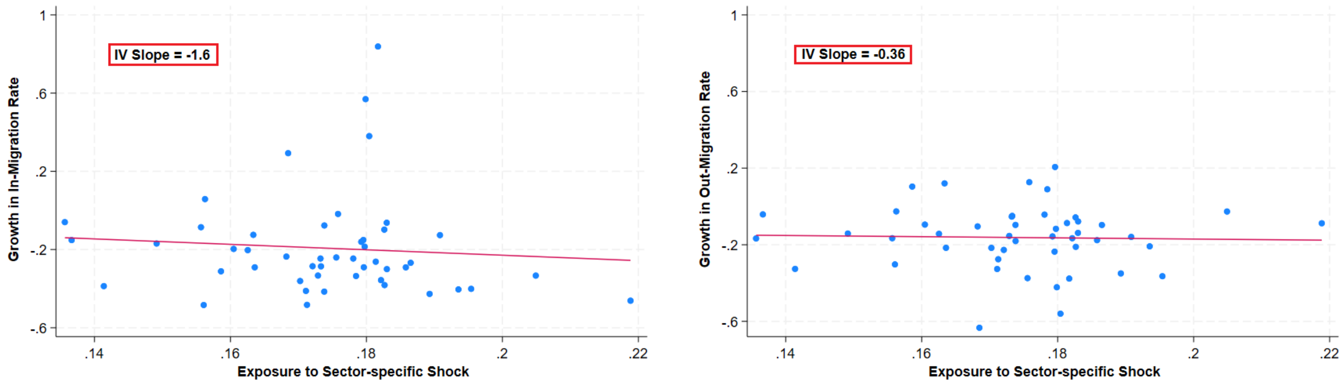
Figure A.2: GDP growth by province during the Great Contagion and the Great Recession



Source: Own elaboration from INE data.
Note: This Figure plots the real GDP growth across provinces during the Great Contagion and the Great Recession. Each point corresponds to a pair of provinces, each belonging to the same rank in the severity of GDP growth of the respective recession. For instance, the province with the largest decline during the Great Contagion is paired with the province with the largest decline during the Great Recession. We compute the GDP growth for each province between the pre-recession national peak and trough of each recession. Moreover, we use annual provincial data on GDP and extrapolate this data to quarterly frequency using quarterly national data on GDP.

B Mobility in the Great Recession

Figure B.1: Changes in gross migration rates



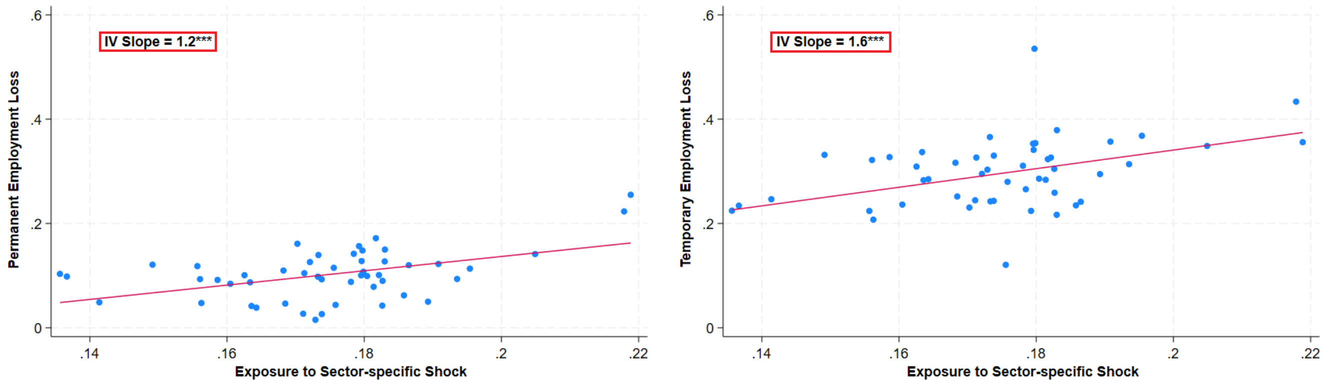
(a) ΔIn-migration rate (b) ΔOut-migration rate

Source: Own elaboration based on affiliation data from the Spanish Social Security (MCVL).
Note: The figure plots the growth rate in the average (a) in-migration and (b) out-migration rate during the crisis (July2008-February2013) relative to the average before the crisis (January2006-June2008). An individual out-migrates if her census residence one year after is different from their current one. An individual in-migrates if her current census residence changed relative to her residence one year before. The graphs display the fitted line from the IV regression and the corresponding slope $\hat{\beta}_1^{\mathrm{IV}}$, where $^{*}p < 0.15$, $^{**}p < 0.05$, $^{*}p < 0.01$.

Section 3.1 uses heterogeneity across Spanish provinces to understand how local labor markets react to sector-specific shocks. However, workers may migrate elsewhere in Spain to mitigate the effect of the shock on their local labor market. To analyze this issue, we consider internal migration flows into and out of provinces with different sectoral exposure to the Great Recession shock. Figure B.1 relates the initial exposure level of a province to the change in the in- and out-migration rate from that province. The first finding to note is that internal mobility becomes less relevant after the onset of the Great Recession since both in- and out-migration rates fall on average by about 20 percent. Moreover, both Figure B.1(b) and Figure B.1(a) show that the change in the fraction of people moving across provinces is not significantly related to the initial exposure level, which supports the assumption of separate labor markets. Together, we take the evidence to support our view that, to a first approximation, provinces can be treated separate labor markets.

C Temporary Employment in Spain

Figure C.1: Changes in employment by contract type



(a) Permanent employment

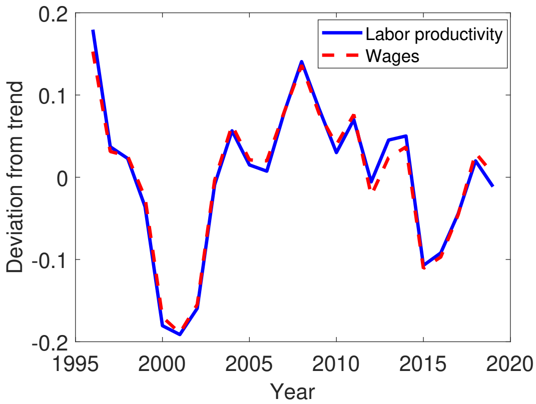
(b) Temporary employment

Source: Own elaboration based on affiliation data from the Spanish Social Security (MCVL).
Note: The figure plots the (a) relative permanent employment loss and (b) relative temporary employment loss during the crisis (July2008-February2013) relative to the average before the crisis (January2006-June2008). The graphs display the fitted line from the IV regression and the corresponding slope $\hat{\beta}_1^{IV}$, where $^{*}p < 0.15$, $^{**}p < 0.05$, $^{*}p < 0.01$.

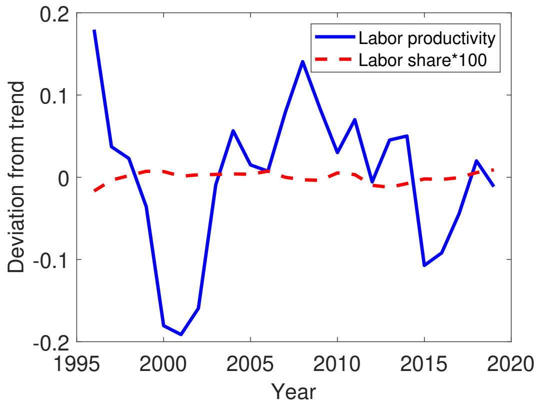
Section 3.1 studies total employment responses to sector-specific shocks. Here, we extend the analysis by considering separately the response of permanent employment and temporary employment. Figure C.1 relates the changes in temporary and permanent employment during the Great Recession to the exposure level of different provinces to the sector-specific shock. We find that more exposed provinces experience an employment decline in both permanent and temporary employment. Moreover, the relationship is somewhat stronger for temporary contracts, which is consistent with the fact that it is less costly for firms to adjust employment through the non-renewal of TC.

D Wage Cyclicality in Spain

Figure D.1: Cyclicality of wages and the labor share



(a) Labor productivity and wages



(b) Labor productivity and the labor share

Source: St Louis FED and own calculations. Wages and labor productivity are measured as log deviations from a HP trend, and the labor share is the deviation from its HP trend and multiplied by 100 for visibility.

As discussed in Hornstein et al. (2005), the cyclicality of wages is a key determinant for the propagation of labor productivity shocks to employment. Our model assumes that wages are always proportional to output, i.e., we abstract from possible wage rigidities. To assess the plausibility of the assumption, this appendix studies wage cyclicality in Spain. We follow Hagedorn and Manovskii (2008) and measure wages as the labor share times labor productivity which we obtain from the St Louis FED database. Figure D.1(a) plots HP-filtered wages against labor productivity, showing that the co-movement, different from the U.S., is close to one-to-one. The implication is that, as shown in Figure D.1(b), the labor share is acyclical in Spain.

E Sensitivity to wage rule

Table E.1: Calibration with $\lambda = 0.9$

Variable	Value ($[H, W]$)	Target
ζ	$1/540$	Average working life 45 years
β	$0.96^{1/12}$	4% Yearly interest rate
η_i	$[363, 356]$	4.5% of quarterly output and 3.7% of wages
γ	0.5	0.5 Matching elasticity of unemployed
$\bar{b}$	823	58% of average wages
$\underline{x}$	7.30	Average wage in W 1412
μ_i	$[0.03, 0]$	Average log wages 0.02 higher in H
σ_ξ	0.21	Std.log wage changes of EUE workers 0.22
$x_{max} - x_{min}$	0.22	Log wage difference of EUE workers H to H minus H to W 0.12
σ_ϕ	34	13% of workers switch sectors with EUE
μ_ϕ	-56	27% of workers in H sector
χ^u	0.60	UE rate of 15%
$\delta_i\%$	$[2.30, 2.25]$	EU rates of 3.2 and 3.4%
λ	0.90	90% of output paid as wages
ν_i	$[141, 138]$	Median tenure 23 months
$\omega_i\%$	$[17.0, 4.8]$	Employment drop of 40 and 6 percent
b_R	$[1007, 988]$	70 percent of mean wages
κ_i	$[16.5, 16.2]$	12% of people on ERTEs after 1 quarter
χ^r	0.05	9% of people on ERTEs at different firm in t+12
ρ_ξ	0.85	76% of people on ERTEs at same firm in t+12

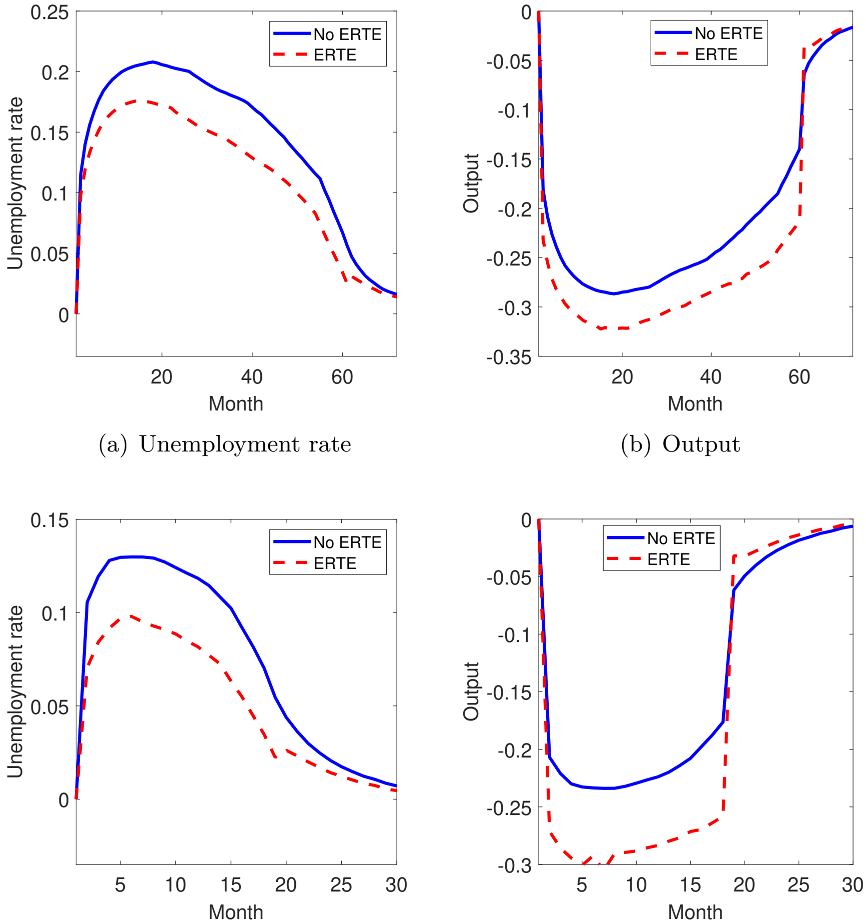
Notes: The left column states the calibrated variable and the right column the target. Numbers in brackets refer to sector-specific calibrations $[H, W]$.

The baseline calibration sets the wage share of output, λ=0.95, similar to the bargaining outcome in Shimer (2005). Here, we show that our results are insensitive to choosing a lower wage share, λ=0.9, once we recalibrate the model.

Table E.1 shows that the calibration strategy implies that fixed costs, ν_i are higher than in the baseline calibration. Since a lower wage share implies that the profits of a match are higher for any given ν_i, we require higher fixed costs to match the tenure distribution of workers. As a result, the calibrated model implies again that the average match surplus is small.

Figure E.1 displays the resulting business cycle dynamics of unemployment and output in a long and a short recession. Comparing those to Figure 6 and Figure 7, the main conclusions remain unaltered: ERTEs reduce unemployment volatility, particularly during a short recession. However, by reducing the number of people actually working, they increase output volatility.

Figure E.1: Aggregate dynamics in a recession



(a) Unemployment rate

(b) Output

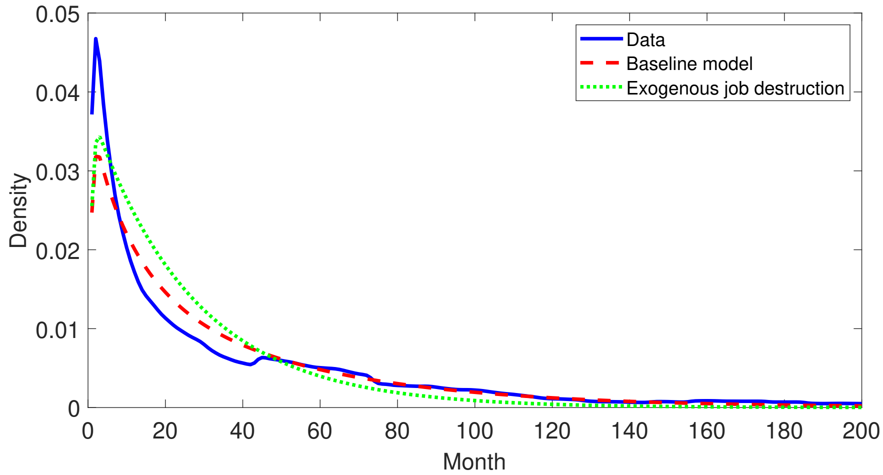
(c) Unemployment rate short recession

(d) Output short recession

Notes: The top panel displays macroeconomic aggregates in a 5-year-long recession period followed by a 1-year expansion. The bottom panel displays the same but for a 1.5-year-long recession. These aggregates are computed as deviations from their values in the steady state without ERTEs.

F Tenure distribution

Figure F.1: Tenure distributions in model and data



Source: Own elaboration based on affiliation data from the Spanish Social Security (MCVL) and model simulations.
Note: The figure displays the density of job tenure. *Baseline model*: the baseline model with endogenous and exogenous job destruction; *Exogenous job destruction*: A model with the same job-loss rate but all job destruction results from exogenous job destruction.

Section 5 highlights that the job tenure distribution implies that the average match surplus is low in Spain. Figure F.1 shows that the baseline model fits well the right tail of this distribution. It misses somewhat the high incidence of very short-duration matches with less than 3 months. One possible interpretation is that some matches used fixed-term contracts because they are designed to end within a few months, a feature absent from the model since ERTE only cover workers with TC until their expiration date. That section also discusses how we use the tenure distribution to distinguish between exogenous and endogenous job destruction and, thereby, deduct match surpluses. To highlight this point further, we re-calibrate a model with the same job destruction rates as in the data, assuming that they all result from exogenous job destruction. Figure F.1 shows that this alternative model, different from the data and our baseline model, features a low share of workers with tenure exceeding 100 months and, foremost, that the bulk of matches has very short tenure and, thus, low match surpluses, mimicking the Spanish dual labor market.

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