The division of unexpected revenue shocks

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Introduction

- What are the implications of *unexpected* demand shocks for:
  - firm performance (sales, investment, employment)
  - worker compensation (avg. wages, within-firm inequality, components of pay)
- How are these decisions shaped by attributes of top managers?
- Growing interest for empirical evidence on these questions in macro, labor, IO, trade
- Empirical research has faced two important challenges:
  1. Quantifying the unexpected component of demand shocks at firm-level
  2. Comprehensive analysis of intertwined decisions at the firm-level has great data requirements

This paper

- New methodology for identifying unexpected component of demand shocks at the firm-level, exploiting:
  1. Gaps between observed and recently forecasted GDP growth in export markets
  2. Differential initial exposure of exporters to destinations
- Unusually rich collection of panel data on firms and workers for Portugal, 2006-2018
  1. Firm census
  2. Employer-employee data
  3. Export transactions
  4. Management survey (subset of firms in 2016)
  5. IMF WEO data on actual and forecast growth

Main takeaways

- Unexpected demand shocks impact sales, employment, investment and average wages
- Wage effects occur mainly close to the top of the within-firm wage distribution
- No evidence of adjustments in the skill composition of the workforce
- Unequal average distribution of rents following an unexpected demand shock is mainly driven by:
  - Wage effects in firms managed by high-skilled managers
  - Changes in overtime pay and other pay for high earners in the firm
- Suggests that managerial skill is associated with the adoption of performance-based pay, which would show up in these wage components

Related literature

- Literature on how firm shocks are transmitted to workers (Card et al., 2018; Frías et al., 2018; Kline et al., 2019)
- Literature on role of managers in shaping firm performance and wages (Bertrand and Mullainathan, 2003; Bertrand and Schoar, 2003; Bastos and Monteiro, 2011; Bender et al., 2018)
- Literature on adjustment of components of compensation over the business cycle (Grigsby and Yildirmaz, 2021)
- Literature on internationally active firms in transmission of business cycles (di Giovanni et al., 2018, 2020)

Methodology for identifying unexpected demand shocks

- Forecast error for a destination-year is defined as:

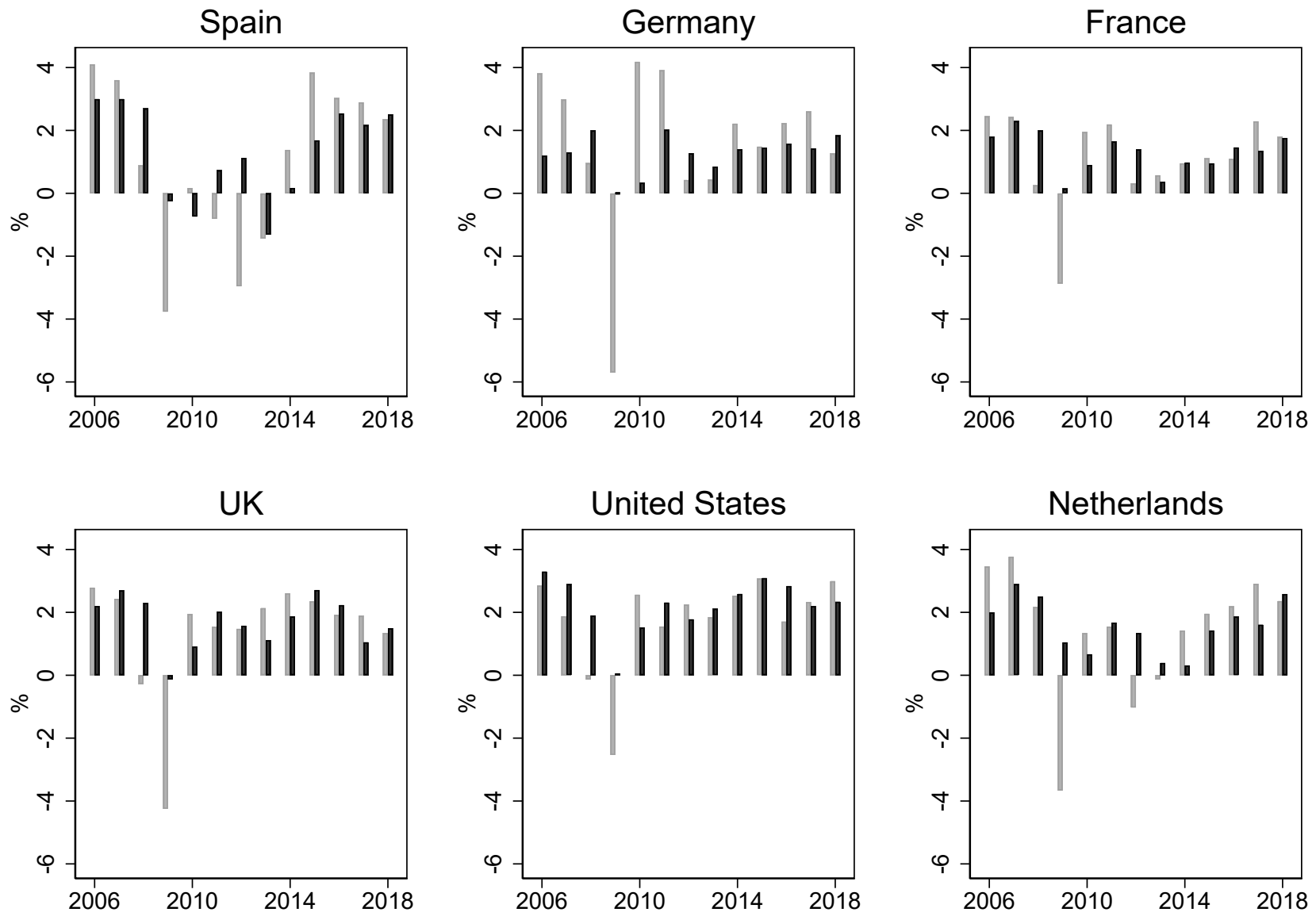
$$FE_{dt} = G_{dt} - FG_{dt}, \tag{1}$$

- G_{dt} is GDP growth rate of destination d in year t
- FG_{dt} is current-year growth forecast for country d in year t
- Aggregate destination-year forecast errors at the firm-year level:

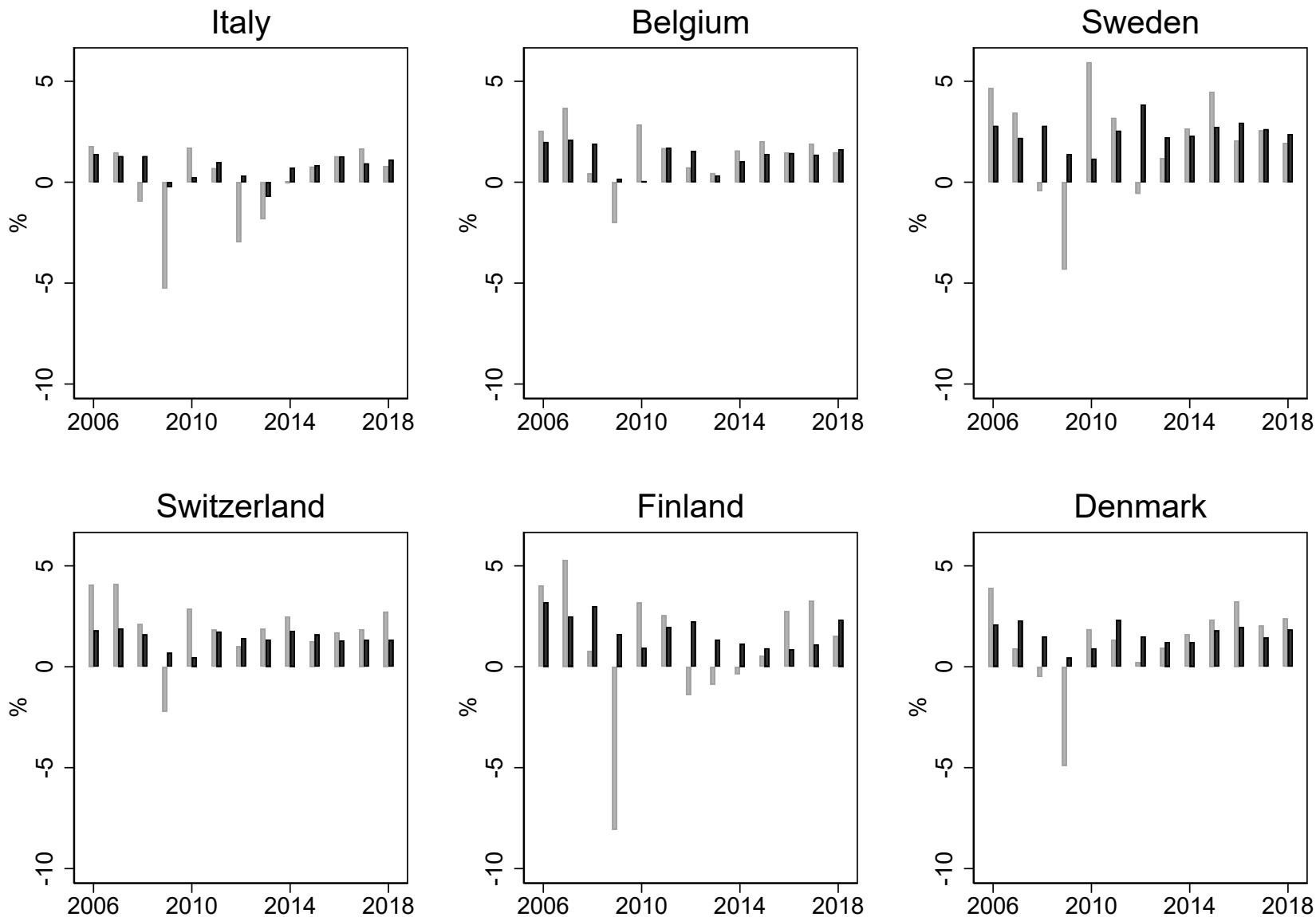
$$WFE_{it} = \sum_{d=0}^{D} s_{di0} FE_{dt}, \tag{2}$$

- s_{d0} is the share of exports to destination d in total sales of firm i in 2006 (the first year of our data)

Actual and forecast growth in top destinations, 1 to 6



Actual and forecast growth in top destinations, 7 to 12

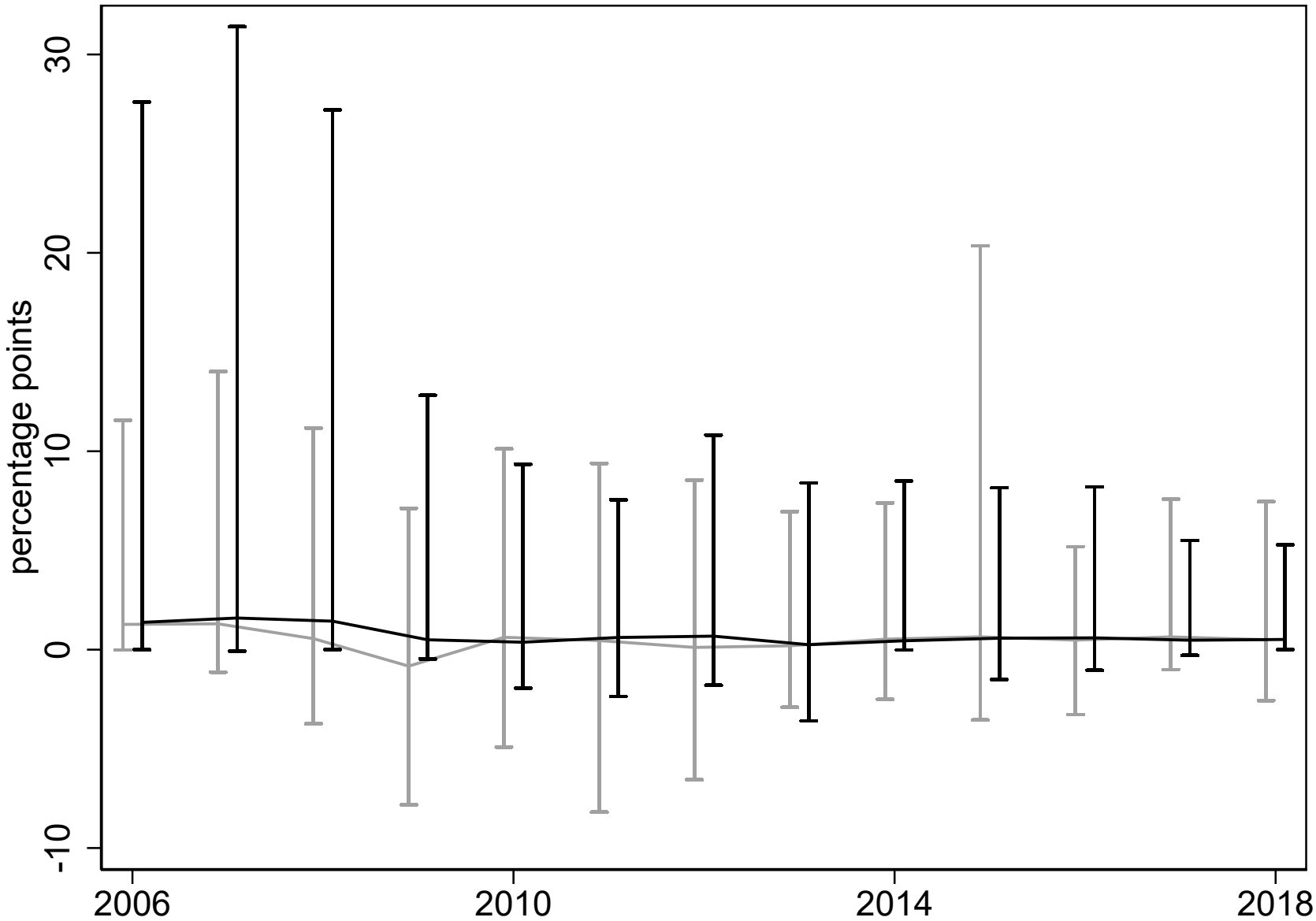


Empirical model

$$\Delta Y_{ip} = \alpha \Delta WFE_{ip} + \beta \Delta WFG_{ip} + \gamma_{jp} + \tau_{rp} + \epsilon_{ip}, \qquad (3)$$

- WFE_{ip} is weighted forecast error in firm i in period p
- WFG_{ip} is weighted forecast growth in firm i in period p
- γ_{jp} is industry-period effect and τ_{rp} is a region-period effect
- Take 3-year period averages of the corresponding firm-year variables (Frías et al., 2018)
- Independent variables with 1-year lag relative to the dependent variable
- Standard errors clustered by firm

Actual and forecast growth in firm-level data



Effects on firm performance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. variable:	log sales	log exports	log (1+ inv. fixed tangible assets)	log (1+ inv. intangible assets)	log employment	log value added	log value added per worker	log avg. worker pay
Weighted forecast error	0.0520***	0.1488***	0.0998*	0.1305***	0.0226***	0.0394***	0.0135	0.0090**
	(0.0107)	(0.0167)	(0.0527)	(0.0493)	(0.0049)	(0.0095)	(0.0084)	(0.0039)
Weighted forecast growth	0.0404***	0.1416***	0.0971***	0.0807***	0.0113***	0.0278***	0.0150***	0.0037*
	(0.0055)	(0.0097)	(0.0292)	(0.0293)	(0.0026)	(0.0049)	(0.0045)	(0.0021)
Period x region FE	Y	Y	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y	Y	Y
N (obs.)	22199	22199	22199	22199	22199	22199	22199	22199
N (firms)	9306	9306	9306	9306	9306	9306	9306	9306
Adj. R^2	0.0830	0.0320	0.0270	0.0080	0.0460	0.0581	0.0245	0.0250
RSS	3936	41307	202918	377904	2119	5726	4496	885

Notes: In each column, the dependent variable is the change between the average of each 3-year period. Standard errors are clustered at the firm-level. *10% level of significance, **5% level of significance, ***1% level of significance.

Effects on worker compensation and worker composition

Dep. variable:	(1) log monthly wage	(2) log hourly wage	(3) log monthly base wage	(4) log (1 + overtime pay)	(5) log (1+ other pay)	(6) log total hours	(7) share with a degree	(8) person FE
Weighted forecast error	0.0074**	0.0073**	0.0055**	0.0194*	0.0212	0.0263***	0.0001	-0.0212
	(0.0032)	(0.0032)	(0.0027)	(0.0116)	(0.0168)	(0.0061)	(0.0018)	(0.0154)
Weighted forecast growth	0.0028*	0.0029*	0.0009	0.0100	0,0064	0.0113***	-0.0002	-0.0048
	(0.0017)	(0.0017)	(0.0013)	(0.0068)	(0.0092)	(0.0032)	(0.0010)	(0.0073)
Period x region FE	Y	Y	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y	Y	Y
N (obs.)	22199	22199	22199	22199	22199	22199	22199	12631
N (firms)	9306	9306	9306	9306	9306	9306	9306	6012
Adj. R^2	0.0120	0.0130	0.0340	0.0200	0.0017	0.0340	0.0070	0.0220
RSS	799	798	444	21879	28275	3625	194	3151

Notes: In each column, the dependent variable is the change between the averages of each 3-year period. Standard errors are clustered at firm-level. *10% level of significance, **5% level of significance, ***1% level of significance.

Effects on worker compensation: high vs low earners

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	log monthly wage					
High vs. low earners	high	low	high	low	high	low
Definition	5%	95%	15%	85%	25%	85%
Weighted forecast error	0.0153***	0.0052**	0.0117**	0.0047*	0.0087**	0.0035
	(0.0054)	(0.0026)	(0.0046)	(0.0025)	(0.0043)	(0.0025)
Weighted forecast growth	0.0063**	-0.0004	0.0043*	-0.0002	0.0030	-0.0006
	(0.0029)	(0.0014)	(0.0024)	(0.0014)	(0.0022)	(0.0014)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	20888	20888	20888	20888	20888	20888
N (firms)	8745	8745	8745	8745	8745	8745
Adj. R^2	0.0070	0.0155	0.0086	0.0161	0.0092	0.0172
RSS	2476	485	1757	446	1451	424

Notes: In each column, the dependent variable is the change between the averages of each 3-year period. Standard errors are clustered at firm-level. *10% level of significance, **5% level of significance, ***1% level of significance.

Effects on worker compensation, high vs low earners, according to managerial skill (defined by occupation)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	log monthly wage					
High vs. low earners	high	low	high	low	high	low
Definition	5%	95%	15%	85%	25%	75%
A. Firms with high-skilled managers						
Weighted forecast error	0.0363***	-0.0001	0.0277**	0.0029	0.0177	0.0007
	(0.0134)	(0.0075)	(0.0112)	(0.0067)	(0.0109)	(0.0069)
Weighted forecast growth	0.0195***	-0.0001	0.0122**	0.0013	0.0082	0.0003
	(0.0071)	(0.0033)	(0.0062)	(0.0031)	(0.0058)	(0.0031)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	5027	5027	5027	5027	5027	5027
N (firms)	1991	1991	1991	1991	1991	1991
Adj. R^2	0.0009	0.0256	0.0023	0.0318	0.0054	0.0345
RSS	589.7	110.4	391.8	95.48	322.4	89.88
B. Firms with low-skilled managers						
Weighted forecast error	0.0021	0.0039	-0.0011	0.0018	-0.0034	-0.0005
	(0.0139)	(0.0068)	(0.0115)	(0.0067)	(0.0111)	(0.0069)
Weighted forecast growth	0.0033	-0.0031	0.0016	-0.0034	0.0010	-0.0034
	(0.0073)	(0.0029)	(0.0060)	(0.0029)	(0.0054)	(0.0029)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	5207	5207	5207	5207	5207	5207
N (firms)	2114	2114	2114	2114	2114	2114
Adj. R^2	0.0114	0.0210	0.0177	0.0196	0.0176	0.0199
RSS	623	108	423	98	341	93

Notes: In each column, the dependent variable is the change between the averages of each 3-year period. Standard errors are clustered at firm-level. *10% level of significance, **5% level of significance, ***1% level of significance.

Effects on worker compensation, high vs low earners, according to managerial skill (defined as top 1% earners)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	log monthly wage					
High versus low earners	high	low	high	low	high	low
Definition	5%	95%	15%	85%	25%	85%
A. Firms with high-skilled managers						
Weighted forecast error	0.0215**	-0.0033	0.0152*	-0.0031	0.0085	-0.0048
	(0.0107)	(0.0046)	(0.0092)	(0.0043)	(0.0085)	(0.0042)
Weighted forecast growth	0.0092*	-0.0028	0.0054	-0.0023	0.0025	-0.0033
	(0.0054)	(0.0025)	(0.0045)	(0.0024)	(0.0041)	(0.0025)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	7826	7826	7826	7826	7826	7826
N (firms)	3114	3114	3114	3114	3114	3114
Adj. R^2	0.0032	0.0192	0.0057	0.0215	0.0079	0.0235
RSS	931	178	629	161	516	153
B. Firms with low-skilled managers						
Weighted forecast error	0.0109*	0.0079**	0.0090*	0.0074**	0.0076	0.0065**
	(0.0062)	(0.0031)	(0.0054)	(0.0031)	(0.0051)	(0.0031)
Weighted forecast growth	0.0047	0.0005	0.0036	0.0006	0.0030	0.0004
	(0.0034)	(0.0017)	(0.0030)	(0.0017)	(0.0027)	(0.0017)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	13058	13058	13058	13058	13058	13058
N (firms)	5631	5631	5631	5631	5631	5631
Adj. R^2	0.0099	0.0191	0.0118	0.0180	0.0130	0.0185
RSS	1522	301	1111	279	919	267

Notes: In each column, the dependent variable is the change between the averages of each 3-year period. Standard errors are clustered at firm-level. *10% level of significance, **5% level of significance, ***1% level of significance.

Effects on different wage components, high vs low earners, according to managerial skill (defined by occupation)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	log base wage		log overtime pay		log other pay	
High versus low earners	high	low	high	low	high	low
Definition	15%	85%	15%	85%	15%	85%
A. Firms with high-skilled managers						
Weighted forecast error	0.0115	0.0012	0.0719*	-0.0017	0.1071*	0.0736*
	(0.0091)	(0.0054)	(0.0433)	(0.0360)	(0.0596)	(0.0421)
Weighted forecast growth	0.0009	-0.0016	0.0264	-0.0069	0.0420	0.0324*
	(0.0042)	(0.0024)	(0.0248)	(0.0216)	(0.0318)	(0.0189)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	5027	5027	5027	5027	5027	5027
N (firms)	1991	1991	1991	1991	1991	1991
Adj. R^2	0.0188	0.0634	0.0401	0.0462	0.0034	0.0062
RSS	211	53	7889	5799	8118	3797
B. Firms with low-skilled managers						
Weighted forecast error	0.0022	0.0050	0.0597*	0.0171	0.0179	0.0265
	(0.0088)	(0.0053)	(0.0359)	(0.0321)	(0.0532)	(0.0417)
Weighted forecast growth	-0.0001	0.0003	0.0238	0.0070	0.0004	-0.0339*
	(0.0050)	(0.0023)	(0.0198)	(0.0178)	(0.0299)	(0.0199)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	5207	5207	5207	5207	5207	5207
N (firms)	2114	2114	2114	2114	2114	2114
Adj. R^2	0.0181	0.0544	0.0331	0.0237	0.0132	-0.0003
RSS	305	55	6655	5234	9702	4994

Notes: In each column, the dependent variable is the change between the averages of each 3-year period. Standard errors are clustered at firm-level. *10% level of significance, **5% level of significance, ***1% level of significance.

Effects on different wage components, high vs low earners, according to managerial skill (defined as top 1% earners)

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. variable:	log base wage		log overtime pay		log other pay	
High versus low earners	high	low	high	low	high	low
Definition	15%	85%	15%	85%	15%	85%
A. Firms with high-skilled managers						
Weighted forecast error	0.0087	-0.0018	0.0717**	0.0160	0.0703*	0.0269
	(0.0074)	(0.0036)	(0.0321)	(0.0272)	(0.0412)	(0.0284)
Weighted forecast growth	0.0012	-0.0029	0.0280	0.0083	-0.0059	-0.0045
	(0.0033)	(0.0020)	(0.0178)	(0.0151)	(0.0249)	(0.0142)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	7826	7826	7826	7826	7826	7826
N (firms)	3114	3114	3114	3114	3114	3114
Adj. R^2	0.0137	0.0454	0.0213	0.0298	0.0091	0.0088
RSS	389	92	12938	9347	14076	6957
B. Firms with low-skilled managers						
Weighted forecast error	0.0072	0.0069***	0.0181	0.0170	0.0087	0.0231
	(0.0046)	(0.0024)	(0.0168)	(0.0163)	(0.0281)	(0.0232)
Weighted forecast growth	0.0024	0.0010	0.0154	0.0061	0.0091	0.0090
	(0.0025)	(0.0013)	(0.0100)	(0.0095)	(0.0155)	(0.0120)
Period x region FE	Y	Y	Y	Y	Y	Y
Period x industry FE	Y	Y	Y	Y	Y	Y
N (obs.)	13058	13058	13058	13058	13058	13058
N (firms)	5631	5631	5631	5631	5631	5631
Adj. R^2	0.0211	0.058	0.0174	0.0171	0.0045	0.0018
RSS	765	156	14868	11253	27679	16695

Notes: In each column, the dependent variable is the change between the averages of each 3-year period. Standard errors are clustered at firm-level. *10% level of significance, **5% level of significance, ***1% level of significance.

Conclusion

- New methodology for identifying unexpected component of demand shocks at the firm-level, exploiting:
  1. Gaps between observed and recently forecasted GDP growth in export markets
  2. Differential initial exposure of exporters to destinations
- Unusually rich collection of panel data on firms and workers for Portugal, 2006-2018
- Wage effects of unexpected demand shocks occur mainly close to the top of the within-firm wage distribution
  - Wage effects in firms managed by high-skilled managers
  - Changes in overtime pay and other pay for high earners in the firm
- Suggests that managerial skill is associated with the adoption of performance-based pay, which would show up in these wage components

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