Caliendo, Monte Rossi-Hansberg

- Garicano (2000) model of hierachies

- Caliendo and Rossi-Hansberg put in general equilibrium, monopolistic competition elements.

- This paper is descriptive, looks at implications in French data

Model

- demand for variety α, $x(p, \alpha, R, P)$ where p price, and R and P agregate revenue and price level

- x increasing in α

- Workers ex ante homogenous, equilibrium reservation wage $\bar{w}$

- Problems come up on a unit interval, let z be worker knowledge.

- Cost of knowledge z is $\bar{w}cz$ (where c is labor units of teachers per unit knowledge)

- Total wage of employee with knowledge z is $w = \bar{w}\,(cz + 1)$

- Suppose fixed entry cost f^E to design product, get draw from $G(\alpha)$ for product quality (monopolistic competition)

- Pay anothe fixed cost f to produce (all in units of labor)

- Agents act as production workers $\ell = 1$, or managers $\ell \geq 1$.

- Let n_L^ℓ, z_L^ℓ and w_L^ℓ be number ,nowldge and total wages at layer ℓ for an organization with L layers.

- Workers solve problem drawn from $F(z)$ with $F''(z) < 0$.

- Layer 2 solve problems $[z_L^1, z_L^1 + z_L^2]$

- In general firm needs $n_L^\ell = hn_L^1 \left[1 - F(Z_L^{\ell-1})\right]$ managers of layer ℓ, where $Z_L^\ell = \sum_{\ell'=1}^{\ell} n_L^\ell$.

Problem

- $C(y,w)$ is minimum cost, and $C_L(q,w)$ if restricted to L layers

$$C(q,w) = \min_{L\geq 1}\left\{C_{L(q,w)}\right\} = \min_{L\geq 1,\{n_L^\ell, z_L^\ell\}} \sum_{t=1}^{L} n_L^\ell w_L^\ell$$

subject to

$$\begin{aligned} q &\leq F(Z_L^L) n_L^1 \\ w_L^\ell &= \bar{w}\left[c z_L^\ell + 1\right] \\ n_L^\ell &= h n^1 [1 - F(Z^{\ell-1})\backslash, \text{ for } L \geq \ell \geq 1 \\ n_L^L &= 1 \end{aligned}$$

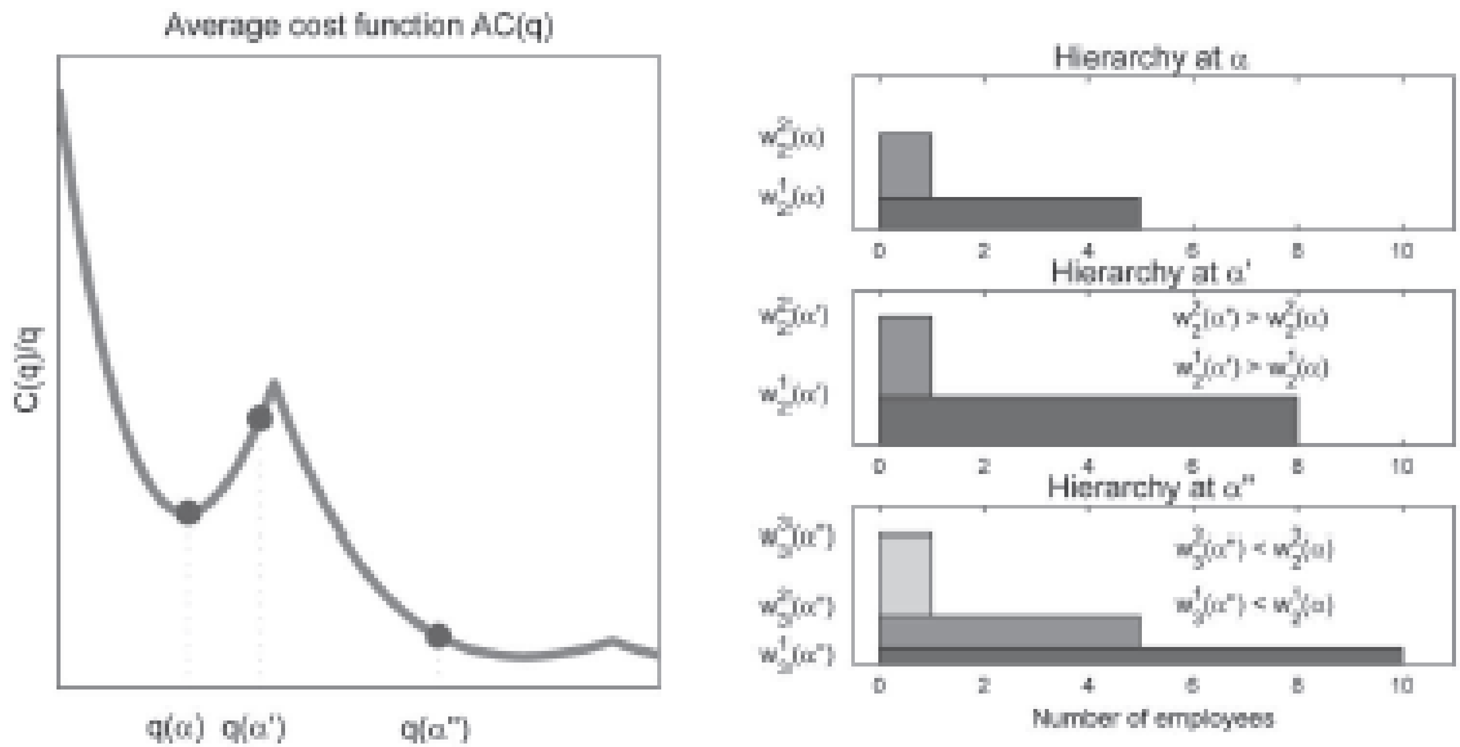

FIG. 1.—The average cost function $C(q; w/q)$ as a function of q

Classes used:

2. firm owners receiving a wage (which includes the CEO or firm directors);
3. senior staff or top management positions (which includes chief financial officers, heads of human resources, and logistics and purchasing managers);
4. employees at the supervisor level (which includes quality control technicians, technical, accounting, and sales supervisors);
5. qualified and nonqualified clerical employees (secretaries, human resources or accounting employees, telephone operators, and sales employees);
6. blue-collar qualified and nonqualified workers (welders, assemblers, machine operators, and maintenance workers).

TABLE 1

Distribution of Average Hourly Wage by Occupation in 2005 Euros

	CEO, Directors	Senior Staff	Supervisors	Clerks	Blue-Collar
Mean	81.39	47.83	26.58	19.01	20.70
p5	23.68	21.45	14.35	10.63	10.64
p10	28.60	25.01	16.21	11.79	11.82
p25	41.51	31.00	19.36	13.84	13.65
p50	58.06	38.28	23.11	16.49	15.97
p75	80.48	47.26	27.76	19.95	19.07
p90	114.51	59.91	34.15	24.66	23.40
p95	142.29	72.08	40.45	29.37	27.87

Note.—This table reports, for each one-digit occupational code present in the PCS-ESE 2003, mean and percentiles of the hourly wage distribution across all firms and years in the data. One observation in an occupation is the average hourly wage in a given firm-year from the BRN source, conditional on the firm reporting the occupation. The average hourly wage is the total labor cost from the BRN data set for an occupation, divided by the number of hours reported in this occupation. The total labor cost for an occupation is computed multiplying the total labor cost from the firm balance sheet times the share of wages paid to the occupation as resulting from the DADS source. Occupation 6 excludes one outlier, which would have driven its mean to 28.89.

TABLE 3

DATA DESCRIPTION BY NUMBER OF LAYERS IN THE FIRM

NUMBER OF LAYERS	FIRM-YEARS	AVERAGE Value Added	AVERAGE Hours	AVERAGE Wage	MEDIAN WAGE
1	80,326	201	7,656	26.90	17.50
2	124,448	401	15,706	21.82	18.64
3	160,030	2,834	80,488	22.31	20.41
4	86,671	8,916	211,098	23.89	22.04

NOTE.—This table reports summary statistics on firm-level outcomes, grouping firm-year observations according to the number of layers reported. Firm-years is the number of firm-year observations in the data with the given number of layers. Value added is the average from the firm's balance sheet. Hours is the average number of total hours from the DADS source. Wage is the average hourly wage from the BRN in 2005 euros. Median wage is the median across all firms in the cell of the average hourly wage from the BRN source in 2005 euros. Value added is in thousands of 2005 euros.

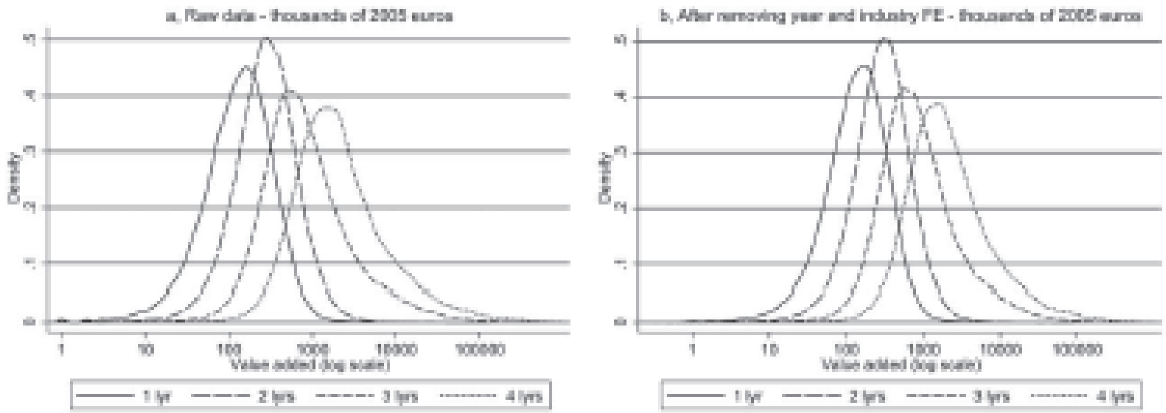

Fig. 2.—Value-added distribution by number of layers. These figures report kernel density estimates of the distribution of log value added by number of layers in the firm. The left panel reports the kernel density estimate of the distribution of log value added on the raw data: one density is estimated for each group of firms with the same number of layers. The right panel shows the same density estimated after removing year and industry fixed effects. To remove these effects, we run a regression of the form $\log v_i = \alpha + \sum_j \beta_j \text{layers}_{ji} + \sum_k \delta_k \text{industry}_{ki} + \sum_y \gamma_y \text{year}_{yi} + \varepsilon_i$, where v_i is value added for firm-year i, and $\text{layers}_{\cdot i}$, $\text{industry}_{\cdot i}$, and $\text{year}_{\cdot i}$ are a set of layers, two-digit industry, and year dummies, respectively. The omitted dummy for layers is for firms with zero layers of management. The log value added for firm-year i without year and industry fixed effects is then $\log \hat{v}_i = \log m + \sum_j \hat{\beta}_j \text{layers}_{ji} + \hat{\varepsilon}_i$, where we set m to the median value added in 2002 for firms with zero layers of management. We then compute four kernel density estimates of the distribution of $\log \hat{v}_i$, grouping firms according to their number of layers.

TABLE 4
PERCENTAGE OF FIRMS THAT HAVE CONSECUTIVELY ORDERED LAYERS

	Among firms with				
	1 Layer	2 Layers	3 Layers	4 Layers	All Firms
Unweighted	87.42	67.39	80.01	100	81.69
Weighted by value added	87.69	68.40	94.60	100	96.73
Weighted by hours	99.17	72.56	93.07	100	95.69

NOTE.—This table reports the fraction of firms with consecutively ordered layers conditioning on the number of layers in the firm (first four columns) and overall (fifth column). The first row reports the simple fraction of firms; the second and third rows assign a weight that is proportional to the total value added in the balance sheet and to the total hours in the DADS, respectively.

TABLE 5

FIRMS THAT SATISFY A HIERARCHY IN HOURS

Number of Layers	$N_L^\ell \geq N_L^{\ell+1}$ All ℓ	$N_L^1 \geq N_L^2$	$N_L^2 \geq N_L^3$	$N_L^3 \geq N_L^4$
2	85.6	85.6	...	...
3	63.4	85.9	74.8	...
4	56.5	86.9	77.5	86.9

NOTE.—This table reports, among all firms with $L = 2, 3, 4$ layers, the fraction of firms that satisfy a hierarchy in hours at all layers (first column) and the fraction of those that satisfy a hierarchy in hours between layer ℓ and $\ell + 1$, with $\ell = 1, \ldots, L - 1$ (second to fourth columns). A firm satisfies a hierarchy in hours between layers number ℓ and $\ell + 1$ in a given year if the number of hours worked in layer ℓ is at least as large as the number of hours worked in layer $\ell + 1$; moreover, a firm satisfies a hierarchy at all layers if the number of hours worked in layer ℓ is at least as large as the number of hours in layer $\ell + 1$, for all layers in the firm. The term N_L^ℓ is the number of hours reported in layer ℓ in a firm with L layers from the DADS source.

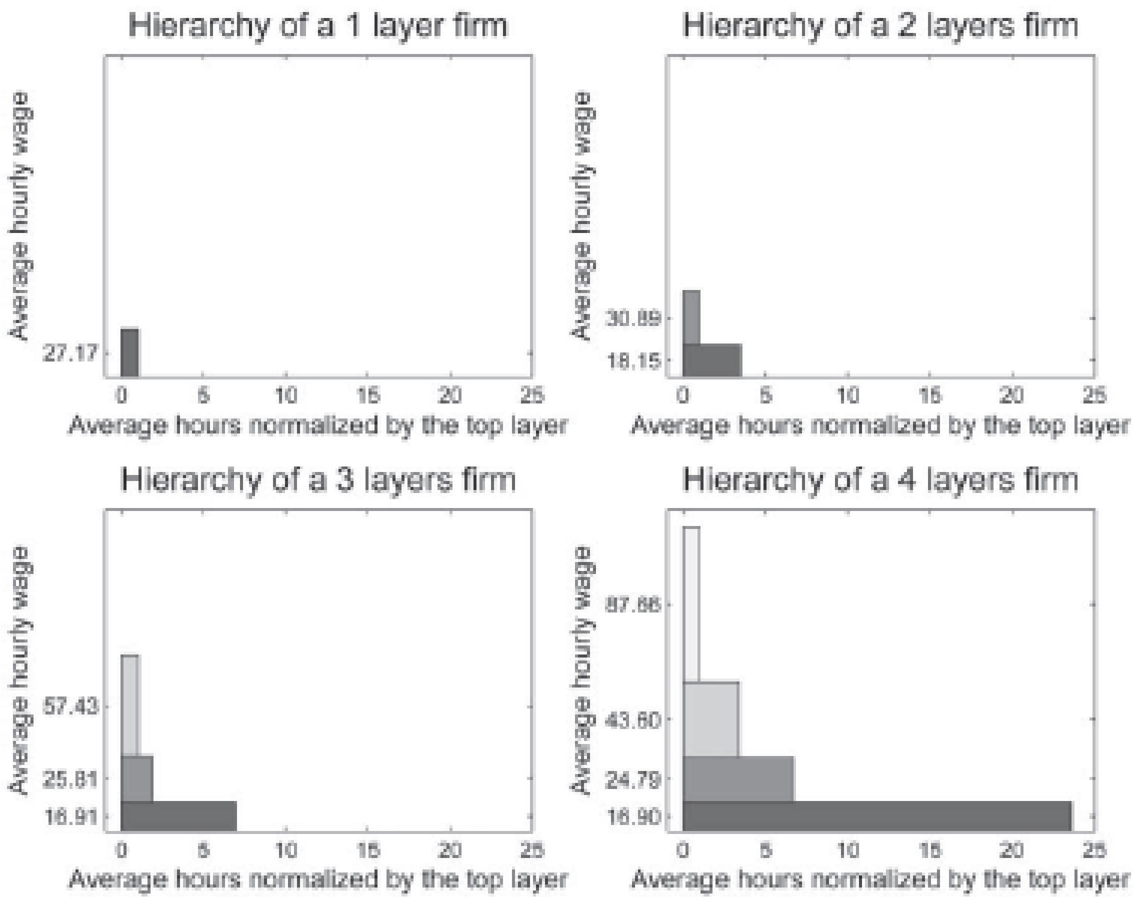
Hierarchy of a 1 layer firm
Average hourly wage
27.17
0 5 10 15 20 25
Average hours normalized by the top layer
Hierarchy of a 2 layers firm
Average hourly wage
30.89
18.15
0 5 10 15 20 25
Average hours normalized by the top layer
Hierarchy of a 3 layers firm
Average hourly wage
57.43
25.81
16.91
0 5 10 15 20 25
Average hours normalized by the top layer
Hierarchy of a 4 layers firm
Average hourly wage
87.86
43.60
24.79
16.90
0 5 10 15 20 25
Average hours normalized by the top layer

TABLE 7
MEAN SHARE OF VARIATION IN WAGES EXPLAINED BY CROSS-LAYER VARIATION

			Weighted by	
	Firm-Years	Unweighted	Hours	Value Added
All firms	434,872	.50	.51	.49
Firms with more than 1 layer	370,997	.59	.51	.50
Firms with 1 layer	63,875	.00	.00	.00
Firms with 2 layers	124,299	.50	.41	.43
Firms with 3 layers	160,028	.62	.51	.50
Firms with 4 layers	86,670	.66	.53	.50

NOTE.—For this table we compute the R^2 of a regression of log hourly wages of workers within a firm on a constant and dummies for layers (all except one), weighted by the number of hours each worker provides to the firm. For each row, the column unweighted reports the average R^2 across all firm-years, while the remaining two columns to the right report the same average when weighting firms by their total number of hours or total value added. The column firm-years reports the number of firm-years used to compute the statistics in the corresponding row. Note that for some firms—e.g., firms with only one worker—the R^2 cannot be computed, and hence the total number of firm-years in the data set does not correspond to the total number of firm-years used. Each row differs from the others according to the subsample of firm-years used in computing the average.

TABLE 8
DISTRIBUTION OF LAYERS AT $t + 1$ CONDITIONAL ON LAYERS AT t

NUMBER OF LAYERS AT t	NUMBER OF LAYERS AT $t + 1$					TOTAL
	Exit	1	2	3	4	
1	15.3	67.5	15.2	1.9	.2	100
2	9.8	10.7	62.2	16.2	1.1	100
3	7.7	1.2	13.1	67.6	10.5	100
4	6.2	.2	2.0	20.5	71.3	100

NOTE.—This table reports the distribution of the number of layers at time $t + 1$, grouping firms according to the number of layers at time t. Among all firms with L layers ($L = 1, \ldots, 4$) in any year from 2002 to 2006, the columns report the fraction of firms that have layers 1, . . . , 4 the following year (from 2003 to 2007) or are not present in the data set, exit. The elements in the table sum to 100 percent by row.

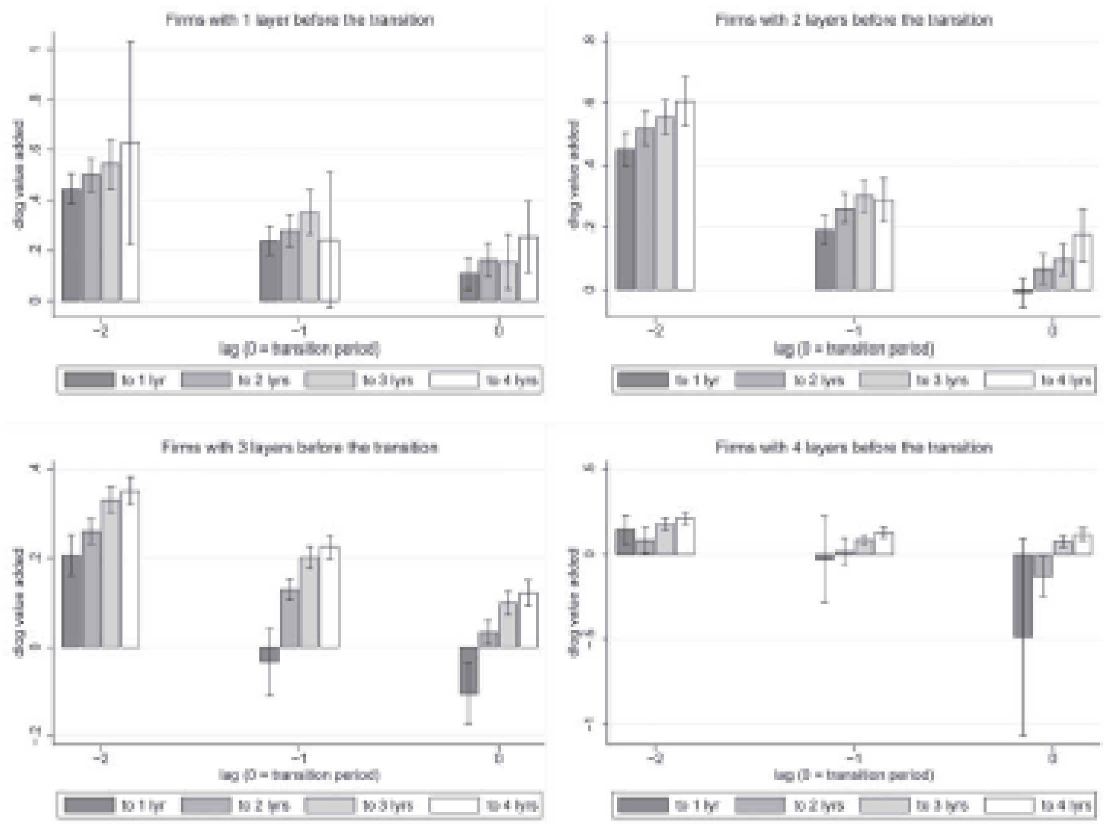

FIG. 7.—Changes in value added before and during transition. These figures show the fixed effect of a given transition (from L to L' number of layers, with $L, L' = 1, 2, 3, 4$) on the average firm growth in a period, conditional on initial size. We use the specification presented in the text. The figure presents the value of $\gamma^1_{LL't-k}$ and its 95 percent confidence interval, grouping in each panel firms with a given number of layers before the transition (i.e., the top-left panel shows $\gamma^1_{1L't-k}$, the top-right $\gamma^1_{2L't-k}$, and so on). Within each panel, the dummies are grouped according to the time lag before the transition, $k = 2, 1, 0$, and, within each group, ordered by the number of layers L' after the transition.

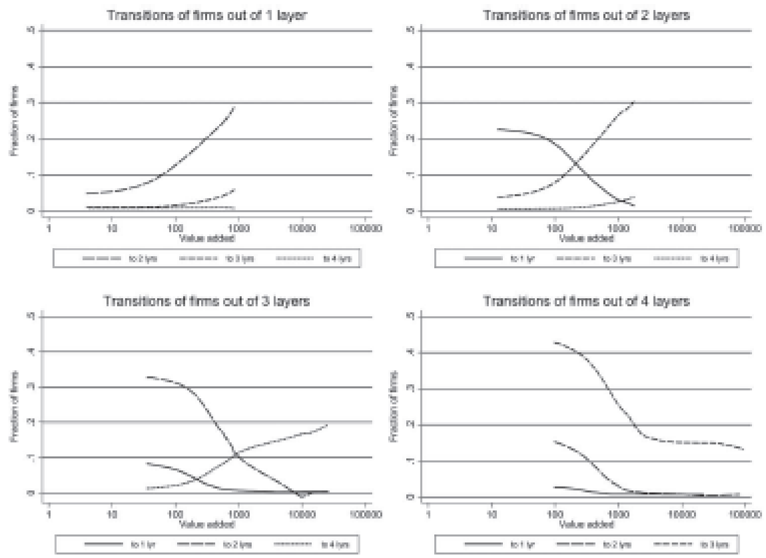

Fig. 6.—Transitions across layers depend on value added. These figures show the probability of transition away from the current layer as a function of the initial value added of the firm. Each panel reports transition probabilities starting from a different initial number of layers. To produce the panel of transitions out of layer $L = 1, \ldots, 4$, we take for each year (from 2002 to 2006) all the firms with L layers and group them into 100 bins according to their value added; for each bin, we compute the fraction of firms that will have any number of layers (or exit the data set) in the following period and plot the average value added in the bin against this fraction. For each transition series we then apply a lowess smoothing for all the probabilities estimated from the first to the ninety-ninth bin.

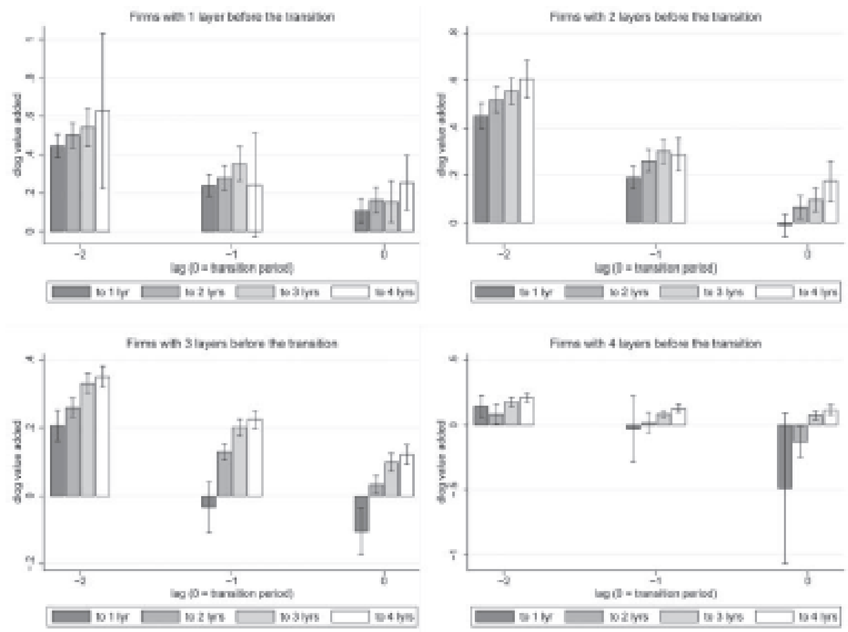

FIG. 7.—Changes in value added before and during transition. These figures show the fixed effect of a given transition (from L to L' number of layers, with $L, L' = 1, 2, 3, 4$) on the average firm growth in a period, conditional on initial size. We use the specification presented in the text. The figure presents the value of $\gamma^1_{LL't-k}$ and its 95 percent confidence interval, grouping in each panel firms with a given number of layers before the transition (i.e., the top-left panel shows $\gamma^1_{1L't-k}$, the top-right $\gamma^1_{2L't-k}$, and so on). Within each panel, the dummies are grouped according to the time lag before the transition, $k = 2, 1, 0$, and, within each group, ordered by the number of layers L' after the transition.

TABLE 9
Elasticity of Hours with Value Added for Firms That Do Not Change L

Number of Layers	Layer	β_L^ℓ	Standard Error	p-Value	Observations
2	1	.042	.012	.000	64,536
3	1	.039	.009	.000	91,253
3	2	.013	.010	.200	91,253
4	1	.107	.014	.000	52,799
4	2	.051	.013	.000	52,799
4	3	.037	.013	.000	52,799

Note.—This table reports the results of regressions of detrended log change in normalized hours at layer ℓ in a firm with L layers on its detrended log change in value added, and no constant, selecting all the firms that stay at L layers across 2 consecutive years. The term β_L^ℓ is the coefficient on log change in value added.

TABLE 11
CHANGE IN FIRM-LEVEL OUTCOMES

	All	Increase L	No Change in L	Decrease L
d ln total hours	−.015***	.040***	−.012***	−.081***
Detrended	. . .	.055***	.003***	−.066***
d ln normalized hours	−.011***	1.362***	.012***	−1.404***
Detrended	. . .	1.373***	.023***	−1.392***
d ln VA	−.008***	.032***	−.007***	−.050***
Detrended	. . .	.040***	.001	−.041***
d ln average wage	.019***	.015***	.019***	.025***
Detrended	. . .	−.005***	.000	.006***
Common layers	.021***	−.101***	.019***	.143***
Detrended	. . .	−.122***	−.002***	.122***
% of firms	100	12.65	73.66	13.68
% value added change	100	40.12	65.08	−5.19

NOTE.—This table reports changes in firm-level outcomes between consecutive years for all firms and for the subsets of those that increase, do not change, and decrease layers. It reports changes in log hours, log normalized hours, log average wage from the BRN, and log average wage in common layers for the whole sample. The change in average wage for common layers in a firm that transitions from L to L' layers is the change in the average wage from the BRN computed using only the first $\min\{L, L'\}$ layers before and after the transition. To detrend a variable, we subtract from all the log changes in a given year the average change during the year across all firms. In the last two rows of the table, % of firms is the percentage of firms observed having each type of behavior; % value added change is the fraction of the total change in real value added observed in the data set accounted for by firms making the given transition.

*** Significant at 1 percent.

TABLE 12
Average Log Change in Hours for Firms That Transition

Number of Layers Before	Number of Layers After	Layer	$d\ln \tilde{n}^{\ell}_{Lt}$	Standard Error	p-Value	Observations
1	2	1	1.537	.018	.000	10,177
1	3	1	1.762	.056	.000	1,263
1	4	1	2.266	.212	.000	97
2	1	1	−1.582	.017	.000	11,106
2	3	1	.716	.012	.000	16,800
2	3	2	.539	.012	.000	16,800
2	4	1	1.205	.049	.000	1,129
2	4	2	1.004	.048	.000	1,129
3	1	1	−1.795	.048	.000	1,584
3	2	1	−.682	.012	.000	17,666
3	2	2	−.518	.012	.000	17,666
3	4	1	1.352	.014	.000	14,113
3	4	2	1.289	.016	.000	14,113
3	4	3	1.174	.016	.000	14,113
4	1	1	−2.119	.173	.000	123
4	2	1	−1.059	.041	.000	1,456
4	2	2	−.918	.040	.000	1,456
4	3	1	−1.411	.014	.000	15,160
4	3	2	−1.345	.015	.000	15,160
4	3	3	−1.260	.015	.000	15,160

Note.—This table reports estimates of the average detrended log change in normalized hours at each layer among firms that transition from L to L' layers, with $L \neq L'$: for a transition from L to L', we can evaluate only changes for layer number $\ell = 1, \ldots, \min\{L, L'\}$. The detrending is explained in the main text. The term $d\ln \tilde{n}^{\ell}_{Lt}$ is the average detrended log change in the transition, estimated as a regression of the detrended log change in the number of normalized hours in layer ℓ in 2 consecutive years on a constant. The table uses all observed transitions in the sample.

TABLE 13

AVERAGE LOG CHANGE IN WAGES FOR FIRMS THAT TRANSITION

Number of Layers Before	Number of Layers After	Layer	$d\ln\tilde{w}^{\ell}_{L\,s}$	Standard Error	*p*-Value	Observations
1	2	1	−.129	.005	.000	10,177
1	3	1	−.332	.020	.000	1,263
1	4	1	−.678	.117	.000	97
2	1	1	.167	.005	.000	11,106
2	3	1	−.050	.002	.000	16,800
2	3	2	−.255	.004	.000	16,800
2	4	1	−.150	.015	.000	1,129
2	4	2	−.409	.019	.000	1,129
3	1	1	.356	.018	.000	1,584
3	2	1	.059	.002	.000	17,666
3	2	2	.249	.004	.000	17,666
3	4	1	−.021	.002	.000	14,113
3	4	2	−.067	.003	.000	14,113
3	4	3	−.199	.004	.000	14,113
4	1	1	.804	.109	.000	123
4	2	1	.139	.012	.000	1,456
4	2	2	.372	.016	.000	1,456
4	3	1	.009	.002	.000	15,160
4	3	2	.040	.003	.000	15,160
4	3	3	.134	.004	.000	15,160

NOTE.—This table reports estimates of the average detrended log change in hourly wage at each layer ℓ among firms that transition from L to L' layers, with $L \neq L'$: for a transition from L to L', we can evaluate only changes for layer number $\ell = 1, \ldots, \min\{L, L'\}$. The term $d\ln\tilde{w}^{\ell}_{L\,s}$ is the average detrended log change in the transition, estimated as a regression of the detrended log change in the average hourly wage at layer ℓ in 2 consecutive years on a constant. The table uses all observed transitions in the sample.

$$d \ln \bar{w}_{Lit} = \ln \bar{w}_{L'it+1} - \ln \bar{w}_{Lit}$$
$$= \ln[(\bar{w}^{l \le L}_{L'it+1}/\bar{w}_{Lit})s + (w^{L'}_{L'it+1}/\bar{w}_{Lit})(1 - s)],$$

TABLE 14
DECOMPOSITION OF TOTAL LOG CHANGE IN AVERAGE WAGES

	$\bar{w}^{l \le L}_{L'it+1}/\bar{w}_{Lit}$				$\bar{w}^{L'}_{L'it+1}/\bar{w}_{Lit}$		
From/To	2	3	4	From/To	2	3	4
1	.963***	.865***	.733***	1	1.507***	1.501***	1.602***
	(10,167)	(1,262)	(96)		(10,166)	(1,263)	(97)
2		.926***	.876***	2		2.040***	2.021***
		(16,783)	(1,128)			(16,783)	(1,129)
3			.958***	3			4.385***
			(14,099)				(14,099)
	s				$d \ln \bar{w}_{Lit}$		
From/To	2	3	4	From/To	2	3	4
1	.741***	.620***	.563***	1	−.007*	−.094***	−.305**
	(10,166)	(1,262)	(97)		(10,166)	(1,263)	(97)
2		.853***	.775***	2		.005**	−.033**
		(16,784)	(1,128)			(16,784)	(1,129)
3			.948***	3			−.001
			(14,099)				(14,098)

NOTE.—This table reports the sources of change in the average hourly wage from the BRN, by type of transition. For a given firm transitioning from L to $L' > L$ layers, write the detrended log change in average wage as

$$d \ln \bar{w}_{Lit} = \ln \bar{w}_{L'it+1} - \ln \bar{w}_{Lit} = \ln[(\bar{w}^{l \le L}_{L'it+1}/\bar{w}_{Lit})s + \bar{w}^{L'}_{L'it+1}/\bar{w}_{Lit}(1 - s)].$$

In this notation, $\bar{w}^{l \le L}_{L'it+1}$ is the average hourly wage after the transition in the common layers, $\bar{w}_{Lit}$ is the average hourly wage before the transition, s is the share of hours of the common layers after the transition, and $\bar{w}^{L'}_{L'it+1}$ is the average wage in the layers added after the transition. We report in the cells the average of each of these quantities in the first three panels; the fourth panel shows the overall average log change in hourly wage during the indicated transition. Each cell is computed excluding observations below the 0.05th and above the 99.95th percentile. Numbers of observations are in parentheses.

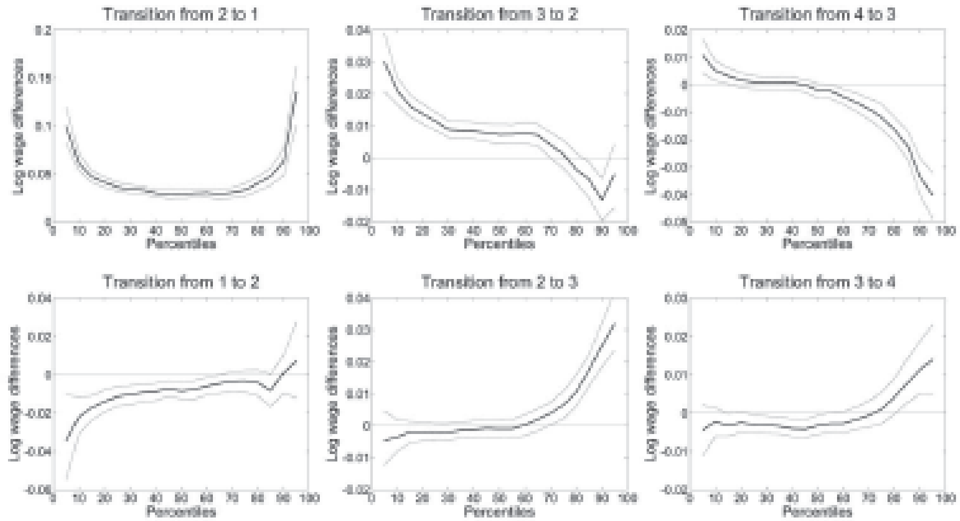

FIG. 8.—Difference in the distribution of wages after minus before the transition. These figures portray, for each transition type, difference in the distribution of wages after minus before the transition. The y-axis in each panel reports the log difference between the wage at the pth percentile after, less its correspondent wage before the transition. To compute standard errors, we performed 500 bootstrap replications of this process, clustering the sampling at the firm-transition level (i.e., one cluster contains all the employees present either before or after a transition in one firm) to preserve the within-firm and within-transition correlation in wages present in the data, and we report the 5th and 95th percentiles of these replications. To compute these panels, we first construct an employee-level data set that contains log hourly wage of each employee, a firm identifier, and year and current number of layers of the firm, and we remove year and firm fixed effects from the log hourly wage distribution. We then focus on all the hours worked in firm-year observations in which the firm is making a transition from ℓ to ℓ' layers (both before and after the transition takes place) and compute the pth percentile (for $p = 5, 10, \ldots, 95$) in the two distributions: the wage distribution after and before the transition. Each distribution of hourly wages is computed making sure that each employee receives a weight proportional to her number of hours in the firm but giving to each firm the same weight, regardless of the total number of hours worked in it (to be consistent with our estimates of changes in log wages in table 13).

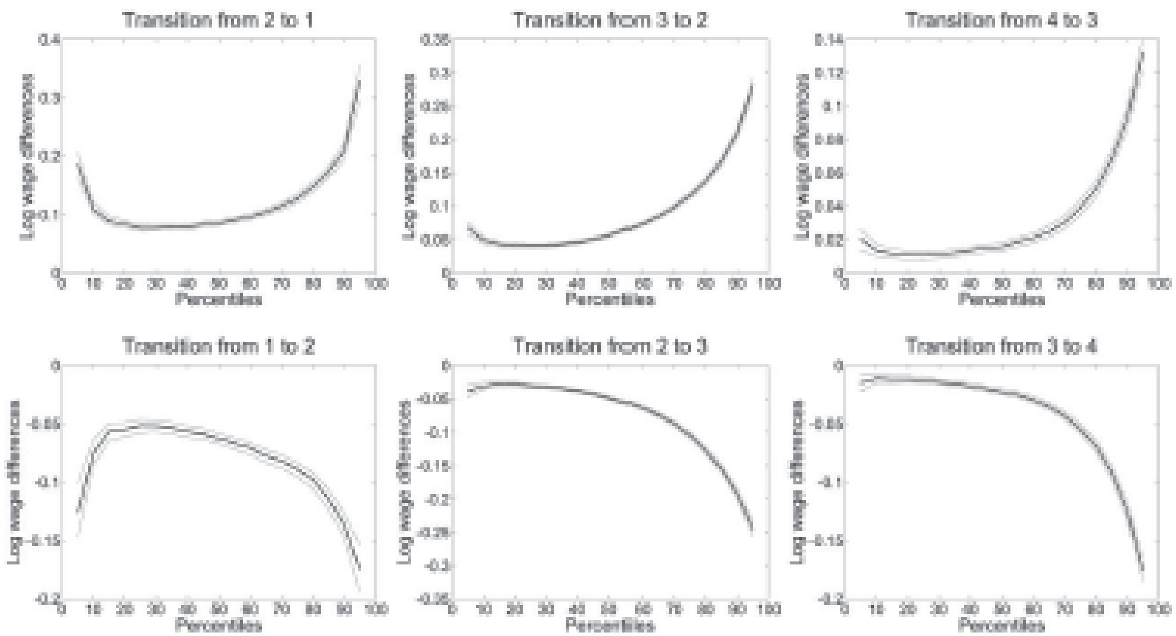

FIG. 9.—Difference in the distribution of wages in common layers after minus before the transition. This figure portrays, for each transition type, the estimated log change (on the y-axis) in the percentiles (on the x-axis) of the wage distribution in common layers within firms, after the transition versus before the transition, and associated 95 percent bootstrapped confidence intervals. To build it we follow the same process described in figure 8, to which we refer, with the only difference that after removing year and firm fixed effects, we focus on the wage distribution implied by all hours worked in layers that are common before and after the transition.

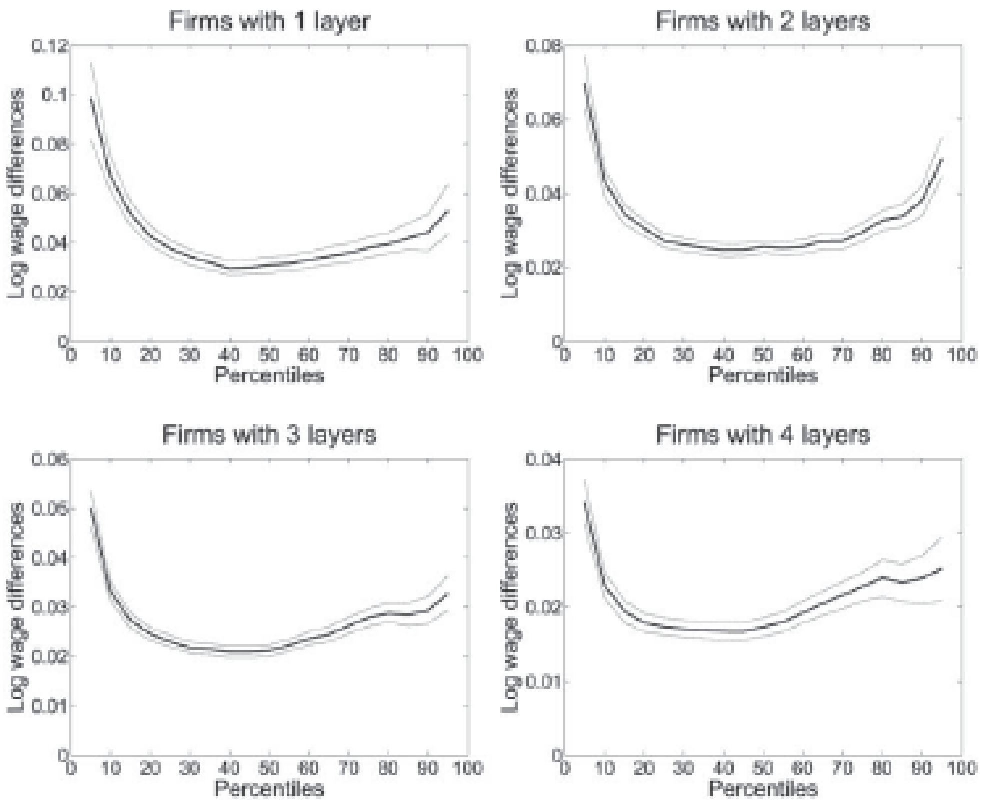

Fig. 10.—Difference in the distribution of wages for firms that do not transition and $d \ln VA > 0$. This figure portrays, for firms staying at a given number of layers in 2 consecutive years and positive change in value added, the estimated log change (on the y-axis) in the percentiles (on the x-axis) of the wage distribution within firms, the year after less the year before, and associated 95 percent bootstrapped confidence intervals. To build it we follow the same process described in figure 8.