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The Stability of Dividends and Wages: Effects of Competitor Inflexibility

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Abstract

We analyze global data about electricity generation and document that the risk exposure of a firm's owners and its workers depends on competitors' ability or willingness to change their output in response to productivity shocks. Competitor inflexibility appears to be a risk factor: the sales of firms with more inflexible competitors respond more strongly to aggregate sales shocks. As a consequence, competitor inflexibility also affects the stability of firms' total wage- and dividend-payments. Firms with relatively flexible competitors appear to smoothen both wages and dividends, but an increase in competitor inflexibility is associated with less dividend-smoothing and more wage-smoothing. Our evidence supports the idea that labor productivity risk associated with competitor inflexibility should be borne by firms' shareholders, rather than by their workers.

President Obama, 2012:

> *"The family business in Warroad, Minnesota, that didn't lay off a single one of their four thousand employees during this recession, even when their competitors shut down dozens of plants, even when it meant the owners gave up some perks and pay - because they understood their biggest asset was the community and the workers who helped build that business – they give me hope."*

1 Introduction

This paper provides evidence for an idea that can be illustrated by President Obama's statement cited above: the risk exposure of a firm's owners and workers depends on competitors' behavior in adjusting the scale of their output. The idea is that, by "shutting down dozens of plants," the competitors of the family business in Minnesota may have facilitated the "insurance" against job loss that this business provided to its employees.[1] More specifically, the employees' productivity may have increased due to external effects of the shut-downs. For example, the residual demand for the employees' output may have increased due to the missing supply of the shut-down plants. Alternatively, the employees' productivity may have increased since the shut-downs reduced input prices by reducing competitors' input demand. Either way, the shut-downs would have reduced any losses of "perks and pay" that the owners of the family business incurred when they kept their workers employed. Had the competitors been less flexible, the workers of the family business may have received less employment insurance.

To the best of our knowledge, our paper provides the first empirical evidence that the risk exposure of a firm's workers and owners depends on the technological configuration of competing firms. Our starting point is the idea that competitors' production technologies determine the way they will respond to industry-wide labor productivity shocks. We combine this idea with the idea discussed above, i.e. that competitor inflexibility affects the extent to which a firm insures its workers against productivity shocks. In combination, the

[1] The idea that workers receive "insurance" against productivity shocks goes back to at least Knight (1921) who described industry as the "system under which the venturesome and confident [...] insure the doubtful and timid."

two ideas suggest that the technological configuration of competitors affects the productivity risk sharing between a firm's owners and workers. We document such effects based on data about firms in electricity generation. The theoretical foundation of our empirical analysis will be further discussed by means of a simple model in Section 2.

Our industry focus is primarily motivated by the need for convincing measures of firms' flexibility in changing the scale of their output. Electricity can be produced by means of a wide range of technologies. In choosing from the technological options, firms face a trade-off between fixed and variable costs of production. Once the choices are made, a firm's response to economic shocks depends on the extent to which it will keep plants running because the plants can produce output at a relatively low marginal cost. The higher the fraction of a firm's total capacity coming from low-cost plants, the more inflexible will the firm respond to, say, changes in demand.

The main explanatory variable of our analysis is a measure of competitor inflexibility. For each firm in our estimation sample, we measure competitor inflexibility based on data about the production capacities and technologies of power plants in the country in which the firm is headquartered. We ignore the firm's own plants, and compute the capacity share of plants with low variable production costs among all competing plants.[2] The result is our measure of competitor inflexibility. We also compute the share of each firm's own capacity associated with low-cost plants in order to use it as a control variable.[3]

The distinguishing feature of our analysis is our focus on effects of competitor inflexibility on the risk exposure of firms' owners and workers. In terms of methodology, our paper is inspired by Ellul, Pagano, and Schivardi (2014). We measure elasticities of suitable dependent variables with respect to shocks that are identified based on changes in the aggregate sales of a firm's competitors.[4] By allowing the elasticities to vary in our measure of competitor inflexibility, we obtain evidence that competitor behavior affects the extent

[2] Our baseline estimates result from considering nuclear, hydro, and geothermal power plants as low-cost plants. In a robustness check, we also include low-cost plants based on intermittent energy sources, i.e. solar- and wind-powered plants.

[3] We check that our results do not depend on whether one controls for firms' (potentially endogenous) own technological choices. To treat the technological choices of firms' competitors as exogenous, we restrict our sample to firms with sufficiently many competitors and a sufficiently small market share.

[4] We focus on a sample of firms with sufficiently many competitors and sufficiently low market share that the competitors' aggregate sales can be regarded as exogenous.

to which firms smoothen their wage- and dividend payments.

Our evidence is based on several dependent variables. Besides analyzing changes in wages and dividends (including share repurchases), we also use two dependent variables that measure the *shares* of firms' sales that firms' workers and owners receive. The two variables are the wages-to-sales ratio, and the dividends-to-sales ratio. They are used as dependent variables in regressions that measure the extent of wage- and dividend smoothing in terms of the elasticities of the two ratios with respect to aggregate sales shocks. For low values of competitor inflexibility, we find significantly negative estimates for both the elasticity of the wages-to-sales ratio and that of the dividend-to-sales ratio. It thus appears that firms with relatively flexible competitors smoothen both wage- and dividend payments: In response to a negative (positive) aggregate sales shock, firms increase (reduce) the extent to which sales are used to finance wage- and dividend payments. For high values of competitor inflexibility, the elasticity of the wages-to-sales ratio stays significantly negative, but that of the dividend-to-sales ratio turns positive. It thus appears that an increase in competitor inflexibility is associated with less dividend-smoothing and more wage-smoothing. Corroborating evidence comes from regressions in which we use firms' wages, dividends, and sales as dependent variables. For example, we find that dividends exhibit a significantly positive elasticity with respect to aggregate sales shocks if competitor inflexibility takes its third quartile value, but the elasticity is insignificant given the first quartile value of competitor inflexibility.

Our evidence suggests that it is efficient to allocate risk associated with competitor inflexibility to firms' owners rather than to their workers. This notion is consistent with Berk and Walden (2013) view that firms' owners should "insure" the firms' workers against risk because the workers have less access to risk-sharing opportunities in financial markets. When it comes to risk associated with competitor inflexibility, the risk should be borne by firms' owners because competing firms can have joint owners, but they will typically employ different workers. Our findings can thus be explained by the idea that, by allowing for joint ownership of competing firms, financial markets create diversification opportunities that enable firms' owners to "insure" the firms' workers against risk associated with competitor inflexibility.

As discussed above, our industry focus allows us to measure competitor inflexibility in a convincing way, but it also comes at a cost. A major concern is regulation. Although we are not alone in analyzing data about firms in the electricity sector,[5] it is standard practice in corporate finance to exclude firms in the electricity sector from empirical analyses. We therefore check whether our results are driven by effects of regulation. We show that similar results are obtained based on a subsample of firms from countries with rules for "ownership-unbundling" that separate the electricity generation business from the – heavily regulated – transmission of electricity. Additional robustness checks confirm that our results are robust to excluding firms in countries without liquid wholesale markets, varying our definition of competitor inflexibility and the way we measure aggregate sales shocks, and controlling for differences between listed and unlisted firms.

The present paper contributes to the growing literature on "insurance within the firm", following the seminal contribution by Guiso, Pistaferri, and Schivardi (2005). Most closely related are contributions regarding effects of competition. Bertrand (2004) analyzes how import competition affects the elasticity of wages to unemployment rates and provides evidence that competitive pressure causes firms to change their wage-setting policies so that workers receive less insurance against changes in their outside options. Cuñat and Guadalupe (2009) extend Bertrand's identification strategy and analyze how import penetration affects CEO compensation, while instrumenting import penetration using exchange rates and tariffs. They find that more foreign competition is associated with a higher sensitivity of CEO pay to performance. Our contribution differs from the literature due to our focus on firms' technological choices and the *nature* of competition, i.e. the way competing firms respond to economic shocks. Moreover, we explicitly analyze risk-transfers between firms' owners and workers by comparing the effect of competitor inflexibility on payments to *both* groups of stakeholders.

Our paper is also related to the large literature on payout policy, recently surveyed by Farre-Mensa, Michaely, and Schmalz (2014) who note that payout policy is usually analyzed in isolation, i.e. without taking potential links to other corporate policies into account. Against this backdrop, our paper stresses the trade-off between using sales to

[5] For recent contributions, see Pérez-Gonzáles and Yun (2013) and Reinartz and Schmid (2015).

finance dividends or wages. Findings of Brav, Graham, Harvey, and Michaely (2005) suggest that this trade-off is indeed relevant: They report that managers of public firms consider it a top priority to maintain stable dividends, and that some even consider laying off a large number of employees in order to avoid dividend cuts. Related evidence appears in Almeida, Fos, and Kronlund (2015) who find that managers are willing to cut employment in order to meet earnings forecasts through stock repurchases. No previous contribution analyzed the effect of competitor inflexibility on the stability of dividends.

2 Theoretical foundations

We discuss the theoretical foundations of our analysis by means of a simple model of a firm exposed to demand risk. We start by considering how the effect of demand changes on the firm's gross profit depends on the average production cost of competing firms. The next subsection motivates our measure of competitor inflexibility and shows that competitor inflexiblity increases a firm's exposure to demand shocks. Specifically, we show that demand shocks will have a stronger effect on our firm's gross profits the less competitors respond to demand shocks because of lower production costs.

2.1 Competitor inflexibility as a risk factor

We consider a firm F which faces N competitors. The firms produce a homogeneous output the price of which is given by a linear inverse demand function: $p(Y) = a - bY$, where Y denotes the firms' aggregate output. All firms can produce output at constant marginal cost. For our purposes, it suffices to distinguish between the marginal production cost of firm F, denoted as c, and the average marginal production cost of the competing firms, denoted as $\bar{c}$. We will interpret the heterogeneity in the firms' production costs as resulting from different technological choices.

Standard Cournot analysis shows that firm F's equilibrium gross profit[6] is given by

[6]Gross profit is defined as the product of the firm's output and the difference between the output price and the production cost c.

the following function:[7]

$$\pi[a] := \frac{(a + N(\bar{c} - c) - c)^2}{b(N+2)^2}.$$

We can use this profit function in order to discuss how firm F's risk exposure depends on its production cost c and the average production cost of the firm's competitors, $\bar{c}$. For now, our measure of risk exposure is the percentage change (growth rate) of the firm's profit caused by marginal changes in parameters of the inverse demand function $p(Y)$. Given our focus on a linear inverse demand function $p(Y)$, it suffices to consider marginal changes in the function's intercept, a.[8] It is easy to show that an increase (decrease) in a raises (reduces) firm F's profit at a rate which decreases in the average cost $\bar{c}$ of the firm's competitors while increasing in the firm's own production cost c:

$$\frac{\partial}{\partial \bar{c}} \left(\frac{\pi'[a]}{\pi[a]} \right) < 0, \text{ and } \frac{\partial}{\partial c} \left(\frac{\pi'[a]}{\pi[a]} \right) > 0, \tag{1}$$

where π' denotes the derivative of the profit function with respect to the intercept of the inverse demand function. These results imply that the exposure of firm F's profits to demand risk will depend on the technological choices of firm F and its competitors, which determine the firms' production costs.

The exposure-increasing effect of a reduction in competitors' average cost $\bar{c}$ can be interpreted as an effect of competitor inflexibility since the average production cost $\bar{c}$ is a measure of the percentage change in the competitors' output induced by a demand change. The lower the average production cost of the competitors, the less flexible will they respond to demand shocks,[9] and the more will such shocks affect firm F's profit. In our empirical analysis, we will therefore measure competitor inflexibility based on the production costs of power plants, and we will check whether competitor inflexibility is indeed a risk.

[7] See the literature started by Kreps and Scheinkman (1983) for foundations of Cournot analysis.

[8] For a marginal change in the slope parameter b, the percentage change in firm F's profit does not depend on the production costs of firm F or its competitors since it simply equals $-1/b$.

[9] Consider the Cournot output of firm F itself: $y[a] = (a + N(\bar{c} - c) - c)/(b(N+2))$. It is easy to show that a change in a will change the output $y[a, b]$ by a percentage which increases in the cost c. Firm F's competitors behave in a similar way.

2.2 Competitor inflexibility risk sharing

We next turn to the effect of competitor inflexibility on the risk-sharing between firm F's owners and workers. For simplicity, we assume that firm F has one representative owner and one representative worker. The two parties differ in terms of their access to risk-sharing opportunities afforded by financial markets: Only the owner can participate in financial markets. To analyze risk-sharing between the two parties, we assume that there are two states, $\{1, 2\}$, each of which is characterized by a pair (e_s, a_s) of parameters, where a_s is a state-specific value of the intercept of the industry's inverse demand function $p(Y)$, and e_s denotes the consumption endowment of firm F's owner in state s.[10] We assume that firm F's owner chooses the firm's output after the demand for its output is revealed, but wage contracting takes place before the resolution of uncertainty.

Given our research agenda, we focus on wage contracting for the purpose of achieving an efficient allocation of risk to the owner and worker of firm F. Wage contracting specifies a pair (w_1, w_2) of wages that firm F's worker receives in the two states. We assume that the wages are quasi-fixed costs which do not depend on the firm's output, and we abstract from the risk that the firm may default on its wage payments.

The dividend received by the firm's owner will be the part of the firms' profit $\pi_s := \pi[a_s]$ that remains after paying wage costs of w_s in a state s. Given the arguments in the last sub-section, the difference $\Delta\pi := \pi_1 - \pi_2$ between the firm's profits in the two states will increase in competitor inflexibility. We next analyze how the profit variation affects the risk exposure of firm F's owner and its worker.

To analyze wage contracting, we can specify the preferences of firm F's owner and its worker in terms of risk-neutral probabilities that determine their certainty equivalent payoffs as follows:

$$\begin{aligned} W &:= Q_W w_1 + (1 - Q_W) w_2, \\ D &:= Q_O(e_1 + \pi_1 - w_1) + (1 - Q_W)(e_2 + \pi_2 - w_2), \end{aligned}$$

[10] As discussed in footnote 8, variation in the slope of the inverse demand curve causes a percentage change in firm F's profit which does not depend on the average production cost of competing firms. It therefore suffices to simply specify a state in terms of a pair (a_s, e_s) without allowing for variation in the slope b of the inverse demand function $p(Y)$ across states.

where W is the certainty equivalent wage, D is the certainty equivalent dividend, and Q_W and Q_O are the risk-neutral probabilities that firm F's worker and its owner assign to state 1. For the purpose of our discussion here, it suffices to adopt the following - particularly tractable - specification of the risk-neutral probabilities:[11]

$$Q_W := P_1 - \gamma_W \Delta w,$$
$$Q_O := P_1 - \gamma_O(\Delta e + \Delta\pi - \Delta w),$$

where $\Delta w := w_1 - w_2$, $\Delta\pi := \pi_1 - \pi_2$, and $\Delta e = e_1 - e_2$ and γ_W and γ_O are parameters that depend on the risk-aversion of the firm's worker and its owner, respectively.

Equating the agents' marginal rates of substitution between their payoffs in the two states yields the following result:

$$\Delta w = (\Delta e + \Delta\pi)\frac{\gamma_O}{\gamma_O + \gamma_W}. \tag{2}$$

The left-hand side is the difference between the wages that the worker receives in the two states. The expression shows that the wage difference increases in the difference between the states in terms of the payoff of firm F's owner, which depends on the variation in the firm's profit across the two states. By increasing the profit variation $\Delta\pi$ (as discussed above), competitor inflexibility will increase the wage risk borne by firm F's worker, provided the variation in $\Delta\pi$ cannot be offset by variation in the endowment of firm F's owner. The ratio $\gamma_O/(\gamma_O + \gamma_W)$ determines the optimal risk exposure of the worker.

The above-stated result can be used to analyze how the effect of competitor inflexibility on wage risk is modulated by the systematic risk of changes in the demand for the industry's output. To do so, we first specify the exposure of firm F's profits to demand risk. Suppose that the two states of our model represent the risk that the intercept of the inverse demand function $p(Y)$ changes from a_0 to either $a_1 = a_0 \exp(+\sigma_a)$ or $a_2 = a_0 \exp(-\sigma_a)$, where σ_a is a parameter that measures the extent of demand risk. Then, a first-order Taylor

[11] This specification results from an approximation of marginal utility as a linear function of the difference between the payoff that an agent receives in a state s, and the agent's expected payoff. For example, the worker's marginal utility in state s is $MU_s := P_s - \kappa_W(w_s - \bar{w})$, where $\bar{w} = P_1 w_1 + (1 - P_1) w_2$ is the expected wage paid by firm F. The risk-neutral probability Q_W is then defined as follows: $Q_W := P_1(MU_1/\bar{MU}_W)$, where $\bar{MU}_W$ denotes the worker's expected marginal utility. $Q_W = P_1 - \gamma_W \Delta w$ with $\gamma_W = \kappa_W P_1(1 - P_1)$.

approximation (around $\sigma_a = 0$) yields the following growth rates of firm F's profits:

$$\frac{\pi[a_s]}{\pi[a_0]} \approx \begin{cases} 1 + \theta\sigma_a & \text{if } s = 1, \\ 1 - \theta\sigma_a & \text{if } s = 2, \end{cases}$$

so that

$$\Delta\pi = \pi[a_1] - \pi[a_2] \approx 2\pi[a_0]\theta\sigma_a,$$

where $\theta := 2a/(a + N(\bar{c} - c) - c)$ is the elasticity of the firm's profit to demand risk: $\theta = d\log(\pi[a])/d\log(a)$. This exposure measure varies in the production costs c and $\bar{c}$ in a similar way as the semi-elasticity $\pi'[a]/\pi[a]$ analyzed in expression (1): $\partial\theta/\partial\bar{c} < 0$ and $\partial\theta/\partial c > 0$. The exposure increases in competitor inflexibility since, as discussed below expression (1), the competitors' average production cost $\bar{c}$ measures how *flexible* they respond to the demand shock.

If the demand risk σ_a is partly diversifiable, only the systematic component will matter for the risk-sharing between the owner and the worker of our representative firm F since the owner can efficiently eliminate the non-systematic risk through diversification. Suppose the systematic component equals $\beta_a\sigma_M$, where σ_M measures the risk of the market portfolio (assumed to be the only risk factor). In this case, the risk-sharing between the firm's owner and worker will concern only the systematic part of the firm's profit variation. As a consequence, equation (2) will apply with

$$\Delta\pi \approx 2\pi[a_0]\theta\beta_a\sigma_M. \tag{3}$$

We next specify the difference Δe in the shareholder's endowment across the two states that enters into expression (2). Suppose that the endowment either equals $e_1 = e_0 \exp(\sigma_e)$ or $e_2 = e_0 \exp(-\sigma_e)$, where σ_e measures the riskiness of the endowment, with a systematic component of $\beta_e\sigma_M$. Then, a first-order Taylor approximation yields that

$$\Delta e \approx 2e_0\beta_e\sigma_M. \tag{4}$$

By using equations (3) and (4) to substitute for $\Delta\pi$ and Δe in equation (2), we obtain the following result:

$$\Delta w \approx 2 w_0 \sigma_w, \text{ with } \sigma_w = \sigma_M \left(\frac{\pi[a_0]}{e_0} \theta \beta_a + \beta_e \right) \frac{\gamma_O}{\gamma_O + \gamma_W},$$

where σ_w measures wage risk based on a first-order Taylor approximation of the wage difference $\Delta w = w_1 - w_2$ with $w_1 := w_0 \exp(\sigma_w)$ and $w_2 := w_0 \exp(-\sigma_w)$. This measure of wage risk depends on competitor inflexibility through the exposure coefficient θ, as discussed above: The smaller the average production cost $\bar{c}$ of of firm F's competitors, the less flexible will the competitors respond to demand shocks, and the more will the firm's profit be exposed to such shocks, i.e. the higher the value of θ. The induced profit risk will, however, only be shared with workers if it cannot be eliminated through diversification. If $\beta_a = 0$, we obtain the null hypothesis that wage risk will not depend on competitor inflexibility.

An alternative null hypothesis is obtained when we use our model to analyze the within-industry effect of competitor inflexibility on the risk exposure of firms' workers and their owners. To do so, it is instructive to start with an extreme case, in which firm F's owner also owns all competitors of firm F. In this case, the difference between the two states in terms of the owner's endowment, Δe, includes the aggregate dividends of all competitors of firm F. As a consequence, the wage contracting in firm F will depend on the difference in the industry's aggregate profits across the two states, i.e. the sum of the profits of firm F's competitors and firm F itself. The same will of course be true for any of firm F's competitors. If the competitors' workers have similar preferences as those of firm F, it will be efficient that all workers in the industry bear the same amount of wage risk, even if different firms' profits vary across the two states to different extents. While differences in competitor inflexibility will cause differences in profit variation across firms (as discussed above), the wage risk exposure of different firms' workers will not vary within-industry. Put differently, the workers of different firms will receive insurance against wage risk to different extents so that their wage risk will not depend on competitor inflexibility. This will be true irrespective of the nature of the underlying demand risk, i.e. whether the risk can be eliminated through diversification.

In practice, variation in competitor inflexibility is likely to cause some within-industry variation in the risk exposure of firms' workers because firms' shareholders will differ. However, the trend towards index funds/portfolio diversification may cause increasing overlaps in the ownership of listed firms.[12] We will therefore test whether the effect of competitor inflexibility on wage risk differs across listed and unlisted firms.

3 Research strategy

We now describe our strategy for analyzing effects of competitor inflexibility on the risk-sharing between firms' workers and owners. Our methodology is inspired by Ellul, Pagano, and Schivardi (2014) who measure the elasticity of firm-level employment and wages to aggregate sales shocks. For each firm in our sample, the aggregate sales shocks will be measured based on changes in the aggregate sales of the firm's competitors (since changes in the firm's own sales are likely to be endogenously determined). To interpret the aggregate sales changes as shocks, we will use fixed effects to control for – possibly predictable – trends.

The distinguishing feature of our analysis is our focus on competitor inflexibility as a risk factor. We will estimate the elasticities of firm-level sales, wages, and dividends with respect to the aggregate sales shocks, and allow for these elasticities to vary in a measure of competitor inflexibility (defined below). The analysis will reveal how competitor inflexibility affects the riskiness of firms' sales and the risk-sharing between firms' owners and workers.

In a second step of our analysis, we will analyze workers' risk exposure in greater detail. While the first step of the analysis focuses on firms' total wage payments, the second step will be based on employment data. We will use the data to distinguish between two components of the growth of total firm-level wage payments, i.e. employment growth and the growth of the average (per capita) wage. The analysis will reveal potential effects of competitor inflexibility on employment stability and average wage stability. Moreover, we

[12] Azar, Schmalz, and Tecu (2015) consider anti-competitive effects of common ownership. We focus on the effects of common ownership on the risk-exposure of firms' workers, but we assume that the firms continue to behave as Cournot oligopolists.

will test whether the average (per capita) wage level depends on competitor inflexibility.

After discussing our research strategy, we conclude this section by defining the main variables.

3.1 Effects of competitor inflexibility on firms' workers and owners

We start by analyzing how competitor inflexibility modulates the exposure of a firm's workers and owners to aggregate sales shocks in the firm's industry. Exposure will be measured in terms of the effect of the aggregate sales shocks on five dependent variables. The first variable is firm-level sales revenue. We will test whether competitor inflexibility increases the elasticity of firm-level sales with respect to aggregate sales shocks. The other dependent variables are more geared towards measuring the specific exposure of firms' owners and workers to the aggregate sales shocks. Worker exposure will be measured in terms of changes in total wage payments, while owner exposure will be measured in terms of changes in dividend payments (including share repurchases). In addition, we will use the ratios of firms' wages-to-sales and dividends-to-sales as dependent variables. These ratios are defined as follows:

$$WtS_{i,c,t} := \frac{WAGES_{i,c,t}}{SALES_{i,c,t}}, \text{ and } DtS_{i,c,t} := \frac{DIVD_{i,c,t}}{SALES_{i,c,t}}, \tag{5}$$

where $SALES_{i,c,t}$, $WAGES_{i,c,t}$, and $DIVD_{i,c,t}$ denote the total sales revenue, total wage payments, and total dividends (incl. share repurchases) of firm i in country c and year t. Changes in the wages-to-sales ratio and the dividend-to-sales ratio determine the deviations in the income growth of a firm's workers and owners from the growth in firm-level sales. By definition,

$$\begin{aligned} \Delta WtS_{i,c,t} &= \Delta WAGES_{i,c,t} - \Delta SALES_{i,c,t}, \\ \Delta DtS_{i,c,t} &= \Delta DIVD_{i,c,t} - \Delta SALES_{i,c,t}, \end{aligned} \tag{6}$$

where Δ denotes the first difference between log-values of the succeeding variable, e.g. $\Delta WAGES_{i,c,t} = \log(WAGES_{i,c,t}) - \log(WAGES_{i,c,t-1})$. The above-stated expressions show that the ratios defined in expression (5) can be used to analyze the relative stability of firms' sales, wages, and dividend payments. For example, wages will be more stable than firm-level sales if firms respond to negative (positive) sales shocks by using a larger (smaller) fraction of their sales to finance wage payments. The opposite holds for dividends if firms' owners insure workers against sales shocks, as stated in the opening quote of our paper. In this case, the share of sales used to finance dividends will decrease (increase) in response to a negative (positive) sales shock and dividends will be less stable than sales.

The equations in expression (6) represent a conceptual framework for our analysis of effects of competitor inflexibility on the stability of the five variables that appear in the equations. For each variable, we will estimate its elasticity with respect to aggregate sales shocks, and we will allow for the elasticity to vary in a measure of competitor inflexibility, defined below. To explain our approach, we present the regression for the change in the wage to sales ratio:

$$\begin{aligned} \Delta WtS_{i,c,t} = \quad & \beta_1 \Delta AGG\,SALES_{-i,c,t} + \beta_2 \Delta AGG\,SALES_{-i,c,t} \times CINFLX_{i,c,t} \\ & + \beta_3 CINFLX_{i,c,t} + \gamma \boldsymbol{X}_{i,c,t} + \nu_i + \tau_t + \epsilon_{i,c,t}, \end{aligned} \tag{7}$$

where i indexes firms, c indexes countries, and t indexes years. The dependent variable is the growth of the wage share of firm i's sales from year $t-1$ to year t, i.e. the difference between the two years in the logarithm of the firm's ratio of wages-to-sales revenue. The explanatory variables are the growth in the aggregate sales of electricity generation companies that compete with firm i headquartered in country c, $\Delta AGGSALES_{-i,c,t}$, our measure of competitor inflexibility denoted as $CINFLX_{i,c,t}$ (defined below), and control variables, $\boldsymbol{X}_{i,c,t}$. ν_i and τ_t are fixed effects at the firm- and year-level, and $\epsilon_{i,c,t}$ denotes an error term.

Given the included firm- and year fixed effects, the regression (7) specifies a relation between growth "shocks" defined as deviations from trends.[13] The main coefficient of interest is β_2. A significantly positive (negative) estimate for β_2 means that higher values of competitor inflexibility are associated with a more positive (negative) elasticity of the dependent variable with respect to the aggregate sales shocks. To interpret a statistically significant estimate for β_2, we also consider the significance and sign of the overall elasticity

[13] By the Frisch-Waugh-Lovell Theorem, we would obtain similar estimates if we used the fixed effects to de-trend all variables in the regression (7) and then analyzed de-trended variables. In essence, we regard the de-trended variables as "shocks".

of the dependent variable to the aggregate sales shocks. We will estimate the overall elasticity for two different values of competitor inflexibility, i.e. the first and the third quartile value.[14]

Suppose that we find significantly negative estimates for the overall value of the elasticity of the wages-to-sales ratio for both the first and third quartile value of competitor inflexibility. In this case, a negative (positive) aggregate sales shock would be associated with an increase (decrease) in workers' share of (firm-level) sales, which would benefit workers when a negative aggregate sales shock occurs. A significantly negative estimate for β_2 would then indicate that, in the event of a negative aggregate sales shock, wages' share of sales increases the more the higher the value of competitor inflexibility. This result would be consistent with the idea that workers receive insurance against a sales-destabilizing effect of competitor inflexibility.

We will use regressions similar to the one stated above in order to analyze the effects of the aggregate sales shocks on all other growth rates stated in the equations in expression (6). We thus gain further insights concerning the interpretation of particular results. As an example, consider the interpretation of the result discussed above, i.e. that competitor inflexibility increases the extent to which workers benefit from an increase in the wages-to-sales ratio in the event of a negative aggregate sales shock. This result can be interpreted as evidence that competitor inflexibility increases the extent of workers' insurance against a negative aggregate sales shock, but such an interpretation would be premature without corroborating evidence concerning related dependent variables. In particular, we would need evidence that competitor inflexibility increases the exposure of firm-level sales to aggregate sales shocks, so that there is a need to insure workers against the increased exposure. We will therefore also run regressions such as that in expression (7) with firm-level sales as the dependent variable.

We end this section by discussing our choice of control variables. We use all firm-level control variables used by Ellul, Pagano, and Schivardi (2014), and also follow their approach by using lagged values of these control variables to avoid endogeneity. Ellul,

[14]Whenever our set of control variables includes interactions of the aggregate sales shocks with variables other than competitor inflexibility, we set those variables to their median values when we estimate elasticities for different quartiles of competitor inflexibility.

Pagano, and Schivardi (2014) control for the logarithm of firm-level total assets (Size), the ratio of long-term debt over total assets (Leverage), the ratio of operating profits over total assets (Profitability), the ratio of fixed assets over total assets (Tangibility), and the logarithm of firm level growth in installed power generation capacity (Own Capacity Growth).[15] In addition, we use two further control variables. The first control variable is the growth of firm-level electricity generation capacity, which is likely to be associated with firm-level employment growth. The second control variable is a variable with controls for firms' technological choices. It is likely that the technological choices of a firm i's competitors (that determine competitor inflexibility) correlate with those of firm i, and that such correlation would bias our estimates for the coefficient β_2. To avoid the bias, we use a variable which is constructed in a similar way as our measure for competitor inflexibility, but instead measures a firm's own inflexibility. Given that a firm's technological choices may be endogenous with respect to its policies for insuring workers against productivity shocks, we run all our regressions with and without controlling for own inflexibility. We generally find that our results are robust and therefore only report the estimates that we obtain when we control for own inflexibility.

3.2 Effects of competitor inflexibility employment and average wages

We now turn to the second step of our analysis. There, we will analyze two dependent variables which are two components of wage growth:

$$\Delta WAGES_{i,c,t} = \Delta EMP_{i,c,t} + \Delta WPC_{i,c,t}, \tag{8}$$

where $EMP_{i,c,t}$ denotes total firm-level employment, and $WPC_{i,c,t}$ denotes the wage per capita, i.e. the ratio of firm i's total wage payments to its total number of employees: $WPC_{i,c,t} = WAGES_{i,c,t}/EMP_{i,c,t}$.

Given our research question, the focus of our analysis will remain on effects of competitor inflexibility. We will therefore run regressions similar to those in expression (7)

[15] Given our research question, it is particularly important that we control for leverage because firms' technological choices may correlate with their financial structures, as documented in Reinartz and Schmid (2015).

also for the two dependent variables $\Delta EMP_{i,c,t}$ and $\Delta WPC_{i,c,t}$. Moreover, we will estimate a regression explaining the log of the per-capita wage $WPC_{i,c,t}$ without using the aggregate sales shocks (and their interactions) as explanatory variables. Instead, we will simply test whether the average wage level depends on competitor inflexibility. The test is motivated by the idea that wages may contain risk premia which compensate workers for effects of competitor inflexibility on the workers' risk exposure. Unfortunately, we do not have any worker-level data in order to include control variables that may proxy for worker risk aversion. Moreover, we cannot control for changes in the average wage due to churning of employees.

3.3 Estimation strategy and main explanatory variables

We next turn to our estimation strategy. As discussed above, we will estimate our regressions based on international data about a single industry: electricity generation. Electricity is an exceptionally homogeneous good produced by means of a wide range of technologies, and traded in markets that are quite segmented along countries' borders. Oseni and Pollitt (2014) report that global exports of electricity are still only about 3% of total production.[16] We can therefore use data about plant location in order to assign power plants to regional markets, i.e. the countries in which the plants are located. We implicitly assume that, within countries, electricity is traded in integrated markets. The US will be treated as an exceptional case since we will assign US states to three virtual countries associated with the three main interconnections, i.e. the Eastern, Western, and Texas Interconnect.

3.3.1 Competitor inflexibility.

Our measures of competitor inflexibility are inspired by our theoretical analysis of effects of demand shocks. We show in Section 2.1 that, the lower the average marginal production cost of a firm's competitors, the less will the competitors respond to demand

[16]See Oseni and Pollitt (2014) and Bahar and Sauvage (2013) for recent information regarding possible reasons for the lack of international trade in electricity. The reasons include insufficient cross-country transmission capacity (and system operators' incentives to push congestion towards a country's borders), the problem that promoting trade may require the abolition of energy subsidies, a reluctance to export electricity at the cost of a reduction in electricity-intensive manufacturing, etc.

shocks, and the more will such shocks affect the firm's profitability. To bring this idea of competitor inflexibility to the data, we classify power plants according to the variable costs at which they can produce electricity. We then measure competitor inflexibility in terms of the fraction of competitors' total production capacity coming from plants that can produce electricity at low variable cost. We will refer to such plants as LVC-plants.

To classify power plants, we use information provided by the U.S. Energy Information Administration (EIA) about the fixed and variable costs of operation and maintenance of different types of plants.[17] The information is summarized in Table 1. Variable costs of operation and maintenance include fuel costs. Costs of capital are separately reported. The final two columns list the ratio of variable costs to the sum of variable and fixed costs, and the ratio of variable costs to the sum of all three types of costs listed in the first three columns.

[Table 1 about here.]

We will consider a power plant as a "low variable cost" (LVC) plant if the source of energy is nuclear, hydro, geothermal, wind or solar power. Table 1 shows that, for these energy sources, the variable costs of operation and maintenance of power plants account for a relatively small share of total costs compared to, say, coal- or gas-powered plants. We further distinguish between power plants based on intermittent energy sources (wind and solar power) and plants whose capacity is continuously available. Our baseline estimates result from only considering nuclear, hydro, and geothermal power plants as LVC-plants, but we add the solar and wind-power plants in a robustness check.

For a firm i headquartered in country c, competitor inflexibility is defined as follows:

$$CINFLX_{i,c,t} = \frac{\sum_{u \in U_{c,t} \setminus U_{i,t}} CAPACITY_u \times 1_{u=LVC}}{\sum_{u \in U_{c,t} \setminus U_{i,t}} CAPACITY_u}, \tag{9}$$

where u indexes power plant units (e.g. a turbine),[18] $CAPACITY_u$ is the capacity (measured in mega watts) of unit u, $U_{c,t}$ is the set of all units in country c (based on all of

[17] See Table 1 on the page `http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf` which is based on the EIA's Annual Energy Outlook 2014.

[18] A power plant may contain several power-generating units. We exclude all units that are marked in our data as units which are either retired, planned, still in design, or under construction.

our plant-level data for the year t), $U_{i,t} \subset U_{c,t}$ is the subset of units owned by firm i, and $U_{c,t} \setminus U_{i,t}$ is the subset of units with other owners. As discussed above, the indicator variable $1_{u=LVC}$ equals one only for nuclear, hydro and geothermal power units in our baseline specification. In a robustness check, we set the indicator variable to one also for solar- and wind-powered units.

Besides competitor inflexibility, we also use a corresponding measure of firm i's own technological setup. The measure of a firm i's "own inflexibility" will be used as a control variable and is defined as follows:

$$OINFLX_{i,c,t} = \frac{\sum_{u \in U_{i,t}} CAPACITY_u \times 1_{u=LVC}}{\sum_{u \in U_{i,t}} CAPACITY_u}. \tag{10}$$

3.3.2 Aggregate sales

For each year t of a firm i in our sample, we compute the aggregate sales of all competing firms for which we have data in firm i's country c. The competing firms are all firms classified as electricity generation businesses in Worldscope or Amadeus (Worldscope: SIC code 4911– Electric Services, Amadeus: NAICS code 2211: Electric Power Generation, Transmission and Distribution). Our baseline results are obtained by restricting the sample to country-years for which we have sales data for at least 6 firms.[19] Changes in country-level aggregate sales below the 5%-ile or above the 95%-ile are regarded as outliers.

In a robustness check, we will test whether our results are robust to refining the criterion that we use to select country-years, i.e. the requirement that we have sales data for at least 6 firms in a country-year. A second refinement will exclude firms with a market share above 50%. These robustness checks are motivated by the concern that the aggregate sales of firms competing with dominant firms may be endogenous to policies of the dominant firms which may affect their wage and dividend payments.

[19] On average, we use sales data for 50-90 firms in a country-year.

4 Data Sources and Sample Selection

Firm-level financial data. For data on firm financials, employment numbers and wages, we rely on two different data sets. Global data on public firms is obtained from Thomson Reuters Worldscope. We use all firms that are classified as Electric Services (SIC code 4911). The second data source is Bureau van Dijk's Amadeus. We obtain data on European public and private firms with the industry classification "Electric Power Generation, Transmission and Distribution" (NAICS code 2211). Whenever a firm is available in both databases (which mostly happens for European public firms), we only keep the data obtained from Worldscope. We download firm-level financial data for the period 2001 - 2014.

Power plant data. The data on electric power generating units comes from the UDI World Electric Power Plants Database. The database covers nearly 196,000 units in more than 230 countries, ranging from Ohio-based Wheelersburg Elementary School's one thousand watt generating Solar Lab Project to China's Three Gorges Corporation's 34 water turbines with a combined capacity in excess of 22 billion watt.[20] We were able to obtain 14 editions of the data for the period from 2001 to 2014. Each edition contains data for a number of plant characteristics such as plant operator, generation technology and fuel type, installed electricity production capacity, and plant location. Many power plants consist of multiple power generation units, for each of which the database separately reports fuel type, generator technology, and production capacity.

Data link. We rely on company names and addresses to establish a link between our plant- and firm-level data. Our primary link results from a manual matching of company names in both databases. When legal abbreviations prevent a perfect match, we resort to corporate websites and address entries in online directories to verify or reject doubtful matches. We also use corporate websites to identify subsidiaries, and to remove subsidiaries from our database by assigning their power plants to their parent companies. Overall, we are able to identify 1,033 firms for which we also have financial as well as employee

[20] More information about Wheelersburg Elementary School's Solar Lab Project can be found at https://aep.com/newsroom/newsreleases/?id=758

and/or wage data. The firms operate in 47 countries and own 42 percent of the total electricity generation capacity of all plants located in the 47 countries according to our plant-level data. We divide the US into separate systems of electricity distribution grids ("interconnections") into which energy producers can feed their produced capacities.[21] California, Nevada, Arizona, Montana, Washington, Oregon, Idaho, Utah, New Mexico, Colorado, and Wyoming form the Western Interconnection. Texas is the only state in the Texas Interconnection. With the exception of Hawaii and Alaska, the remaining US states belong to the Eastern Interconnection.

Table 2 lists the countries that are included in our analysis and provides a breakdown of our sample across regions. For each country, we report the number of available first differences between log-values of firm-level sales (column Δ SALES), the ratio of wages-to-sales (column Δ WtS), the ratio of dividends-to-sales (column Δ DtS), and total employment (column Δ EMP).[22] For all of these columns, we also require available data for our control variables, which are reported in Table 3. The column labeled "Unbundling" reports the year in which ownership unbundling regulations were introduced in the respective country.[23] Moreover, for each region, we report subtotals of the aforementioned variables in the rows labeled "Total". As an example, consider our first region *North America*. It consists of Canada and the three US interconnections (East, Texas, and West). For this region, we have 673 observations with non-missing first differences between log-values of firm-level sales, only 11 observations with non-missing first differences between log-values of the ratio of wages-to-sales, and 556 and 578 observations for the respective first differences between log-values of the ratio of dividends-to-sales and total employment. The total in the unbundling column refers to the number of non-missing first differences between log-values of firm-level sales that stem from country-years with unbundling regulation in place. In our example of *North America*, this applies to all observations in the Δ SALES column. The last row of Table 2, labeled "Grand Total", shows the total number of observations over all countries in the respective column. These numbers are equivalent to our final

[21]See The Regulatory Assistance Project (2011) p.15.

[22]We always include share repurchases in our dividends-to-sales measure.

[23]As discussed in the introduction, we condition on the existence of ownership unbundling regulation in a robustness check aimed at testing for effects of regulation. See Section 7.3.

sample size. They range from 6,492 observations for first differences between log-values of firm-level sales to 1,850 observations for first differences between log-values of the ratio of dividends-to-sales.

[Table 2 about here.]

5 Descriptive statistics

Table 3 provides summary statistics for all firms which we are able to match to our power plant dataset (Panel A), and the final sample used for estimation (Panel B). The two samples differ in terms of data availability: to be included in Panel B, an observation must be sufficiently complete that we have all data required for our regressions. In addition, we require that growth in aggregate sales can be measured based on data about at least 6 firms (as discussed above).

[Table 3 about here.]

For each variable, the table reports mean, median, standard deviation, and the number of firm-years. The first 7 rows of each panel summarize our dependent variables. These are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), the ratio of dividends-to-sales (Δ DtS, where dividends include share repurchases), total wage payments (Δ WAGES), total dividends and share repurchases (Δ DIVD), total employment (Δ EMP), and wage per capita (Δ WPC).

With the exception of Δ WtS and Δ DtS, all mean growth rates in Panel A are positive and between 1 percent and 10 percent. The mean of Δ WtS is slightly negative at −0.2 percent. The mean of Δ DtS is 0.4 percent. In our final sample (Panel B), all mean growth rates are somewhat lower, but the difference is only significant for three of these rates: Δ EMP declines from 3.6 percent to 2.2 percent, Δ WAGES and Δ SALES decline by 1.5 and 0.7 percentage points, respectively. A possible explanation for the difference between the two samples is the fact that the sample in Panel B results from excluding country-years for which we have data about strictly less than 6 firms. We thus end up with a sample that is biased towards more saturated markets in which firms grow at smaller rates.

The second part of each panel lists explanatory variables and further controls. Explanatory variables are first differences between log-values of aggregate sales in a firm's market (Δ AGG SALES), our measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). The mean of Δ AGG SALES equals 7.6 percent in Panel A and equals 7.8 percent in Panel B. Mean competitor inflexibility is at roughly 42 percent in both samples, meaning that on average, 42 percent of a firm's competitors' capacity is generated by plants which can produce electricity at low variable cost. The firms' average own inflexibility (OINFLX) is about 5 percentage points lower at around 37 percent in both Panels. The difference relative to mean competitor inflexibility is due to the fact that we measure competitor inflexibility based on all of our plant-level data, but we only measure firms' own inflexibility for firms for which we have balance sheet data. It seems that firms' technological choices correlate with the availability of balance sheet data. None of the differences for these three variables between Panel A and Panel B are statistically significant.

Table 3 also reports summary statistics for the control variables. Given that we use one-period lagged values for all control variables in our regressions, the summary statistics also refer to the lagged values. The control variables are firm-level measures of the logarithm of total assets (Size), the ratio of long-term debt over total assets (Leverage), the ratio of operating profits over total assets (Profitability), the ratio of fixed assets over total assets (Tangibility), and the logarithm of firm level growth in installed power generation capacity (Own Capacity Growth). A comparison of the two panels reveals that, by requiring sales data about at least 6 firms in each country (Panel B), we obtain a sample in which the average firm is somewhat larger and reports a higher level of average profitability (2.4 percent vs. 1.5 percent). Moreover, the mean level of tangible assets is higher at 66 percent in Panel B compared to 62 percent in Panel A. In terms of the other control variables, the differences between the two samples are not statistically significant.

The last row of each Panel shows that around 44 percent of our sample firms are listed companies. In this respect, the difference between the two panels is only marginally significant at the 10 percent level.

6 Main results

6.1 Effects of competitor inflexibility on firms' workers and owners

Table 4 presents estimates for regressions explaining firm-level sales, as well as the wage- and dividend-share of sales, i.e. the wages-to-sales ratio and the dividends-to-sales ratio, respectively. All regressions include year- and firm-level fixed effects which absorb trends. The standard errors are clustered at the firm-level, and the resulting p-values are stated below the point estimates of the regression coefficients. To avoid spurious results due to outliers, we exclude observations with values of the dependent variable below the 5%-ile or above the 95%-ile.

[Table 4 about here.]

The baseline elasticity of firm-level to aggregate sales is highly significant and positive: as shown in the first line of columns (1) and (4), we obtain point estimates of 20.7% and 15.9%. In addition, we observe a significantly positive effect of competitor inflexibility, which becomes highly significant once we include control variables. It thus appears that competitor inflexibility increases the response of firm-level sales to aggregate sales shocks. The economic magnitude of the effect of competitor inflexibility can be seen by comparing the estimates that we obtain for the elasticity of firm-level to aggregate sales when we consider the first and third quartile value of competitor inflexibility (and median own inflexibility). These estimates are stated in the bottom of Table 4, in the rows labeled $Q1(CINFLX)$ and $Q3(CINFLX)$. We find that an increase in competitor inflexibility by one interquartile range almost doubles the elasticity of firm-level to aggregate sales.

We next turn to the estimates regarding the way firms' sales are used to finance wage payments and cash distributions to firms' owners, i.e. dividends and share repurchases. Columns (2) and (5) of Table 4 concern the wages-to-sales ratio, while columns (3) and (6) concern the dividends-to-sales ratio (where share repurchases are included in dividends). In each column, the first row reports negative baseline estimates for the elasticities of the ratios with respect to aggregate sales. Of those negative elasticities, only those that concern dividends are significant. The baseline estimates are consistent with the idea that firms smooth both wages and dividends by increasing (decreasing) the fraction of sales paid out to their workers and owners in the event of a negative (positive) sales shock.

Turning to the effect of competitor inflexibility, the estimates indicate different effects on firms' workers and owners. Competitor inflexibility tends to magnify the response of the wages-to-sales ratio to changes in aggregate sales, while diminishing the response of the dividends-to-sales ratio: we find significantly negative estimates for the interaction of competitor inflexibility and aggregate sales in columns (2) and (5), but significantly positive estimates in columns (3) and (6). The latter estimates are slightly less precise than the former estimates, which is not surprising given the differences in sample size reported in the bottom of Table 4. There is, however, strong evidence that competitor inflexibility has different effects on wage- and dividend-smoothing.

We first discuss the effect of competitor inflexibility on wage smoothing. Table 4 reports point estimates for the elasticity of the wages-to-sales ratio to aggregate sales that we obtain for the first and third quartile value of competitor inflexibility (and median own inflexibility). The point estimates for the third quartile are close to -50%, compared to estimates of about -24% for the first quartile. The substantial difference suggests that competitor inflexibility is an important determinant of the extent of wage smoothing. While competitor inflexibility magnifies the positive exposure of firm-level sales to changes in aggregate sales, it also magnifies the negative exposure of the wages-to-sales ratio. We therefore find that competitor inflexibility increases the extent to which workers benefit from an increase in the wages-to-sales ratio in the event of a negative aggregate sales shock. In fact, this effect of competitor inflexibility seems to be sufficiently strong that it more than offsets the sales-destabilizing effect of competitor inflexibility on firm-level sales.[24]

We next turn to the effect of competitor inflexibility on dividend smoothing. Table 4 reports point estimates for the elasticity of the dividends-to-sales ratio to aggregate sales that we obtain for the first and third quartile value of competitor inflexibility (and median own inflexibility). The point estimates for the first quartile in columns (3) and (6) are negative and marginally significant, but those for the third quartile are positive

[24]A direct test of this statement appears in Table 5. But this effect seems somewhat weaker in the robustness check that we present in Table 10.

and insignificant. For low values of competitor inflexibility, negative (positive) changes in aggregate sales are associated with an increase (decrease) in the dividend-to-sales ratio, which is consistent with dividend smoothing. The evidence for dividend smoothing however disappears for high values of competitor inflexibility. It thus seems that an increase in competitor inflexibility is associated with risk-taking by firms' owners.

Besides the main results discussed above, Table 4 also reveals some interesting effects of control variables. The coefficient of the interaction of aggregate sales growth with own inflexibility is generally insignificant, but a somewhat precise estimate appears in column (4). As one would expect, the sign of the estimate is opposite to that of column (4)'s coefficient of the interaction of aggregate sales growth with competitor inflexibility. A number of other control variables also receive significant coefficients with plausible signs.

The next set of results appears in Table 5 which presents regressions explaining the growth of wages and dividends (including share repurchases). Given the equations in expression (6), the dependent variables in Table 5 can be interpreted as sums of the dependent variables in Table 4:

$$\begin{aligned} \Delta WAGES_{i,c,t} &= \Delta SALES_{i,c,t} + \Delta WtS_{i,c,t}, \\ \Delta DIVD_{i,c,t} &= \Delta SALES_{i,c,t} + \Delta DtS_{i,c,t}. \end{aligned}$$

The evidence in Table 4 (discussed above) concerns the variables that appear on the right-hand side of the equations above: competitor inflexibility reduces the stability of firms sales, but there also is evidence for an offsetting effect on the extent of wage smoothing at the expense of dividend smoothing. Against this backdrop, the results in Table 5 can be interpreted as evidence regarding the overall effects of competitor inflexibility on wages and dividends.

[Table 5 about here.]

For wages, Table 5 shows significantly positive estimates for the baseline elasticity with respect to aggregate sales, but significantly negative estimates for the coefficient of the interaction of aggregate sales growth with competitor inflexibility. All of those estimates have the same sign as the sums of the corresponding estimates regarding firm-level sales and the wages-to-sales ratio in Table 4.[25] This observation suggests that the significantly positive estimates reported in Table 5 for the baseline exposure of wages to aggregate sales are a consequence of somewhat imperfect wage smoothing which occurs at very low levels of competitor inflexibility. Moreover, it appears that the negative effect of competitor inflexibility on the stability of firms' sales (discussed above) is somewhat more than neutralized by the positive effect of competitor inflexibility on the extent of wage smoothing (also discussed above) through changes in the wages-to-sales ratio.

Overall, we find little evidence that firms' wage payments respond to changes in aggregate sales, even though firm's sales do. The bottom of Table 5 reports mostly insignificant estimates for the wages-to-aggregate-sales elasticities that we obtain for the first- and third-quartile value of competitor inflexibility and median own inflexibility. The lack of statistical significance is remarkable given the highly significant estimates of the elasticities of firm-level-to-aggregate-sales that are reported for the first- and third-quartile value of competitor inflexibility in columns (1) and (4) of Table 4. We therefore conclude that the negative effect of competitor inflexibility on the stability of firm-level sales is offset by additional wage smoothing.

Turning to the estimates regarding dividends, we find evidence for a positive effect of competitor inflexibility on the elasticity of dividends with respect to aggregate sales shocks. These estimates are consistent with the findings reported in Table 4. In particular, we again find that competitor inflexibility has a qualitatively different effect on firms' owners and their workers. In contrast to wages, dividends appear to be more exposed to changes in aggregate sales for higher values of competitor inflexibility: we find a significantly positive estimate of the elasticity of dividends to aggregate sales shocks for the third quartile value of competitor inflexibility. The evidence is again consistent with the idea that competitor inflexibility increases the risk exposure of firms' owners.

[25] For example, we find a significantly positive baseline elasticity in column (3) of Table 5 with a value of 11.3%. The sign of the estimate is consistent with that of the sum of the estimates of the baseline elasticities in columns (4) and (5) of Table 4, which equals 5.9%.

6.2 Effects of competitor inflexibility on employment and average wages

In this section, we present further results concerning workers' risk exposure. In the previous section, the risk exposure of workers has been measured based on firms' total wage payments. We next use employment data in order to take a closer look at effects of competitor inflexibility on workers by decomposing total wage growth according to expression (8). Table 6 presents the results of regressions similar to that in expression (7) for the two components of wage growth: employment growth and average (per-capita) wage growth.

[Table 6 about here.]

We first discuss the results regarding employment in columns (1) and (3). We obtain insignificant negative baseline estimates for the elasticity of employment with respect to aggregate sales, and positive but also insignificant estimates for the coefficient of the interaction of aggregate sales and competitor inflexibility. The results show that, in our sample, competitor inflexibility has no significant effect on employment stability. There is no evidence that employment responds to changes in aggregate sales, neither for the first quartile of competitor inflexibility, nor for the third quartile.

We next turn to the results in columns (2) and (4) of Table 6. There, the dependent variable is the growth of average wages. The results contain insignificant negative estimates for the coefficient of the interaction of aggregate sales and competitor inflexibility. Here, it is important to keep in mind that the dependent variable measures changes in firms' average wages, where the average is taken across workers. The average wages may change because of changes in wages within employment relationships and/or changes in the workforce as firms engage in employee churning (hiring and firing at the same time). Without access to worker-level data, it is impossible for us to disentangle these two sources of variation in average wages. With these caveats in mind, we conclude that competitor inflexibility does not seem to modulate the elasticity of a firm's employment and average wage to aggregate sales shocks.

We conclude this section by presenting some results concerning the average wage level. These results are obtained by estimating regressions explaining the log average wage using competitor inflexibility, own inflexibility, control variables, as well as fixed effects at the firm-level and year-level. We also report regressions explaining average wage growth.

[Table 7 about here.]

Table 7 contains the results. In columns (1) and (3), the dependent variable is the log average wage level, $\log WPC_{i,c,t}$. In columns (2) and (4), the dependent variable is average wage growth, i.e. $\Delta WPC_{i,c,t}$. There is no evidence for an effect of competitor inflexibility on the level of average wages.

6.3 Effects of competitor inflexibility for listed firms

In this section, we explore whether the risk exposure of workers employed by publicly listed companies differs from the exposure of workers of privately held companies. Table 8 presents estimates for regressions explaining firm-level sales, the wage-share of sales, and wages. We do not report results regarding dividends because we only have dividend data for listed firms.

[Table 8 about here.]

Table 8 contains two specifications regarding each dependent variable. In our first specification, presented in columns (1) - (3) of Table 4 we only add two variables to the model : A dummy variable for listed firms and its interaction with aggregate sales growth. When we allow that the elasticity of our dependent variables with respect to aggregate sales growth varies between listed firms and their private counterparts, we implicitly test whether our measure of competitor inflexibility is simply picking up differences between these two types of firms. The estimates show that our previous estimates are robust.

In our second specification, we add triple interactions of aggregate sales growth with competitor inflexibility and a firm's listing status to our regressions. We thus test whether the effects of competitor inflexibility differ between listed and private firms. This test is motivated by the idea (discussed in Section 2.2) that workers of listed firms may receive more insurance against risk-increasing effects of competitor inflexibility.

Columns (4) - (6) of Table 8 present the results. The estimates of the triple interaction of aggregate sales growth with competitor inflexibility and a firm's listing status are negative in both columns, but insignificant. The estimates regarding the coefficients of the simple interaction of aggregate sales growth with competitor inflexibility are similar to those in previous regressions, but we do loose some statistical significance.

7 Robustness checks

In this section, we present robustness checks concerning our measures of competitor inflexibility and own inflexibility. Moreover, we check the robustness of our results with respect to concerns about regulation.

7.1 Alternative measures of competitor inflexibility

Table 9 presents a robustness check in which we change the way in which we measure competitor inflexibility and own inflexibility. The changes are best explained by referring to the expressions (9) and (10). In this expressions, the dummy variable $\mathbb{1}_{u=LVC}$ indicates low variable cost (LVC) plants that can continue to operate profitably even if the output price drops to a value close to zero. These plants will rarely be shut-down so that their owners will respond less flexible to changes in the output price. So far, the dummy equals one for nuclear, hydro, and geothermal power plants, even though it is arguable that solar and wind-powered plants also satisfy our criterion.[26] We therefore check that our results are robust to changing the definition of the dummy $\mathbb{1}_{u=LVC}$ so that it equals one also for solar- and wind-powered plants.

[Table 9 about here.]

Table 9 reports the results. For all dependent variables, the results confirm the robustness of our estimates in Tables 4-7.

[26] The counterargument was that, due to weather risk, the stated capacity of solar- and wind-powers plants cannot be compared to that of, say, nuclear plants.

7.2 Exogeneity of aggregate sales shocks

The next robustness check concerns the way we measure aggregate sales shocks. We do so by computing aggregates of the sales of all competitors of a firm i in a country c and year t while restricting the sample to country-years for which we have sales data about at least 6 firms. The restriction is motivated by the concern that our measure of aggregate sales is endogenous, but it only partially alleviates this concern. We have therefore tested the robustness of our results by varying the number of firms for which we must have data in order to add a country-year to our estimation sample. Moreover, we have tested whether our results are robust to excluding observations associated with markets in which there exist dominant players with a market share above 50 percent. We only report the results of the second robustness check in Table 10

[Table 10 about here.]

7.3 Effects of regulation

The external validity of our results may be questioned because the electricity sector is heavily regulated in many countries. By focusing on electricity generation, we actually focus on a business that is not subject to the heavy regulation targeting the transmission of electricity. Despite this focus, the external validity of our results may be compromised because some firms in our sample may be active in both the generation and the transmission of electricity. We will therefore check whether we obtain similar results if we restrict the sample to countries with rules for "ownership unbundling", i.e. rules that require that the ownership and control of transmission grids is separate from electricity generation and distribution.

Table 11 presents estimates based on the subsample of firms headquartered in countries with rules for ownership unbundling. We thus focus on a subsample of firms that own power plants, but do not own or control electricity transmission grids. The estimates are quite similar to those in Tables 4 – 7, but less precise. We however still obtain evidence for most of our key results in Table 4 and Table 5. The lack of precision of the estimates in Table 11 mostly concerns the estimates regarding dividends. While we can confirm our previous results regarding the overall stability of dividends, we find only a marginally significant effect of competitor inflexibility on the elasticity of the dividend-to-sales ratio with respect to aggregate sales growth. The loss of significance is not surprising given that the focus on countries with ownership unbundling is associated with a substantial reduction in sample size.

[Table 11 about here.]

We next check that our results are robust to restricting the sample to observations regarding firms that operate in the presence of liquid wholesale markets. This robustness check is inspired by the idea that wholesale markets are typically introduced when countries deregulate their electricity sector. The results appear in Table 12.

[Table 12 about here.]

We again find all of our major results. In particular, the significance and signs of any previously significant coefficients of the interaction between aggregate sales growth and competitor inflexibility prove to be robust. Focusing on the subsample with liquid wholesale markets appears to only compromise the statistical significance of some of the baseline coefficients of aggregate sales growth. Moreover, we obtain substantially higher point estimates for the coefficients of the interaction between competitor inflexibility and aggregate sales growth in the regressions regarding dividends.

8 Conclusion

Our paper provides an empirical analysis of competitor inflexibility as a risk factor. We show that competitor inflexibility reduces the stability of firm-level sales, and analyze the implications for the risk-exposure of firms' owners and workers, as well as the risk-sharing between them. To do so, we analyze the stability of firm-level wages and dividends and the ratios of wages-to-sales and dividends-to-sales. Dividends always include share repurchases.

The results show that risk associated with competitor inflexibility will decrease the stability of firms' dividends. While we find evidence for dividend smoothing, the extent of dividend smoothing appears to decrease in competitor inflexibility. If competitor inflexibility equals its third quartile value in our sample, firms' dividend payments exhibit a significantly positive elasticity with respect to industry-level aggregate sales shocks.

When we analyze firms' wages, we find that the stability of wages is *not* compromised by the destabilizing effect of competitor inflexibility on firm-level sales. While competitor inflexibility increases the elasticity of firm-level sales with respect to aggregate sales shocks, the effect on the elasticity of wages is, if anything, negative. (However, the negative effect disappears when we control for differences between listed and unlisted firms.) The reason for the difference can be found in the way competitor inflexibility effects the wages-to-sales ratio. Firms tend to stabilize their wages by responding to negative (positive) sales shocks with an increase (decrease) in the share of sales used to finance wage payments. We show that an increase in competitor inflexibility is associated with more wage stabilization: the wages-to-sales ratio will vary more strongly at higher values of competitor inflexibility.

Our paper represents a first step towards a broader view of risk sharing between firms' workers and their owners. While most previous contributions consider such risk-sharing in a single-firm context, we take into account that such risk-sharing includes risk associated with external effects of competitor behavior rooted in competitors' production technologies. We thus aim at analyzing within-firm risk-sharing based on an industry equilibrium view which takes into account that firms' technology choices are endogenously determined. Such analyses are left for future research.[27]

[27]See Palacios and Stomper (2015) for a first step towards analyzing within-firm risk sharing in an industry equilibrium inspired by Maksimovic and Zechner (1991).

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Table 1:
Costs per MWh (in 2012 US$)

The table presents levelized capital costs, fixed costs of operation and maintenance (O&M) and variable costs of O&M for several types of power plants. The table reproduces data contained in Table 1 of `http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf` which is based on the Annual Energy Outlook 2014 published by the U.S. Electricity Information Association (EIA). The data is for plants entering service in 2019. Levelized capital costs are the cost of capital required to build and operate a power plant over its lifetime divided by the total power output of the plant over that lifetime. Variable costs of O&M include costs of fuel. Abbreviations: IGCC integrated gasification combined cycle, CCS carbon capture and storage, CC combined cycle, PV photovoltaic.

Plant type	(1) **Levelized capital cost**	(2) **Fixed costs of O&M**	(3) **Variable cost of O&M**	(4) **Ratio** $\frac{(3)}{(2)+(3)}$	(5) **Ratio** $\frac{(3)}{(1)+(2)+(3)}$
Convtl coal	60.0	4.2	30.3	87.8%	32.1%
Coal IGCC	76.1	6.9	31.7	82.1%	27.6%
Coal IGCC with CCS	97.8	9.8	38.6	79.8%	26.4%
Natural gas fired:					
Convtl CC	14.3	1.7	49.1	96.7%	75.4%
Advcd CC	15.7	2.0	45.5	95.8%	72.0%
Advcd CC with CCS	30.3	4.2	55.6	93.0%	61.7%
Convtl combstn turbine	40.2	2.8	82.0	96.7%	65.6%
Advcd combstn turbine	27.3	2.7	70.3	96.3%	70.1%
Advcd nuclear	71.4	11.8	11.8	50.0%	12.4%
Geothermal	34.2	12.2	0	0%	0%
Biomass	47.4	14.5	39.5	73.1%	39.0%
Wind	64.1	13.0	0	0%	0%
Wind offshore	175.4	22.8	0	0%	0%
Solar PV	114.5	11.4	0	0%	0%
Solar thermal	195.0	42.1	0	0%	0%
Hydroelectric	72.0	4.1	6.4	61.0%	7.8%

Table 2:
Summary Statistics: Country Breakup

The table presents the number of firm-year observations that are available to estimate our main specifications by country. Columns (1) to (4) refer to the regression specifications that use first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), the ratio of dividends-to-sales (Δ DtS), and total employment (Δ EMP) as dependent variable. The column "Unbundling" reports the year in which unbundling regulations where introduced in a country. "Total" denotes the number of firm-year observations in each region and the subset available from unbundling countries (for the firm-level sales specification).

Country	Δ SALES	Δ WtS	Δ DtS	Δ EMP	Unbundling
North America					
CA	154	7	120	70	1996
USEI	390	4	327	374	1998
USTI	17	–	10	18	1998
USWI	112	–	99	116	1998
Total	673	11	556	578	673
Latin America					
AR	12	14	3	–	1992
BR	189	167	121	168	1995
CL	33	4	28	7	1985
CO	10	3	9	5	1994
PE	45	29	36	21	1992
Total	289	217	197	201	289
Scandinavia					
DK	9	10	–	10	1998
FI	336	305	10	270	1997
NO	875	706	6	8	1992
SE	298	106	5	121	1992
Total	1,518	1,127	21	409	1,518
Central Western Europe					
AT	36	31	20	31	1995
BE	41	38	–	48	1989
CH	117	115	66	108	–
DE	1,044	1,020	73	928	–
ES	279	237	46	253	1989
FR	116	101	33	78	–
GB	181	173	50	184	1990
GR	39	12	8	31	–

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Table 2 – continued from previous page

Country	Δ SALES	Δ WtS	Δ DtS	Δ EMP	Unbundling
IE	13	5	–	6	–
IT	399	354	79	356	1999
NL	14	9	–	13	1998
PT	72	49	5	58	1994
Total	2,351	2,144	380	2,094	1,022
Eastern Europe and Russia					
BA	25	12	2	11	2005
BG	14	12	–	13	–
CZ	159	138	7	153	2003
HR	7	9	–	9	2005
HU	2	2	2	2	1992
LT	4	2	–	4	–
PL	67	23	17	45	1990
RO	9	9	–	9	1998
RU	201	119	56	87	–
UA	15	–	2	8	1996
Total	503	326	86	341	273
Asia					
CN	320	138	93	311	2002
IN	321	321	196	138	1996
JP	117	2	100	117	–
KR	8	6	4	7	2001
LK	16	7	16	4	–
MY	57	58	37	32	1997
PH	51	47	27	42	2001
PK	42	41	23	–	2004
SG	4	4	4	3	1995
TH	32	25	32	17	–
TR	54	19	2	42	2001
VN	46	–	22	5	–
Total	1,068	668	556	718	857
Australia and New Zealand					
AU	36	30	14	23	1993
NZ	54	42	40	9	1996
Total	90	72	54	32	90
Grand Total	**6,492**	**4,565**	**1,850**	**4,373**	**4,722**

Table 3:
Summary Statistics: Electricity Generating Firms

The table presents summary statistics of an unbalanced panel containing data about 1,019 electricity generation firms from 49 countries/markets over the period 2001-2014. The full sample is based on all firms with available data and a link to the power plant database, the final sample requires available data for all explanatory variables. The dependent variables are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), the ratio of dividends-to-sales (Δ DtS), total wage payments (Δ WAGES), total dividends and share repurchases (Δ DIVD), total employment (Δ EMP), and wage per capita (Δ WPC). The explanatory variables are first differences between log-values of aggregate sales in a firm's market (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity.

Variable	**Mean**	**Median**	**StDev**	**N**
Panel A: Full Sample				
Δ SALES	0.090	0.067	0.217	10,165
Δ WtS	-0.002	-0.009	0.239	7,085
Δ DtS	0.004	-0.002	0.505	2,947
Δ WAGES	0.096	0.057	0.192	7,453
Δ DIVD	0.081	0.050	0.484	2,951
Δ EMP	0.036	0.000	0.441	7,602
Δ WPC	0.050	0.035	0.145	4,968
Δ AGG SALES	0.076	0.070	0.103	10,755
CINFLX	0.426	0.291	0.299	14,861
OINFLX	0.372	0.000	0.457	14,864
Size	5.544	5.259	3.648	13,533
Leverage	0.243	0.188	0.250	13,037
Profitability	0.015	0.000	0.070	12,830
Tangibility	0.622	0.697	0.273	13,797
Own Capacity Growth	0.059	0.000	0.479	13,141
Listed	0.436	0.000	0.496	11,261
Panel B: Final Sample				
Δ SALES	0.083	0.064	0.208	6,492
Δ WtS	-0.008	-0.011	0.221	4,482
Δ DtS	-0.000	-0.004	0.488	1,847

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Table 3 – continued from previous page

Variable	Mean	Median	StDev	N
Δ WAGES	0.081	0.051	0.167	4,422
Δ DIVD	0.081	0.048	0.474	1,840
Δ EMP	0.022	0.000	0.318	4,233
Δ WPC	0.046	0.033	0.133	2,976
Δ AGG SALES	0.078	0.070	0.101	6,492
CINFLX	0.418	0.293	0.286	6,492
OINFLX	0.376	0.018	0.453	6,492
Size	6.483	6.239	3.338	6,492
Leverage	0.246	0.215	0.221	6,492
Profitability	0.024	0.000	0.052	6,492
Tangibility	0.661	0.711	0.222	6,492
Own Capacity Growth	0.063	0.000	0.475	6,492
Listed	0.445	0.000	0.497	6,492

Table 4:
Effects of competitor inflexibility on firm's workers and owners

The table presents estimates based on an unbalanced panel containing data about 1,019 electricity generation firms from 49 countries/markets over the period 2001-2014. The dependent variables are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), and the ratio of dividends-to-sales (Δ DtS). The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ SALES	Δ WtS	Δ DtS	Δ SALES	Δ WtS	Δ DtS
Δ AGG SALES	0.207***	−0.125	−0.774***	0.159***	−0.100	−0.672**
	(0.000)	(0.120)	(0.004)	(0.005)	(0.216)	(0.014)
Δ AGG SALES × CINFLX	0.277**	−0.502***	1.641***	0.433***	−0.620***	1.495**
	(0.037)	(0.007)	(0.009)	(0.002)	(0.001)	(0.021)
Δ AGG SALES × OINFLX	−0.089	−0.067	−0.344	−0.156*	−0.009	−0.143
	(0.295)	(0.564)	(0.346)	(0.073)	(0.941)	(0.694)
CINFLX	−0.023	0.259	−0.132	−0.009	0.245	−0.084
	(0.844)	(0.138)	(0.789)	(0.939)	(0.175)	(0.871)
OINFLX	0.053	0.025	0.147	0.069	0.032	0.102
	(0.213)	(0.553)	(0.120)	(0.113)	(0.493)	(0.332)
Size				−0.041***	0.014	0.116**
				(0.000)	(0.245)	(0.033)
Leverage				0.000	−0.061	−0.489**
				(0.999)	(0.217)	(0.011)
Profitability				−0.537***	0.511***	1.560***
				(0.000)	(0.003)	(0.001)
Tangibility				0.099***	−0.050	0.039
				(0.003)	(0.269)	(0.818)
Own Capacity Growth				0.014**	0.007	−0.004
				(0.010)	(0.359)	(0.882)
Fixed Effects	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F	F	F
N	7,061	4,887	2,001	6,492	4,565	1,850
R^2	0.063	0.061	0.029	0.080	0.072	0.049
Q1(CINFLX)	0.267	−0.234	−0.417	0.253	−0.235	−0.347
	(0.000)	(0.000)	(0.046)	(0.000)	(0.000)	(0.102)
Q3(CINFLX)	0.401	−0.478	0.381	0.464	−0.537	0.381
	(0.000)	(0.000)	(0.263)	(0.000)	(0.000)	(0.273)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 5:
Effects of competitor inflexibility on firm's workers and owners

The table presents estimates based on an unbalanced panel containing data about 1,019 electricity generation firms from 49 countries/markets over the period 2001-2014. The dependent variables are first differences between log-values of total wage payments (Δ WAGES) and total dividends and share repurchases (Δ DIVD). The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ WAGES	Δ DIVD	Δ WAGES	Δ DIVD
Δ AGG SALES	0.156***	−0.422*	0.113*	−0.375
	(0.006)	(0.073)	(0.054)	(0.124)
Δ AGG SALES × CINFLX	−0.285**	1.603***	−0.243*	1.568***
	(0.019)	(0.004)	(0.054)	(0.005)
Δ AGG SALES × OINFLX	−0.042	−0.351	−0.010	−0.165
	(0.596)	(0.292)	(0.903)	(0.620)
CINFLX	0.026	−0.486	0.131	−0.403
	(0.839)	(0.278)	(0.297)	(0.394)
OINFLX	0.029	0.207**	0.031	0.168
	(0.439)	(0.046)	(0.429)	(0.135)
Size			−0.036***	0.020
			(0.001)	(0.691)
Leverage			−0.005	−0.366**
			(0.873)	(0.041)
Profitability			−0.159**	0.909**
			(0.039)	(0.016)
Tangibility			0.000	0.176
			(0.996)	(0.276)
Own Capacity Growth			0.020**	−0.008
			(0.010)	(0.720)
Fixed Effects	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F
N	4,976	1,992	4,620	1,840
R^2	0.032	0.030	0.043	0.043
Q1(CINFLX)	0.094	−0.073	0.061	−0.034
	(0.037)	(0.679)	(0.185)	(0.851)
Q3(CINFLX)	−0.044	0.708	−0.058	0.729
	(0.500)	(0.013)	(0.386)	(0.011)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 6:
Effects of competitor inflexibility on employment and average wages

The table presents estimates based on an unbalanced panel containing data about 1,019 electricity generation firms from 49 countries/markets over the period 2001-2014. The dependent variables are first differences between log-values of total employment (Δ EMP) and wage per capita (Δ WPC). The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ EMP	Δ WPC	Δ EMP	Δ WPC
Δ AGG SALES	−0.150	−0.009	−0.037	−0.043
	(0.423)	(0.894)	(0.788)	(0.539)
Δ AGG SALES × CINFLX	0.587	−0.171	0.148	−0.158
	(0.254)	(0.306)	(0.723)	(0.345)
Δ AGG SALES × OINFLX	−0.034	0.136*	0.028	0.168**
	(0.852)	(0.088)	(0.874)	(0.034)
CINFLX	0.212	−0.102	0.128	−0.041
	(0.336)	(0.427)	(0.565)	(0.751)
OINFLX	−0.009	0.001	−0.058	−0.002
	(0.878)	(0.969)	(0.370)	(0.959)
Size			−0.080**	0.011
			(0.022)	(0.379)
Leverage			0.005	0.001
			(0.954)	(0.986)
Profitability			0.010	−0.200**
			(0.967)	(0.043)
Tangibility			0.069	−0.033
			(0.432)	(0.367)
Own Capacity Growth			−0.003	0.006
			(0.858)	(0.408)
Fixed Effects	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F
N	4,826	3,241	4,373	3,000
R^2	0.006	0.011	0.013	0.015
Q1(CINFLX)	−0.023	−0.046	−0.004	−0.078
	(0.850)	(0.365)	(0.963)	(0.133)
Q3(CINFLX)	0.263	−0.129	0.068	−0.155
	(0.277)	(0.140)	(0.753)	(0.069)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 7:
Effects of competitor inflexibility on average wages

The table presents estimates based on an unbalanced panel containing data about 724 electricity generation firms from 40 countries/markets over the period 2001-2014. The dependent variables are the log average wage level (*log* WPC) and the first differences between log-values of average wage (Δ WPC). The explanatory variables are a measure of competitor inflexibility (CINFLX) and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	*log* WPC	Δ WPC	*log* WPC	Δ WPC
CINFLX	−0.196	−0.083	−0.104	−0.043
	(0.591)	(0.488)	(0.798)	(0.729)
OINFLX	0.010	0.018	0.044	0.014
	(0.908)	(0.502)	(0.608)	(0.604)
Size			0.070***	0.010
			(0.001)	(0.341)
Leverage			−0.073	−0.012
			(0.267)	(0.743)
Profitability			−0.098	−0.211**
			(0.737)	(0.041)
Tangibility			−0.139**	−0.043
			(0.030)	(0.213)
Own Capacity Growth			0.007	0.006
			(0.310)	(0.306)
Fixed Effects	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F
N	4,555	3,629	3,788	3,336
R^2	0.173	0.009	0.157	0.011

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 8:
Effects of Competitor Inflexibility for Listed Firms

The table presents estimates based on an unbalanced panel containing data about 1,019 electricity generation firms from 49 countries/markets over the period 2001-2014. The dependent variables are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), and total wage payments (Δ WAGES) The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). The dummy variable LISTED takes a value of one if a firm's equity is traded on a stock exchange in a given year, and zero otherwise. We also include interactions between LISTED and both measures of inflexibility, but do not report the coefficients here for ease of exposition. We consider the capacity of nuclear, hydro, geothermal, solar and wind-power plant as "committed capacity" in computing our measures of competitor and own inflexibility. Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX, which we compute for listed firms. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ SALES	Δ WtS	Δ WAGES	Δ SALES	Δ WtS	Δ WAGES
Δ AGG SALES (Δ AS)	0.071	−0.155	0.102	0.187*	−0.224	−0.006
	(0.348)	(0.135)	(0.145)	(0.065)	(0.100)	(0.946)
Δ AS × CINFLX	0.447***	−0.618***	−0.243*	0.507**	−0.519*	−0.064
	(0.001)	(0.001)	(0.054)	(0.047)	(0.087)	(0.723)
Δ AS × OINFLX	−0.150*	−0.005	−0.009	−0.433***	0.028	0.003
	(0.081)	(0.968)	(0.911)	(0.006)	(0.874)	(0.978)
Δ AS × LISTED	0.118*	0.082	0.019	−0.058	0.184	0.186*
	(0.096)	(0.377)	(0.729)	(0.613)	(0.231)	(0.054)
Δ AS × CINFLX × LISTED				−0.076	−0.154	−0.279
				(0.800)	(0.689)	(0.222)
Δ AS × OINFLX × LISTED				0.448**	−0.052	−0.030
				(0.019)	(0.828)	(0.850)
Control Variable	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F	F	F
N	6,492	4,565	4,620	6,492	4,565	4,620
R^2	0.081	0.073	0.043	0.084	0.074	0.044
Q1(CINFLX)	0.287	−0.207	0.068	0.223	−0.186	0.105
	(0.000)	(0.002)	(0.160)	(0.000)	(0.008)	(0.041)
Q3(CINFLX)	0.504	−0.508	−0.050	0.433	−0.514	−0.062
	(0.000)	(0.000)	(0.457)	(0.000)	(0.000)	(0.444)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 9:
Competitor Inflexibility including wind and solar power

The table presents estimates based on an unbalanced panel containing data about 1,019 electricity generation firms from 49 countries/markets over the period 2001-2014. The dependent variables are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), the ratio of dividends-to-sales (Δ DtS), total wage payments (Δ WAGES), total dividends and share repurchases (Δ DIVD), total employment (Δ EMP), and wage per capita (Δ WPC). The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). We consider the capacity of nuclear, hydro, geothermal, solar and wind-power plant as "committed capacity" in computing our measures of competitor and own inflexibility. Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ SALES	Δ WtS	Δ DtS	Δ WAGES	Δ DIVD	Δ EMP	Δ WPC
Δ AGG SALES	0.159***	−0.089	−0.654**	0.118**	−0.369	−0.043	−0.045
	(0.006)	(0.282)	(0.021)	(0.049)	(0.143)	(0.758)	(0.527)
Δ AGG SALES × CINFLX	0.361***	−0.474***	1.400**	−0.259**	1.453**	0.093	−0.237
	(0.007)	(0.010)	(0.033)	(0.038)	(0.011)	(0.822)	(0.153)
Δ AGG SALES × OINFLX	−0.084	−0.168	−0.101	0.000	−0.071	0.092	0.256***
	(0.318)	(0.139)	(0.777)	(1.000)	(0.827)	(0.597)	(0.001)
CINFLX	−0.019	0.240	0.007	0.135	−0.373	0.108	0.020
	(0.881)	(0.202)	(0.989)	(0.330)	(0.451)	(0.656)	(0.884)
OINFLX	0.068*	0.017	0.109	−0.006	0.200**	−0.060	0.008
	(0.064)	(0.688)	(0.277)	(0.892)	(0.035)	(0.300)	(0.770)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F	F	F	F
N	6,492	4,565	1,850	4,620	1,840	4,373	3,000
R^2	0.080	0.073	0.049	0.042	0.043	0.013	0.018
Q1(CINFLX)	0.237	−0.203	−0.343	0.059	−0.045	−0.017	−0.087
	(0.000)	(0.001)	(0.097)	(0.188)	(0.800)	(0.847)	(0.089)
Q3(CINFLX)	0.413	−0.434	0.340	−0.067	0.664	0.028	−0.202
	(0.000)	(0.000)	(0.322)	(0.287)	(0.017)	(0.894)	(0.014)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 10:
Effects of competitor inflexibility on firm's workers and owners

The table presents estimates based on an unbalanced panel containing data about 942 electricity generation firms from 46 countries/markets over the period 2001-2014. We drop all firm-years in with a firm's market share exceeds 50 percent from our final sample. The dependent variables are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), the ratio of dividends-to-sales (Δ DtS), total wage payments (Δ WAGES), total dividends and share repurchases (Δ DIVD), total employment (Δ EMP), and wage per capita (Δ WPC). The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ SALES	Δ WtS	Δ DtS	Δ WAGES	Δ DIVD	Δ EMP	Δ WPC
Δ AGG SALES	0.163***	−0.087	−0.669**	0.094	−0.356	−0.045	−0.032
	(0.007)	(0.303)	(0.019)	(0.124)	(0.143)	(0.762)	(0.684)
Δ AGG SALES × CINFLX	0.459***	−0.675***	1.517**	−0.226*	1.604***	0.145	−0.212
	(0.001)	(0.001)	(0.026)	(0.087)	(0.002)	(0.755)	(0.285)
Δ AGG SALES × OINFLX	−0.177**	−0.013	−0.197	−0.022	−0.226	0.005	0.134*
	(0.048)	(0.911)	(0.603)	(0.790)	(0.511)	(0.978)	(0.095)
CINFLX	−0.054	0.349*	−0.070	0.134	−0.149	0.135	−0.086
	(0.671)	(0.073)	(0.892)	(0.337)	(0.762)	(0.571)	(0.557)
OINFLX	0.071	0.040	0.121	0.053	0.191*	−0.077	0.016
	(0.110)	(0.411)	(0.241)	(0.132)	(0.089)	(0.242)	(0.598)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F	F	F	F
N	6,399	4,476	1,784	4,525	1,775	4,279	2,917
R^2	0.080	0.076	0.049	0.042	0.041	0.015	0.015
Q1(CINFLX)	0.263	−0.236	−0.336	0.045	−0.005	−0.013	−0.078
	(0.000)	(0.000)	(0.125)	(0.339)	(0.980)	(0.889)	(0.150)
Q3(CINFLX)	0.485	−0.563	0.399	−0.065	0.773	0.057	−0.181
	(0.000)	(0.000)	(0.276)	(0.339)	(0.005)	(0.806)	(0.060)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 11:
Countries with unbundling regulation in place

The table presents estimates based on an unbalanced panel containing data about 748 electricity generation firms from 37 countries/markets over the period 2001-2014. Each of these countries has unbundling regulations in place which restrict the joint ownership of electricity generation, distribution, and transmission facilities. The dependent variables are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), the ratio of dividends-to-sales (Δ DtS), total wage payments (Δ WAGES), total dividends and share repurchases (Δ DIVD), total employment (Δ EMP), and wage per capita (Δ WPC). The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ SALES	Δ WtS	Δ DtS	Δ WAGES	Δ DIVD	Δ EMP	Δ WPC
Δ AGG SALES	0.145**	−0.059	−0.549*	0.125*	−0.287	−0.053	−0.113
	(0.033)	(0.557)	(0.079)	(0.082)	(0.270)	(0.705)	(0.241)
Δ AGG SALES × CINFLX	0.540***	−0.679***	1.379*	−0.188	1.532***	0.577	−0.040
	(0.000)	(0.001)	(0.059)	(0.189)	(0.010)	(0.107)	(0.880)
Δ AGG SALES × OINFLX	−0.206**	−0.070	−0.349	−0.107	−0.493	−0.192	0.145
	(0.038)	(0.607)	(0.394)	(0.266)	(0.175)	(0.289)	(0.130)
CINFLX	0.068	0.317	0.490	0.270*	0.109	0.213	−0.080
	(0.618)	(0.146)	(0.434)	(0.071)	(0.845)	(0.440)	(0.601)
OINFLX	0.071	0.046	0.123	0.052	0.190	−0.071	0.000
	(0.185)	(0.411)	(0.302)	(0.239)	(0.135)	(0.338)	(0.992)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F	F	F	F
N	4,722	3,136	1,442	3,207	1,436	2,964	1,856
R^2	0.088	0.087	0.045	0.048	0.037	0.021	0.020
Q1(CINFLX)	0.247	−0.207	−0.280	0.078	0.007	0.056	−0.112
	(0.000)	(0.006)	(0.241)	(0.165)	(0.933)	(0.546)	(0.072)
Q3(CINFLX)	0.532	−0.566	0.448	−0.021	0.815	0.361	−0.133
	(0.000)	(0.000)	(0.304)	(0.844)	(0.013)	(0.061)	(0.292)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

Table 12:
Countries with competitive wholesale markets for electricity

The table presents estimates based on an unbalanced panel containing data about 815 electricity generation firms from 30 countries/markets over the period 2001-2014. In each of these countries, electricity is traded in competitive wholesale markets, e.g. on electricity exchanges. The dependent variables are first differences between log-values of firm-level sales (Δ SALES), the ratio of wages-to-sales (Δ WtS), the ratio of dividends-to-sales (Δ DtS), total wage payments (Δ WAGES), total dividends and share repurchases (Δ DIVD), total employment (Δ EMP), and wage per capita (Δ WPC). The explanatory variables are first differences between log-values of aggregate sales in a firm's market excluding the firm itself (Δ AGG SALES), a measure of competitor inflexibility (CINFLX), and own inflexibility (OINFLX). Further control variables include one-period lagged firm-level Size (logarithm of total assets), Leverage (long-term debt over total assets), Profitability (operating profits over total assets), and Tangibility (fixed assets over total assets). Own Capacity Growth is defined as the logarithm of firm level growth in installed power generation capacity. The rows labeled Q1(CINFLX) and Q3(CINFLX) present estimates of elasticities for the first and third quartile value of CINFLX (and median OINFLX). These estimates result from the coefficients of Δ AGG SALES and interactions of Δ AGG SALES with CINFLX and OINFLX. We include firm and year fixed effects. Standard errors are clustered by firm.

Dependent Variable	Δ SALES	Δ WtS	Δ DtS	Δ WAGES	Δ DIVD	Δ EMP	Δ WPC
Δ AGG SALES	0.060	−0.051	−1.087***	0.106	−0.752**	0.027	−0.063
	(0.375)	(0.609)	(0.001)	(0.148)	(0.010)	(0.866)	(0.487)
Δ AGG SALES × CINFLX	0.602***	−0.757***	2.409**	−0.263*	2.316***	−0.031	−0.143
	(0.000)	(0.000)	(0.016)	(0.074)	(0.005)	(0.964)	(0.574)
Δ AGG SALES × OINFLX	−0.179*	−0.008	−0.298	−0.019	−0.314	−0.092	0.187**
	(0.098)	(0.953)	(0.584)	(0.844)	(0.513)	(0.654)	(0.033)
CINFLX	−0.003	0.077	−0.694	−0.090	−0.812	0.079	−0.133
	(0.983)	(0.722)	(0.234)	(0.580)	(0.118)	(0.755)	(0.388)
OINFLX	0.013	0.007	0.346**	0.061	0.223	−0.072	−0.013
	(0.799)	(0.879)	(0.019)	(0.126)	(0.132)	(0.316)	(0.674)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y	F,Y
Cluster	F	F	F	F	F	F	F
N	4,769	3,454	1,093	3,528	1,092	3,296	2,382
R^2	0.082	0.097	0.081	0.042	0.060	0.015	0.022
Q1(CINFLX)	0.191	−0.216	−0.563	0.049	−0.248	0.020	−0.094
	(0.000)	(0.004)	(0.046)	(0.385)	(0.263)	(0.848)	(0.115)
Q3(CINFLX)	0.484	−0.584	0.610	−0.079	0.880	0.004	−0.163
	(0.000)	(0.000)	(0.296)	(0.293)	(0.049)	(0.991)	(0.189)

p-values in parentheses: * (p<0.10), ** (p<0.05), *** (p<0.01)

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