Firms are flattening their corporate hierarchies. Spans of control have broadened and the number of levels within firms has declined. These trends are suggested and documented in a number of academic papers (e.g., Paul Osterman 1996, Richard Whittington et al. 1999, and Raghuram G. Rajan and Wulf 2006) and are often discussed in the business press. However, much less is known about what causes flattening and organizational change more broadly. This is surprising given the role found, not only for hierarchies (Jose Maria Liberti 2005; Luis Garicano and Thomas N. Hubbard 2007), but also for organizational (Timothy F. Bresnahan, Erik Brynjolfsson, and Loren M. Hitt 2002) and human resource practices in explaining firm productivity (Casey Ichniowski, Kathryn Shaw, and Giovanna Prennushi 1997; Sandra E. Black and Lisa M. Lynch 2001; Nicholas Bloom, Raffaella Sadun, and John Van Reenen 2009). At the same time, a number of economic forces have strengthened competition in product markets. International competition has intensified from falling tariffs and transport costs, and several waves of trade liberalization. Domestic competition has increased from deregulations as well as reductions in

The Flattening Firm and Product Market Competition: The Effect of Trade Liberalization on Corporate Hierarchies

By Maria Guadalupe and Julie Wulf

This paper establishes a causal effect of product market competition on various characteristics of organizational design. Using a unique panel dataset on firm hierarchies of large US firms (1986–1999) and a quasi-natural experiment (trade liberalization), we find that competition leads firms to flatten their hierarchies: firms reduce the number of positions between the CEO and division managers, and firms increase the number of positions reporting directly to the CEO. The results illustrate how firms redesign their organizational structure through a set of complementary choices in response to changes in their environment. We discuss several possible interpretations of these changes. (JEL D23, F13, G34, M12, M51)
information and transport costs. A number of authors have suggested that the trends in organizational change and competition are related (R. Preston McAfee and John McMillan 1995; Dalia Marin and Thierry Verdier 2003, 2008; John Roberts 2004; Ricardo Alonso, Wouter Dessein, and Niko Matouschek 2009; Paola Conconi, Patrick Legros, and Andrew F. Newman 2009), but there is little convincing empirical evidence to support this claim.¹

In this paper, we investigate whether and how changes in product markets lead firms to restructure their organizations. In particular, we focus on how hierarchical structures—measured by the number of management levels (depth) and chief executive officer (CEO) span of control—respond to competition. One important contribution of this paper is to go beyond correlations between measures of product market competition and organizational change to establish causal identification. Our main finding is that greater competition causes firms to flatten: they reduce the number of management levels and broaden the span of control for the CEO. We also discuss several possible interpretations of these changes. To the best of our knowledge, this is the first paper to use a credible identification strategy to show that exposure to trade leads to change in organizational form and to establish a clear causal mechanism driving changes in firm hierarchies.

Why are hierarchies important? There are two strands of research in the organizational economics literature that analyze hierarchies as characterized by their depth and span of control. The first addresses misaligned incentives and considers hierarchies as a form of governance in which managers supervise subordinates. As such, managerial span of control is limited by the time required to supervise employees, while the number of levels in the organization is limited by the loss of control across levels (e.g., Oliver E. Williamson 1967; Guillermo A. Calvo and Stanislaw Wellisz 1978, 1979; Sherwin Rosen 1982; and Yingyi Qian 1994). More recent papers about incentive problems focus on the allocation of authority inside the firm (e.g., Philippe Aghion and Jean Tirole 1997; Oliver Hart and John Moore 2005; and Alonso et al. 2008a), but do not make explicit predictions on hierarchical levels or spans of control.² The second strand of the literature focuses on the role of hierarchies in processing and communicating information. Levels in a hierarchy potentially lead to distortions in the transmission of information and implementation delays, while spans of control are limited by how much information a manager can process (e.g., Michael Keren and David Levhari 1979; Roy Radner 1993; Patrick Bolton and Mathias Dewatripont 1994; Garicano 2000).³

In contrast with the number of theoretical papers, there has been limited empirical work analyzing depth and span because of the difficulty in obtaining data. The richness of our data allows us to address this gap and leads to a significant advantage over most of the existing empirical research on organizations that is traditionally based on cross-sectional analysis or a study restricted to a specific industry. We use

¹ One exception is Alfaro et al. (2010) who predict and find that trade policy across a large set of countries affects vertical integration.
² One exception is Rajan and Luigi Zingales (2001) who predict that flat hierarchies with fewer levels are optimal in human capital-intensive industries.
³ For a discussion of the measures of corporate hierarchy and a survey of related research, see Massimo G. Colombo and Marco Delmastro (2008).
a unique panel dataset of the internal organization of large US firms in a broad set of manufacturing industries over 14 years (1986–1999). The data include detailed information on characteristics of firm hierarchies—CEO span of control and hierarchical depth (or number of management levels)—as well as rich information on compensation for various senior manager positions. To ensure that our results are not driven by unobserved attributes of firms or divisions that may be correlated with organizational decisions, we fully exploit the panel dimension of the data (i.e., variation both within firms and within division manager positions).

Using this panel dataset, we show that flattening is indeed associated with a variety of proxies for product market competition, such as import penetration, industry price-cost margins, and trade costs (sum of transport costs and tariffs). But, while this evidence is suggestive of a link between competition and hierarchical structure, it is not conclusive evidence.\(^4\) We go beyond existing research and exploit exogenous changes to entry barriers into an industry in order to identify a causal effect of foreign competition on organizational change. Our identification strategy exploits a quasi-natural experiment based on a trade shock. Our experiment is the Canada-United States Free Trade Agreement of 1989 (FTA) that eliminated tariffs and other trade barriers between the two countries (Daniel Trefler 2004). The US firms most affected by the liberalization were those with the largest tariff reductions (i.e., firms in industries with high US tariffs on Canadian imports prior to 1989). These firms experienced a larger decline in entry barriers and thus were arguably exposed to a greater increase in competition.

We use this quasi-natural experiment and the differential increase in competitive pressure across industries in order to implement a difference-in-differences strategy. We find that for a firm with average tariffs before the liberalization, span of control increased by 6 percent and depth decreased by 11 percent after 1989. Overall, our results show a number of precisely estimated effects of competition on hierarchies and account for a moderate, but arguably causal share of the secular change in firm hierarchies.

Since the trade liberalization was bilateral, it also implied a reduction in Canadian tariffs on US exports potentially leading to market expansion opportunities for our US firms. However, while we find effects of these market expansion opportunities on other outcomes (such as firm size and market value), if anything they had a dampening effect on firm flattening (although not statistically significant). So, all the “flattening” is driven by intensifying competition from the fall in import tariffs (and not by market expansion from the fall in export tariffs).

We also evaluate a number of alternative explanations for the observed flattening and assess the robustness of the main results to additional specifications. In particular, we evaluate the role of the rise of information technology\(^5\), CEO turnover, and a host of other potential factors. Overall, we find that the results are robust to

\(^4\) The standard measures, as is well known, are subject to numerous concerns: they do not measure the underlying competition parameter (the entry barrier), they are endogenous to changes in the competitiveness of markets, and they are non-monotonic in competition (Richard Schmalensee 1989).

\(^5\) A number of papers have explored the relationship between IT and organizational characteristics (e.g., Bresnahan, Brynjolfsson, and Hitt 2002; George P. Baker and Hubbard 2004; Ann Bartel, Casey Ichniowski, and Kathryn Shaw 2007).
alternative specifications and that increasing competition leads firms to adopt flatter structures, reducing depth and increasing span.

While the main result in this paper is to establish a robust causal relationship between the trade liberalization and the flattening of firms, we also discuss possible interpretations of these changes. Management scholars have long argued that increased competition leads firms to search for new organizational practices in an attempt to replace traditional hierarchical structures.\(^6\) To our knowledge, in econometrics, there are very few theoretical papers that directly link competition and the main measures of hierarchical structure, depth and span.\(^7\) In this paper, the purpose is not so much to discriminate between theories, but rather to exploit the unique richness of the data to document causal changes in several organizational variables in response to an exogenous shock.

Firms could flatten in the face of competition to improve their speed in responding to market changes (David Thesmar and Mathias Thoenig 2000) or to minimize the distortion of information across levels within the hierarchy (McAfee and McMillan 1995). Relatively, they could also flatten to exploit increased returns to decentralized decision making in more competitive environments (Marin and Verdier 2003, 2008; Alonso, Dessein, and Matouscheck 2008b, 2009; Paola Conconi, Patrick Legros, and Andrew F. Newman 2009). Other reasons for flattening might be to eliminate slack and cut costs (Harvey Leibenstein 1966); or to alter the structure in response to a change in scope (i.e., the number of products or businesses as in Andrew B. Bernard, Stephen J. Redding, and Peter K. Schott 2006), the location of production, or their outsourcing decisions. We explore these different mechanisms in the data and, overall, our findings show little support for flattening as a way to simply cut costs. However, we do find some evidence that the liberalization led firms to become less diversified. We also find that the trade liberalization, in addition to causing firms to flatten, led to an increase in division manager compensation which we argue is more consistent with greater authority being allocated to division managers rather than less (Bengt Holmstrom and Paul Milgrom 1994; Canice Prendergast 2002).

Given the simultaneity of the organizational changes in response to an exogenous shock, our results are a good illustration of the theory of complementarities among a firm’s organizational design elements (e.g., Milgrom and Roberts 1995). We show that following an \textit{exogenous} shock to their competitive environment, firms redesign their organizations to “fit” the environment in which they operate, and simultaneously reorganize along several dimensions: flattening the hierarchy by increasing span and reducing depth, changing their scope, and changing the structure of compensation.

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\(^6\) Refer to Whittington et al. (1999) for a review of the relevant literature in management. For early works that discuss the link between organizational change and the environment, refer to Paul R. Lawrence and Jay W. Lorsch (1967).

\(^7\) One exception is McAfee and McMillan (1995) who develop a model of the costs of private information arising from an agent’s ability to exploit an informational advantage in a hierarchical organization. Since hierarchies with more levels have greater informational inefficiencies, firms might flatten in response to an increase in competition to offset these inefficiencies.
The remainder of the paper is organized as follows. Section I describes the data and our empirical strategy. Section II outlines and discusses our results of changes in the hierarchy and other firm outcomes. Section III concludes.

I. Data and Empirical Strategy

A. Organizational Data

The primary dataset from which we draw our sample is an unbalanced cross-industry panel of more than 300 publicly traded US firms over the period 1986–1999. This dataset includes detailed information on job descriptions, titles, reporting relationships, and reporting levels of senior and middle management positions. The dataset is rather unique because it allows us to identify changes in hierarchies within firms over a 14-year period that is characterized by significant organizational change.

The data are collected from a confidential compensation survey conducted by Hewitt Associates, a leading human resources consulting firm specializing in executive compensation and benefits. The survey is the largest private compensation survey (as measured by the number of participating firms).

Clearly, an important issue in datasets such as this one is the question of sample selection and whether the firms in the dataset are distinct from, or representative of, employers of similar size in their industry. The survey participants are typically the leaders in their sectors and, in fact, more than 75 percent of the firms in the dataset are listed as Fortune 500 firms in at least one year. We evaluate the representativeness of the broader sample by comparing key financial measures of our survey participants to a matched sample from Compustat. We begin by matching each firm in the Hewitt dataset to the Compustat firm that is closest in sales within its two-digit SIC industry in the year the firm joins the sample. We then perform Wilcoxon signed rank tests to compare the Hewitt firms with the matched firms. While the firms in the Hewitt dataset are, on average, slightly larger in sales than the matched sample, we found no statistically significant difference in employment and profitability (return on sales). We also found no statistically significant difference in sales growth, employment growth, or annual changes in profitability for all sample years. In sum, the survey sample is most representative of Fortune 500 firms (for more details, see Rajan and Wulf 2006). See Table 1 for summary statistics of the final sample.

An observation in the dataset is a managerial position within a firm in a year. This includes both operational positions (e.g., CEO and division managers) and senior staff positions (e.g., chief financial officer (CFO) and general or legal counsel). The data for each position include all components of compensation, as well as position-specific characteristics such as job title, the title of the position that the job reports to (i.e., the position’s boss), number of positions between the position and the CEO in
We analyze changes in organizational structure by focusing on two characteristics that are discussed in the theoretical literature on hierarchies: span of control and depth of the hierarchy (Colombo and Delmastro 2008). These can be defined consistently across firms and over time, and reflect important information about two important positions in the hierarchy, namely the division manager and the CEO.

Our first measure, span, is a firm-level measure that captures a horizontal dimension or breadth of the hierarchy (e.g., Keren and Levhari 1979, Qian 1994, Garicano 2000). It measures CEO span of control and is defined as the number of positions reporting directly to the CEO. One obvious question when using this variable is: what information is reflected in a direct reporting relationship to the CEO? First, the CEO should have direct authority over the manager in the position (i.e., his subordinate) (e.g., Hart and Moore 2005). Second, presumably the exchange of information
between the CEO and the manager is more direct than it would be if the “chain of command” included other intermediary positions. Since the CEO is at the top of the lines of authority and communication, his job involves decision making at the highest level, but also includes a role as coordinator of information and decisions that is associated with a complex, multidivisional firm (e.g., Alonso, Dessein, and Matouschek 2008a; Heikki Rantakari 2008a).

Our other measure, depth, is defined at the division level and represents the vertical dimension, or steepness, of the hierarchy (Williamson 1967, Radner 1993, Qian 1994, Garciano 2000). It is defined as the number of positions between the CEO and the division manager. Division managers are the highest authority in the division, where a division is defined as “the lowest level of profit center responsibility for a business unit that engineers, manufactures and sells its own products.” We focus on the division manager position for two reasons: it is the position furthest down the hierarchy that is most consistently defined across firms; and it is informative about the extent to which responsibility is delegated in the firm.

Figure 1 displays an example of a hierarchy for a textile manufacturer that demonstrates both measures of span and depth in two time periods (pre- and post-FTA). In the pre-FTA chart, the measure of span equals five (there are five positions reporting directly to the CEO), and the measure of depth equals two (there are two positions between the CEO and each division manager). In the post-FTA chart, the span has increased to seven and the depth has decreased to one as the division managers move closer to the CEO. In our sample, average span increased from 4.5 positions in 1986 to 7 positions in 1999, and average depth fell from around 1.5 to 1.

In this paper, we focus on the subset of firms that operate in the manufacturing sector for which we have data on tariffs. This leads to a sample of approximately 1,962 firm-years and 5,702 division-years that includes 230 firms and 1,524 divisions. We will report both firm-level regressions (span of control is a firm level variable) and division-level regressions (division depth varies by division within the firm).

We also have information on division-level sales and employment, and the above data are supplemented with financial information from Compustat. Finally, we
construct a number of variables that are used as controls and that we will describe in the results section.

B. A Quasi-Natural Experiment for Product Market Changes:
The 1989 Canada-US Free Trade Agreement

In January 1989, US President Ronald Reagan and Canadian Prime Minister Brian Mulroney signed the FTA to eliminate trade barriers and, in particular, all tariffs between Canada and the United States. The agreement encountered substantial opposition in Canada, and the Liberal Party announced that it would use its majority in the Senate to block passage of the free trade agreement until Canadian voters decided the agreement’s fate in a general election. The highly contested election took place in October 1988 with a narrow Conservative victory. Three months later the agreement came into effect and the first round of tariff reductions took place.

This turn of events has important advantages for our empirical strategy (see also discussion in Trefler 2004). Since the passage of the agreement was highly improbable and unexpected, it can be interpreted as an exogenous shock. Furthermore, there were no other important trade agreements during that period so that the shock to trade with Canada is unlikely to be confounded with other factors.

This reduction of US tariffs on imports from Canadian firms increased imports from Canada substantially (Kimberly A. Clausing 2001). The FTA actually affected a significant fraction of US trade since the US-Canada trade relationship is the world’s largest (Canadian imports represented an average of 20 percent of total US imports at the time). Tariff reductions for industries defined at four-digit Standard Industrial Classification Codes (SIC) ranged from 0 percent to as high as 36 percent (with more variation at higher levels of aggregation). In addition, Canada is similar to the United States in terms of product specialization, so that Canadian products are likely to compete directly with US products. We discuss the effect that the liberalization had on US firms more extensively below.

In order to evaluate the effect on organizational change of the trade agreement as a quasi-natural experiment, we exploit the fact that US firms in industries with high tariffs on Canadian imports prior to 1989 suffered a bigger “competitive shock” following the liberalization than firms facing low tariffs. The reductions in US tariffs on imports from Canada after 1989 were dramatic.

All tariffs were scheduled to go to zero after 1989, but while some tariff reductions took effect immediately, others were scheduled to be phased out over a period of five or ten years. This phase-out schedule is a potential source of endogeneity. The phase-out times are endogenous choices, given they are potentially influenced by firms that seek protection from the government through lobbying. To avoid the endogeneity of the schedule, we treat all industries equally regardless of their phase-out schedule, and only exploit the level of tariffs before the agreement.

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9 Keith Head and John Ries (2001) estimate the elasticity of substitution between US and Canadian goods to be very high, at approximately eight.

10 This is the correct specification if one is concerned about endogeneity, and also given that all information on future tariff reductions was known in 1989. We also find that our main result holds if we use the actual Canadian
Therefore, we define $AvT^{89}_s$ to measure the level of exposure of the firm to the liberalization. This is the three-year average tariff on Canadian imports by industry $s$ for the period between 1986 and 1988 (Robert C. Feenstra 1996), where tariffs are defined as duty divided by customs value by four-digit SIC (or three-digit SIC) by year. Our dependent variables are a set of organizational variables $ORG_{d, t}$ (e.g., division-level depth and firm-level CEO span of control) by division $d$ (or firm), industry $s$, and year $t$, such that our basic empirical specification is the following reduced form:

$$ORG_{d, t} = \theta AvT^{89}_s \times \text{Post}^{89}_t + X'_{d, t} \beta + d_t + \eta_{d} + \eta_{d} \times t + \epsilon_{d, t},$$

where $AvT^{89}_s$ is the average level of tariffs on Canadian imports in the industry pre-89, $\text{Post}^{89}_t$ is a dummy that equals one from 1989 onward; $X_{d, t}$ are division (or firm) characteristics such as size; $d_t$ are year dummies; $\eta_d$ are division fixed effects that absorb any permanent cross-sectional division/firm/industry differences; and $\epsilon_{d, t}$ is an error term. This is a standard difference-in-differences specification that exploits the trade liberalization where $AvT^{89}_s$ (the “treatment”) is continuous. The coefficient of interest, $\theta$, captures the differential effect of the liberalization on firms according to their trade exposure prior to 1989. Or, in other words, since all tariffs were scheduled to go to zero, it is the effect of the change in tariffs due to the FTA, net of the general change post-1989, and net of possible permanent differences across industries.

We argued earlier that the agreement itself was largely unexpected and therefore one can consider it as an exogenous shock to the different industries. However, in order to make sure that there are no differential pre-existing trends in organizational variables that may be correlated with the initial tariff level, we saturate the model even further and include division (firm)-specific linear trends, $\eta_{d} \times t$.

But even if the implementation of the agreement was unexpected, and if we do not allow for endogenous phase-out of tariffs to identify our results, we still need to address the fact that the pre-89 level of tariffs is not necessarily random. We do this in two different ways. Trefler (2004) argues that one source of tariff endogeneity is that declining industries may have high tariff levels. He addresses this concern by controlling for industry-specific trends. As mentioned, we address this concern by controlling for division-specific time trends ($\eta_{d} \times t$) that absorb the industry secular trends. We further control for other pre-existing industry characteristics that are typically related to tariff protection: skill intensity, capital intensity, and TFP growth of US industries. The vector $Z_{d}$ includes the averages of each of these measures by industry before the FTA (between 1986 and 1988). Analogous to our tariff measure,


12 Firms and divisions are assigned the industry reported as the firm’s primary four-digit SIC in the first year they appear in the sample using historic SICs. This industry classification is not allowed to vary over time since these changes are endogenous.
we also allow organizational change to vary along these dimensions after 1989 through the interaction term \((Z_s \times Post89)_t\).

Finally, one concern in estimating equation (1) is that our organizational variables, both span and depth, exhibit a strong trend over time (as suggested in Figures 2 and 3) leading to autocorrelated errors. We estimate equation (1) in first-differences, since this removes the autocorrelation \((F\text{ statistic of } 2.6)\), and thus is the efficient estimator in this case. Furthermore, since AvT89 is defined at the industry level, we cluster standard errors by four-digit SIC in all specifications to allow for correlation across observations within an industry.

Once we include all the relevant variables and take first-differences, the regression we estimate is

\[
\Delta \text{ORG}_{dst} = \theta \Delta \text{AvT89}_t \times \text{Post89}_t + \Delta \text{X}_{dst}' \beta
+ \Delta d_t + \eta_d + \Delta (Z_s \times \text{Post89}_t)' \varphi + \Delta \varepsilon_{dst}.
\]

**Economic Impact of the FTA on US Firms.**—An important final question before we proceed to the results is what evidence do we have on the impact of the FTA on US firms? Clausing (2001) studies the FTA using disaggregated data at the commodity level (ten-digit product categories) and finds that the increase in US imports from Canada was larger, the larger the tariff reduction (the higher the pre-1989 tariff). For imports that saw a tariff reduction in excess of 5 percent, trade doubled in size between 1989 and 1994. Head and Ries (2001) and John Romalis (2007) also find a sizable effect of the tariff reductions on trade volumes.

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13 A test of autocorrelation strongly rejects the null of no autocorrelation, even when allowing for division-specific time trends \((F\text{ statistic of } 431.2)\). This implies that the fixed effects (within) estimation is inefficient.
So, overall, the trade liberalization increased bilateral trade flows and import penetration, which is consistent with an increase in competitive pressure for firms on both sides of the border. Using our data, we also found a significant effect of the FTA on firms in our sample (Table A1), and evidence that the FTA led to greater competitive pressure for our firms from the reduction in US tariffs, but also increased opportunities for market expansion from Canadian tariff reduction. Next, we assess the organizational response to this quasi-natural experiment.

II. Results

A. Trade Liberalization and Flattening:
Changes in Division Depth and CEO Span of Control

In this section, we focus on the effect of the trade liberalization on changes in division depth and CEO span of control as the main organizational variables. In 14 We found (Table A1) that reductions in US tariffs on Canadian imports led to reductions in average price-cost margin for our firms, suggesting a significant negative effect of competition on accounting measures and no significant changes on market returns or employment. Canadian tariff reductions, computed in an analogous way to AvT89, and using data from Trefler (2004), did raise firm employment and excess market returns (and had no effect on price-cost margins), which is consistent with the market expansion interpretation. Trefler (2004) shows that the FTA increased productivity of Canadian firms and their exports to the United States, which is consistent with increased competitive pressure for US firms.

15 Before turning to the main specification of the paper that exploits a quasi-natural experiment, we studied the correlation between some standard measures of product market competition, depth, and span. We found that division depth and CEO span significantly respond to other standard measures of competitive pressure (Table A2). Higher competition, as reflected in lower trade costs (defined as tariffs plus transport costs, columns 1 and 4), a lower industry Lerner Index (columns 2 and 5) or higher import penetration (columns 3 and 6) significantly reduces depth and increases CEO span of control. While these measures can be subject to many criticisms, and are by no means exogenous, that is why we use the FTA as our core specification, they provide evidence consistent with the main result in this paper: flattening is a response to increased competitive pressure.
Section IIB, we will explore how other aspects of organizations are also changing over time in order to provide a fuller picture of organizational change and to explore the possible explanations for these changes.

Figures 2 and 3 show the main variation that we exploit in our empirical analysis. We divide firms and divisions according to whether the firm is in an industry with an above or below the median tariff reduction following the FTA (i.e., with a tariff above or below the median tariff pre-1989). We plot the average span (Figure 2) and depth (Figure 3) by year for the two subgroups. While we observe trending in organizational variables in both groups, there is a distinct difference in the change in trend after 1989 between the groups. Firms in industries with large tariff changes increase their span by more and decrease depth by more after the trade liberalization in comparison to firms in low-tariff reduction industries.\footnote{These graphs restrict the sample to firms that are present in the data before 1989 to avoid compositional changes driving these patterns (we observe even starker patterns in the whole sample).}

Table 2—Division Depth and Trade Liberalization

<table>
<thead>
<tr>
<th>Division depth</th>
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<th>Division depth</th>
<th>Division depth</th>
<th>Division depth</th>
<th>Division depth</th>
<th>Division depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>AvT89×Post89</td>
<td>−3.661</td>
<td>−3.501</td>
<td>−3.73</td>
<td>−3.279</td>
<td>−3.539</td>
<td>−3.739</td>
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<tr>
<td>[1.191]***</td>
<td>[1.190]***</td>
<td>[1.147]***</td>
<td>[1.177]***</td>
<td>[1.177]***</td>
<td>[1.118]***</td>
<td></td>
</tr>
<tr>
<td>Export: AvT89×Post89</td>
<td>0.655</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AvT89×Post88(placebo)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>[1.443]***</td>
</tr>
<tr>
<td>Change of CEO</td>
<td>−0.182</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.025]***</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>IT invest (2 digit)</td>
<td>4.981</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[3.693]***</td>
</tr>
<tr>
<td>CT invest.</td>
<td>56.901</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[17.044]***</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Notes: Standard errors are in brackets, clustered by industry (SIC4). All regressions are estimated in first differences and include year dummies and the interaction of Post89 with US industry skill intensity, capital intensity, and TFP growth pre-89 to account for tariff endogeneity in a base year (for all three measures, we take the average for 1986–1988), from Eric J. Bartelsman and Wayne Gray (1996). Division depth is the number of managers between the DM and the CEO. AvT89 is the average US tariff rate on Canadian imports in 1986–1988, by industry. Column 3 also includes the Canadian tariff on US exports. Change CEO is a dummy variable indicating a CEO change; see notes to Table 1 for definition of other variables.

***Significant at the 1 percent level.

*Significant at the 10 percent level.
Table 3—CEO Span of Control and Trade Liberalization

<table>
<thead>
<tr>
<th>CEO span</th>
<th>CEO span</th>
<th>CEO span</th>
<th>CEO span placebo</th>
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<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>AvT89 × Post89</td>
<td>8.106</td>
<td>9.908</td>
<td>11.386</td>
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<tr>
<td></td>
<td>[3.613]**</td>
<td>[3.839]**</td>
<td>[3.590]***</td>
</tr>
<tr>
<td>Export: AvT89 × Post89</td>
<td></td>
<td>−3.544</td>
<td>[3.529]</td>
</tr>
<tr>
<td>AvT89 × Post88 (placebo)</td>
<td></td>
<td></td>
<td>−5.61</td>
</tr>
<tr>
<td>Change of CEO</td>
<td></td>
<td></td>
<td>[4.601]</td>
</tr>
</tbody>
</table>

IT invest (2 digit)

<table>
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<tr>
<th>In firm sales</th>
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<th>0.947</th>
<th>0.961</th>
<th>0.959</th>
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<td>[0.290]***</td>
</tr>
<tr>
<td>Firm FE</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Firm trends</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
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<tr>
<td>R²</td>
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<td>0.021</td>
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<td>0.02</td>
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<table>
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<tr>
<th>CEO span change CEO</th>
<th>CEO span IT</th>
<th>CEO span functional pos.</th>
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<tr>
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<td>6</td>
<td>7</td>
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<td>[3.883]**</td>
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<td>0.021</td>
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<td>230</td>
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</table>

Notes: Standard errors are in brackets, clustered by industry (SIC4). All regressions are estimated in first differences and include year dummies and the interaction of Post89 with US industry skill intensity, capital intensity, and TFP growth pre-89 to account for tariff endogeneity. Span is the number of managers that report directly to the CEO. AvT89 is the average US tariff rate on Canadian imports in 1986–1988, by industry. Column 3 also includes the Canadian tariff on US exports. Change CEO is a dummy variable indicating a CEO change. See notes to Table 1 for definition of other variables.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.
raw differences in organizational change of firms in industries facing different competitive shocks, they do not take into account firm or division characteristics, unobserved heterogeneity, or the overall time trend. For this, we turn to our regression analysis.

**Estimates of the Effect of the FTA on Division Depth and CEO Span.**—In Tables 2 and 3, we report the results of the effect of the FTA on division depth and CEO span of control, respectively. The tables have a similar structure with specifications reported in roughly the same order. In the depth regressions (Table 2), the unit of observation is the division-year (there are 1,524 divisions in the data); while in the span regressions (Table 3), it is the firm-year (230 firms).

All regressions follow the structure of equation (2) and include year dummies and controls for firm size (as the natural logarithm of sales) and the endogeneity of tariffs through interactions of industry characteristics (skill intensity, capital intensity, and TFP growth) with a post-89 dummy. Standard errors are clustered at the industry level. The regressions also account for permanent unobserved heterogeneity (firm or division) that might bias our estimates. This is a big advantage of this dataset, in that the estimates are exclusively identified from within-firm variation in their exposure to the FTA (and not from differences across firms).

The coefficient of interest is the interaction of the average tariff in the industry before the 1989 FTA with a post-89 dummy (variable $AvT89_s \times Post89_t$). We expect the 1989 FTA to lead to a greater increase in competitive pressure (i.e., a larger fall in entry barriers) in industries with high tariffs relative to low-tariff industries.

The main results are shown in column 1 of Tables 2 and 3. In column 1 of Table 2 (depth), the coefficient on the interaction term is negative and statistically significant. This suggests that firms in industries with higher tariffs prior to the trade liberalization decreased division depth more over the period as their product markets faced greater competition due to a decline in tariffs. A firm in an industry with average US tariffs on Canadian imports (4 percent) decreased division depth by 0.146 positions following the trade liberalization ($3.661 \times 0.04$). This represents 11.2 percent of average depth in the sample. But, how can we interpret the magnitude of the effect? One way to interpret it is to imagine a firm with six division managers each with one position between them and the CEO (i.e., depth of one). Following the trade liberalization, a firm with average tariffs would move one of the six division managers to report directly to the CEO. This requires a change in the level of reporting for one of the divisions in this example, so it is relatively easy to implement and does not involve significant reorganization costs (it simply requires that the CEO decides that one of the six division managers now reports directly to him).

Turning to span of control, in column 2 of Table 3, we find a positive and statistically significant coefficient suggesting that firms increase span of control more in response to a greater fall in tariffs in their industries. A firm with average tariffs

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17 It is important to run the depth regressions at the division level, rather than averaging by firm, in order to look at changes of the same division over time, and also to be able to control for division size. Given that the coverage of divisions within a firm can fluctuate (firms do not report all divisions in the data), changes in average depth within firms may be capturing compositional changes.
before 1989 increased span by 0.324 positions following the trade liberalization $(8.106 \times 0.04)$, or 6 percent of average span in the sample. This implies that one of every three firms in our sample increased the CEO’s span of control by one position (i.e., that either one more division manager or functional staff reports directly to the CEO). Again, this could simply require the CEO to change the reporting structure of one position.

In Table 2 (depth), columns 2–7, we also control for division-specific time trends and for division size (the log of division employment), and still find that firms more affected by the FTA repositioned their division managers closer to the top of the hierarchy.\footnote{18} We lose around 700 observations where division employment is missing, but this does not substantially alter the results. Perhaps, not surprisingly, larger firms have greater depth and larger divisions within firms are closer to the top. Column 2 of Table 3 (span) controls for firm-specific time trends, and we obtain a similar though slightly larger effect than in column 1 (coefficient of 9.9 instead of 8.1). This indicates that the result is not driven by pre-existing trends in span that may have pre-dated the liberalization agreement.

Next, since the trade liberalization implied not only a fall in US tariffs on Canadian imports, but also a reduction of Canadian tariffs on US exports, we allow for an effect of this second aspect of the liberalization that we know affected employment and market value significantly for these firms (Table A1). Column 3 includes an interaction of the average Canadian tariff on US exports with a post-1989 dummy (labeled as Export $AvT_{89}$ and defined in an analogous way to US $AvT_{89}$). The effect is positive for depth and negative for span, suggesting that, on average, the market expansion possibilities led US firms to steepen their hierarchies relative to the trend. However, since this is the opposite effect of that for import tariffs (although it is not statistically significant), we conclude that firms flatten in response to increasing competition from imports and not from greater export opportunities.

Column 4 in Tables 2 and 3 provides a test of the assumption that the shock was unanticipated. We replace the Post-89 dummy in $AvT_{89} \times Post_{89}$ with a $Post_{88}$ dummy variable (equals one from 1988 onwards), and keep the same set of controls (this is a standard placebo test for differences-in-differences). If the liberalization was anticipated, or if there was a pre-existing trend, then this new variable would pick up what we argue is a discrete “shock” before it occurred. If it is zero, it provides support to the maintained hypothesis that the shock was unanticipated (recall our estimates are in first-differences). The coefficient is statistically insignificant in both tables, lending credibility to the fact that the liberalization was truly unanticipated and that firms only started to respond after 1989.

Overall, we find convincing evidence that the effect of the trade liberalization on the flattening of firms took place around the 1989 period.\footnote{19} Next, we consider two important alternative explanations that could affect our main results.

\footnote{18} This suggests that our main result is unlikely to be driven by downsizing of divisions due to outsourcing or offshoring of certain activities, since this would possibly lead to a reduction in employment. (We found no relationship between log division employment and the experiment, and hence we can include it as a control.)

\footnote{19} We also found larger effects in firms that did not change industry over the sample period, in firms that reported a four-digit SIC industry, and when using a weighted average of tariffs taking into account the different segments
One frequent reason for why firms change their organizations is because there is a change in firm leadership. We found no significant effect of the trade liberalization on CEO turnover (unreported), so that we can include a dummy that indicates a change in CEO as a regressor in column 5. We find that depth decreases by 0.182 positions (division managers move closer to the top) in the event of a change in the CEO, and that span increases by 0.446 positions. However, as expected, the effect of the trade liberalization is unchanged, confirming that it has an independent effect on organizational change that is distinct from CEO turnover.

Finally, we try to consider the relevance of IT as a driver of organizational change. The mere availability of IT and falling IT prices should not be a problem for our identification since the availability of IT was similar across industries and our experiment exploits the differential effect across industries after 1989. However, if the FTA causes firms to adopt IT, the effect we are estimating would not be the direct effect of competition on hierarchies, but the indirect effect of competition through higher IT adoption. Since both effects are interesting in themselves, we would like to assess their relative importance to the extent that the data allow, and given we only have one source of exogenous variation. First, we tested whether IT adoption is related to our quasi-natural experiment with insignificant results (unreported). Therefore, we introduce IT investment as a control in our main specification. We control for two types of IT investment at the industry level: total IT in column 6 of Table 2 (includes hardware, software, and communications) and communication technology (CT) in column 7 of Table 2.

First, we confirm that our coefficient of interest is unaffected. But, more importantly for the interpretation of our results, the coefficient on overall IT (column 6 in Tables 2 and 3) is positive for both depth and span, suggesting that increases in IT are associated with steeper organizations (more levels) and wider spans of control. However, both coefficients are statistically insignificant. Interestingly, though, when we focus on the communications component of IT (Table 2, column 6), we find a positive and statistically significant coefficient in the depth regression (but, insignificant for span-unreported). This is consistent with theories of IT and hierarchies that say that improvements in communication technologies (costs of acquiring/communicating information) can increase depth and span (Garicano 2000). Therefore, if anything, the effect on delayering of more IT (CT) goes in the opposite direction to the competition effect that we have shown in this study.

Finally, we assess how much of the increase in span is directly related to the reduction in depth, and whether the change in span and depth are capturing different phenomena inside the firm. Span can increase because division managers start reporting directly to the CEO, but also because other senior staff positions report directly to the CEO. Column 7 of Table 3 regresses the number of nonoperational positions that report directly to the CEO (i.e., positions independent of division the firm operated in a base year. We also found that flattening was more pronounced in industries that had an average tariff on Canadian imports in 1989 larger than the average tariff on imports from the rest of the world (unreported).

These are defined as the investment in IT (CT) capital stock at the two-digit SIC industry level based on data from the Bureau of Economic Analysis (BEA). The data are very aggregated relative to what one would require for a conclusive analysis, however, they allow us to shed light on the importance of investments in information technology in explaining our results.
managers) and shows that this increases as a result of the reduction in import tariffs, and decreases from the reduction in export tariffs. Since the measure of span that excludes division managers (and the effect from changes in depth) increases with tariff reductions, we conclude that the two dimensions of hierarchies, depth and span, are capturing related, but distinct responses to the FTA.

Overall, we find systematic evidence that firms experiencing a larger shock following the trade liberalization (those in more protected industries prior to 1989) reduced division depth and increased CEO span of control more relative to firms less affected by the liberalization.

**B. Why Are Firms Flattening?**

The previous results show that the quasi-natural experiment based on the FTA explains flattening—both the increased span of control of the CEO and the decreased depth of division managers. However, even though we document a significant effect, we have not discussed the reasons why firms may decide to alter their organizational structure. While it is beyond the scope of this paper to try to identify the precise channels for these facts, in this section, we discuss to what extent the evidence is consistent with a number of possible mechanisms.

**Changes in Decision Making.**—Mirroring the two strands in the theoretical literature, flattening hierarchies could reflect two distinct, but related changes in the way that firms make decisions. Firms may flatten to improve the processing and communication of information (e.g., Keren and Levhari 1979; Radner
1993; Bolton and Dewatripont 1994; Garicano 2000). Or, firms may flatten to align incentives and improve governance by delegating authority to better-informed managers (e.g., Williamson 1967; Calvo and Wellisz 1978, 1979; Rosen 1982; Qian 1994). However, what causes these changes? Organizational change may be a direct response to increased competition in product markets (Thesmar and Thoenig 2000). For example, when firms face greater competition and lower profit margins, they may eliminate levels to reduce inefficiencies arising from informational advantages of lower level managers with greater market knowledge (McAfee and McMillan 1995). Furthermore, competition can cause firms to change the allocation of decision-making authority (Marin and Verdier 2003, 2008; Alonso, Wouter, and Matouschek 2008b, 2009; Rantakari 2008b; Conconi, Legros, and Newman 2009).

Our variables, depth (number of reporting levels) and span (number of direct reports), cannot capture the flow of information, the speed of decisions, or where decisions are made. So we cannot test directly for changes in decision making. However, as division managers move closer to the CEO, they are subject to less supervision by intermediaries (although possibly to more supervision by the CEO). Since there are clear theoretical predictions (e.g., Susan Athey and Roberts 2001, Prendergast 2002) and supporting empirical evidence on the complementarities between decision-making authority and incentive provision, we can analyze how division manager compensation changes as competition increases, and assess whether the decrease in depth is consistent with more or less authority for division managers.

Column 3 of Table 4 shows that division manager pay increases more for firms with higher tariff reductions after 1989. This is controlling for individual times division specific fixed effects, such that it is the same individual with the same job title that sees his pay increase. Column 4, in turn, shows that the fraction of long-term incentives (defined as above) out of total pay that division managers receive also increases. The results show that the trade liberalization led to a 3.5 percentage point higher fraction of total pay in the form of long-term incentives for division managers in a firm with average tariffs. We also found (unreported) that the sensitivity of division manager pay to division-level performance (as measured by the natural log of division sales) increased with competition from the trade liberalization (consistent with Vicente Cuñat and Guadalupe 2009). While not conclusive proof of changes in decision making, to the extent that greater authority generally goes hand-in-hand with increased incentive provision, this set of facts is consistent with flattening reflecting greater decision-making authority to division managers as a result of intensified competition.

Cost-Cutting.—Perhaps the simplest reason why firms reorganize is to downsize or cut costs. A common argument is that firms in a noncompetitive setting do not fully minimize costs (managers live “the quiet life” of a monopoly) and that an increase in competition forces them to eliminate organizational slack or X-inefficiency (Leibenstein 1966). To evaluate whether reducing slack and increasing efficiency is the first order reason for flattening, we focus on the intermediary position between

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21 There is empirical evidence that delegation and incentives move together (Margaret Abernethy et al. 2004; Wulf 2007; and Jan Bouwens et al. 2007).
the CEO and the division manager for which we have some information, the group manager. These managers have multiple profit center responsibility and are typically positioned between the CEO and the division manager (see Figure 1).

In column 1 of Table 4, we regress the number of group positions in the firm on our competition measure and include firm fixed effects, firm-specific linear trends, and a control for firm size. We find that the trade liberalization (weakly) reduces the number of group managers. However, we also find that total pay of the remaining group managers increases (column 6). This increase in the total pay (labor costs) is at odds with the simplest version of the cost-cutting explanation. Next, we evaluate how the level of pay of division managers themselves changes with the trade liberalization. The dependent variable in column 3 of Table 4 is the logarithm of division manager total compensation defined as the sum of salary, bonus, and long-term compensation (including the Black-Scholes value of stock options grants, restricted stock, and other long-term incentives). We control for manager times division-specific fixed effects and trends, such that it reflects the change in pay for the same individual in the same position. We find that higher competitive pressure leads to higher total pay. Division managers in industries with average tariff changes (average pre-1989 tariffs) received a 7.3 percent increase \((1.817 \times 0.04)\) in total compensation after the trade liberalization relative to managers in industries with no tariffs throughout.

Overall, we observe that total pay going to division managers and other senior managers increases in response to the trade liberalization. This is inconsistent with the simple explanation of cost-cutting, if the elimination of positions aims to reduce compensation costs.

Changes in Firm Scope.—Another equally plausible explanation for some of the changes that we observe is that firms change the scope of their operations. First, firms may diversify into more businesses as the result of the liberalization, or reduce the number of products (Bernard, Redding, and Schott 2006) and as a result change their organizational structure. To test for this explanation, we use the Herfindahl Index of sales across different 2 digit segments, as an inverse measure of firm diversification. We find that firms decrease scope and focus their business operations (become less diversified), the larger the tariff reduction from Canada (column 5, Table 4). This suggests that a possible additional mechanism for increased flattening may be through reductions in firm scope. Relatedly, firms may respond to increased competition by restructuring, merging with other firms, or by outsourcing or offshoring activities. However, as mentioned earlier, we find no effect of changes in employment as a result of the reduction in import tariffs due to the FTA, suggesting this is not a primary driver.

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22 We also found that total pay for a group of senior executive positions increased including the CEO, group managers, division managers, the CFO, general counsel, head of human resources, and head of strategic planning (unreported).

23 We also looked at the effect of the trade liberalization on selling, general and administrative expenses (SG&A), as a measure of overhead costs. We found the effect to be, if anything, positive (although not significant) indicating higher overhead costs in response to greater competition, which is also at odds with the simple cost-cutting explanation.
Finally, since many of these firms have multinational operations, and some are likely to have Canadian subsidiaries before 1989, we tested whether their choice of being located in Canada changed with the liberalization. If US firms created Canadian subsidiaries because of trade barriers, we might expect the benefits of local presence in Canada to disappear with freer trade. Column 6 shows a negative but insignificant effect of the trade liberalization on the number of Canadian subsidiaries of the firm. We only have information on subsidiaries for 1988 and 1993, and therefore rely on the change between the two years, but overall one cannot ascribe the main effect we find on depth and span solely to this explanation.

III. Conclusion

Empirical evidence suggests that firm hierarchies have been flattening; they have fewer levels and broader spans of control. However, there is little systematic evidence explaining these changes. The main contribution of this paper is to establish a causal effect between increased foreign competition from a quasi-natural experiment (the trade liberalization between Canada and the United States) and the flattening of firms. We use a unique panel dataset of organizational practices that allows us to identify our results from variation within divisions and firms over time, moving beyond cross-sectional analysis of earlier research. Since the trade liberalization was bilateral, it also implied a reduction in Canadian tariffs on US exports potentially leading to market expansion opportunities for our US firms. However, our findings suggest that it is increased competition that causes firms to flatten rather than greater market expansion opportunities. We find that US firms in manufacturing industries more exposed to the trade liberalization reduce the number of hierarchical levels and broaden the span of control for the CEO.

We found no evidence that these changes resulted from pure cost-cutting efforts by firms. In fact, we find that pay of division managers (and other senior management positions) increases in more competitive environments which seems at odds with the simple cost-cutting or X-inefficiency explanation. We also find that the effect of competition on flattening is not driven by changes in outsourcing, changes in IT, or CEO turnover. We do, however, find some evidence that firms decreased their business scope as a result of the trade liberalization and became less diversified. This may be contributing to their flattening. We also find evidence on pay that indicates possible changes in the way decisions are made inside the firm, in particular, greater decision-making authority to division managers.

This paper is an important step in the understanding of the role of product markets in explaining organizational change. While we establish a causal effect, our results account for a moderate fraction of the flattening phenomenon. We would expect that other sources of increasing domestic and foreign competition (besides the FTA) are important contributors to the secular flattening of firms. Analyzing other drivers of competition, the interaction between organizational structure and other corporate responses, and the overall impact of these changes on firm performance is left for future research.
Appendix

Table A1—Effect of the Trade Liberalization on Stock Returns, Employment, and Average Price Cost Margins

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<th>Excess returns</th>
<th>Excess returns</th>
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<th>ln firm employ</th>
<th>Average PCM</th>
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Notes: Standard errors are in brackets, clustered by industry (SIC4). All regressions include year dummies. The dependent variables are the excess stock market returns (columns 1 and 2) computed from CRSP data as the difference between calendar year company and market returns. Company returns are compounded daily and include all dividends. Total market returns are CRSP’s NYSE/AMEX/NASDAQ market weighted returns. The log of total firm employment (columns 3 and 4), and average price cost margin computed from Compustat data as (firm sales-cost of sales)/firm sales (columns 5 and 6); AvT89 is the average tariff rate on Canadian imports in the period 1986–1988 by industry (Export: AvT89 for US exports respectively). Columns 2, 4, and 6 restrict the sample to firms whose largest segment represented at least 50 percent of sales before the liberalization (in 1988).

Table A2—Correlation between Organizational and Competition Variables

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</table>

Notes: Standard errors are in brackets, clustered by industry (SIC4). All regressions include year dummies. Trade costs are the sum of tariff and transport costs by industry, and import penetration is the percentage of imports out of total domestic consumption by 4 digit industry (Source: Bernard, J. Bradford Jensen, and Schott 2006). Lerner Index is the industry average price cost margin computed using Compustat (4 digit SIC), columns 3 and 7 include firms in services and manufacturing, while the others are restricted to manufacturing industries.

References


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