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Globalization and the Provision of Incentives Inside the Firm: The Effect of Foreign Competition

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This article studies the effect of changes in foreign competition on the structure of compensation and incentives of U.S. executives. We find that import penetration (instrumented with exchange rates and tariffs) leads to more incentive provision in a variety of ways. First, it increases the sensitivity of pay to performance. Second, it increases within-firm pay differentials between executive levels, with CEOs typically experiencing the largest wage increases. Finally, higher foreign competition is also associated with a higher demand for talent. These results suggest that increased foreign competition can explain some of the recent trends in compensation structures.

I. Introduction

The structure of wages and compensation in the United States changed substantially during the 1980s and 1990s: earnings inequality and returns to skill increased, with a particularly dramatic rise in pay at the top of the wage distribution (Katz and Autor 1999; Autor, Katz, and Kearney 2006). The executive labor market replicated the trends for workers in

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general, with inequality between executives and job mobility increasing, and CEO pay going up disproportionately (Frydman 2005). Simultaneously, firms increased their use of incentives and performance-related pay (such as piece rates, bonuses, and stock options) in the overall compensation of executives and workers (Murphy 1999; Lemieux, MacLeod, and Parent 2009), significantly altering the structure of pay and the relative importance of fixed versus variable pay. This last fact has received much less attention, and there is limited knowledge of the causes behind the changes in incentive contracts and compensation structures inside firms.[1] In this article, we show that a major force behind some of these changes is the increase in foreign competition resulting from reductions in trade barriers and the globalization of economic activity.

A number of theoretical papers have shown that product market competition can directly affect the provision of incentives by firms in a principal-agent setting because of its impact on profits and, therefore, on the returns to effort (Hermalin 1992; Schmidt 1997; Raith 2003). The globalization of economic activity and trade is associated with a number of phenomena—higher imports, reductions in trade barriers, lower costs of transport, and information diffusion—all of which tend to increase the degree of competition that firms face.[2] While there are other sources of increased product market competition, in order to identify a clear causal effect that is not confounded by overall trends, we focus on a particular channel through which competition may operate—namely, foreign competition, measured as the degree of import penetration faced by U.S. firms. A common problem with other standard measures of competition (such as Herfindahl indices and price-cost margins) is that they are endogenous and difficult to measure or interpret systematically across firms over time and their levels are not necessarily indicative of the degree of competition (Schmalensee 1989).

Import competition allows us to overcome some of these problems. To the extent that it varies over time and across industries, we can assess how

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[1] Murphy and Zábojník (2004a, 2004b), Frydman (2005), and Gabaix and Landier (2008) provide a rationale for and evidence on the increase in total CEO pay.

[2] The term "globalization" is also sometimes used to refer to facts other than the increase in trade (such as higher migration or Foreign Direct Investment flows) and even to the trend toward cultural homogenization across countries. Here, we restrict ourselves to its meaning as higher trade integration. See Tybout (2003) for a comprehensive survey on the effect of increased foreign competition on the decrease in domestic markups and on the increase in competition in general.

different U.S. manufacturing firms, with different evolutions in their trade exposure in the 1990s, changed the incentive structures they offered to their executives. Furthermore, in order to isolate fluctuations in foreign competition that are exogenous to the firms' incentive policies and uncorrelated with potential omitted variables, we use import tariffs and exchange rates as instrumental variables.[3]

Compensation is measured using a matched employer-employee panel data set (Execucomp) of large U.S. manufacturing firms with five executives per firm between 1992 and 2000. It contains very detailed information on both firm characteristics and executive pay, providing a fairly comprehensive picture of internal labor markets and incentive provision. One can track executives as the extent of foreign competition faced by the firm evolves and evaluate how incentives change over time and across industries. Although we restrict the analysis to changes in import penetration in order to be able to identify a precise causal mechanism, the data set allows us to be more general regarding the aspects of compensation that we analyze. Incentives to exert effort and to improve the manager's contribution to the productivity of the firm can be provided in several ways. Some are explicit and contractual, such as agreeing on a bonus or a performance-related pay scheme. Others are implicit (without an explicit written contract) and enforced on the basis of commitment and reputation. These include discretionary bonuses or the commitment of the firm to a given promotion scheme. Finally, some incentives may not be provided directly by firms but, rather, are implicit in labor market conditions (e.g., the good performance of one executive in a given firm may lead another firm to offer this same executive a better job).[4] We relate changes in foreign competition to a number of wage and labor market outcomes, including fixed and variable pay, performance-pay sensitivities, and within-firm wage differentials between executive ranks. Furthermore, exploiting the panel dimension of the data set, we are also able to assess whether firms seek to hire more "able" or "talented" executives as foreign competition changes (with talent measured as the permanent unobserved component of wages). These measures, taken together, give us a good description of the wage structure and the provision of incentives among top executives.

Our main finding is that higher foreign competition substantially changes the structure of compensation: it reduces the level of non-per-

[3] We are able to compute the level of import penetration faced by the firm itself by taking into account the fact that it may have products in different four-digit SIC industries. Exchange rates and tariffs are also firm specific and weighted by the relative importance of each currency (trading partner) in total industry imports.

[4] See Gibbons and Waldman (1999), Prendergast (1999), and Gibbons (2005) for a broad survey of theoretical and empirical results on the different channels for incentive provision.

formance-related pay and increases the sensitivity of pay to performance, such that incentive provision is higher. This increase in performance-pay sensitivities is more pronounced for the highest-paid executives, and, as incentive provision goes up with foreign competition, wage differentials between executives also increase. Finally, we also find that the overall increase in wage differentials between executives is driven partly by the fact that, faced with more competition, firms are hiring more talented executives at the top.

Even though executives comprise a particular subsample of workers, they are an ideal group in which to study performance-related pay because one has a clear measure of their performance: firm performance as reflected by the stock market. Furthermore, this particular group of employees allows us to identify better the effect of changes in foreign competition on firm contracting behavior independent of its effects on labor markets. This is because the boundaries of labor and product markets are relatively independent for executives, who more frequently change firms between industries rather than within industries.[5] Finally, even though executives constitute a very specific subset of highly skilled workers, they are representative of the higher end of the wage distribution, and understanding how their contracts have evolved may shed light on the mechanisms behind the polarization of earnings (Autor et al. 2006). In fact, Lemieux et al. (2009) empirically establish the link between the growing use of performance-related pay and the increase in wage inequality in the United States between the 1970s and 1990s. They argue that the increase in performance-related pay accounts for nearly all of the increase in compensation above the 20th percentile of the distribution. Our article provides one explanation for why the use of performance pay has increased.

This article also contributes to the literature on the positive relationship between wage inequality and trade openness. We show that foreign competition may affect the provision of incentives within firms in two ways that raise inequality: by increasing wage dispersion and through the use of performance-related pay. This is important because most of the mechanisms explored to link inequality and trade have failed to fully account for the overall positive correlation, including the effects of openness on total labor supply, total labor demand, skill-biased labor demand, and institutions (Slaughter 1998). Here, we suggest an additional mechanism.

The rest of the article is as follows. In Section II, we present the motivation of the article and the related literature; Section III presents the

[5] For example, 71% of the transitions of executives between firms included in Execucomp are between four-digit SIC industries (64 between three-digit SIC industries). Moreover, collective bargaining is virtually nonexistent among executives. Therefore, it is unlikely that individual executives internalize the effect of their joint compensation packages on firm profits.

data used, Section IV.A shows the specification and the results relative to fixed and variable pay, Section IV.B presents the results on promotion ladders, Section IV.C explores how firms demand talent differently according to the degree of foreign competition, and Section V provides an overall picture and concludes.

II. Background and Related Literature

The trends toward globalization of trade and the increase in foreign competition imply that firms are increasingly exposed to competitive pressure (Tybout 2003). An increase in import penetration in an industry means that domestic firms face more competition because goods from foreign firms have a bigger presence in the market. Furthermore, changes in foreign competition can permanently reshape the general competitive configuration of an industry—in the presence of fixed entry costs, once foreign firms decide to export into a market, they are unlikely to exit.[6] Therefore, one can think of the increase in foreign competition as an increase in competitive pressure for the industry.

A number of theoretical papers have examined the effect of competition on incentive provision within the principal-agent framework (e.g., Schmidt 1997; Raith 2003; Vives 2008). A general result in most competition models is that, with more competition, the residual demand that a firm faces becomes more elastic and shifts down. This generates two counteracting effects in terms of incentives: on the one hand, more competition raises the reward to market-stealing activities due to the higher elasticity of market shares to productivity differentials. Everything else equal, this implies a higher marginal return to managerial and workers' effort and leads firms to introduce steeper incentive packages. On the other hand, the residual demand that a firm faces shrinks, reducing markups and the profitability/value of a given market share, thus making market stealing less attractive. This leads the firm to reduce the steepness of its incentive contracts. The composition of these two opposing forces implies that, a priori, the overall effect is ambiguous.

However, when one allows for endogenous entry of firms into the industry, since firm profits are constant and dictated by a zero-profit condition, the second effect is not present. Raith (2003) models competition and incentive pay allowing for free entry and exit of firms and shows that, in that case, competition—measured as increased elasticity of substitution or larger market size that leads to further entry—always leads to an increase in the provision of incentives. The effect is, however, reversed when competition increases due to a fall in entry costs.

Competition may also have other effects on firms. For instance, it may affect implicit incentives to the extent that it increases the risk of the firm

[6] See Baldwin (1988), Baldwin and Krugman (1989), and Dixit (1989).

going bankrupt and may lead workers to exert more effort to avoid losing their jobs, thus reducing the need for the firm to provide explicit incentives. Schmidt (1997) explicitly models this incentive, and several empirical papers (Nickell 1996; Galdon-Sanchez and Schmitz 2002) show that if additional competition leads to more pressure on profits, employees tend to work harder.

An increase in competition also may increase the available information about market conditions and help firms to better assess the contribution of an executive to profits (Hart 1983; Scharfstein 1988; Hermalin 1992). This may lead to a change in the steepness of incentive schemes and, more generally, to increased use of relative-performance evaluation. However, this literature makes no clear predictions regarding the effect of competition on the provision of incentives based on a firm's own performance.

Overall, the total effect of competition on incentive pay is theoretically ambiguous, which makes this an interesting empirical question.[7] Our analysis asks: what is the net effect that dominates empirically?

To the extent that firms can increase performance (cut marginal costs of production) either by inducing more effort or by hiring a more skilled/talented manager, many of the arguments for rewarding managerial effort are also valid for rewarding skill (Guadalupe 2007) and managerial talent. Marin and Verdier (2003) present a model in which globalization affects the hierarchical structure of the firm and the reward for talent. Firms change their hierarchical structure—and, thus, the explicit and implicit incentives that executives face—and increase their demand for talented CEOs. Murphy and Zábojník (2004a, 2004b) and Frydman (2005) argue that the increase in CEO pay is due to higher demand for general skills, and Gabaix and Landier (2008) suggest that the increase in firm size has increased the impact of CEO skills and, therefore, that small differences in skill can lead to larger differences in compensation. Our analysis is complementary to theirs since foreign competition could be an additional reason for why general skills are more important and for which small differences in talent matter more. We also analyze explicitly the empirical effect of competition on within-firm inequality (Sec. IV.B) and the reward for talent (Sec. IV.C).

Our findings also complement those in Black and Strahan (2001) and Bertrand and Mullainathan (2003). These articles find that competition (from easier market entry or deregulation) seems to improve governance and leads managers to focus on increasing firm profits. The use of more

[7] There is surprisingly little evidence on the effects of competition on incentive provision within the firm. Some related papers that analyze the effects of the product market on incentives are Cuñat and Guadalupe (2005) on UK workers and managers and Cuñat and Guadalupe (2009) on U.S. banking deregulation.

high-powered incentives that we find in this article could be a way through which this happens.

The present article is related to several others that associate foreign competition with the level of wages for regular workers. For workers in general, there is evidence that higher foreign competition leads to higher unemployment and lower wages (Revenga 1992) and to a replacement of implicit contracts by spot contracting (Bertrand 2004). There is also evidence of rent sharing between workers and firms. Abowd and Lemieux (1993), using Canadian data, and Abowd and Allain (1996) and Kramarz (2006), using French data, find a positive elasticity of salaries to firms' quasi-rents, when the latter are instrumented using shocks to foreign competition. The idea behind these articles is that foreign competition exogenously modifies the rents available to be split in the industry and, therefore, affects collective-bargaining conditions and rent sharing. For executives, it has been argued that rent extraction may be a determinant of executive pay (Bertrand and Mullainathan 2001; Bebchuk and Fried 2004). To the extent that product market competition and governance interact, as we discuss later, rent extraction issues may be relevant to our analysis.

This article also differs from the ones mentioned above because we study not only pay levels but also changes in the structure of compensation within firms (fixed pay vs. performance-related pay), changes in wage differentials between executives, and the demand for talent. To the best of our knowledge, there is no paper that systematically explores how all these aspects of employment contracts have changed over time with competition. We also extend the identification strategy in Bertrand (2004) by using tariffs as an additional instrument for import penetration and by calculating firm-specific import penetration, exchange rates, and tariffs.

III. Data

A. Compensation Data

We use the Standard & Poor's Execucomp data set. This is a panel (starting in 1992) of all firms in the S&P 1500 index.[8] Each firm reports detailed yearly information on the pay structure of the five most-highly-paid executives in the firm (ranked by salary and bonus), as well as some individual characteristics of the executives. The data also contain information from financial statements on firm characteristics and performance. For our purposes, one unique feature of this data is that they allow us to follow firms and executives over time, in a panel setting. The Execucomp data start in 1992, and 2000 is the last year for which we are able

[8] The index includes firms in the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices, so it represents a stratified sample of listed firms of all sizes.

to compute import penetration. Since we have trade data only for the manufacturing sector, we are able to use yearly data from 1992 to 2000 for all manufacturing industries. This leaves us with 831 firms and 7,571 executives (25,146 unique observations).

From these data, we use a comprehensive measure of total yearly compensation for each executive, including the components of pay that are related to performance and those that are not. Our measure of total compensation is the natural logarithm of the sum of salary, bonus, total value of stock options granted (valued using the standard Black-Scholes formula), total value of restricted stock granted, long-term incentive payouts, and other annual compensation.[9] Table 1 provides summary statistics of all the variables.

B. Discussion of Foreign Competition and Its Instruments: Identification

The data analysis in the next section evaluates the effect of lagged foreign competition ($\text{Import Pen}_{fjt-1}$) for firm f in industry j at time $t-1$ on a number of aspects of individual i's compensation and incentives.[10] To evaluate the effect of import penetration and, eventually, its interaction with some variables X_{ifjt}, we estimate regressions of the form

$$\ln(W_{ifjt}) = \alpha + \gamma_1 \text{Import Pen}_{fjt-1} + \text{Import Pen}_{fjt-1} \times X'_{ifjt}\gamma_2 + X'_{ifjt}\gamma_3 + v'_{ifjt}\beta + u_{ifjt}, \quad (1)$$

where W_{ifjt} is total compensation, v'_{ifjt} is a vector of control variables such as firm size or CEO status, and the variables included in X_{ifjt} (firm performance, pay-rank dummies) depend on the outcome of interest. We allow for different specifications of the error term u_{ifjt} that include firm or firm-specific individual fixed effects (see each individual model below). The measure of import penetration, $\text{Import Pen}_{fjt-1}$, used in what follows is defined at the firm level and takes into account that a firm may operate in different industries. Standard errors are clustered by firm in all specifications (to allow for autocorrelation of the error term within firms across years, since the import penetration variable is defined at the firm level).

To derive this firm-specific measure of import penetration, we first define industry-level import penetration as imports (into the four-digit

[9] This is the standard measure of total executive compensation as described in Jensen and Murphy (1990) and Murphy (1999), among many others.

[10] We evaluated whether firms respond more to contemporaneous or lagged imports in setting contracts by including both variables in our regressions. Even though, when introduced separately, they are both significant, we found that, when considered together, lagged imports is what drives the results, so we use lagged imports in all our analyses.

Table 1
Summary Statistics

	Mean	SD	25th Percentile	Median	75th Percentile	Observations
Total Comp ($1,000s)	1,668.12	4,854.543	446.45	819.5	1,658.6	25,146
Salary ($1,000s)	338.63	211.96	195.17	278.68	414.08	25,146
Market value ($1,000,000)	6,330.605	2.10E + 04	372.26	1,025.49	3,464.99	25,146
ln Total Comp	6.809	.989	6.101	6.709	7.414	25,146
ln Performance	7.106	1.708	5.92	6.933	8.15	25,146
Import Pen (raw)	.156	.142	.056	.125	.21	25,146
Import Pen	.003	.02	−.007	0	.011	25,146
ln Assets	6.886	1.591	5.778	6.764	7.909	25,146
Assets ($1,000,000)	463.392	1.50E + 04	323.179	865.799	2,720.908	25,146
CEO	.191	.393	0	0	0	25,146
Talent FE	.002	.82	−.482	−.129	.347	25,146
Lag Exch rate (raw)	2.225	.894	1.566	2.231	2.835	18,167
Lag Exch rate	0	.001	0	0	.001	18,167
Lag Tariff (raw)	.031	.06	.011	.025	.04	18,167
Lag Tariff	.195	5.059	−.232	.033	.82	18,167
Export Openness (raw)	.213	.183	.078	.195	.284	13,277
Export Openness	.013	.058	0	.009	.029	13,277

NOTE.—Total Comp is total yearly compensation that includes salary, bonus, total value of stock options granted (Black-Scholes value), total value of restricted stock granted, long-term incentive payouts, and other annual compensation; ln Performance is the natural log of shareholders value and includes the market value of the shares and reinvestment of dividends (in $,1000s); ln Assets measures firm size; CEO is an indicator for who is the company CEO; Import Pen (raw), Lag Tariff (raw), and Lag Exch rate (raw) are firm-specific weighted averages of the industry measures (Import Penetration is imports divided by imports plus domestic production at four-digit SIC; tariffs are tariffs paid on U.S. imports; and exchange rates are defined in foreign currency per dollar) where the weights are the fraction of sales in each of the firm's business segments in a base year. Import Pen, Lag Tariff, and Lag Exch rate are the same measures, which have been demeaned by industry first (that is why the mean is close to zero). These demeaned variables are the ones used in our analysis. Export Openness is industry exports divided by industry output at four-digit SIC, demeaned. FE = fixed effects. See data appendix for further details and sources.

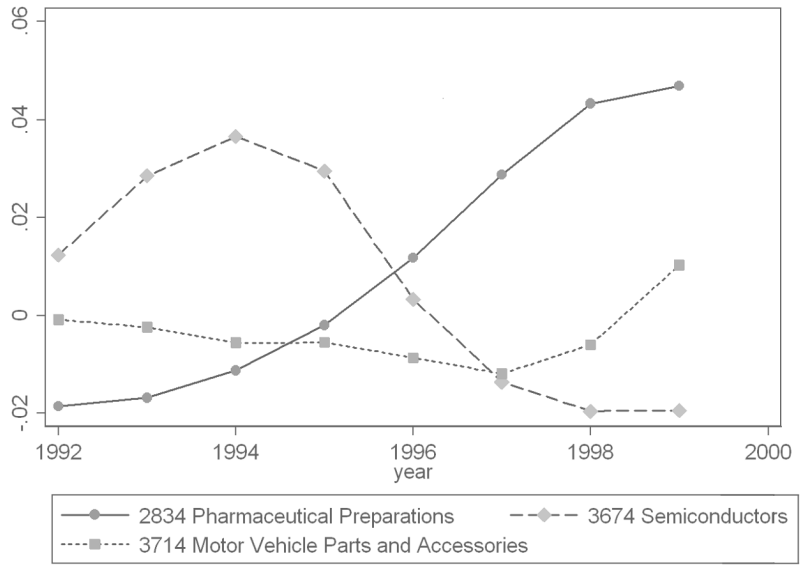

FIG. 1.—Import penetration (deviation from mean) in three selected industries

SIC market) divided by the total value of internal production plus imports and take its deviation with respect to the industry mean for all years. This measures the extent to which foreign competitors are present in the domestic market. Taking the deviation and including industry dummies in all the regressions ensures that $\hat{\gamma}_2$ does not capture unobserved differences by industry that are correlated with import penetration. Over the sample period, average import penetration goes from 0.16 to 0.20, but it increases for some sectors and decreases for others such that, in any given year, one may find a rich combination of changes for different sectors. As an example, figure 1 shows this variation for three selected industries.

However, since many firms sell goods in more than one industry, import penetration into the firm's main industry may be a misleading measure of the actual import penetration that the firm faces. To account for this, we define a firm-specific import penetration measure, Import Pen_{fjt-1}, as the weighted average of the industry-level import penetration (computed as above), where the weights are constructed as the fraction of total sales associated with each SIC4 industry in which the firm operates (declared business segments from Compustat Segments data).[11] Because the industries in which the firm operates may change endogenously over time, the weights are based on the firm's operations in 1991 (presample). Here, the

[11] While 56% of the firms in the sample declare only one segment, 17% declare two, 15% declare three, and 8% declare four; only 3% declare five or more.

identification arises from import penetration changing within a firm over time. The advantage of this choice is that it is a good reflection of the firm's industries of operation and is immune to endogenous production decisions. The disadvantage is twofold. First, if firms tend to radically change their industries of operation, by the end of the sample, and given the fixed 1991 weights, variations in this measure may not be highly correlated with the actual import penetration that the firm faces in a particular year; second, the segment weights can introduce measurement error.[12]

Notice that we will be exploiting the panel nature of the data set, such that we can include firm and individual fixed effects to control for unobserved heterogeneity. However, no matter how rich the variation of import penetration is in the panel, its use still can be subject to a number of criticisms in terms of possible endogeneity problems. For example, reverse causality may arise if changes in compensation structure drive the behavior of executives and, therefore, the degree of competition in the market (Aggarwal and Samwick 1999) and the extent to which foreign firms enter. Further, if firms anticipate import fluctuations, actual changes in a given year may underestimate their effective reaction. Finally, our weighted import penetration may be measured with error, thus leading to attenuation bias. For all of these reasons, our results on the effect of import penetration may be biased toward zero. To deal with these endogeneity concerns, we use exchange rates and import tariffs as instrumental variables.

We construct industry-specific import-weighted exchange rates (Bertrand 2004) and tariffs, where the weights on the bilateral exchange rates and tariffs between the United States and its trading partners are the share of imports from each partner country in a base year (average of 1990–91 for exchange rates and 1993 for tariffs). By choosing static weights, we avoid any possible endogeneity that could arise from the joint determination of the import weights and exchange rates or tariffs. We use both current and one-lag exchange rates, as well as lagged tariffs.[13] The final instruments are calculated at the firm level using the (fixed) weights from

[12] The results are not substantially different if we use "running" firm-specific weights (where the weights vary as the firm changes its product mix), suggesting that the changes in business mix have a limited effect. We also ran all of the specifications where each firm is assigned to its primary SIC4 code, and our results—albeit smaller in magnitude—were qualitatively similar to the ones using the firm-based variable.

[13] Note that exchange rates are superior to other measures, such as terms of trade, because the latter also includes domestic prices. Domestic prices are arguably not exogenous to executives' decisions, thus not satisfying the exclusion restriction. By constructing our instruments using aggregate exchange rates and fixed weights, we do not capture sector-specific demand shocks. Aggregate shocks should be captured by the year dummies.

the Compustat segments data, as we did with the import penetration measure.

Table 2 shows the different first-stage regressions used for different specifications of equation (1) in the article. Columns 1 and 2 begin by showing the basic correlation between (firm-weighted) import penetration and the (firm-weighted) instruments when we use one observation per firm and year (instead of the full data set with all executive observations) and only control for year dummies, log assets, and firm fixed effects. Column 1 presents the results for current and lagged weighted exchange rates and shows that a dollar appreciation significantly reduces import penetration in the same year and 1 year later.[14] Column 2 replaces exchange rates with lagged tariffs and shows that import penetration is lower the higher the tariff rate. These regressions are at the base of our instrumental variables (IV) strategy. Columns 4–6 present the first stage regressions for the specifications in tables 4, 5, and 6, using the whole sample. To provide two-stage least squares estimates of equation (1), both Import Pen_{fjt-1} and Import $\text{Pen}_{fjt-1} \times X_{ifjt}$ must be instrumented. Given an instrumental variable vector for import penetration Z_{fjt}, the appropriate instruments are Z_{fjt} and $Z_{fjt} \times X_{ifjt}$ (Z_{fjt}, in our case, includes the current and lagged source-weighted exchange rate, as well as lagged tariffs). Columns 4 and 5 show the first stage, when X_{ifjt} is log firm performance. Column 6 presents the first-stage results when X_{ifjt} are pay-rank dummies (the interaction of pay-rank dummies and performance is not reported).

For an instrument to be valid, it must be exogenous and satisfy the exclusion restriction. To the extent that exchange rates are determined in international financial markets, and tariffs are determined either at trade negotiation rounds or by federal policy, they are possibly uncorrelated with firms' compensation policies and, therefore, arguably exogenous.[15] One might still be concerned about endogeneity of tariffs if executives could lobby for increases in tariffs when imports go up. However, over this period, most of the tariff variation occurs around 1995, when the Uruguay round was implemented. This can be seen in figure 2, which shows a 36% drop in tariffs after the Uruguay round for firms in our

[14] We found that it significantly raises imports with a 2-year lag, which reflects the *J*-curve effect discussed in the trade literature (unreported).

[15] Tariff data come from the UNCTAD TRAINS data set (available from 1993 to 2000 for the United States) that contains scheduled tariffs. Scheduled tariffs are superior to calculated average tariffs (available in the NBER database) to prevent the instrument from being mechanically correlated with imports. Since calculated average tariffs are measured as duties paid over total import value by industry and year, and import penetration is calculated from the same total import value, any measurement error on tariffs would mechanically improve the fit of the instrumented variable, and not necessarily through changes in actual tariff rates, which is the variation we want.

Table 2
First-Stage Regressions

Dependent Variable Specification Second-Stage Table	Import Pen Basic (1)	Import Pen Basic (2)	Export Open (3)	Import Pen Pay Structure (T4) (4)	Import Pen Pay Structure × ln Perf (T4) (5)	Import Pen Pay-Ranks (T5) (6)
Exch rate	−2.476		1.343	−2.196	−58.478	−3.19
	[.092]***		[3.239]	[2.672]	[18.579]***	[1.040]***
Lag Exch rate	−3.664		4.471	−1.687	−56.071	−3.299
	[.93]***		[2.904]	[2.998]	[21.323]***	[1.087]***
Lag Tariff		−.013	−.001	−.105	−.162	−.013
		[.005]***	[.001]	[.058]*	[.350]	[.006]**
ln Perf				.0002	.011	
				[.001]	[.005]**	
Exch rate × ln Perf				−.088	5.086	
				[.340]	[2.739]*	
Lag Exch rate × ln Perf				−.211	4.314	
				[.385]	[3.071]	
Lag Tariff × ln Perf				.01	.004	
				[.006]	[.040]	
Unit of observation	Firm/year	Firm/year	Exec/year	Exec/year	Exec/year	Exec/year
Firm FE	Yes	Yes				
Indiv × Firm FE			Yes	Yes	Yes	Yes
Observations	3,715	3,715	13,237	18,167	18,167	18,167
R^2	.221	.214	.03	.208	.222	.208
Shea R^2				.08	.149	.026
F-test of excl. instr.				6.58***	12.54***	4.32**
Hansen *J*-statistic (*p*-value)				.24	.24	.43

NOTE.—Standard errors (in brackets) clustered by firm year in cols. 3–6. Columns 1 and 2 only include one observation per firm and year; the other columns include the whole sample, all executive observations. Import Penetration is imports divided by imports plus domestic production at four-digit SIC, demeaned and weighted at the firm level, where weights take into account the sectors of operation of the firm in a base year. Export Openness is industry exports divided by industry output at four-digit SIC, demeaned. Performance is total shareholders' return, including shareholders' value at fiscal year end plus reinvestment of dividends. All regressions control for year dummies, ln Assets and a CEO dummy. FE = fixed effects; excl. instr. = excluded instrument. See table 1 and data appendix for further details and sources.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

FIG. 2.—Average tariff on U.S. imports

sample. The exogeneity of the trade liberalization and the use of lagged tariffs alleviates the concern of tariff endogeneity. One advantage of using both sets of instruments is that the overidentifying restriction can be tested using two very different sources of variation in imports. In the Hansen-Sargan overidentification test, we cannot reject the joint null hypothesis that the instruments are valid instruments (in col. 4, the Hansen J-statistic has a p-value of 0.24). The tests for the joint significance of the endogenous regressors (both the classic F-test and the modified Anderson-Rubin test) show that they are highly significant jointly.

Using static import weights helps in addressing the exclusion restriction since they increase the explanatory power of exchange rates and tariffs for imports and reduce their explanatory power for potential confounding factors (to the extent that the firm weights are uncorrelated with these other factors). In fact, we find that import-weighted exchange rates and tariffs are poorly related to export openness (i.e., exports over total production at four-digit SIC, demeaned by industry; see col. 2 of table 2). This suggests that the instrumented regressions are unlikely to be capturing an indirect effect through changes in exports, which lends some support to the exclusion restriction.

All the trade information comes from the National Bureau of Economic Research (NBER) trade database and the tariff information from the

UNCTAD TRAINS data set.[16] Total production at the industry level comes from the Bureau of Economic Analysis Industry Shipments data. Further details of all the variables and their construction can be found in the appendix. Since tariff data are available only from 1993 onward, and because we use lagged tariffs, our instrumented regressions effectively cover the period 1994–2000.[17]

Even though globalization is a pervasive trend, the effect identified here is deliberately much narrower and focuses only on import penetration. Focusing on this narrow channel using the panel and instrumental variables has the advantage that we know where the variation is coming from, and it provides a clear channel for the effect. However, there are many other reasons why competition may change, and foreign competition is just one that we can easily identify, measure, and find instrumental variables for. U.S. firms have also experienced the pressure of market deregulation, direct entry of domestic and foreign firms into the market, and reductions in information and communication costs. While these may be important, our identification strategy remains silent about these channels.

IV. Results

A. Pay Structure

Executive pay typically has a part that is fixed and a component that is related to performance. Therefore, in order to estimate the effect of foreign competition on the structure of compensation, we model incentive contracts as follows. Total compensation for each executive i in firm f, in industry j, in year t, can be written as

$$\ln(W_{ifjt}) = a_0 + a_1 \text{Import Pen}_{fjt-1} + b_0 \ln \text{Perf}_{ft} + b_1 \text{Import Pen}_{fjt-1} \times \ln \text{Perf}_{ft} + v'_{ifjt}\beta + d_t + d_f + \eta_i + \varepsilon_{ifjt}. \quad (2)$$

The dependent variable $\ln(W_{ifjt})$ is a comprehensive measure of compensation; $\ln \text{Perf}_{ft}$ is firm performance measured as the logarithm of the total market value of the firm, when this value includes the reinvestment of dividends and excludes mergers, share buyouts, spin-offs, and seasoned

[16] "U.S. Imports, Exports and Tariff Data, 1989–2001 (NBER 9387)." See Feenstra, Romalis, and Schott (2002) for a detailed description of the construction of each of these variables.

[17] We present results using all observations for which we have data available (from 1992 in the OLS specifications and from 1994 in the instrumented regressions). Similar results were obtained when restricting the sample in all the specifications to post 1994.

equity offerings.[18] The variable Import Pen$_{fjt-1}$ is lagged import penetration defined as in the previous section; v_{ifjt} includes other determinants of pay structure such as firm size (logarithm of assets) and a CEO dummy; d_t and d_f are time and firm dummies; η_i are individual fixed effects; and ε_{ifjt} is a white noise.[19]

The coefficient $\hat{a}_0$ captures the baseline fixed component of the incentive contract, and $\hat{b}_0$ its variable component, which is a function of performance. Since all regressions include firm (and individual) dummies, the estimated coefficient $\hat{b}_0$ captures the baseline elasticity of pay to firm performance or the percentage change in compensation from a percentage change in firm performance. The main coefficients of interest are $\hat{a}_1$, which measures the effect of foreign competition on the fixed component of pay, and $\hat{b}_1$, which captures the differential slope of the performance-related-pay agreement with respect to different levels of import penetration.[20] Ideally, one would like to have direct measures of b_0 and b_1, but these are not available, even when we have detailed information on the different components of compensation (salary, bonus, etc.), because even though salaries are conventionally considered fixed, raises and promotions are performance related. And, while bonuses are considered variable, executive contracts often have a guaranteed (e.g., sign-in) bonus or a minimum bonus (Murphy 1999). So, estimating equation (2) lets the data speak and provides us with direct estimates of the fixed component and the slope of the incentive contract. Standard errors are clustered at the firm level.

Table 3 shows the effect of foreign competition on performance-pay sensitivities. Increases in import penetration are generally associated with

[18] Given that the estimation includes firm fixed effects, this performance measure is equivalent to using the log of total annual shareholder returns including dividends. This specification is similar to the ones in Murphy (1986) and Bertrand and Mullainathan (2001), among others.

[19] Unfortunately, the data contain only limited biographical information about the executives. Data items such as gender, age, or tenure are available for only a subset of individuals. The fixed-effect regression will capture gender, education, and other time-invariant characteristics.

[20] We evaluated whether systematic changes in imports, exchange rates, or tariffs on firm profits could be driving the results. This can arise if, for example, rent extraction is a significant determinant of pay and executives are paid for changes in firm value beyond the contribution of their effort (an effect known as "pay for luck," as in Bertrand and Mullainathan 2001). Similarly, if log pay were a concave transformation of returns (as with some bonus schemes) or a convex one (as in options), then any systematic effect of exchange rates or tariffs on firm value would change the sensitivity of pay to performance. We instrumented the performance measure with our instrumental variables (tariffs and exchange rates) and found no significant relationship between the unexpected component of performance and pay, suggesting that it is unlikely that changes in incentives are driven by systematic changes in performance associated with the shocks to competition.

Table 3
Pay Structure: Performance-Related Pay

	Dependent Variable Is ln Total Compensation						
	(1)	(2)	(3)	(4)	(5)	CEOs (6)	CEOs (7)
ln Perf	.22	.25	.24			.32	
	[.02]***	[.02]***	[.02]***			[.03]***	
Lag Import Pen	−3.4	−4.38	−4.49	−3.23	−4.54	−7.21	−1.25
	[1.90]*	[1.68]***	[1.71]***	[1.72]*	[1.98]**	[2.40]***	[3.66]***
Lag Import Pen × ln Perf	.73	.85	.86	.59	.81	1.26	1.6
	[.26]***	[.24]***	[.24]***	[.25]**	[.29]***	[.33]***	[.54]***
ln Assets	.21	.15	.1	.19	.2	.2	.25
	[.03]***	[.03]***	[.04]**	[.03]***	[.03]***	[.04]***	[.04]***
CEO	.86	.26	.26	.26	.26		
	[.01]***	[.02]***	[.02]***	[.02]***	[.02]***		
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes						
Indiv. × firm FE		Yes	Yes	Yes	Yes	Yes	Yes
Industry trends				Yes	Yes		Yes
Industry dummies × ln Perf				Yes	Yes		Yes
Year dummies × ln Perf				Yes	Yes		Yes
Industry dummies × year × ln Perf					Yes		Yes
Observations	25,146	25,146	24,543	25,146	25,146	4,812	4,812
R^2	.37	.23	.23	.28	.31	.25	.39

NOTE.—Standard errors clustered by firm in brackets. The dependent variable is the log of total yearly compensation that includes salary, bonus, total value of stock options granted (Black-Scholes value), total value of restricted stock granted, long-term incentive payouts, and other annual compensation; Perf (Performance) is total shareholders' return, including shareholders' value at fiscal year end plus reinvestment of dividends; Import Pen is imports divided by imports plus domestic production at four-digit SIC, demeaned and weighted at the firm level, where weights take into account the sectors of operation of the firm in a base year; ln Assets measures firm size; CEO is an indicator for who is the company CEO. See data appendix for further details and sources.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

a lower fixed component of pay ($\hat{a}_1 < 0$) and a variable component of pay that is more sensitive to firm performance ($\hat{b}_1 > 0$).

Column 1 includes firm fixed effects, while columns 2–7 include firm-specific individual fixed effects, so that results are identified from within firm and individual changes in pay, not from individuals moving between firms with different compensation structures.[21] Columns 1–5 pool all executives, and columns 6 and 7 restrict the analysis to CEOs. The effect of import penetration is sizable. For all executives, and controlling for executive and firm fixed effects (col. 2), a one standard deviation increase in (within-firm) import penetration generates an average drop in fixed pay of 8.8% (0.02 × 4.38) and an increase in the sensitivity of pay to performance of 1.7 percentage points (0.02 × 0.85), or 6.8% relative to the baseline sensitivity (0.017/0.25).[22] For CEOs only (col. 6), the changes are even larger and correspond to a 14.4% fall in fixed pay and a 2.5 percentage point increase in the sensitivity of pay to performance.

Column 3 includes a large set of additional controls to allow for the possibility that compensation may be changing for reasons other than competitive pressure. Our basic result could be driven by changes in the demand for labor if foreign competition leads to an increase in the demand for skilled (and, therefore, managerial) labor. To control for this, we include a set of variables that will likely capture this increased demand for skills. These are the log of property plant and equipment, investment over assets, and the log of the number of employees. We also control for other determinants of executive compensation as in Himmelberg et al. (1999) (these are log of sales, the ratio of long-term assets to sales, operating income to sales, R&D intensity, advertising intensity, and the ratio of capital expenditures to property plant and equipment). The main result is unaltered by the inclusion of these variables, but since many of them are potentially outcome variables themselves, we omit them in what follows.

To allow for the base sensitivity of pay-to-performance to change over time for all firms, and for different sensitivities across industries, in columns 4 and 5, we interact the performance measure with year dummies and with industry dummies. We also allow for industry-specific trends in pay levels (col. 4), and, finally, we include industry-specific trends in performance (col. 5), with results similar to column 2 and coefficients also statistically similar in magnitude. This highly saturated model alleviates

[21] In this case, the firm and the individual effects are not separately identified, but this does not affect the other coefficients. We found very similar results when controlling for individual and firm effects separately. The results are also robust to including interaction between Import Pen × ln Perf with firm/individual dummies.

[22] The standard deviation of import penetration in our sample is 0.14, but this includes both the between- and within-firm deviations. The origin-weighted within-firm standard deviation is 0.02.

the concern that all we are capturing are concurrent trends in imports and incentives, since it identifies not only from within firm and individual variation in performance-pay sensitivities but also from deviations from the industry-specific parametric trends (in levels and slopes).

We find that more competition leads to steeper incentives so that, to the extent that competition is likely to depress the average rent of firms, this result is at odds with some of the rent-extraction literature, in which rent extraction is camouflaged in the variable component of pay and executives appear to get paid for luck (Bertrand and Mullainathan 2001; Bebchuk and Fried 2004). If present, the rent-extraction mechanism actually would tend to reduce the size of our incentive-related coefficients, thus pushing our results downward.[23]

In terms of the magnitude of these effects, while import penetration increased by 6 percentage points in the economy over our sample period, in our sample, average (origin-weighted, firm-specific) import penetration increased by 4.3 percentage points. This implies, using the results in column 5, a fall in the level of compensation of 23% (0.043 × 4.54) and an increase in the slope of 3.5% (0.043 × 0.81), or around 14% of the baseline.

Because potential endogeneity is always a concern in these regressions—either because different pay structures lead to management strategies that may preempt foreign competition or because both may be codetermined by some omitted variable—we go on to provide instrumental variable results in table 4. Since the sample size is reduced because of the limited availability of tariff data for the early part of our sample, we present the ordinary least squares (OLS) results on the IV sample in column 1 for comparability and show that they are quite similar.

Column 2 presents the basic IV results. We find that the effect of a one standard deviation increase in import penetration coming from changes in the exchange rate and tariffs is to reduce the average intercept by 3.6 percentage points (0.02 × 1.8) and to increase the slope of contracts by 4.7 (0.02 × 2.37) percentage points. For CEOs (col. 6), the intercept falls by 13.4%, and pay sensitivity increases by 5.9 percentage points.

The IV estimate for the slope of the contract is larger than the OLS equivalent, which, as mentioned earlier, is not surprising, given that all the sources of bias mentioned would tend to attenuate the coefficient. The estimated effect for the intercept is not significant in column 2, but it becomes so when we account for secular trends in the fully saturated specification of column 3. Columns 4 and 5 show the results when using

[23] More generally, we tested explicitly for the possibility that a systematic effect of changes in imports, exchange rates, or tariffs on firm profits could be driving the results (for instance, in the presence of nonlinearities in performance pay elasticities) and could find no evidence for this hypothesis. Results available upon request.

Table 4
Pay Structure: IV Results

	Dependent Variable Is ln Total Compensation						
	OLS Sample (1)	IV (2)	IV (3)	IV (4)	IV (5)	IV CEOs (6)	IV CEOs (7)
ln Perf	.24	.21				.26	
	[.02]***	[.03]***				[.04]***	
Lag Import Pen	−3.62	−1.8	−15.6	−10.82	−31.26	−6.72	−18.33
	[1.74]**	[8.25]	[9.08]*	[11.44]	[13.03]**	[10.54]	[13.75]
Lag Import Pen × ln Perf	.73	2.37	4.21	3.93	5.91	2.97	5.04
	[.24]***	[.86]***	[1.66]**	[1.86]**	[2.59]**	[1.15]**	[2.17]**
ln Assets	.19	.23	.22	.22	.21	.25	.26
	[.03]***	[.04]***	[.04]***	[.04]***	[.04]***	[.06]***	[.05]***
CEO	.28	.28	.27	.27	.27		.26
	[.03]***	[.03]***	[.03]***	[.03]***	[.03]***		[.04]***
Instruments	All	All	All	Exch. rates	Tariffs	All	All
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual × firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies × ln Perf			Yes			Yes	Yes
Year dummies × ln Perf			Yes			Yes	Yes
Industry trends			Yes			Yes	Yes
Industry dummies × ln Perf × year			Yes			Yes	Yes
Observations	1,8167	18,167	18,167	18,167	18,167	3,685	3,685
R^2	.18	.04	.14	.10	.15	.11	.19

NOTE.—Standard errors clustered by firm in brackets. Columns 2–7 are two-stage least squares regressions of table 3 where Lag Import Penetration and its interaction with ln Performance are instrumented with (lagged and double-lagged) exchange rates and lagged tariffs (see table 2, cols. 4 and 5, for the first-stage results). The dependent variable is the log of total yearly compensation that includes salary, bonus, total value of stock options granted (valued using the standard Black-Scholes formula), total value of restricted stock granted, long-term incentive payouts, and other annual compensation; Performance is total shareholders' return, including shareholders' value at fiscal year end plus reinvestment of dividends; Import Penetration is imports divided by imports plus domestic production at four-digit SIC, demeaned and weighted at the firm level, where weights take into account the sectors of operation of the firm in a base year; ln Assets measures firm size; CEO is an indicator for who is the company CEO. See data appendix for further details and sources.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

only one instrument at a time (exchange rates or tariffs, respectively). It is worth underscoring that our results are not qualitatively different if we use just one set of instrumental variables, such that if one had a preference for using one instrument over the other this would yield similar results. However, the point estimates are different, suggesting a different local treatment effect in the different regressions.

All the results above use the estimated slope of the contract as our variable of interest. In doing so we are implicitly treating option grants as a cash award. To the extent that managers can rebalance their portfolios of nonrestricted options and stock, this is the right approach. An alternative to this would be to use explicitly the performance-pay sensitivity implied by the option grants and restricted stock as a dependent variable (Core and Guay 1999; Aggarwal and Samwick 2003). When doing this, we obtained evidence consistent with the overall results in the article but often with large standard errors. In the instrumental variables regressions, we found a significant increase from competition in the sensitivity of restricted stock but not from options grants.[24]

Overall, tables 3 and 4 show an important result: when firms face additional foreign competition, their pay structure shifts toward more performance-related pay and less fixed pay. That is, competition leads to an increase in incentives, and firms shift the different components of pay in a way that should induce executives to increase firm performance. This is true if we both control for individual fixed effects and saturate the model with interactions of year and industry dummies with performance. The use of instrumental variables deals with the endogeneity concerns and allows us to confirm that the causality of this effect goes from foreign competition to pay, not the other way around.

B. The Wage Ladder

Incentives can be provided through performance-pay contracts, as in the previous section, but also directly with pay levels, through efficiency wages, or with wage differentials between executives in tournament-like mechanisms.[25] This section analyzes the net effect of import penetration on total compensation and on wage differentials between executives within a firm: the wage ladder. Unfortunately, we do not have a precise description of reporting relationships or promotion profiles, and our data are insufficient to assess potential changes in organizational structure induced by competition, such as "delayering" (Rajan and Wulf 2006), but we are able to analyze the pay hierarchy.

To measure changes in the wage ladder, we rank each executive within

[24] Results are available upon request.

[25] Main et al. (1993) and Eriksson (1999) study wage differentials and the tournament nature of executive promotions as a way to provide incentives.

the firm according to total compensation in a given year, as in Barron and Waddell (2003). We construct five dummy variables, h_k with $k \in (1, 2, \ldots, 5)$, where h_1 takes value one if the executive is the highest-paid executive in the firm in a given year and zero otherwise, h_2 takes value one if the executive is the second-highest-paid executive in the firm in that year, and so on up to h_5. We then run regressions with the following specification:

$$\ln(W_{ifjt}) = a_0 + \sum_{k=2}^{5} \beta_k h_k + \sum_{k=2}^{5} \theta_k h_k \text{Import Pen}_{fjt-1} + v'_{ifjt}\chi + d_t + d_f + \eta_i + \varepsilon_{ifjt}, \quad (3)$$

where the variables are as described in Section IV.A. The coefficients β_k represent the average wage differential between the highest- and the kth-highest-paid executives. Given that the pay measure is in logs, these differentials should be interpreted as total pay ratios between executives. Therefore, they do not capture the fact that pay increased for all executives during the period. The coefficients of interest are θ_k, a measure of the change in these differentials with competition. If the difference in pay between executives increases with Import Pen_{fjt-1}, we would expect to find that θ_k is negative and decreases in k (increases in absolute value); this indicates that the wage differentials are more marked with high foreign competition, conditional on controls, and unobserved heterogeneity. The inclusion of individual fixed effects in these regressions implies that the estimated differences between pay levels, β_k, are not attributable to the different abilities of executives in the hierarchy. That is, if the highest-paid employee ($k = 1$) receives a higher wage than the others (reflected by $\beta_k < 0$), it is not because he or she is the most talented individual, since unobserved ability, which we can think of as general skill or talent, is accounted for in the fixed effect. We present and discuss the results with and without individual fixed effects. Section IV.C exploits directly the information in the individual fixed effects of the executives that firms hire and how this changes with competition.

Table 5 shows the results of this specification. Before studying the effects of import penetration on wage differentials within the firm, we analyze the wage ladder itself (coefficients of variables second, third, fourth, and fifth—the omitted category is always the highest-paid executive). The coefficients are all negative and increasing in absolute value as one goes down the wage ladder.[26] A comparison of columns 1 (with firm fixed effects) and 2 (with firm × individual fixed effects and industry

[26] This is by construction, as the dependent variable (log total compensation) is used to rank the executives: the coefficients on the dummies reflect the percentage difference from the highest-paid executive in total compensation.

× year effects) shows that the wage ladder is less steep when one controls for individual unobserved heterogeneity: the difference between the top and the fifth executives is reduced by one-third (from −1.27 to −0.88). This indicates that one of the reasons for existing wage differentials among executives is that workers with different ability levels occupy different levels in the hierarchy. However, ability is only part of the explanation, since column 2 still shows significant and sizable differences between the different levels. Therefore, "advancing in the pay hierarchy" is associated with a wage increase and, thus, may provide, in itself, incentives.

Regarding import penetration, the results on $\hat{\theta}_2$ to $\hat{\theta}_5$ show how imports affect the differential between executive levels, net of all characteristics that are controlled for in X_{ifjt}, and individual unobserved heterogeneity. The coefficients $\hat{\theta}_2$ to $\hat{\theta}_5$ are generally negative and increasing in absolute value. As import penetration increases, the wage schedule becomes steeper, with the highest-paid executive earning proportionally more than the second-highest-paid executive, and so on, for all five categories. For the highest-paid executive, and accounting for firm (and not individual) unobserved heterogeneity (col. 1), a single standard deviation (0.02) increase in foreign competition increases total pay by 4.7% and the differential between the first- and fifth-highest-paid executives by 2.6%. However, these numbers drop to 1.4% and a differential of 0.8% that cease to be significant when controlling for firm-specific individual fixed effects and industry trends (col. 2), showing a substantial reduction in the effect when we account for individual unobserved heterogeneity.

Next, since OLS may be biased downward, and to assess the causal effect of foreign competition, we use instrumental variables as before (cols. 3 and 4). They yield a pattern similar to that in columns 1 and 2, although the magnitude of the effects (but also the standard errors) is larger. Total pay and wage differentials between executives increase with instrumented imports for all executives (col. 3) where one standard deviation increase in import penetration leads to a 21.8% (0.02 × 10.89) increase in pay for the highest-paid executive and to a 9.2% or 12.1% increase for the third- and fourth-highest-paid executives. Therefore, the IV regressions indicate that total pay went up at all levels, but more at the top, such that there was a significant change in wage differentials within firms and that part of it was driven by changes in workers' skill.[27]

However, in light of the results in the previous section on incentive contracts, we expect changes in total pay to be a mixture of workers

[27] Murphy and Zábojník (2004a, 2004b) and Frydman (2005) suggest that the increase in the level of CEO pay is the result of increased demand for general human capital or managerial talent. Our results complement their work since we provide evidence for changes in the observed distribution of talent at the top of the firm and are able to systematically test whether competition is one reason for this increase in the demand for managerial ability.

Table 5
Promotion and Wage Ladders

	Dependent Variable Is ln Total Compensation					
	OLS (1)	OLS (2)	IV (3)	IV (4)	OLS (5)	OLS (6)
Lag Import Pen	2.33	.72	15.74	10.89	−4.92	−6.1
	[.70]***	[.70]	[6.25]**	[5.20]**	[2.46]**	[2.53]**
Second × Lag Import Pen	−.66	.71	−4.02	−.61	1.29	2.6
	[.49]	[.53]	[2.22]*	[2.54]	[2.44]	[2.59]
Third × Lag Import Pen	−1.21	−.06	−5.93	−6.13	2.56	3.76
	[.52]**	[.55]	[2.19]***	[2.23]***	[2.19]	[2.59]
Fourth × Lag Import Pen	−1.25	−.27	−7.04	−4.87	3.74	3.26
	[.53]**	[.57]	[2.27]***	[2.53]*	[2.23]*	[2.48]
Fifth × Lag Import Pen	−1.31	−.39	−7.6	−1.35	4.7	7.33
	[.59]**	[.68]	[2.47]***	[2.66]	[2.48]*	[3.47]**
ln Perf					.25	.27
					[.02]***	[.02]***
Lag Import Pen × ln Perf					1.06	1.12
					[.34]***	[.34]***
Second × Lag Import Pen × ln Perf					−.27	−.29
					[.33]	[.36]

Third × Lag Import Pen × ln Perf					−.54	−.55
					[.30]*	[.35]
Fourth × Lag Import Pen × ln Perf					−.72	−.52
					[.31]**	[.34]
Fifth × Lag Import Pen × ln Perf					−.87	−1.15
					[.36]**	[.47]**
Second (cols. 1–4); second × ln Perf (cols. 5–6)	−.55	−.37	−.54	−.35	−.02	−.03
	[.01]***	[.02]***	[.02]***	[.03]***	[.01]***	[.01]***
Third (cols. 1–4); third × ln Perf (cols. 5–6)	−.88	−.59	−.86	−.54	−.03	−.05
	[.01]***	[.02]***	[.02]***	[.03]***	[.01]***	[.01]***
Fourth (cols. 1–4); fourth × ln Perf (cols. 5–6)	−1.08	−.73	−1.05	−.69	−.03	−.05
	[.01]***	[.03]***	[.02]***	[.04]***	[.01]***	[.01]***
Fifth (cols. 1–4); fifth × ln Perf (cols. 5–6)	−1.27	−.88	−1.24	−.85	−.03	−.05
	[.01]***	[.03]***	[.02]***	[.04]***	[.01]***	[.01]***
Fixed effects	Firm	Indiv. × firm	Firm	Indiv. × firm	Firm	Indiv. × firm
Industry dummies × year		Yes		Yes		
Observations	25,146	25,146	18,122	18,167	25,146	25,146
R^2	.52	.31	.47	.22	.55	.32

NOTE.—Standard errors clustered by firm in brackets. Second is a dummy that records the second-most-highly-paid executive, third is the third-most-highly-paid executive, etc. (corresponding to dummies h_1 to h_5). The base category is the most-highly-paid executive in the firm. All regressions include ln Assets, year dummies, and pay-rank dummies (not reported in cols. 5 and 6) as controls. The first stage for the IV regressions is in table 3, col. 6. See data appendix and table 2 for further details and sources.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

getting different levels of fixed pay and different performance-pay-sensitivities that induce different levels of effort. Thus, to provide a better interpretation of the mechanism behind the steepening of the wage ladder, we investigate how the slope and level of pay changed with foreign competition at different levels of the pay hierarchy. Columns 5 and 6 of table 5 report the results for this OLS regression. First, it shows that the baseline performance-pay-sensitivity is higher for executives closer to the top (elasticity of 0.25 for the most-highly-paid executive versus 0.22 for the fifth executive in col. 1), which is consistent with the idea that the marginal contribution to firm performance is higher the higher up in the hierarchy the worker is (this is in line with results in Aggarwal and Samwick 2003 and Barron and Waddell 2003). Next, it shows that these performance pay sensitivities increased more with competition for top executives (interaction of pay-rank dummies, performance, and import penetration in rows 7 to 11) and that the level of fixed pay also falls more for the highest-paid executives with additional imports (interaction of pay-rank dummies and imports in rows 1–5).[28]

In sum, these results indicate that the ratio of the total pay of an executive to the total pay of the next lower-paid executive grows with foreign competition (cols. 1–4), partly as a result of incentive contracts becoming steeper as the executive climbs within the firm (cols. 5–6), and maybe also from the higher effort exerted with more high-powered incentives. This also suggests that there may be higher rewards for an internal promotion (for a given level of effort), which is also a way to provide incentives in addition to the increase in performance-pay-sensitivities documented in the previous section.[29]

The net result of all these changes is that total pay increases at the top of the firm as a result of more competition, and more so the higher up the executive is in the pay-rank hierarchy. This complements the results in Revenga (1992), Abowd and Lemieux (1993), and Abowd and Allain (1996), who analyze workers and find a negative effect on total pay from increasing foreign competition. We find that, for the very top executives, compensation actually may increase, and, thus, inequality within firms goes up.

[28] For the fifth executive we find no significant decrease in pay.

[29] Alternatively, one could interpret these results as unrelated to tournaments and more in line with competition increasing the impact of talent at the top of the firm. If the results are interpreted in this way, our work can be seen as complementary to Gabaix and Landier (2008). While their argument is that the increase in corporate size has levered executive talent, making it more valuable, our results would support a similar argument where the leverage comes from an increase in product market competition.

C. Talent

The previous section showed that controlling for individual fixed effects changed our results significantly and therefore that overall changes in wage differentials were partly attributable to firms hiring workers with what we called different ability or talent (measured as the unobserved fixed component of wages). The last thing we do in this section is document how employees are sorted across firms and industries according to their "ability" as a function of import penetration. Finding good measures of executive ability is not straightforward. However, using the individual fixed effects of a wage regression, which measures the fixed component of an executive's pay that is not explained by observables, can be interpreted as a fairly good proxy for ability or talent. Strictly speaking, the fixed effects will include anything that affects wages, is constant over time for executives, and is not included in the regressions. Notice that this is typically interpreted as innate talent, ability, and education, but it will also include the fact that a specific managerial job/task becomes increasingly important, and commands a higher wage premium, as well as other characteristics that are not part of the usual definition of talent, such as risk-aversion or the disutility of work.

We model the natural logarithm of total compensation $\ln(W_{ifjt})$ as a function of some observable variables, time dummies, an individual fixed effect η_i, and a firm fixed effect d_f.[30]

$$\ln(W_{ifjt}) = \alpha + \beta_1 \text{Import Pen}_{fjt-1} + \sum_{k=1}^{5} \beta_2^k h_k + \beta_3 \ln \text{assets}_{fjt} + d_t + d_f + \eta_i + \varepsilon_{ifjt}. \quad (4)$$

In this model, the estimated individual fixed effect $\hat{\eta}_i$ is net of the effect of import penetration ($\text{Import Pen}_{fjt-1}$), firm size ($\ln \text{assets}_{fjt}$), position in the firm's wage ladder (h_k are pay-rank dummies), and aggregate time effects (d_t). It is also net of firm fixed effects, d_f. The individual fixed effect $\hat{\eta}_i$ contains all the executive and job-specific characteristics that are not controlled for in the previous regression. As the fixed effect is measured in pay units, and to the extent that the market for executives is competitive, $\hat{\eta}_i$ includes all the characteristics that increase compensation. Throughout the rest of the section we refer to this measure as talent.

With this estimate in hand, we can study how the $\hat{\eta}_i$ of the top five executives hired at each firm (their talent) varies with import penetration

[30] This regression does not include performance, given that if an individual with higher ability leads the firm to perform better, we do not want to net this out of our ability estimate.

Table 6
Talent Regressions

	Talent (1)	Talent (2)	Talent (3)	Talent IV (4)	Talent IV (5)
Lag Import Pen	1.99	.58	.61	.78	.83
	[1.08]*	[.23]**	[.23]***	[.42]*	[.43]**
Second × Lag Import Pen			−.05		−.05
			[.06]		[.13]
Third × Lag Import Pen			−.04		−.08
			[.08]		[.14]
Fourth × Lag Import Pen			−.04		−.13
			[.08]		[.16]
Fifth × Lag Import Pen			−.04		−.05
			[.09]		[.18]
Second			−.19		−.2
			[.01]***		[.02]***
Third			−.03		−.3
			[.02]***		[.02]***
Fourth			−.35		−.35
			[.02]***		[.03]
Fifth			−.4		−.41
			[.02]***		[.03]***
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	25,146	25,146	25,146	18,167	18,167

NOTE.—Standard errors clustered by firm in brackets. The dependent variable is the estimated individual fixed effect from a first-stage regression of log of total pay on firm size, hierarchy, year, and firm dummies (see eq. [4]). Import Penetration is imports divided by imports plus domestic production at four-digit SIC defined at the firm level (demeaned in col. 1). Second is a dummy that records the second-most-highly-paid executive, third is the third-most-highly-paid executive, etc. (corresponding to dummies h_1 to h_5). See data appendix for further details and sources.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

within and across firms. So, we can define $\hat{\eta}_{kfjt}$ as the fixed effect estimated for the kth executive of firm f at time t and estimate

$$\hat{\eta}_{kfjt} = \lambda + \gamma \text{Import Pen}_{fjt-1} + d_t + u_{kfjt}, \tag{5}$$

where d_t are year dummies, and u_{kft} is white noise. Firm effects and the effect of the level of imports, hierarchies, and firm size on pay are already partialled out in equation (4).

Table 6 presents the results of the talent regressions. Column 1 shows a positive average effect of import penetration on talent (coefficient of 1.99). This reflects that more "talented" individuals sort to firms facing more competition. Given that we only have 203 observed firm movers in the sample, there is limited variation to identify changes within firms. Therefore, in columns 2–5 we present results based on the nondemeaned (firm-origin-weighted) measure of import penetration, so that we also identify cross-industry differences in the sorting of talent. Column 2 confirms the sorting of talent (higher fixed effect) toward firms facing more import competition.

The results in columns 1 and 2 could hide heterogeneity in the response along the wage ladder, as we saw in the previous section. Column 3 interacts import penetration with the pay-rank dummies to show the differential change in talent for each hierarchy level. For the base category—highest-paid executive—the talent measure increases (coefficient of 0.61), and there is no substantial difference across pay ranks. In the instrumented regressions (cols. 4 and 5), we find a similar result.[31]

In sum, we find some evidence that firms hire more talented workers at the top as they face more competition. Therefore, firms not only try to elicit more effort from workers through incentives (as shown in Sec. IV.A) but also pay them more (Sec. IV.B) and seem to attract more talented workers.

V. Conclusion

In this article, we identify the effect of foreign competition through imports on different aspects of executive pay and the provision of incentives within the firm. Eliciting the empirical relationship between competition and the provision of incentives is particularly important, as the existing theoretical predictions are largely ambiguous and there is little evidence that explains the increased use of incentive contracts for both executives and workers.

Our results show that, in U.S. manufacturing firms, increases in foreign competition lead to lower levels of fixed pay and a higher sensitivity of pay to performance. We estimate that the increase in import penetration over the studied period implied a 23% fall in the non-performance-related component of compensation and a 3.5% increase in the sensitivity of pay to performance (or 14% of the average elasticity). We also find some evidence to suggest that increased competition is not associated with a consistent decrease in total pay across all executives. Instead, we observe that total compensation increases particularly for the highest-paid executives and that the wage ladder of the firm becomes steeper; that is, the highest-paid executives in the firm tend to earn proportionally more when competition is high, and inequality within firms increases. Some of this increase in wage differentials is driven by changes in the composition of top executives. In fact, we find some evidence that higher foreign competition leads to a higher demand for talent.

There are certainly other reasons why compensation structures may have changed over time. We established that one important contributor is the extent of import penetration and the implied increase in product

[31] Given that talent is measured through its impact on pay, the coefficient γ captures both demand effects, such as firms paying more for talent, and supply ones, such as the sorting of more talented executives toward more competitive industries.

market competition: as they face more competitive pressure, firms demand more talent and are also willing to pay more for "effort." This explains the use of incentive contracts and also provides a rationale and potential causal explanation for the increased skewness and polarization of the wage distribution. There are many sources of increased competition other than foreign competition, and these are possibly contributing further to the overall change in the wage distribution. Developing our understanding of these mechanisms further is left to future research.

Appendix

Data

I. Execucomp Data Set

The Execucomp database is a panel that records information on at least the top five executives of the firms included in the S&P 1500 index from 1992 onward. We concentrate on the firms in industries for which we have import penetration (the manufacturing sector in 1992–2000). We also restrict the sample to the top five executives of each firm (ranked by salary plus bonus) and drop the observations where there is no information on total pay received by the executive.

A. Total Compensation

Total compensation includes the sum of salary, bonus, total value of stock options granted (valued using the standard Black-Scholes formula), total value of restricted stock granted, long-term incentive payouts, and other annual compensation, in real 1996 dollars (Execucomp variable TDC1).

B. Firm Performance

Firm performance is measured as the total market value of the firm, when this value includes the reinvestment of dividends and excludes mergers, share buyouts, spin-offs, and seasoned equity offerings. Since we take logs and include fixed effects in our regressions, this is equivalent to using as performance the return to shareholders that includes the market value of the firm and the monthly reinvestment of dividends (computed from Execucomp variables market value [mktval] and 1 year shareholder returns [trs1yr]).

II. Trade Data

A. Import Penetration

Import penetration is defined at the industry level (four-digit SIC) as the total value of imports (total import data by SIC4 come from the NBER data set, available until 2001) divided by imports plus domestic

production (domestic production is from the Census Bureau's Annual Survey of Manufactures—Statistics for Industry Groups and Industries—provided by the Bureau of Economic Analysis and available until 2000) demeaned at the industry level. Next, for each firm, we construct weights that correspond to the fraction of sales associated with each industry (business segments in Compustat) in which it operated in 1991 (or the first year it appears in Compustat if not present in 1991). The final import penetration measure is the weighted average of all manufacturing industries in which the firm operates in the base year, available for 1992–2000 (source: NBER database, "U.S. Imports, Exports and Tariff Data, 1989–2001 (NBER 9387)" [see Feenstra et al. 2002] and Compustat Segments data).

B. Tariffs

The average tariff measure is defined as the weighted average of the scheduled tariffs imposed by the United States on imports to each country, where the weights are the fraction of imports coming from each country in 1993. Tariffs are obtained from the UNCTAD TRAINS data set. These are defined by country and six-digit harmonized system code (HS) product code and available for the United States for the years 1993–96, 1998–99, and 2000 (year 1997 is imputed from 1996). For each HS6 category, we construct a weighted average of tariffs by product, where the country weights within HS6 are kept constant over time and equal to the base year. To aggregate the HS6 average tariffs to the SIC4 industry level, we use a correspondence and weight each product by its share in the industry. Tariffs are also demeaned and weighted to obtain the firm-specific measure.

C. Exchange Rates

The exchange rate index is defined as in Bertrand (2004) at the industry level (three-digit SIC code) as the weighted average of the log real exchange rates of importing countries (expressed in foreign currency per dollar), where the weights are the share of each foreign country's import on total imports in a base period (1990–91). Real exchange rates are nominal exchange rates multiplied by the U.S. Consumer Price Index (CPI) and divided by the trading partner CPI. Nominal exchange rates and foreign CPIs are obtained from the International Financial Statistics of the International Monetary Fund. Exchange rates are also demeaned and weighted to obtain the firm-specific measure.

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