Import Penetration and Executive Compensation*

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Abstract

We examine the effects of Chinese import penetration on executive compensation of US firms. We find that import penetration reduces executives' total compensation, stock grants, wealth-performance sensitivity, and opportunistic grant timing, suggesting that competition mitigates agency problems and the need for conventional alignment mechanisms. Furthermore, we find that import penetration increases option grants and option duration, thus incentivizing more innovation and risk-taking.

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"Monopoly […] is a great enemy to good management."
--Adam Smith (Smith (1776))

In recent decades, improved transport and containerization, trade agreements, and new communication technologies have accelerated globalization and, in turn, dramatically affected the competitive landscape. The intensified competition creates new challenges and alters firms' optimal strategy. For example, extant literature shows that firms facing greater import competition scale down operations (Autor, Dorn, and Hanson (2013) and Pierce and Schott (2016)).

The need for firms to adapt to new competition along with greater pressure on executives could also affect executive compensation. The model of Hart (1983) predicts that competition mitigates managerial slack and discretionary behavior, because owners are better able to gauge executives' actions and performance in a competitive environment. An implication is that competition reduces the need for shareholders to design compensation that helps align incentives between shareholders and executives. Another implication is that competition reduces executives' ability to extract compensation beyond what is optimal. By contrast, Scharfstein (1988) shows that under different assumptions about managerial preferences, product market competition exacerbates agency problems, with the opposite implications for executive compensation. Thus, the effects of competition on executive compensation are theoretically ambiguous.

We examine the empirical effects of competition on executive compensation. In particular, we examine the effects of Chinese import penetration in the US on the level and structure of executive compensation, including the use of bonuses, stock, and stock options. Chinese import penetration is particularly suited for studying the effect of competition. First, the dramatic increase in Chinese import penetration, as indicated by a twentyfold increase in US imports from China from 1991 to 2016, should prompt a measurable effect. Second, because Chinese manufacturers

also penetrated markets outside the US, we can instrument for the Chinese trade penetration in the US using the Chinese trade penetration in other developed countries, following the identification strategy of Autor, Dorn, and Hanson (2013).

Our evidence shows that one standard deviation increase in import penetration reduces total executive compensation by about 7%, bonuses by 8%, and the value of stock grants by 10%. The decline in stock grants contributes to a decrease in wealth-performance sensitivity (delta) of 10%. Both our identification strategy and the use of control variables for firm size and performance allay the concern that the results stem from declines in firm size or performance. Instead, we interpret our results to be consistent with the prediction of Hart (1983) that competition mitigates agency problems, reducing both the ability of executives to extract excessive compensation and the need for compensation to align incentives. Our results are further consistent with Giroud and Mueller (2010, 2011), who also report evidence that product market competition alleviates agency problems.

As a more direct test of the ability to extract excessive compensation, we examine opportunistic timing of executive stock option grants. Yermack (1997) and Aboody and Kasznik (2000) document abnormal return patterns around at-the-money stock option grants, which Lie (2005) and Heron and Lie (2007) attribute to backdating of grants to dates with particularly low stock prices. Such backdating serves to enhance option grant values and is arguably symptomatic of agency conflicts. If import penetration alleviates agency problems, we expect backdating to retreat with greater import penetration. Our evidence supports this conjecture; import penetration significantly reduces the prevalence of backdating. The effect is especially strong before August 29, 2002, when the SEC tightened filing requirements, thus limiting the gains from backdating.

We further investigate the effect of import penetration on CEO pay slice, i.e., the fraction of aggregate compensation for the top five executive team captured by the CEO. Bebchuk, Cremers, and Peyer (2011) show that high CEO pay slice is indicative of agency problems. Moreover, Kale, Reis, and Venkateswaran (2009) argue that high CEO pay slice provides promotion incentives among the next level of managers to expend greater effort, which is especially beneficial in the presence of agency problems. In either case, if competition mitigates agency problems, as in Hart (1983), we conjecture that increased competition reduces the CEO pay slice. The results support this conjecture.

We alternatively consider whether competition affects executive compensation via a need to alter innovation activities. Increased competition might elevate firms' optimal level of innovation, either because firms need to differentiate products relative to the new competition or lower costs to improve price competitiveness. For example, the model of Arrow (1962) shows that competition increases firms' incentive to innovate to reduce costs on competitive output. But inherently risk-averse executives might resist a boost in innovation. Manso (2011) studies how incentives should be structured when the principal needs to motivate the agent to increase innovation, where innovation entails "exploration of untested approaches that are likely to fail" (p. 1851). He shows that the optimal contract tolerates early failures and rewards long-term success. Unlike standard pay-for-performance schemes, stock options with long vesting periods meet both of these criteria. Thus, Manso concludes that the optimal contract that motivates innovation includes options with long-vesting periods, but not regular stock.[1]

[1] Other studies arrive at similar conclusions. One set of studies dating back to at least Jensen and Meckling (1976) recognize that stock options encourage risk-taking because of the convexity of their payoffs. A second set of studies, including Bolton, Scheinkman, and Xiong (2006) and Edmans, Gabaix, Sadzik, and Sannikov (2012), show that long vesting periods resolve managerial myopia and encourage managers to maximize long-term firm value.

We observe that one standard deviation increase in import penetration raises executive option awards by 16%, and, accordingly, the wealth-volatility sensitivity (vega) by 6%. The combination of more options and less stock encourages executives to plot a more risky course and boost innovation (Manso, 2011), which might be optimal to maintain a competitive position (Arrow, 1962). Because Manso emphasizes that options are particularly effective in encouraging innovation if they have long vesting periods, we also examine how import penetration affects vesting periods of executive stock options. We find that a standard deviation increase in import penetration raises the average vesting period of the options by 14%, thus corroborating the notion that firms respond to increased competition by increasing managers' incentives to innovate.

In an ancillary test, we examine the effect of exogenous option grants, per Shue and Townsend (2017), on innovation in a general setting. Because an exogenous increase in option grants inflates both the number of options in executives' portfolios and the average vesting period of those portfolios, Manso (2011) predicts that innovation subsequently increases. The results support this prediction. Our results complement Lie and Yang (2017), who find that Chinese import penetration boosts innovation. The increase in stock options is a likely channel through which import penetration raises innovation.

We contribute to a substantial literature on product market competition and executive compensation in three major ways. First, unlike past studies, we document that competition reduces total pay and pay-performance sensitivity. Hubbard and Palia (1995), Crawford, Ezzell, and Miles (1995), Cuñat and Guadalupe (2009a, 2009b), and Dasgupta, Li, and Wang (2017) report that competition *raises* pay-performance sensitivity, and Hubbard and Palia (1995) also find that competition *raises* total pay. We believe that our identification strategy of using Chinese import penetration in the US instrumented with Chinese import penetration in other developed

countries is cleaner than those used in past studies. Hubbard and Palia (1995), Crawford, Ezzell, and Miles (1995), and Cuñat and Guadalupe (2009a) employ banking deregulation as an exogenous shock to competition. But a secular trend among banks might explain these results. In any event, it is unclear whether the results for the commercial banking sector can be generalized to other firms. Cuñat and Guadalupe (2009b) and Dasgupta, Li, and Wang (2017) examine the effect of shocks in competition triggered by tariff changes. But an extensive international trade literature argues that trade protection is endogenous (Hillman, 1982, Mayer, 1984, Magee, Brock, and Young, 1989, Bohara and Kaempfer, 1991, and Trefler, 1993). Indeed, we report in our preliminary analysis that, unlike increases in import penetration, tariff reductions fail to portend sales declines.

Our second major contribution to the literature is that we provide novel results on how competition affects opportunistic timing aimed at enriching option grants. We report that increased import competition reigns in such opportunistic behavior, which we interpret as evidence that competition mitigates the extent to which executives extract covert compensation. In addition, we find that increased competition compresses the compensation structure among the top executives, which is consistent with both reduced agency problems and reduced need to provide promotion incentives.

Our third contribution is that we are the first to examine the effect of competition on executive stock option grants, including vega and duration. We show that competition increases both executive stock option grants (and, thus, vega) and the average vesting period of options, which Manso (2011) predicts will raise managers' incentive to innovate. We even provide supplementary evidence that exogenous increases in option grants spur innovation. Our results

conform with Arrow's (1962) prediction that firms should increase innovation in response to greater competition.

I. Methodology

The Chinese government began to reform its economy in 1978, and the reform accelerated after its leader Deng's inspection of Southern China (the "Southern tour") in 1992. The reform efforts led to an explosive growth in productivity, rural to urban migration, and capital accumulation (Naughton (2007)). As a result, manufacturing production and exports skyrocketed; China's share of world manufacturing exports grew from 2.3% in 1991 to 18.8% in 2013 (Autor, Dorn, and Hanson (2016)). Figure 1 shows that US imports from China as a proportion of its imports from the world increased from about three percent in 1991 to more than 20 percent in 2016. Autor, Dorn, and Hanson (2013), Acemoglu et al. (2016), and Pierce and Schott (2016) report that this had a large impact on the US labor market.

We study the effects of Chinese import penetration on executive compensation of US firms. Following Autor et al. (2014) and Acemoglu et al. (2016), we define import penetration for the SIC three digit industry *j* in year *t* as

$$\text{Import Penetration}_{jt} = \frac{M_{jt}^{UC}}{Y_{j,91} + M_{j,91} - E_{j,91}},$$

where the numerator M_{jt}^{UC} is the imports from China in year *t*, and the denominator is the initial absorption in 1991 measured as industry shipment, $Y_{j,91}$, plus industry imports, $M_{j,91}$, minus industry exports, $E_{j,91}$. We use 1991 as the base year, because it is the first year for which a large number of bilateral industry-level trade data is available.

We further alleviate the concern that domestic shocks induce changes in executive compensation by employing import penetration in other high-income countries as an instrumental variable. These high-income countries include Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. Following Autor et al. (2014) and Acemoglu et al. (2016), we define other import penetration for the SIC three digit industry *j* in year *t* as

$$\text{Other Import Penetration}_{jt} = \frac{M_{jt}^{OC}}{Y_{j,91} + M_{j,91} - E_{j,91}},$$

where M_{jt}^{OC} is the other high-income countries' imports from China in year *t*. By using this instrumental variable, our first assumption is that Chinese import penetration in the US is highly correlated with Chinese import penetration in other high-income countries. Our first-stage F statistic greatly exceeds ten and, therefore, strongly rejects the null hypothesis that the instrument is weak. The strong correlation between import penetration and other import penetration is attributable to China's dramatic improvement in productivity unleashed by the economic reform (Zhu (2012) and Autor, Dorn, and Hanson (2016)). We further assume that other import penetration only affects US firms' compensation decisions through US import penetration.

To study how import penetration affects executive compensation, we construct several compensation variables. Total compensation consists of salary, bonus, value of restricted stock granted, value of options granted, long-term incentive payouts, and other compensation. Stock option compensation is defined as the Black-Scholes value of options grants evaluated at the end of the fiscal year. We choose the fiscal year end value of the options to be consistent with the calculation of delta and vega. Also, this mitigates concerns regarding opportunistic timing of grant dates (Lie (2005) and Heron and Lie (2007, 2009)). Nevertheless, our results remain similar if we value the options at the time of the grant dates. We compute delta and vega following Core and

Guay (2002) and Coles, Daniel, and Naveen (2006).[2] For our volatility measure, we calculate the standard deviation of daily returns over the previous 250 trading days and then annualize it, similar to De Angelis, Grullon, and Michenaud (2017). Delta is the estimated dollar change in executives' wealth for a 1% change in stock price. Vega is the estimated dollar change in executives' wealth for a 0.01 change in standard deviation of returns.

Our primary regression is:

$$\log\left(1+Compensation_{i,t}\right)=\gamma_0+\gamma_1 ImportPenetration_{i,t}+\boldsymbol{\gamma}'\mathbf{x}_{i,t}+c_i+\lambda_t+\epsilon_{i,t} \quad (1)$$

where $Compensation_{i,t}$ denotes various compensation variables, including total compensation, salary, bonus, stock grant value, option grant value, delta, and vega. We transform compensation using the natural logarithm to mitigate skewness. The explanatory variable of interest, $ImportPenetration_{i,t}$, is, as noted earlier, the (SIC three-digit) industry's imports from China divided by the year 1991 initial absorption (measured as industry shipments plus industry net imports). We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. In the baseline model, the control variables, $\mathbf{x}_{i,t}$, include the log of total assets, a CEO dummy, and return on assets. The CEO dummy equals one if the executive is the CEO, and zero otherwise. As a robustness check, we add more proxies for firm performance, including Tobin's Q (also a proxy for growth opportunities), log of sales (also a proxy for firm size), and the fiscal year stock return. In addition, we control for traditional measures of domestic industry competition, the Herfindahl-Hirschman Index (HHI) and HHI squared. For each industry, HHI equals the sum of the squared share of sales of each domestic firm. All regressions include

[2] For early work on pay-performance sensitivity, see, for example, Jensen and Murphy (1990).

executive-firm fixed effects, c_i, and year fixed effects, λ_t. We cluster the standard errors at the executive-firm level.

II. Data

Our main sample consists of US manufacturing firm executives (SIC 2000-3999). Our sample starts in 1992, the first year with available data from Execucomp. Furthermore, because FAS123R changed the reporting requirements of the compensation data in 2006, we end our sample in 2005 to ensure that all variable definitions are consistent and comparable over time. This has the additional benefit of bypassing any confounding effects from the Financial Crisis. We require that firms have positive assets and non-missing SIC code to be included in a given year. We obtain trade data from the UN Comtrade database, and use David Dorn's crosswalk between HS6 and SIC to find the industry-level trade flows.[3] Firm financial data come from Compustat, stock return data from CRSP, and compensation data from Execucomp. To reduce the effect of outliers, we winsorize all variables at the first and 99th percentiles.

Table I presents summary statistics. The average compensation was almost $1.7 million, more than half of which stems from option grants. The average delta and vega are $185 thousand and $41 thousand, respectively, suggesting that compensation is quite sensitive to both changes in stock prices and volatility. The average Chinese import penetration in the US is 4% (with a standard deviation of 9%), compared to 3% (and a standard deviation of 5%) to other high-income countries.

[3] This is available from David Dorn's website: http://www.ddorn.net/data.htm.

III. A comparison of import competition measures

In the preliminary analysis, we examine the effect of three import competition measures on sales. These measures include our instrumented import penetration and two measures based on tariffs. An increase in import competition should negatively affect the sales of domestic firms, either because the foreign firms capture market share or drive down product market prices. Thus, an increase in exogenous measures for import competition should portend sales declines for domestic firms. The purpose of the preliminary analysis is to validate this basic property for the three import competition measures.

Panel A of Table II presents results from regressing the sales of US firms against instrumented Chinese import penetration and control variables. The results indicate that an increase in Chinese import penetration induces sales declines among US firms in the affected industry; one standard deviation increase in the import penetration reduces the sales by more than 3%, which is statistically significant at the one percent level.[4] This validates the use of Chinese import penetration as an exogenous measure of import competition.

Prior studies, including Dasgupta, Li, and Wang (2017), use tariff cuts as a proxy for increases in import competition. To examine the effect of tariffs on the sales of domestic firms, we obtain tariff data from Bernard, Jensen, and Schott (2006), Fresard (2010), Valta (2012), and Frésard and Valta (2016). For each three-digit SIC industry-year, the tariff rate is estimated as the duties collected by US customs divided by the free-on-board value of imports. Panel B of Table II presents results from regressions of domestic firms' sales against tariffs and control variables. The results suggest that tariffs hurt the sales of domestic firms; one standard deviation increase in the

[4] To avoid the confounding effects of merger and acquisition on sales, we eliminate observations with sales growth larger than 200%, following Almeida, Campello, and Weisbach (2004) and Fresard (2010). If we retain those observations, the magnitude and statistical significance of the coefficients are similar.

tariff reduces the sales by about 4%, and it is statistically significant at the one percent level. The documented relation between tariffs and sales suggests that tariff changes do not represent exogenous changes in import competition. Rather, the relation suggests that tariff changes are endogenous, consistent with arguments and empirical results in the international trade literature (see, e.g., Hillman, 1982; Mayer, 1984; Magee, Brock, and Young, 1989; Bohara and Kaempfer, 1991; and Trefler, 1993). For example, firms in industries with dwindling sales might seek tariff protection, thus giving rise to a negative relation between sales and tariffs.

We also examine an alternate tariff measure. Following Dasgupta, Li, and Wang (2017), we construct a tariff cut dummy that equals one during the three years after an industry has experienced a tariff rate reduction that exceeds three times the median tariff rate reduction in the same industry, and zero otherwise. Moreover, consistent with Dasgupta, Li, and Wang, we exclude tariff cuts that are followed by equally large increases in tariffs within the subsequent three years. Dasgupta, Li, and Wang use this dummy variable to capture large and non-transitory tariff reductions. Panel C of Table II shows that this tariff cut dummy has an economically and statistically insignificant effect on subsequent sales.

Overall, the results in this section suggest that the instrumented import penetration on which we rely in later analysis serves as an exogenous measure of import competition for US firms. In contrast, the results suggest that the tariff measures are plagued by endogeneity, and are not suitable to measure exogenous variation in import competition. Thus, we should interpret studies that employ tariffs to examine the effect of import competition with caution.

IV. Import penetration and executive compensation

In this section, we explore the effect of import penetration on total executive compensation and its main components, including salary, bonus, stock grants, and option grants. As noted earlier, we do this by regressing the compensation measures against instrumented import penetration and control variables.

Table III presents the estimated effects of import penetration on total compensation (Panel A) and its cash components, i.e., salary (Panel B) and bonus (Panel C). Panel A shows that import penetration negatively affects total compensation. For example, the last model suggests that a standard deviation increase in import penetration reduces total compensation by about 7%, which differs statistically from zero at the 0.01 significance level. Panel B shows that import penetration has an imperceptible effect on salary, whereas Panel C shows that import penetration negatively affects executive bonuses.

Table IV presents the estimated effects of import penetration on the value of security grants to executives, including stock (Panel A) and stock options (Panel B). Panel A shows that import penetration reduces the value of stock grants. In particular, one standard deviation increase in import penetration induces an average reduction in stock grant values of about 10%. By contrast, Panel B shows that import penetration increases the value of option grants; one standard deviation increase in import penetration induces an average increase in option grant values of 16-20%.

Grants of stock and options to executives naturally affect the sensitivity of those executives' portfolios to both stock prices and volatility. In a complementary analysis to the one presented in Table IV, we therefore examine how import penetration affects delta and vega. Table V presents results of regressions of delta (Panel A) and vega (Panel B). The results indicate that one standard

deviation increase in import penetration reduces delta by 9–15% (Panel A) and increases vega by 6–7% (Panel B), and both effects are statistically significant at the 0.01 level[5].

The negative effects of import penetration on executive bonuses, stock grants, delta, and total compensation are consistent with the prediction of Hart (1983) that competition mitigates agency problems as any mismanagement becomes more visible to outsiders. When allowed to flourish, agency problems have two major effects on executive compensation. First, they provide a setting for executives to extract compensation in excess of what is optimal to maximize firm value. Second, they escalate the need for compensation to be tied to shareholder wealth to curtail mismanagement of corporate resources.[6] On this basis, import penetration should reduce both (i) excess compensation and (ii) compensation that is designed to align incentives of executives with those of shareholders, including bonuses and stock grants. The documented negative effects of import penetration on total compensation and bonuses line up with (i), whereas the negative effects on bonuses, stock grants, and delta line up with (ii).

The positive effects of import penetration on option grants and vega are consistent with the joint predictions of Arrow (1962) and Manso (2011). Arrow's model shows that enhanced competition increases firms' incentives to innovate to remain competitive. Manso's model shows that, unlike stock, stock options with long vesting periods encourage executives to boost innovation, because such options tolerate early failures and reward long-term success. Combined, the models of Arrow and Manso suggest that firms that face enhanced competition should increase

[5] Edmans, Gabaix, and Landier (2009) suggest scaling the delta by the total pay to filter out the size effect. We control for the size effect by including the log of total assets as a control variable. In our setting, import penetration reduces both the delta and the total pay, leading to a less pronounced effect on the scaled delta. To alleviate the effects of import penetration coming through the scaling variable, we divide the delta by the lagged total pay and find that import penetration reduces the scaled delta. One standard deviation increase in the import penetration reduces the scaled delta by 3%-8% with p-values ranging from 0.01 to 0.1.

[6] Edmans, Gabaix, and Jenter (2017) provide detailed discussion on how shareholder value maximization by boards and rent extraction by executives affect compensation.

their reliance on long-term executive options to encourage the innovation that is necessary to thrive in a fiercer market place. In later analysis, we examine the effect of import penetration on the duration of option grants to test Manso's predictions further. Also, in an ancillary analysis, we examine whether the use of stock options spurs corporate innovation.

V. Import penetration and backdating of stock options

In the previous section, we interpret the negative effect of import penetration on total compensation as evidence that competition reduces the ability of executives to extract excess compensation. In this section, we test the effect of competition on executive rent extraction more directly. In particular, we examine how import penetration affects the opportunistic timing of executive stock option grants.

Yermack (1997) and Aboody and Kasznik (2000) document that stock prices tend to be particularly low on days that executives are granted at-the-money stock options. Lie (2005) and Heron and Lie (2007) attribute this tendency to backdating of grants to dates with particularly low stock prices with the objective of enhancing the value of the options. Such backdating was concealed from most shareholders for decades, and is arguably symptomatic of agency conflicts between executives and shareholders. If product market competition alleviates agency problems, as predicted by Hart (1983), we expect import penetration to alleviate backdating of stock option grants among domestic firms.

We obtain executive stock option data from the ExecuComp database and identify at-the-money grants based on the procedure described in Lie (2005). Following Heron and Lie (2007), we classify a grant as scheduled if it occurred within one day of the one-year anniversary of a prior grant date, and unscheduled otherwise. If no grant date information is available for the prior fiscal

year, we exclude that grant from the analysis. We also exclude grants for which we lack surrounding stock price data and grants occurring in months during which the firm's stock went ex-dividend (following Bebchuk, Grinstein, and Peyer (2010)). Following Heron and Lie (2009), we form a backdating dummy that equals one if the executive stock option is unscheduled *and* the return difference is positive. The return difference is $Ret[1,20] - Ret[-19,0]$, where day 0 is the day of the option grant, and $Ret[1,20]$ and $Ret[-19,0]$ are returns from day 1 to day 20 and from day –19 to day 0, respectively. We also construct a dummy, *Post*, that equals one if the grant date is after August 29, 2002, when the Securities and Exchange Commission requirement that option grants must be reported within two business days took effect, thus effectively limiting the gains from backdating.

Table VI reports results from regressions of either the backdating dummy (Panel A) or a dummy for whether grants were scheduled (Panel B) against instrumented import penetration, the post dummy, and an interaction between the two. We view the regressions of the scheduled dummy as complementary to the regressions of the backdating dummy. Heron and Lie (2007) show that there is trivial backdating among scheduled grants. Thus, we conjecture that import penetration reduces the prevalence of backdating, and that this partially results from an increase in the use of scheduled grants.

The results in Panel A suggest that the SEC reporting requirement that took effect in 2002 reduces the probability of backdating, consistent with Heron and Lie (2007). More importantly for the purposes of our study, import penetration also reduces the probability of backdating. The effect is particularly pronounced during the years before 2002, when backdating was more prevalent, with a coefficient of *Import penetration* hovering around –0.5 (p-value < 0.01). But the effect is

even present after the new reporting requirements took effect, with a coefficient a little above –0.3 (the sum of the coefficients of *Import penetration* and *Import penetration* × *Post*).

The results in Panel B suggest that import penetration increases the use of scheduled grants. The effect is most pronounced before the new reporting requirements in 2002, with a coefficient of *Import penetration* a little above 0.6 (p-value < 0.01), and the effect is cut in half after 2002, as indicated by the coefficient on the interaction variable of a little more (in absolute value terms) than –0.3 (p-value < 0.01). Thus, it appears that import penetration increases the use of scheduled grants, which, in turn, accounts for a reduction in backdating.

In sum, our results indicate that greater competition in the form of import penetration constrains firms' tendency to opportunistically time at-the-money option grants via backdating. We view this as evidence that import penetration reduces the ability of executives to extract rents from shareholders.

VI. Import penetration and CEO pay slice

Bebchuk, Cremers, and Peyer (2011) define CEO pay slice as the fraction of aggregate compensation of the top-five executive team that is captured by the CEO. They show that a high CEO pay slice signifies agency problems. On the other hand, Kale, Reis, and Venkateswaran (2009) argue that a high CEO pay slice provides an incentive among the next level of managers to expend greater effort with the goal of being promoted, and this promotion incentive is especially beneficial in the presence of agency problems. Either way, if competition mitigates agency problems and reduces the need for promotion incentives, as in Hart (1983), we conjecture that increased competition reduces the CEO pay slice.

Table VII presents the results of the CEO pay slice regressions. Import penetration has a negative and statically significant effect on CEO pay slice. The effect is also economically meaningful; one standard deviation increase in import penetration reduces the CEO pay slice by about 0.017, representing a 4.5% decline relative to the mean of 0.374. While there is no consensus in the literature for the purpose and implication of a large pay slice, we interpret the negative effect of import penetration on pay slice to mean that import penetration resolves agency problems and reduces the need to use an extra carrot for the top executive team to exert effort.

VII. Import penetration and stock option duration

In Manso's (2011) model, options are more effective in stimulating innovation if they have long vesting periods. Furthermore, Gopalan et al. (2014) and Edmans, Fang, and Lewellen (2017)) show that duration of equity compensation affects earnings management and investment policy. Thus, in our next analysis, we examine the effect of import penetration on compensation duration.

We focus on the duration of stock options for three reasons. First, Manso's (2011) model predicts that options with long vesting schedules stimulate innovation, but his model offers no comparable prediction for restricted stock with long vesting schedules. Second, data on vesting schedules for stock is not generally available during our sample period from 1992 to 2005. Both Gopalan et al. (2014) and Edmans, Fang, and Lewellen (2017) start their sample in 2006 because SEC required firms to disclose the stock vesting schedules starting that year. Third, as our summary statistics show and supported by Murphy (2013), stock options represent by far the largest component of equity compensation during our sample period.

Following Cadman, Rusticus, and Sunder (2013), we merge vesting schedule data in the Thomson Financial database with option grant data in ExecuComp. To ensure high data quality,

we require the total number of underlying shares in the two databases to agree to be included in our analysis. Building on the pay duration definition in Gopalan et al. (2014), we define option duration as

$$Duration = \frac{\sum_{i=1}^{n} Option_i \times t_i}{\sum_{i=1}^{n} Option_i}$$

where $Option_i$ is the value of the stock option grant i and t_i is the vesting period of that option grant and

$$t_i = \frac{\sum_{j=1}^{m} Share_j \times \tau_j}{\sum_{j=1}^{m} Share_j}$$

where $Share_j$ is the number of underlying shares of tranche j of grant i and τ_j is the vesting period of that tranche.

The results in Table VIII show that one standard deviation increase in import penetration increases option duration by about 14%. Combined with the earlier results on stock options, these results suggest that greater import penetration induces firms to escalate the use of long-term options. Based on the model of Manso (2011), the long-term options encourage executives to boost innovation. While the past literature is unsettled on the optimal investment policy in response to intensified competition, some studies, including Arrow (1962), argue that firms should boost innovation to jockey for position in the more competitive product market. Hence, the increase in long-term options can be viewed as an optimal response to the threat posed by overseas competitors.

VIII. CEO stock option and innovation

Our earlier results suggest that import penetration induces greater use of executive stock options. Manso (2011) predicts that such options stimulate innovation. Furthermore, Bloom, Draca, and Van Reenen (2016) and Lie and Yang (2017) find that import penetration prompts more innovation. In this section, we offer ancillary evidence of a more direct link between executive stock options and innovation, albeit in a broader setting than only firms that face import penetration.

An extensive literature examines the effect of executive compensation on corporate risk-taking.[7] Shue and Townsend (2017) point out two main problems with the prior literature. First, executive compensation policy is endogenous. Second, compensation committees typically do not consider delta and vega in isolation. Rather, they consider the amount of stock option grants (along with other compensation components), which contains both delta and vega. Therefore, it is useful to study the overall effect of stock options on risk-taking.

To overcome the endogeneity problem, Shue and Townsend (2017) exploit the institutional features of multi-year compensation plans. One commonly used plan is the fixed-value plan under which an executive receives the same value of options throughout a cycle. But at the beginning of a new cycle, the option value typically increases. Shue and Townsend use the length of an executive's previous cycle to predict the beginning of the next cycle. Thus, the predicted first year of a CEO fixed value cycle serves as the instrumental variable. When regressing the value of the stock option on the indicator that that CEO-year is the predicted first year, the coefficient is highly positive and significant (untabulated), indicating that the relevance criterion of the instrumental variable is satisfied. Because other time-varying factors that affect firm's risk-taking decisions are

[7] See for example, Guay (1999), Coles, Daniel, and Naveen (2006), Chava and Purnanandam (2010), Liu and Mauer (2011), Armstrong and Vashishtha (2012), Hayes, Lemmon, and Qiu (2012), and Gormley, Matsa, and Milbourn (2013).

unlikely to coincide with the beginning of the fixed value cycle, the predicted first year of the fixed value cycle can plausibly generate an exogenous increase in the stock option value. Moreover, the predicted first year is only based on the past information, and therefore unlikely to be related to current investment opportunities. Thus, the exclusion criterion of the instrumental variable should be satisfied. Following the methodology of Shue and Townsend (2017), we identify the fixed value cycles and use the predicted first year of those cycles as our instrumental variable.

We measure innovation based on patents. The patent data come from Kogan et al. (2017). Kogan et al. provide one of the largest publicly available datasets on US patents from 1926 to 2010. They download all US patent data from Google and then carefully clean it. When they apply their techniques to the sample period covered by the NBER patent data, their sample is essentially the same as the NBER data. This external validation shows the high quality of their data and ensures that our patent data is comparable to previous studies using the NBER data. Hall, Jaffe, and Trajtenberg (2005) and Kogan, Papanikolaou, Seru and Stoffman (2017) report that citation-weighted patents have a large impact on the firm's market value. Therefore, we use citation-weighted patents as our primary measure of innovation, similar to Aghion, Van Reenen, and Zingales (2013). That is, we define our citation measure as

$$\text{Citation}_{i,t} = \sum_{j \in P_{i,t}} \left(C_j / \bar{C}_j \right),$$

where $P_{i,t}$ is the set of all patents for which firm i applies (and is eventually granted) in year t, C_j is the number of citations that patent j receives, and $\overline{C_j}$ is the average number of citations received by all patents applied for in year t in the same technological class as C_j. Following Kogan et al. (2017), we scale C_j by $\overline{C_j}$ to mitigate the citation truncation problem (Hall, Jaffe, and Trajtenberg (2000)). The dependent variable is the difference between the natural log of citation in $t + 3$ and

t. Following Atanassov (2013), Aghion, Van Reenen, and Zingales (2013), and Fang, Tian, and Tice (2014), we control for Tobin's Q, Log(Asset), ROA, stock return, and R&D expenditure, firm age, HHI, HHI squared, tangibility, and leverage.

Table IX presents the results from regressions of innovation against instrumented change in the value of CEO stock options. The effect is positive and marginally statistically significant, with a p-value of less than 0.05 when the measure for CEO stock options is based on the largest grants of each year (Panel A) and less than 0.10 when the measure for CEO stock options is based on the all grants in each year (Panel B). While the results are not statistically strong, they suggest that stock options spur innovation. Thus, they also support our interpretation that firms that face greater import penetration grant more executive stock options as part of their competitive strategy to boost innovation.

IX. Import penetration and insider trading

It is possible that import penetration motivates executives to unload their stock and, thus, reduce their delta. To investigate this possibility, we examine insider trading behavior. Using data from Thomson Reuters, we construct four measures of buy ratios:

$$\frac{Buy}{Buy+Sell}, \frac{\#Buy}{\#Buy+\#Sell}, \log\left(1+\frac{Buy}{Buy+Sell}\right), \log\left(1+\frac{\#Buy}{\#Buy+\#Sell}\right)$$

where Buy $(\#Buy)$ is the value (number) of company i's shares bought by insider j in year t, and $Sell$ $(\#Sell)$ is defined similarly. We apply a natural log transformation to reduce the skewness of the variable. Another common measure of insider trading is the net buy ratio (Lakonishok and Lee (2001)), NBR, defined as net buying divided by the sum of buying and selling. Our measure is a monotonic transformation of the net buy ratio. We choose not to use NBR because it sometimes

equals −1, rendering $\log(1 + NBR)$ undefined. Following prior literature (e.g., Cohen, Malloy, and Pomorski (2012)), we focus on the open market purchases and sales, and exclude option exercises and private transactions.

Columns (3) and (4) of Table X show that the one standard deviation increase in import penetration ratio raises the buy ratio by 3%, with a p-value < 0.01. Thus, if anything, import penetration causes executives to buy more shares, and we can rule out the possibility that import penetration reduces delta through managers unloading their shares.

X. Conclusion

We study the empirical effects of competition on executive compensation. To do so, we examine the effect of Chinese import penetration on multiple dimensions of executive compensation for US firms. Our setting allows for strong identification, because Chinese import penetration increases dramatically during our sample period, varies greatly across industries, and is arguable exogenous to US firms. In addition, we can instrument for Chinese import penetration in the US using Chinese import penetration in other high-income countries.

One set of our results is consistent with Hart (1983)'s prediction that product market competition serves to alleviate agency problems, thus reducing (i) the ability of executives to extract excess compensation and related rents and (ii) the need for traditional incentive alignment. First, we show that import penetration reduces total compensation, bonuses, stock grant values, and delta, which indicates that excess compensation recedes and incentive alignment via both bonuses and stock (and, correspondingly, delta) moderates. Second, import penetration reduces the prevalence of stock option backdating that is designed to extract rents for executives. Third,

import penetration flattens the pay structure among top executives, thus reducing the incentives to exert effort to be promoted to CEO.

Another set of results suggests that firms respond to import penetration by incentivizing executives to boost innovation. In particular, Manso (2011) builds a model in which the optimal contract to motivate innovation includes long-term options (but no stock). We do indeed find that import penetration increases stock option grant values, vega, and stock option duration. In an ancillary analysis, we employ the identification strategy in Shue and Townsend (2017) to show that more option grants spur more innovation.

Overall, we interpret our results as evidence that the increased competition from import penetration reduces agency conflicts between executives and shareholders and prompts firms to position themselves for more innovation. The primary consequences for compensation policy include leaner compensation levels and a shift away from bonuses and stock toward long-term stock options.

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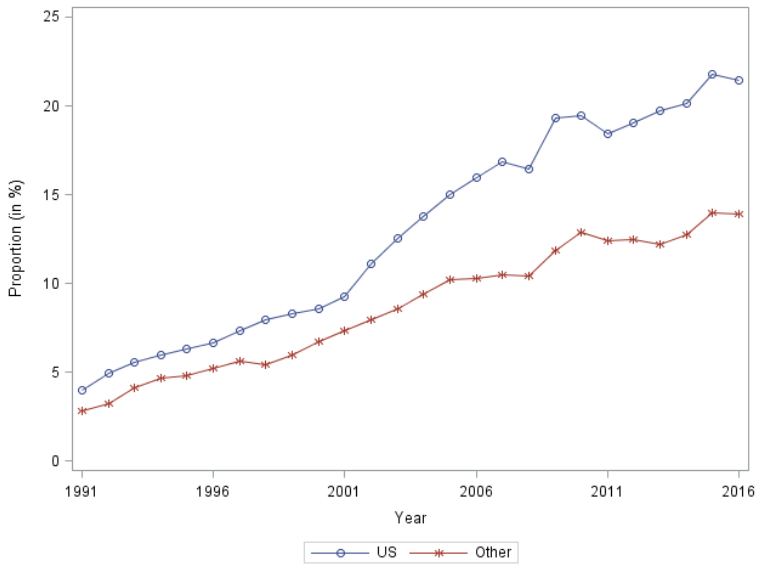

Figure 1. The proportion of imports from China

The figure shows the imports of US and other high-income countries (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland) from China as a proportion of their respective imports from the world between 1991 and 2016.

Table I: Sample statistics

The table presents summary statistics for the sample of the US manufacturing executive-firm-years from 1992 to 2005. Total compensation consists of salary, bonus, restricted stock grant value, stock option grant value (using the Black-Scholes formula), long-term incentive payouts, and other compensation. Delta is the dollar change in executives' wealth for a 1% change in stock price. Vega is the dollar change in executives' wealth for a 0.01 change in standard deviation of returns. Import penetration is the (SIC three-digit) industry's imports from China divided by the year 1991 initial absorption (measured as industry shipments plus industry net imports). Other import penetration is imports from China in the (SIC three-digit) industry across eight other high-income countries divided by the initial absorption in the industry in 1991. These high-income countries are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. Tobin's Q is the market value of assets (the book value of assets less the book value of equity plus the market value of equity) divided by the book value of assets. Assets are total book value of assets. Sales is net sales. ROA is the ratio of the firm's net income to total assets. Stock return is the annual stock return. All variables are winsorized at the first and 99th percentiles.

	Mean	Median	Standard Deviation
Total compensation ($ thousand)	1,678	833	2,608
Salary ($ thousand)	324	266	207
Bonus ($ thousand)	233	120	348
Stock grant ($ thousand)	95	0	367
Stock option grant ($ thousand)	873	133	2,369
Delta ($ thousand)	185	45	456
Vega ($ thousand)	41	12	87
Import penetration	0.04	0.01	0.09
Other import penetration	0.03	0.01	0.05
Tobin's Q	2.23	1.69	1.69
Asset ($ million)	3,389	860	7,559
ROA	0.03	0.05	0.13
Stock return	0.19	0.10	0.63

Table II: The effect of import competition measures on sales

The table presents the effect of various import competition measures, including import penetration, tariffs, and a tariff cut dummy, on sales. We control for Log(Assets) in column (1). In addition to the regressors in column (1), we control for Tobin's Q, and leverage in column (2), tangibility in (3), investment in (4), and selling expense in (5). Column (6) includes all the control variables in columns (1) through (5). Leverage is the book value of total debt divided by total assets. Tangibility is computed as (0.715 × Accounts Receivables + 0.547 × Inventory + 0.535 × Fixed Capital) / (Total Assets). Investment is capital expenditure over assets. Selling expense is the ratio of advertising and selling expenses to total sales. For each three-digit SIC industry-year, the tariff rate is equal to the duties collected by US customs divided by the free-on-board value of imports. The tariff cut dummy is set to one for the first three years after an industry has experienced a tariff rate reduction that is larger than three times the median tariff rate reduction in the same industry and zero otherwise. We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. To facilitate interpretation, import penetration and tariff are standardized to have standard deviation equal to one. The regressions in Panel A are estimated with 2SLS, while those in Panels B and C are estimated with OLS. All regressions include firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Log(1+Sales)			
Import penetration	–0.037***	–0.035***	–0.036***	–0.033***	–0.037***	–0.031***
	(–3.68)	(–3.51)	(–3.59)	(–3.36)	(–3.66)	(–3.10)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	35,317	35,115	35,317	34,800	35,317	34,645
R-squared	0.978	0.978	0.978	0.978	0.978	0.979
			Panel B: Log(1+Sales)			
Tariff	–0.040***	–0.038***	–0.037***	–0.046***	–0.040***	–0.040***
	(–2.92)	(–2.85)	(–2.73)	(–3.30)	(–2.92)	(–2.95)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	35,465	35,262	35,465	34,948	35,465	34,792
R-squared	0.978	0.978	0.978	0.978	0.978	0.978
			Panel C: Log(1+Sales)			
Tariff cut dummy	–0.008	–0.007	–0.006	–0.007	–0.008	–0.006
	(–0.77)	(–0.68)	(–0.63)	(–0.66)	(–0.79)	(–0.60)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	35,465	35,262	35,465	34,948	35,465	34,792
R-squared	0.978	0.978	0.978	0.978	0.978	0.978

Table III: The effect of import penetration on total pay, salary, and bonus

The table presents the effect of import penetration on total pay, salary, and bonuses of executives in the manufacturing industry. We control for Log(Assets), ROA, and CEO dummy in column (1). In addition to the regressors in column (1), we control for Tobin's Q in column (2), Log(sales) in (3), stock return in (4), and HHI and HHI squared in (5). Column (6) includes all the control variables in columns (1) through (5). The CEO dummy is equal to one if the executive is the CEO, and zero otherwise. We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. To facilitate interpretation, import penetration is standardized to have standard deviation equal to one. All regressions are estimated through 2SLS and include executive-firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the executive-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Log(1+Total pay)						
Import penetration	–0.099***	–0.078***	–0.094***	–0.096***	–0.096***	–0.074***
	(–6.33)	(–5.22)	(–6.05)	(–6.15)	(–6.18)	(–4.91)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49,858	49,837	49,858	49,281	49,858	49,260
R-squared	0.800	0.806	0.801	0.802	0.801	0.807
Panel B: Log(1+Salary)						
Import penetration	–0.007	–0.007	–0.005	–0.007	–0.005	–0.003
	(–0.79)	(–0.81)	(–0.53)	(–0.82)	(–0.53)	(–0.30)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	61,464	61,443	61,464	60,773	61,464	60,752
R-squared	0.827	0.827	0.827	0.826	0.827	0.827
Panel C: Log(1+Bonus)						
Import penetration	–0.125***	–0.080**	–0.099**	–0.092**	–0.123***	–0.079**
	(–3.17)	(–2.05)	(–2.56)	(–2.37)	(–3.12)	(–2.03)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	61,464	61,443	61,464	60,773	61,464	60,752
R-squared	0.560	0.565	0.563	0.572	0.560	0.573

Table IV: The effect of import penetration on stock and option grants

The table presents the effect of import penetration on stock grants and stock option grants of executives in the manufacturing industry. We control for Log(Assets), ROA, and CEO dummy in column (1). In addition to the regressors in column (1), we control for Tobin's Q in column (2), Log(sales) in (3), stock return in (4), and HHI and HHI squared in (5). Column (6) includes all the control variables in columns (1) through (5). The CEO dummy is equal to one if the executive is the CEO, and zero otherwise. We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. To facilitate interpretation, import penetration is standardized to have standard deviation equal to one. All regressions are estimated through 2SLS and include executive-firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the executive-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Log(1+Stock award)						
Import penetration	–0.116***	–0.116***	–0.109**	–0.109**	–0.110**	–0.102**
	(–2.65)	(–2.65)	(–2.49)	(–2.48)	(–2.50)	(–2.31)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	61,464	61,443	61,464	60,773	61,464	60,752
R-squared	0.550	0.550	0.550	0.551	0.550	0.551
Panel B: Log(1+Option)						
Import penetration	0.160**	0.208***	0.161**	0.174**	0.167***	0.201***
	(2.37)	(3.07)	(2.37)	(2.56)	(2.68)	(2.97)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	61,187	61,166	61,187	60,525	61,187	60,504
R-squared	0.440	0.442	0.440	0.444	0.440	0.446

Table V: The effect of import penetration on delta and vega

The table presents the effect of import penetration on deltas and vegas of portfolios of executives in the manufacturing industry. We control for Log(Assets), ROA, and CEO dummy in column (1). In addition to the regressors in column (1), we control for Tobin's Q in column (2), Log(sales) in (3), stock return in (4), and HHI and HHI squared in (5). Column (6) includes all the control variables in columns (1) through (5). The CEO dummy is equal to one if the executive is the CEO, and zero otherwise. We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. To facilitate interpretation, import penetration is standardized to have standard deviation equal to one. All regressions are estimated through 2SLS and include executive-firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the executive-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Log(1+Delta)						
Import penetration	–0.158***	–0.099***	–0.158***	–0.131***	–0.156***	–0.099***
	(–6.80)	(–4.92)	(–6.80)	(–5.99)	(–6.71)	(–4.92)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	42,860	42,841	42,860	42,413	42,860	42,394
R-squared	0.901	0.920	0.901	0.915	0.902	0.923
Panel B: Log(1+Vega)						
Import penetration	0.057**	0.068***	0.057**	0.061***	0.059***	0.073***
	(2.47)	(2.94)	(2.48)	(2.64)	(2.60)	(3.18)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,390	46,370	46,390	45,913	46,390	45,893
R-squared	0.865	0.866	0.865	0.865	0.865	0.866

Table VI: Import penetration and backdating

The table presents the effect of import penetration on the backdating of the executive stock options. Backdating dummy is equal to one if the executive stock option is unscheduled *and* the return difference is positive. We define the return difference as $Ret[1,20] - Ret[-19,0]$, where day 0 is the day of the option grant and $Ret[1,20]$ and $Ret[-19,0]$ are returns from day 1 to 20, and day –19 to 0, respectively. Post is equal to one if the grant date is after August 29, 2002, when the Securities and Exchange Commission requirement that option grants must be reported within two business days took effect. The schedule dummy is set to one if an option grant was awarded on the same date plus/minus one day in the preceding year. We control for Tobin's Q, Log(Asset), ROA, and CEO dummy in column (1) and (2). In addition to regressors column (1), we control for log(sales) and stock return in (3) and (4), and log(sales), stock return, HHI, HHI squared in (5) and (6). We instrument for Chinese import penetration in the US with other import penetration (Chinese import penetration in other high-income countries), and import penetration × Post with other import penetration × Post. All regressions are estimated through 2SLS and include executive-firm fixed effects. *t*-statistics based on standard errors clustered at the executive-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Backdating dummy						
Import penetration	–0.434**	–0.476***	–0.477***	–0.525***	–0.443**	–0.485***
	(–2.41)	(–2.78)	(–2.63)	(–3.04)	(–2.43)	(–2.81)
Import penetration × Post	0.126	0.133	0.162*	0.167*	0.149	0.153*
	(1.37)	(1.46)	(1.75)	(1.81)	(1.61)	(1.67)
Post	–0.056***	–0.060***	–0.057***	–0.059***	–0.057***	–0.056***
	(–2.90)	(–5.60)	(–2.92)	(–5.34)	(–2.92)	(–5.12)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
Observations	43,272	43,272	43,149	43,149	43,149	43,149
R-squared	0.361	0.359	0.361	0.359	0.362	0.360
Panel B: Schedule dummy						
Import penetration	0.632***	0.641***	0.633***	0.618***	0.631***	0.609***
	(3.27)	(3.58)	(3.28)	(3.45)	(3.26)	(3.38)
Import penetration × Post	–0.323***	–0.375***	–0.327***	–0.372***	–0.315***	–0.362***
	(–3.25)	(–3.74)	(–3.30)	(–3.74)	(–3.21)	(–3.66)
Post	–0.002	0.056***	0.000	0.058***	–0.001	0.056***
	(–0.11)	(5.23)	(0.01)	(5.30)	(–0.03)	(5.13)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No
Observations	43,272	43,272	43,149	43,149	43,149	43,149
R-squared	0.408	0.404	0.409	0.405	0.410	0.405

Table VII: Import penetration and CEO pay slice

The table presents the effect of import penetration on CEO pay slice. CEO pay slice is defined as the fraction of the aggregate compensation of the top-five executive team captured by the CEO. We control for Log(Assets) and ROA, in column (1). In addition to the regressors in column (1), we control for Tobin's Q in column (2), Log(sales) in (3), stock return in (4), and HHI and HHI squared in (5). Column (6) includes all the control variables in columns (1) through (5). We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. To facilitate interpretation, import penetration is standardized to have standard deviation equal to one. All regressions are estimated through 2SLS and include executive-firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the executive-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	CEO pay slice					
	(1)	(2)	(3)	(4)	(5)	(6)
Import penetration	–0.018***	–0.016***	–0.018***	–0.017***	–0.019***	–0.017***
	(–3.01)	(–2.69)	(–3.10)	(–2.89)	(–3.21)	(–2.96)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,782	7,780	7,782	7,705	7,782	7,703
R-squared	0.518	0.519	0.518	0.521	0.518	0.522

Table VIII: Import penetration and stock option duration

The table presents the effect of import penetration on the duration of executive stock options. The dependent variable is the natural logarithm of one plus the stock option duration. We instrument for import penetration in the US with other import penetration. We control for Log(Assets) and ROA, in column (1). In addition to the regressors in column (1), we control for Tobin's Q in column (2), Log(sales) in (3), stock return in (4), and HHI and HHI squared in (5). Column (6) includes all the control variables in columns (1) through (5). To facilitate interpretation, import penetration is standardized to have standard deviation equal to one. We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. All regressions are estimated through 2SLS and include executive-firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the executive-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Log(1+Duration)					
	(1)	(2)	(3)	(4)	(5)	(6)
Import penetration	0.142***	0.144***	0.143***	0.143***	0.145***	0.148***
	(2.90)	(2.91)	(2.92)	(2.89)	(2.91)	(2.91)
Executive-firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,002	12,997	13,002	12,875	13,002	12,870
R-squared	0.626	0.626	0.626	0.628	0.626	0.628

Table IX: CEO stock options and innovation

The table presents the effect of CEO stock options on innovation. Citation is the firm's total number of scaled citations received on firm's patents filed (and eventually granted) in year *t*, where the scaled citation is a patent's number of citations divided by the average number of citations received by all patents applied for in year *t* in the same technological class. The dependent variable is the difference between the natural log of citation in $t+3$ and *t*. CEO stock option is defined as either the value of the largest option grant during the fiscal year (Panel A) or the total value of the option grants during the fiscal year (Panel B), and it is measured as the difference between the natural log values in t and $t-1$. We control for Tobin's Q, Log(Asset), ROA, stock return, and R&D expenditure in column (1). In addition to column (1), we control for firm age in columns (2), HHI, HHI squared in (3), tangibility in (4), and leverage in (5). Columns (6) includes all the control variables in columns (1) through (5). We instrument for the change in the CEO stock option grant with the dummy variable that year *t* is the predicted first year in the fixed-value option grant cycle. All regressions are estimated through 2SLS and include CEO-firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the CEO-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: ΔLog(Innovation)						
ΔLog(CEO option)	0.154**	0.159**	0.154**	0.147**	0.161**	0.158**
	(2.11)	(2.15)	(2.12)	(2.05)	(2.17)	(2.17)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,822	1,817	1,822	1,822	1,822	1,817
R-squared	0.475	0.471	0.476	0.482	0.470	0.476
Panel B: ΔLog(Innovation)						
ΔLog(CEO option)	0.268*	0.277*	0.269*	0.261*	0.276*	0.278*
	(1.79)	(1.81)	(1.79)	(1.76)	(1.83)	(1.83)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,805	1,800	1,805	1,805	1,805	1,800
R-squared	0.309	0.295	0.310	0.322	0.297	0.296

Table X: Import penetration and insider trading

The table presents the effect of import penetration on insider trading. Insider trading is measured by the value of the company's shares bought (sold) during the fiscal year, Buy (Sell), and the number of the company's shares bought (sold) during the fiscal year, #Buy (#Sell). We control for Tobin's Q, Log(Assets), ROA, stock return, and idiosyncratic volatility. We instrument for Chinese import penetration in the US with Chinese import penetration in other high-income countries. To facilitate interpretation, import penetration is standardized to have standard deviation of one. All regressions are estimated through 2SLS and include insider-firm fixed effects and year fixed effects. *t*-statistics based on standard errors clustered at the insider-firm level are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1) Buy/(Buy+Sell)	(2) #Buy/(#Buy+#Sell)	(3) Log(1+Buy/(Buy+Sell))	(4) Log(1+#Buy/(#Buy+#Sell))
Import penetration	0.043***	0.043***	0.030***	0.030***
	(6.54)	(6.61)	(6.54)	(6.61)
Executive-firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	71,926	72,009	71,926	72,009
R-squared	0.715	0.715	0.716	0.716