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EXECUTIVE COMPENSATION:
SIX QUESTIONS THAT NEED ANSWERING

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ABSTRACT

In this article, we focus on how recent research advances can be used to address the following six questions: (1) How much does executive compensation cost the firm? (2) How much is executive compensation worth to the recipient? (3) How well does executive compensation work? (4) What are the effects of executive compensation? (5) How much executive compensation is enough? (6) Could executive compensation be improved? We stress the formal link between executive pay and performance that is provided by stock options and equivalent forms of long term compensation. We compare executive compensation in 12 OECD countries for the period from 1984-1996. There are good reasons why the answers to the first two questions are different. Executive compensation research should be very careful to distinguish the concepts of employer cost and the value to the executive. Agency theory remains the only viable candidate for answering the question about how executive compensation works but the empirical research to date cannot explain very much about the structure of the optimal contract. For this reason, it is also hard to answer the questions about the effects of executive compensation and the adequacy of the amounts of executive compensation, although it is clear that companies can provide both too little and too much contingent compensation, in the context of agency theory. We suggest two fertile areas for research regarding the improvement of executive compensation.

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Introduction to Executive Compensation

The big news this year isn't in the big numbers—it's in the fine print. Buried in the latest pay contracts chief executives are signing and the lists of stock-options they're salting away in the wall safe are the auguries and portents of things to come. (*Business Week*, April 24, 1995, pp. 88.)

As the quotation above suggests, there is a growing realization by the popular business press that a proper analysis of stock and option holdings is crucial to understanding US executive compensation practices. The academic economics literature has also come to this conclusion, although only very recently. Despite being in its infancy, the economics literature on the effects of stock and options holdings has already yielded large dividends, and has the potential for much more.

In this article, we focus on how this recent advance can be used to address the following six questions:

1. How much does executive compensation cost the firm?
2. How much is executive compensation worth to the recipient?
3. How well does executive compensation work?
4. What are the effects of executive compensation?
5. How much executive compensation is enough?
6. Could executive compensation be improved?

Murphy (1999) reviews the extensive research on executive compensation. In this article, we consider, instead, some of the implications of that research and some important directions for future research. We begin by noting how US CEO compensation policies compare with other OECD countries. Figure 1 shows an international comparison of the importance of some of the major components of CEO compensation from 1984-1996, based on data from 12 OECD countries. Figure 2 shows the analogous comparison for human resource directors. The components are salary, annual bonus, benefits (including pension), and long-term compensation. The methodology used to construct the chart is the same as Abowd and Bognanno (1995), and relies on publicly available data from various governmental statistical agencies, Towers Perrin, a compensation consulting firm, and other private companies. The estimates shown are for the domestic national CEO of a company incorporated in the indicated country with \$200-500 million in annual sales (1990 dollars).¹ Salary is defined as cash compensation that is determined

¹ Our comparative data come from a variety of sources, which target different size companies in the individual countries. To make the sources comparable, Abowd and Bognanno regression adjusted the compensation data so that the size of the reference company was 200-500 million 1990 dollars. We note that it is difficult to get

at the beginning of an annual pay cycle. Annual bonus is defined as cash compensation that is determined at the end of an annual pay cycle and is based on only one-year's worth of performance information. Benefits are the company's cost to provide retirement income, health care, and other services, evaluated on an annualized basis. Long-term compensation is the annualized present value of any cash, or cash-equivalent compensation that is based on outcomes measured over periods longer than one year.² The data in this, and subsequent figures, have been updated for this paper and are available from the authors on request or from the web site mentioned in the acknowledgements.

Not surprisingly, figure 1 shows that US CEOs receive compensation levels that appear out of line with the other OECD countries, although figure 2 shows that this is not the case for human resource directors.³ We will see, however, that the high compensation received by US CEOs is composed of several complex instruments that require a more detailed analysis in order to understand US compensation systems.

Although figure 1 shows that US CEOs receive higher levels of pay than those in other OECD countries, comparisons along other dimensions are also useful. Kaplan (1994) compares Japanese management practices to those in the US. He finds that the sensitivities of cash compensation and probability of turnover to market returns are not statistically different across the two countries. One difference is that financial institutions take a more active role in corporate governance in Japan, particularly following negative earnings. This may explain why turnover and compensation are more responsive to negative earnings in Japan. Rather than relying on monitoring from the board of directors, the interests of US CEOs and shareholders are aligned through higher stock ownership. Overall, however, Kaplan's conclusion is that the US and Japanese systems are quite similar.

The Basic Structure of Contingent Executive Compensation

The system has doled out rich rewards—but it can and does impose hefty penalties on those who don't perform. More than ever, the boss is likely to lose his job and his perks when he doesn't deliver the profits shareholders expect. (*Business Week*, April 22, 1996, pp. 102.)

comparative data for native executives (not foreign nationals) when one looks at very large companies because there are relatively few of them in most OECD countries.

² Long-term compensation includes stock options (the right to purchase company stock at a given price), restricted stock (stock that cannot be sold for some specified period of time), performance share plans (formula-based stock compensation), and cash equivalents of all of the above.

³ A figure showing that US manufacturing operatives receive compensation levels similar to those in other OECD countries is included in this working paper and on the web site mentioned in the acknowledgements. Figures that use real exchange rates rather than purchasing power parity rates are also included in this working paper. Real exchange rates are useful to compare differences in employer costs across countries. See the supplementary figures in the Data Appendix to this working paper.

Most of the early economics literature focused on attempts to model the level and structure of compensation. Unfortunately, data constraints prevented the detailed analyses of stock and option holdings that have recently proved so useful. The first puzzle for the literature was explaining why firm size appeared quite important in explaining cross-sectional variability in compensation, while firm profitability appeared insignificant. Ciscel (1974) noted this fact and Ciscel and Carroll (1980) hypothesized that the growth of firm size was an important method for the CEO to increase profitability, so rewards for increasing size might be consistent with neoclassical theory.

Murphy (1985) made great strides in assessing the incentives provided to executives by using a panel of firms. He noted that compensation equations estimated on cross-sectional data look quite different from those that controlled for fixed firm effects. Large firms tend to exhibit lower rates of return, while paying their executives more than their smaller counterparts. He showed that firm performance, as measured by the realized shareholder return, is strongly and positively correlated with managerial remuneration in specifications that controlled for firm effects. He noted, however, that growth of firm sales is also strongly related to managerial remuneration. Coughlan and Schmidt (1985) showed that termination decisions are affected by the firm's stock market performance, while Deckop (1988) documented that CEO compensation is positively related to firm profits as a percentage of sales.

Having established the strong statistical link between executive compensation and firm performance, the literature attempted to assess the magnitude and importance of this link. The seminal article in this line of inquiry is Jensen and Murphy (1990a), which reported a weak alignment between shareholder interests and managerial incentives. They estimated that CEO wealth changes \$3.25 for every \$1,000 change in shareholder wealth, primarily due to the fact that the median value for CEO stock holdings as a fraction of shares outstanding was 0.0025 in 1987, the only year for which they collected stock-holdings data from proxy statements. Stock held by family members and shares held as options exercisable within 60 days were treated identically to shares owned by the CEO. The remaining \$0.75 came from the sum of average pay-for-performance sensitivities arising from cash compensation, stock-option grants, and threat of dismissal, which were all estimated with data from the *Forbes* annual surveys of CEO compensation. They concluded that CEO compensation policies provided incentives that were too weak to be consistent with agency theory. Haubrich (1994), however, showed through calibrations of agency models that such low levels of alignment are reconcilable with agency theory given reasonable values for CEO risk-aversion parameters. That is, even low levels of alignment impose significant wealth risk on CEOs, so it is not clear that efficiency would be enhanced by increasing alignment.

Recently, Hall and Liebman (1998) introduced a great technical innovation in the study of the sensitivity of executive compensation to changes in shareholder wealth. Using the entire portfolio of long-term compensation—new awards plus the change in the market value of options and stock already awarded, they found that CEO wealth changes are significantly larger than those reported by Jensen and Murphy. They estimate that, in 1994, the mean (respectively, median) sensitivity of CEO wealth to firm performance is about \$25.11 (\$5.29) for every \$1,000 change in shareholder wealth. Changes in the value of stock-option holdings, which were not included in the Jensen and Murphy estimate, account for \$3.66 (\$2.15) of this figure. While Hall

and Liebman note that their estimate of the slope of CEO compensation contracts is quite far from a benchmark of perfect alignment (which would provide first-best incentives), they do show through simulations that their estimated level of incentive alignment imposes enormous lifetime consumption risk on CEOs. This is essentially the same argument Haubrich used to reconcile agency theory with the data, although Hall and Liebman make this point using a less structural approach.

As Hall and Liebman demonstrated, examining the annual surveys of executive pay in *Business Week* or *Forbes* cannot provide the information required for analyzing executive compensation policies. One needs to examine holdings of restricted stock and stock options in order to address the six questions we consider. Since this is a relatively new innovation for the literature, we will focus much of our paper on these issues. To begin this analysis we briefly review option-pricing theory; then, we show the relation between the option pricing hedge ratio and the slope of the incentive compensation (pay-for-performance) relation.

Starting with the basics, a typical call option used in a compensation system allows an executive to purchase a specified number of shares of stock at a fixed exercise price, K . Typically, options granted to US executives have maturity dates of five to ten years; that is, the right to purchase the stock at the fixed price expires five to ten years after the grant date. The option contracts are written to allow the executives the right to exercise before the option matures (American-style calls). Usually, there are some formal restrictions on early exercise during the first few years of the option's life (vesting restrictions). Once the options are fully vested, less formal mechanisms discourage, but don't eliminate, early exercise. From the vantage point of option pricing theory, which we apply below, it is rarely a wealth maximizing strategy to exercise these options before maturity.

While the Black-Scholes (1973) formula is the most famous tool used for valuing stock options, the formula is only accurate when the wealth-maximizing exercise strategy is to hold the options until the expiration date. Since it is well known that the presence of dividends can make early exercise optimal, we choose to present the binomial pricing formula instead. Unfortunately this methodology does not yield a closed-form solution, although it can be understood using simple dynamic programming concepts. We provide an introduction to the binomial option-pricing model in the mathematical appendix, which we summarize below.

The basic insight of option pricing theory is straightforward. Suppose an investor wants to replicate the payoff of a call option that is held beyond the current period. As we discuss in some detail in the appendix, this can be accomplished with a purchase of Δ shares of stock, which is partially financed by borrowing B dollars at the riskless interest rate.⁴ As the stock price (P) changes over time, the investor need only manage this hedge portfolio by adjusting Δ and B , without adding funds or taking funds out, to replicate the payoff of the option. Assuming the option is held beyond the current period, the value of the option at any date must equal the value of the hedge portfolio at that date because the cash flows for the two assets are identical at

⁴ Since the investor borrows money, $-B$ always enters the formulas.

all dates, by construction. Of course, the option may be exercised in the current period, which yields a payoff of $P - K$. Combining these two cases yields the following expression for the value of the option:

$$C = \max[P - K, P\Delta - B].$$

More importantly for our purposes, Δ , which is commonly called the hedge ratio, measures the degree to which the option-holder's wealth is affected by dollar changes in stock price. The hedge ratio is the number of shares of the underlying stock held in the hedge portfolio per option. Hence, the hedge ratio is the derivative of the call value with respect to the price of the underlying security

$$\frac{\partial C(P, K, T)}{\partial P} = \Delta(P, K, T),$$

where T is the time to maturity. See Cox and Rubinstein (1985) for details. We now show that the key design parameters in the compensation contract from an agency-theoretic point of view, the expected total compensation and the slope of expected compensation with respect to a change in the price of the firm's common stock, can be directly modeled using the riskless hedge call valuation method.

First we need to establish some notation. We will consider an executive's compensation over three periods; let 0 denote the initial period and 1 and 2 denote the subsequent compensation periods. All subscripts denote the compensation period. We focus on an executive who has been employed by the firm in periods 0 and 1, and will be employed by the firm in period 2 with probability $p(P_2)$, where P_2 denotes the stock price in period 2.

Denote $E[V_2(P_2)|P_2]$ as the expected value of period 2 compensation, conditional on P_2 . Virtually all of the empirical analyses of executive compensation discussed in this article or in Murphy (1999) can be interpreted as estimates of

$$\frac{\partial E[V_2(P_2)|P_2]}{\partial P_2} \text{ or } \frac{\partial E[\ln V_2(P_2)|P_2]}{\partial \ln P_2}.$$

We need more notation before proceeding. Denote S_t as base salary, F_t as the cost of the benefit package, and N_t as the number of options granted; assume all three depend on P_t . Also denote S_t^A as the compensation the executive receives if employed outside the firm and assume that S_t^A does not depend on P_t .

Straightforward application of the call valuation arguments we made above, combined with the results in the appendix, yields the following expression:

$$\begin{aligned}
\frac{\partial E[V_2(P_2)|P_2]}{\partial P_2} &= \mathbf{p}(P_2) \left(\begin{array}{l} \frac{\partial S_2}{\partial P_2} + \frac{\partial F_2}{\partial P_2} + \frac{\partial N_2}{\partial P_2} C(P_2, K_2, T) \\ + N_2 \Delta(P_2, K_2, T) + N_1 \Delta(P_2, K_1, T-1) \\ + N_0 \Delta(P_2, K_0, T-2) \end{array} \right) \\
+ \frac{\partial \mathbf{p}(P_2)}{\partial P_2} &\left(\begin{array}{l} S_2 + F_2 + N_2 C(P_2, K_2, T) \\ + N_1 (C(P_2, K_1, T-1) - C(P_1, K_1, T)) \\ + N_0 (C(P_2, K_0, T-2) - C(P_1, K_1, T-1)) \\ - S_2^A \end{array} \right)
\end{aligned} \tag{1}$$

While statistical analysis may be the only method of estimating certain parts of equation (1), like $\partial S_2/\partial P_2$, other parts of the equation, like N_j, K_j , and Δ are data—parts of the compensation system design. Unfortunately, most companies do not keep track of these parameters, even when they use riskless hedge methods to compute the cost of their compensation systems. Companies do keep data on certain design features—long-term compensation eligibility, long-term compensation to salary ratio, grant size, etc.—but these are only crudely related to the slope of expected total compensation with respect to the stock price. Thus, the primary challenge in uncovering the true links between pay and performance, and the reason the Hall and Liebman data set on stock and option holdings is so valuable, is the problem of estimating the derivative in equation (1) using as much data from the executive’s actual compensation package as possible.

Core and Guay (1998) address this challenge by introducing an inexpensive algorithm for estimating the sensitivity of options to stock price (Δ), volatility, and dividend changes using information available from individual proxies or from the data in Compustat’s Execucomp. The correlation between their estimate of Δ and Δ itself is over 0.99 in their sample, indicating that their methodology could be a powerful tool for future research.

Note that that restricted stock be can be trivially analyzed in this framework. Restricted stock can be viewed as an option to purchase stock at an exercise price of zero, which generates a hedge ratio of one. Since recent empirical work has demonstrated that the vast majority of the link between shareholder and executive wealth comes from stock and stock-option holdings, we are now armed with a methodology useful for examining our six questions.

Our discussion below will focus on the role of agency theory, which predicts that stock-based compensation will align executive and shareholder interests by linking the executive’s compensation directly to increases in the market value of the company. Less risk-averse executives require less expected total compensation as the slope of the compensation/stock price relation increases. Agency theory is really the only viable candidate for a theoretical framework because it is the only model that predicts that the answer to the first two questions we posed in the introduction (cost to the company vs. value to the executive) will be different.

Risk aversion plays no role in option-pricing theory since the risk generated by an option can be eliminated with a hedge portfolio. Agency theory, however, predicts that the employer must prevent this hedging by the employee; hedging unravels the incentive effects of the option. A risk-averse employee will therefore value the option below its market price. This wedge between employer cost and employee value can only be optimal if the firm receives a productivity benefit from the option grant, since the firm must incur higher costs to retain the employee.

Question 1: How much does executive compensation cost the firm?

The staggering rise in pay for the good, the bad, and the indifferent has left even some advocates of pay for performance wondering whether the balance between the CEO and the shareholder is tilting the wrong way. (*Business Week*, April 21, 1997, pp. 62)

The analysis of the cost of executive compensation centers on the opportunity cost to the company of the stock and performance-based components. The cost to the company is the foregone resources represented by the compensation contract. To estimate the amount of these foregone resources we use the riskless hedge argument discussed above: if the executive follows a wealth maximizing strategy, then the cost of the call option cannot exceed the cost of creating the hedge portfolio that exactly offsets the cash flows of the executive's option portfolio. With a constant dividend yield, the binomial approximation to the riskless hedge provides a reliable estimate of this cost.

Figure 3 shows estimates of the cost of the 1996 compensation for the CEOs of the S&P 500 companies (Source: Compustat Execucomp, N=496). As can be clearly seen, the values of the long-term components (options, restricted stock and performance plans) greatly exceed the other components. These estimates do not include the change in the value of the executive's previously awarded stock and stock options. Changes in the value of stock and option holdings are not relevant in this section since we are considering the cost of creating the hedge portfolio at the grant date.

There are some conventional problems associated with this method of determining the cost of executive options. One important problem is that executives exercise the options early (before the wealth-maximizing date). In this case, the binomial pricing model will lead us to overstate the cost of the option grants to the firm. To see this, suppose that the firm, anticipating that it will be forced to pay the executive when he exercises his stock options, decides to create the hedge portfolio prescribed by the binomial pricing model. This method requires an initial purchase of company stock and borrowing riskless bonds at the option grant date. Appropriate management of this fund, adjusting the stock holdings and riskless borrowing at frequent intervals, will result in the hedge portfolio having the exactly the same value as the executives' option holdings, assuming optimal exercise behavior. If the executive exercises the option prematurely, we know that the value of the option and, hence, the value of the hedge portfolio will both exceed $P - K$, which is what the executive receives. The firm can therefore liquidate the hedge portfolio, pay the executive the amount due at early exercise, and have something left over. Premature exercise therefore reduces the cost of writing the option below that of creating

the hedge portfolio, making the riskless hedge valuation procedure an overestimate of employer cost.

There are other conventional valuation problems. Interest rate and dividend yield variation are not priced by the conventional riskless hedge portfolio. Long-term volatility rather than short-term matters. Finally, the exercise restrictions and vesting of the stock-based compensation are not reflected in conventional riskless hedge pricing models.

Some of these problems can be addressed. Statistically, we need information on the actual cash payoffs and exercise dates from a representative sample of executives. If the executives are exercising earlier than the wealth-maximizing date, then properly constructed hedge portfolios should accumulate cash, providing an estimate of the difference between actual employer cost and the cost of the hedge portfolio. If deviations from the constant volatility, dividend yield and risk-free interest rate assumptions are important, the error in the hedge portfolios should be significant relative to the cash flows on the options themselves, indicating that more complicated hedging strategies would be warranted.

There are also some rather unusual problems in applying option pricing models to estimate the cost of executive compensation. The binomial pricing model assumes that the exercise of the option and the creation of the hedge portfolio both have no effect on share price. Typically, in markets with many small players, this is a reasonable assumption. If one of these small players, however, is a top executive in the company, the market might anticipate the incentive effects of his holdings, resulting in a shift of the probability distribution of returns.

An area of compensation research that may grow in importance tries to refine methods for estimating the cost of executive stock options. A good example of this type of research is Cuny and Jorion (1995) who note that executive departure typically forces an early exercise of options. They show that properly accounting for the fact that departure is more likely following poor firm performance is important for obtaining reliable estimates of option costs. A related study by Saly (1994) uses a model where stock-option plans are renegotiated after market downturns. Saly's empirical results were consistent with the hypothesis that option plans were renegotiated after the market crash of 1987, *i.e.*, post-crash option grants were significantly larger than pre-crash option grants.

Question 2: How much is executive compensation worth to the recipient?

The salaries, bonuses, perks and stock gains paid to the top 25 chief executives over the past five years amount to nearly \$1.9 billion. These individuals were smart and lucky enough to lead highly successful companies during a roaring bull market. (*Forbes*, May 20, 1996, pp. 189)

Although the executive can usually realize the wealth maximizing value of the option, his or her investment portfolio is sub-optimally diversified (the employing company constitutes too large a proportion of the executive's wealth portfolio). The executive would, generally, be willing to exchange the option-based compensation for salary with a present value less than the current value of the hedge portfolio.

Estimates of this compensating differential are not easy to find. Using as the risk measure the elasticity of total compensation with respect to the stock price (approximately the share of stock-based compensation in total compensation) proprietary executive compensation data for the 1980s show that for every 1% increase in the compensation risk measure, expected total compensation is 1.8% larger (elasticity of 1.8). The typical compensation package in that era (20% stock-based compensation for all long-term eligible executives) is, thus about 40% larger, on average, than total compensation packages with no stock-based compensation. Hall and Liebman also attempt to estimate this compensating differential and find that it is on the same order of magnitude for their CEO sample—increases in the executive's position in the employing company's stock or options have a certainty equivalent that is about half of the market value of the compensation. In the United States, the Financial Accounting Standards Board (FASB) and the Security and Exchange Commission (SEC), which jointly regulate stock-based compensation and the form of mandatory disclosures regarding this compensation, should recognize that executives should disagree over the value of the options in their personal portfolios because they will have differing attitudes toward risk. The difference between company cost and executive value is a critical feature of contingent compensation systems. It is one reason why executives receive the compensating differentials estimated above. Differences in ability and differences in bargaining power could also explain these differentials.

We turn now to other differences between employer cost and employee value. Differences in purchasing power have important effects on the value of pay packages. Interested readers can request figures identical to figures 1 and 2 except that real exchange rates are used instead of purchasing power parity rates. The use of purchasing power parity inflates US compensation relative to compensation in most of the other OECD countries. The reader is reminded that the data are for significantly smaller companies than were shown in Figure 3.

There are also significant tax and public benefits (pensions) that enter into the executive's valuation of the compensation package, especially outside the United States. Figure 4 shows a comparison of the after-tax, purchasing-power adjusted, compensation of the CEO pay packages examined in figure 1. All tax payments (income taxes and mandatory employer and employee public benefit contributions) are shown as negative amounts. Private after-tax compensation is the dark gray positive amount. The value of public benefits (primarily retirement income and health care) is shown as the white block at the top. For CEOs, we note that there is considerable variability in the proportion of the pay package that comes as publicly-provided benefits (France, Italy and Sweden having the largest components). The tax payments due on the compensation vary much less than the after-tax compensation itself. Figures analogous to figure 4 for human resource directors and manufacturing operatives are included in this working paper. See the supplementary figures in the Data Appendix.

Question 3: How well does executive compensation work?

You don't expect a neat correlation in any one year. A chief executive might be cashing in option gains he had accumulated in other years. But over five years? Shouldn't a fat paycheck be matched by shareholder results? (*Forbes*, May 18, 1998, pp. 232)

As noted earlier, the slope of the compensation/stock price relation is essentially the option hedge ratio Δ multiplied by the number of shares held as options. It is impossible to infer this relation from executive paychecks, which explains the *Forbes* quote and many others like it. Hall and Liebman show that, for 1994, the median change in CEO wealth given an increase of \$1,000 in firm value is 5.29. The median elasticity of CEO wealth to firm value is 3.94 in 1994, which is more than three times the 1980 figure. Perhaps in response to widespread criticism of CEO pay, the links between CEO wealth and performance have increased dramatically over time. At the same time as the business press advocated stronger links between pay and performance as a formula for improved profitability, the connection between stock price and executive wealth was increasing because of increased stock and stock option holdings. It is difficult to determine whether these increases in incentive compensation had the predicted effect on stock-market performance and profitability.

The availability of measures of both compensation and firm performance make executive compensation a good place to test agency-theoretic models. A simple and direct test of some of the most basic implications of agency theory is found in Garen (1994). His analysis relies on Jensen and Murphy's (1990b) analysis of 430 large firms for which they estimated the sensitivity of CEO wealth to changes in shareholder wealth. Garen's main finding—variables that are related to greater variability of firm profitability are negatively related to the Jensen and Murphy estimates of the pay-for-performance sensitivities—is predicted by the theory. More recently, Aggarwal and Samwick (1999) address these same issues with more complete data. Using Compustat-Execucomp, which has data on roughly the 1,500 largest publicly-traded US firms, they also find that pay-for-performance sensitivity is negatively correlated with the variability of firm stock-market performance, primarily because CEOs of high-variability firms tend to own a lower percentage of their firm's stock.

There have been many attempts in the compensation literature to test the relative performance evaluation (RPE) hypothesis. The basic idea behind RPE is that there are some identifiable aspects of firm performance that are outside the executive's control. A market-wide movement in stock returns is the classic example. A compensation scheme that negatively links an executive's wealth to the performance of other firms can therefore reduce the risk necessary to achieve any level of incentive alignment. Antle and Smith (1986) was the first paper that tested this hypothesis, but found little evidence that two-digit industry returns affect executive cash compensation, although they did find some evidence that two-digit industry returns negatively affect broader definitions of compensation. Barro and Barro (1990) study RPE for CEOs of banks. They found no evidence that the average stock-market and accounting performance for other banks within a bank's region affects the cash compensation of CEOs, though higher average regional performance makes turnover more likely, as predicted by RPE theory.

Using a broader sample of firms, Gibbons and Murphy (1990) found that the salary plus bonus of a CEO is increasing in own firm rate-of-return, while decreasing in either industry or market-wide return, exactly as the theory predicts. They note, however, that industry measures of rate-of-return have little explanatory power compared to market returns, which seems surprising since industry returns should more accurately reflect the environment of the firm. They found similar results for turnover. Janakiraman, Lambert, and Larcker (1992) estimated firm-specific compensation equations and found results that were, on average, similar to Gibbons and Murphy.

Bertrand and Mullainathan (1999) use annual cash compensation plus the value of stock options granted to test whether CEOs are rewarded for exogenous shocks in oil prices. They find very little evidence of RPE and, to the extent that they do find it, it is stronger for negative shocks than for positive ones.

To our knowledge, the only paper that investigates the RPE hypothesis with data on stock and option holdings is Aggarwal and Samwick (1999), which finds no evidence of RPE. This is not surprising, since the instruments that primarily link performance outcomes to executive wealth, stock and option holdings, have no relative components in them. We therefore conclude that, despite the obvious attractive features of RPE, it is surprisingly absent from US executive compensation practices. Why shareholders allow CEOs to ride bull markets to huge increases in their wealth is an open question.

Gibbons and Murphy (1990), and Aggarwal and Samwick (forthcoming) offer explanations for the weak evidence in support of RPE. Gibbons and Murphy note that a negative link between CEO compensation and the performance of rival firms can encourage actions that lower the performance of rival firms, even at the expense of own-firm performance. Aggarwal and Samwick take this argument step further and argue that a positive link between CEO compensation and rival performance can create incentives that mimic collusive outcomes. Aggarwal and Samwick also present surprising evidence that, in some industries, CEO compensation is positively affected by the performance of rival firms. Differences across industries in the strengths of the links accord well with their theoretical model. Despite the arguments made in these two papers, we view the weak evidence of RPE as an important puzzle for executive compensation research.

Question 4: What are the effects of executive compensation?

Despite the soaring pay, many experts argue that the system is working better than ever. They see the bull market and healthy corporate sector as proof positive that companies get what they pay for. (*Business Week* April 21, 1997, pp. 60)

One of the most fundamental questions for the early CEO pay literature was whether or not incentive contracts actually motivate executives. In particular, the impact of incentives on stock-market returns has been studied extensively. Before reviewing the literature on the effect of incentive plans on stock returns, we should stress how difficult it is to obtain guidance on this subject from economic theory. These difficulties arise for at least two reasons.

The first difficulty is that stock returns have shareholder expectations imbedded in them. As we mentioned earlier, an option grant might affect the distribution of stock returns for the company. The forward-looking nature of stock prices might allow this shift to occur prior to the executive taking any action. In fact, the shift in the distribution of prices, and therefore a current return reflecting this shift, might occur when shareholders first begin to expect an incentive plan, which may occur well before the plan is announced and, even more likely, before it is fully implemented. This could explain why early exercise of options is discouraged, since early (and unanticipated) exercise could allow executives to reap the benefits of shareholder expectations without delivering on them.

The second difficulty arises because economic theory does not predict that increases in incentives necessarily lead to increases in profitability. If firms are providing their executives with incentives that are close to their profit-maximizing levels, then a small increase in incentives should lead to almost no change in profitability.

Despite these theoretical difficulties, the effect of incentive plans on stock returns has been studied extensively. Masson (1971) is the earliest of the studies linking financial incentives to subsequent performance. He found that firms that provided greater financial incentives for their CEOs exhibited better stock-market performance over the postwar period, which he interpreted as evidence that firms systematically provided sub-optimally low incentives. Larcker (1983) also found a positive stock-market reaction when the adoption of a short-term compensation plan, a bonus plan based on single-year performance measures, was announced. Tehranian and Waagelein (1985), however, note that abnormal returns seem to precede the announcement of the adoption of a short-term compensation plan, making it difficult to interpret the Larcker result.

Leonard (1990) found that in his sample of large firms from 1981-85, that companies with long-term incentive plans exhibited greater increases in return on equity than those without these plans. Abowd (1990) found that the sensitivity of managerial compensation in one year is positively related to corporate performance in the next year, although this relationship is much stronger for market measures of performance than for accounting measures. This result reflects the difficulty of testing for optimal compensation system design because of the problems, discussed above, of measuring performance expectations in an efficient capital market and attempting to estimate a first-order condition for the best design.

When outcomes other than profitability are examined, economic theory can provide clear guidance. Economic theory certainly predicts that executives will work harder when given larger incentives to do so. Kahn and Sherer (1990) tested this prediction by examining longitudinal data from one firm. The firm had two types of incentive programs: bonuses that mainly targeted higher levels of management, and merit payments available across all managerial levels. They showed that managers with high sensitivities of bonus payments to subjective performance evaluations tended to have higher subsequent evaluations, as compared to other managers at that firm, even after controlling for prior evaluations. They found no significant effects of merit pay on subsequent performance.

Another important area of research focuses on some unintended effects of incentive plans. One of the seminal articles in this field is Healy (1985), who studied the effects of non-linear bonus schemes on managerial accrual and accounting procedures. He found that managers are more likely to choose income-decreasing accruals (decisions that lower reported profitability) when their bonus plan's upper or lower bound is binding, *i.e.*, the pay-for-performance sensitivity is zero. Note that there is no profit-maximizing rationale for this behavior. It is simply a rational response by the managers to the incentives they face, even though this behavior might be harmful to long-term profitability.

Holthausen, Larcker and Sloan (1995) returned to this issue with a data set in which they can directly identify whether a manager is operating above the upper bound or below the lower

bound of the bonus plan, instead of imputing this as in Healy's work. They found that managers do manipulate earnings downward when they are operating above the maximum of their bonus plan, but they found little evidence that such manipulation occurs when managers are below the minimum performance level that allows a bonus.

The results on perverse behavior in certain incentive compensation systems lead in an interesting direction for future research. Healy's work demonstrates the unfortunate or unintended effects of incentive plans that contain floors and ceilings. Many case studies also document unintended effects of high-powered incentives. Is there a downside to increased stock and option holdings of top executives? Might the increased incentives imposed on today's executives be motivating them to do more harm than good? One candidate for an unintended consequence of high levels of stock and option holdings is that they might encourage excessively cautious behavior. Since Hall and Liebman showed wealth fluctuations for CEOs can be quite high, risky but *ex-ante* profitable projects may seem quite unappealing to executives.

6. Question 5: How much executive compensation is enough?

Institutional investors, small shareholders, academics, employees, and even pay consultants are challenging the vast pay packages given to CEOs. Many of them express particular dismay that the average CEO paycheck continues to bulge even in a recession year, when CEOs are demanding sacrifices from their employees and laying off thousands of workers. The annual largess, many critics say, is out of step with the times—a hangover of the go-go 1980s that seems egregious in the frugal 1990s. (*Business Week*, May 6, 1991, pp. 90)

One of the most common complaints about US CEO compensation policies is how much CEOs receive relative to others in the firm. Figure 5 shows the after-tax compensation plus benefits of CEOs as a multiple of the after-tax compensation plus benefits of manufacturing operatives across 12 OECD countries. This figure shows that US CEOs do, in fact, have exceptionally high pay relative to manufacturing operatives. Figure 6 shows that this is not true of US human resource directors.⁵ The high US CEO relative compensation is particularly striking when compared to the lower relative pay of German and Japanese CEOs during periods when they outperformed their US counterparts.

Hallock (1998) provides a small measure of comfort on the issue of “fairness” in the compensation of CEOs given the welfare of other workers. Contrary to popular opinion, CEOs do not receive higher compensation when layoffs are announced. Since layoff announcements have small negative effects on share prices, CEOs are punished for layoffs. This punishment is, however, quite small and unlikely to be a significant deterrent to layoffs. Dial and Murphy (1995) use a case study to illustrate that layoffs can be a productivity enhancing strategy, for which the CEO should be rewarded. That is, while CEOs should not be rewarded directly for layoffs, they should be rewarded for the increased profitability generated by the layoffs.

⁵ Analogs of figures 5 and 6 that use total compensation, which reflects employer costs, are included in this working paper. See the supplementary figures in the Data Appendix.

The question of “How much is enough?” is an inherently difficult one. We have already mentioned estimates of the degree to which total compensation rises as compensation risk rises, but reliable estimates of risk-aversion parameters are necessary to determine if the high compensation levels in US companies merely reflects a fair risk-return tradeoff. It is difficult to imagine how these estimates might be obtained.

Kole and Lehn (1996) provide some insight into this issue in their study of airline deregulation. They found that, relative to CEOs in other industries, CEOs in the airline industry received increases in their compensation following deregulation, primarily due to increased stock-option grants. Kole and Lehn provide one example of changes in compensation levels within US firms in response to environmental changes. Whether observed differences between compensation levels in the US and other OECD countries reflect optimal responses to environmental differences or abuses in US compensation systems is a difficult question.

Question 6: Could executive compensation be improved?

Inside every boardroom, the key issue is how best to link pay to performance. The standard solution is the stock option, but a number of more rigorous committees are beginning to wonder if it's the right answer. The reason harks back to the old Wall Street saw about not confusing brains with a bull market. Options, by rewarding CEOs whose stock rises with the tide, may be doing just that. (*Business Week*, April 26, 1993, pp. 64)

Since Hall and Liebman demonstrated that CEOs face enormous wealth volatility, firms should find every possible method to reduce this volatility without reducing incentives. While this may seem like a daunting task, we mention two possibilities, which we do not claim as our own insights.

Relative Performance Evaluation. Stock options reward stock price appreciation regardless of the performance of the economy or sector. Why should CEOs be rewarded for doing nothing more than riding the wave of a strong bull market? If the exercise price could be linked to measures like the S&P 500, or an index of close product-market competitors, then executives would be rewarded for gains in stock price in excess of those explainable by market factors outside their control. If market-wide stock movements could be netted out of executive incentive schemes, then equivalent incentives could be provided while reducing the volatility of the executives' portfolios.

An interesting research question would be to investigate the extent to which relative performance evaluation could reduce wealth volatility, while maintaining executive incentives (hedge ratios multiplied by the number of shares held as options) at their current levels. That is, how much volatility of executive wealth could be eliminated by not holding them responsible for share price movements that can be identified as a function of bull or bear markets? These estimates, combined with estimates of risk-aversion parameters, would lend insight into the value of resources squandered by a failure to implement relative performance evaluation plans.

Multiple Payoff Criteria. A portfolio of stock options, some with constant exercise prices, some with exercise prices linked to external criteria (*e.g.* S&P 500), and some with exercise prices linked to internal criteria (*e.g.* division profits or specific executive goals) would provide more dimensions along which to give direct share price incentives, relative performance incentives and individual incentives.

While linking executive wealth to stock-market performance has obvious attractive features, stock-market performance should not be the only measure used. Executives function as a team and stock-based compensation rewards team performance, but some adjustments should be made for individual performance to avoid the free rider problem. While the link between the expected total compensation and the degree of risk in the compensation system is conceptually well-understood, a better calibration of the compensation sensitivity parameters (slopes or elasticities) would permit better cost control. In particular, whenever an individual's contribution can be isolated, higher-powered incentives can be provided without imposing more compensation risk on the executive, thus reducing the cost of the compensation.

Conclusions

We have shown that there are good reasons why the answer to the question “How much does executive compensation cost the firm?” is different from the answer to the question “How much is executive compensation worth to the recipient?” for CEO pay. Future executive compensation research, in the spirit of Hall and Liebman, should be very careful to distinguish these two concepts. Agency theory remains the only viable candidate for the answer to the question “How well does executive compensation work?” but the empirical research to date cannot explain very much about the structure of the optimal contract. For this reason, it is also hard to answer the questions “What are the effects of executive compensation?” and “How much executive compensation is enough?” although it is clear that companies can provide both too little and too much contingent compensation. Finally, we have suggested two fertile areas for research regarding the question “Could executive compensation be improved?”

One maxim seems clear—whatever happens to CEO pay, the business press will always have a multitude of kudos and brickbats to hand out every April when they turn their attention to the recently released proxy statements. Mandatory disclosure of the specifics of American CEO compensation contracts distinguishes US executives from their colleagues in other countries and provides the fuel for the empirical study of size and consequences of explicit incentive compensation programs.

Mathematical Appendix

The binomial pricing methodology assumes that we can divide time into discrete components, and that the price of the stock can rise or fall in discrete amounts each period. If dividends were dropped from this exercise, we could derive the Black-Scholes pricing formula, which is based on a continuous-time model, as a limiting case of the binomial model as the distance between periods approaches zero.

We follow Cox and Rubinstein (1985) quite closely, and examine a call option to purchase one share of stock at a fixed exercise price. Suppose that with one period remaining prior to expiration, the stock price has the following possibilities for the last period.

$$d(1-d)^n P \text{ or } u(1-d)^n P,$$

where the down and up factors satisfy $0 < d < u$, d is the constant dividend yield, $n = 1$ if the last period is an ex-dividend date and 0 otherwise, and P is the current stock price. When the expiration date arrives, the option will be worth

$$C_d = \max[0, d(1-d)^n P - K] \text{ or } C_u = \max[0, u(1-d)^n P - K],$$

where K is the exercise price. As Black and Scholes noted when they discussed the riskless hedge that completed their option pricing model, in the binomial formulation there exist numbers Δ and B such that holding Δ shares of stock and borrowing B dollars using riskless bonds is a payoff-equivalent strategy to holding the option. That is

$$dP\Delta - rB = C_d \text{ and } uP\Delta - rB = C_u,$$

which implies

$$\Delta = \frac{C_u - C_d}{(u-d)P} \text{ and } B = \frac{dC_u - uC_d}{(u-d)r}.$$

The payoff from holding the option must be equivalent to the payoff of a portfolio with Δ shares of stock and B dollars borrowed using riskless bonds. For this reason, this portfolio is usually called the option hedge portfolio and the dynamic trading strategy associated with the binomial option pricing formula is called a riskless hedge. If the option is not exercised early, the value of the option (which we denote C) must equal the value of this portfolio, namely $P\Delta - B$. It is possible, however, that the value of exercising the option prior to the last period ($P - K$) exceeds $P\Delta - B$, in which case the option is exercised early.

The value of the option is, therefore,

$$C = \max[P - K, P\Delta - B].$$

More importantly for our purposes, Δ , which is commonly called the hedge ratio, measures the degree to which the option-holder's wealth is affected by dollar changes in stock price. The hedge ratio is the number of shares of the underlying stock held in the hedge portfolio per option. While the analysis thus far has focused on the period prior to expiration, we can apply dynamic programming techniques to derive the call option value for 2, 3, ..., N periods prior to expiration. As the interval associated with a period tends toward zero, we can express the value of the call option as $C(P, K, T)$, where T is the amount of time until the option expires. Regardless of time to maturity, the hedge ratio can be expressed as a function of u , d , the current stock price, and

the possible values for the option in the following trading period as shown above. Hence, the hedge ratio is the derivative of the call value with respect to the price of the underlying security

$$\frac{\partial C(P, K, T)}{\partial P} = \Delta(P, K, T)$$

Consider an executive currently employed at a given firm. Let period 0 denote the executive's initial compensation period. Let P_0 denote the value of the employing firm's stock at the end of period 0. The executive receives total compensation with a cost to the company given by

$$S_0 + F_0 + N_0 C(P_0, K_0, T)$$

where S_0 is salary, F_0 is the periodic cost of the benefit package, N_0 is the number of call options awarded, K_0 is the exercise price of these call options and T is the time to expiration of the call options. At the end of period 1, a new stock price P_1 is realized. The executive remains employed at this firm with probability $\mathbf{p}(P_1)$. If separated the executive receives alternative compensation S_1^A , which does not depend upon P . At the end of period 1, the executive receives a new stock option grant of N_1 shares at exercise price K_1 expiring in T years. Salary and benefits costing $S_1 + F_1$ are also paid at this time. A comparable exercise occurs at the beginning of period 2.

We now consider the realized and expected future compensation of a mid-career executive, which we will interpret as the values in the model above at the end of period 1. The executive's realized compensation at the end of period 1, assuming continued employment, is

$$V_1 = S_1 + F_1 + N_1 C(P_1, K_1, T_1) + N_0 (C(P_1, K_0, T - 1) - C(P_0, K_0, T)),$$

where the first three terms are comparable to compensation awarded in the initial period and the final term represents the capital gain or loss on the stock options awarded in the first period. Viewed as a function of P_2 , the executive's expected future compensation at the end of period 2 is

$$E[V_2(P_2)|P_2] = \mathbf{p}(P_2) \left(\begin{array}{l} S_2 + F_2 + N_2 C(P_2, K_2, T) \\ + N_1 (C(P_2, K_1, T - 1) - C(P_1, K_1, T)) \\ + N_0 (C(P_2, K_0, T - 2) - C(P_1, K_0, T - 1)) \end{array} \right) + (1 - \mathbf{p}(P_2)) S_2^A.$$

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Total Compensation of CEOs at Purchasing Power Parity Exchange Rates (12 OECD Countries 1984-1996)

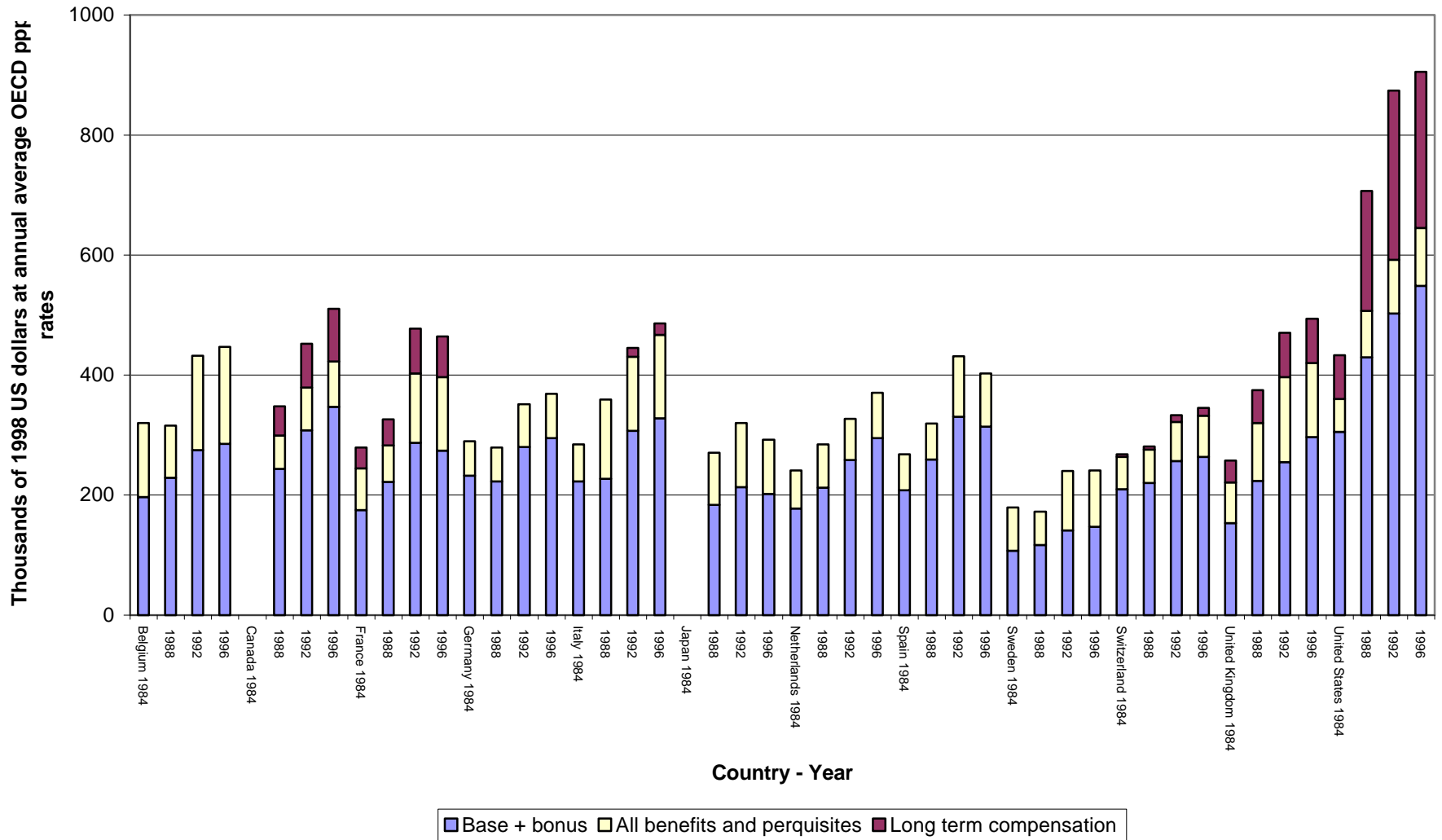


Figure 1

Total Compensation of HRDs at Purchasing Power Parity Exchange Rates (12 OECD Countries 1984-1996)

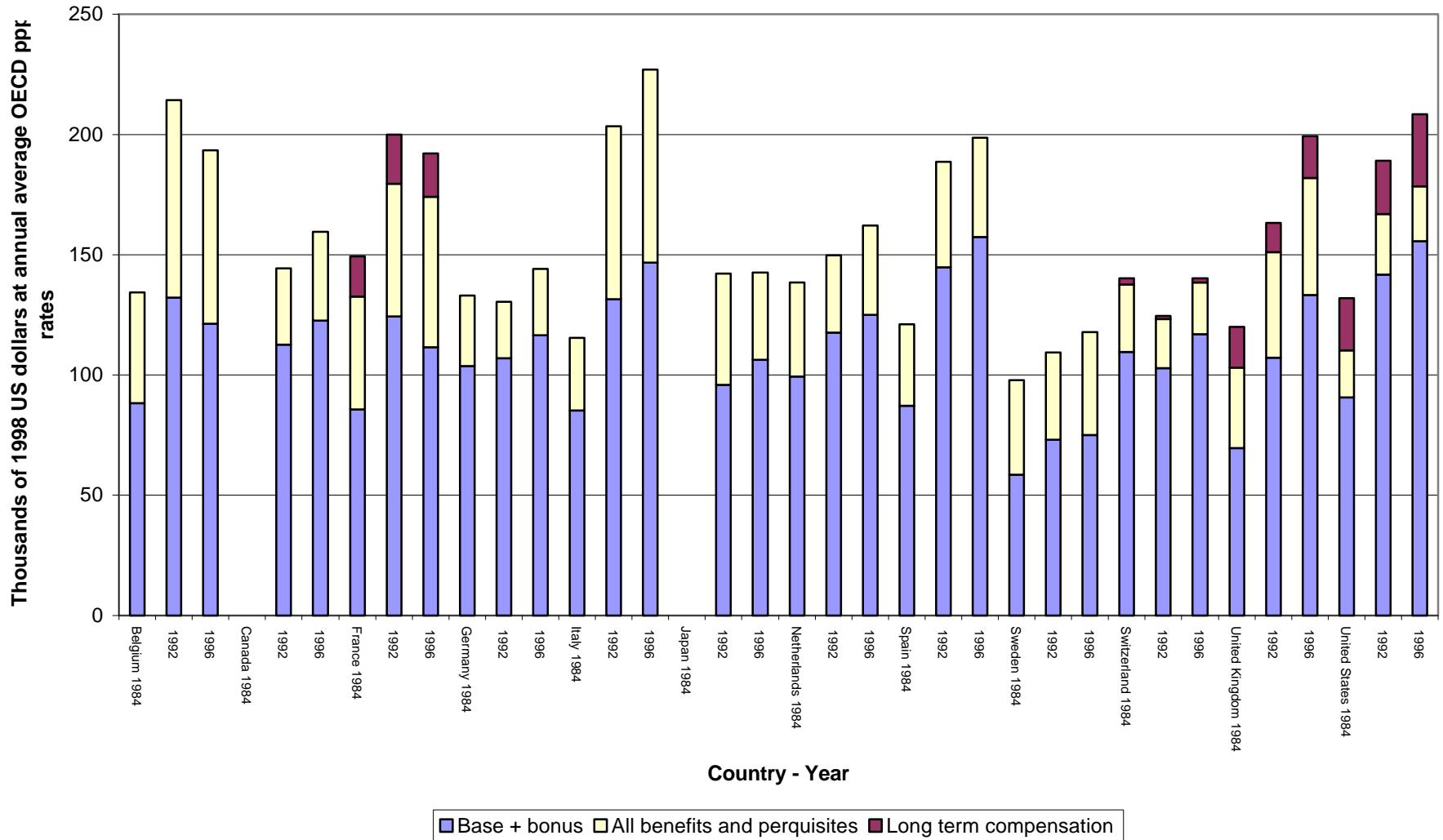


Figure 2

1996 CEO Compensation S&P 500 (thousands of 1998 US Dollars)

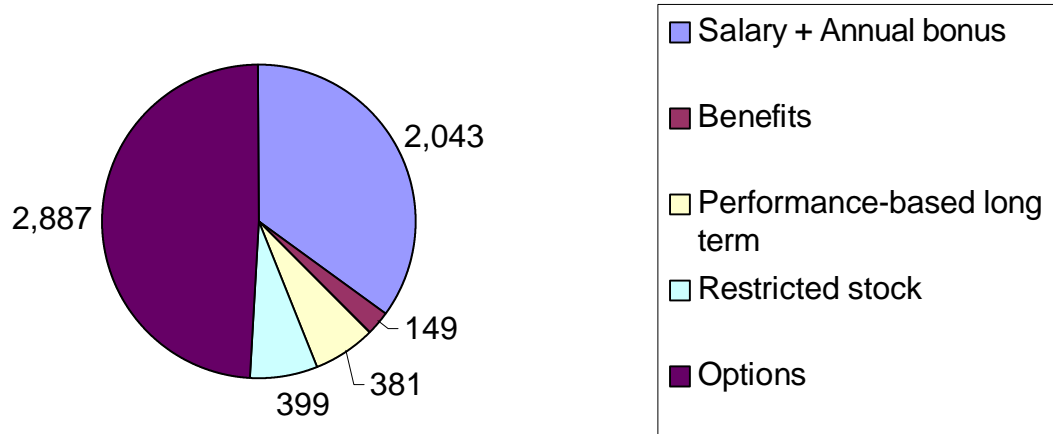


Figure 3

Total Taxes, Private After Tax Compensation, and Public Benefits for CEOs (12 OECD Countries 1984-1996)

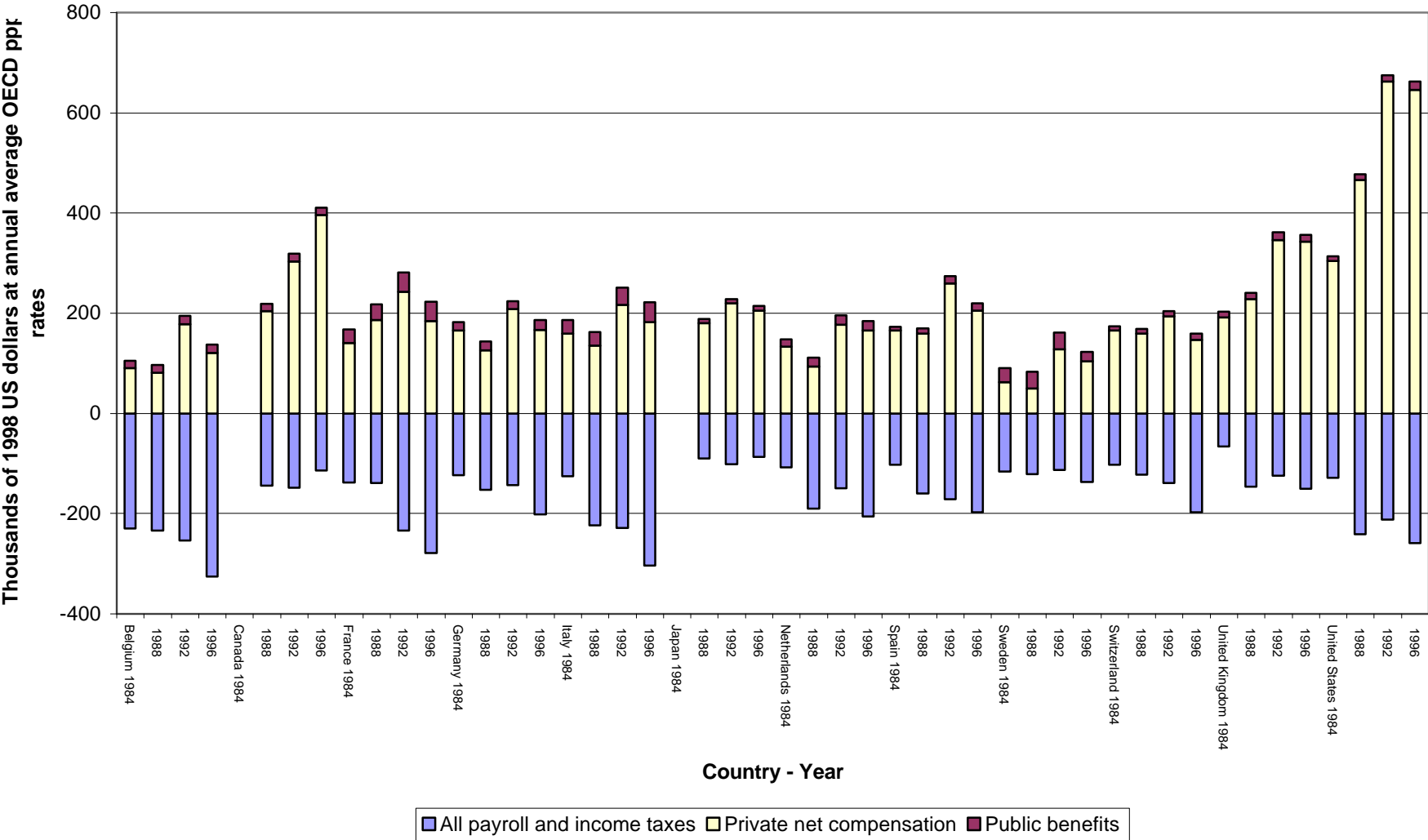


Figure 4

Ratio of CEO After-Tax Compensation and Benefits To That Of Manufacturing Operatives (1984-1996)

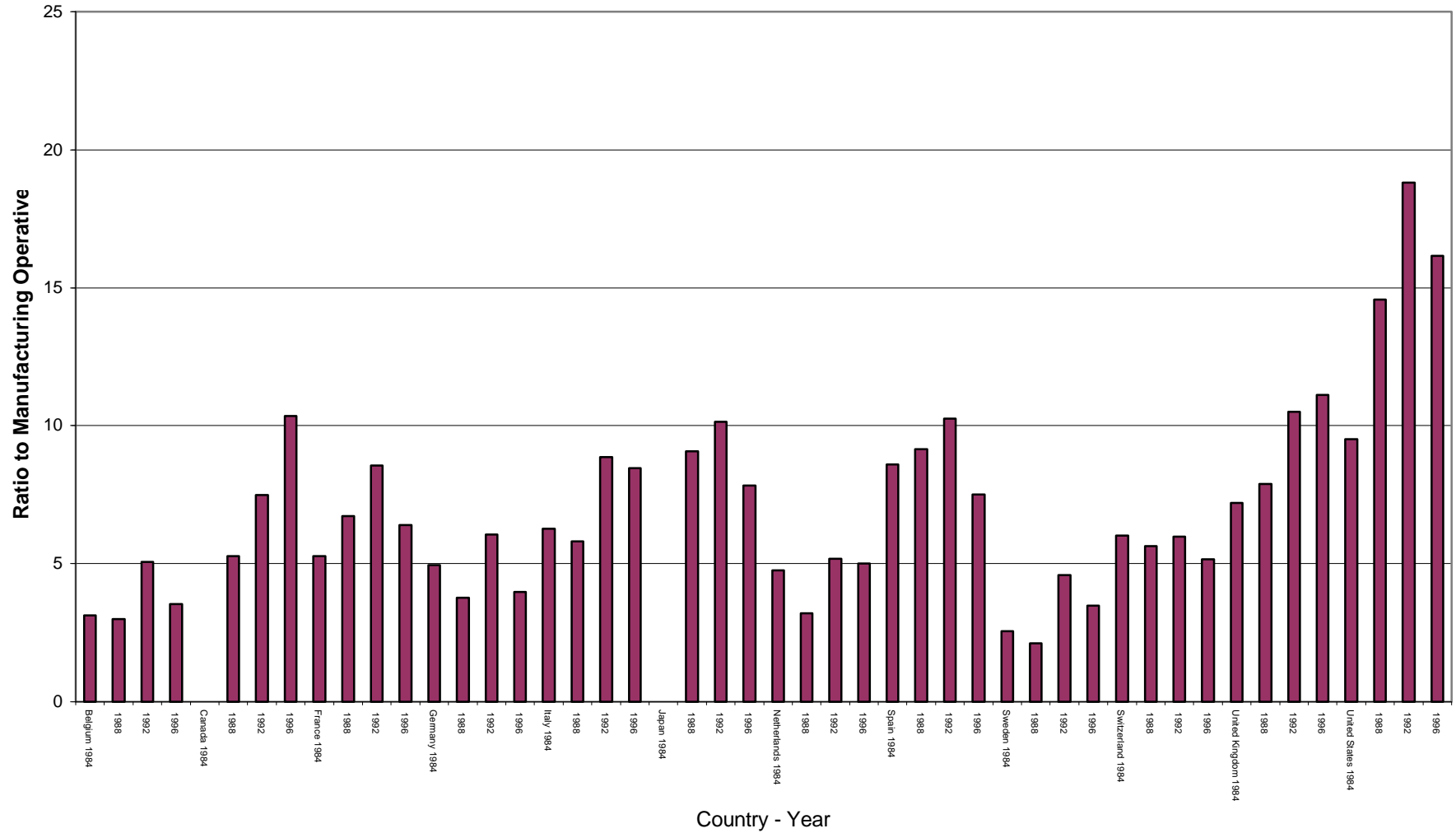


Figure 5

Ratio of HRD After-Tax Compensation and Benefits To That Of Manufacturing Operatives (1984-1996)

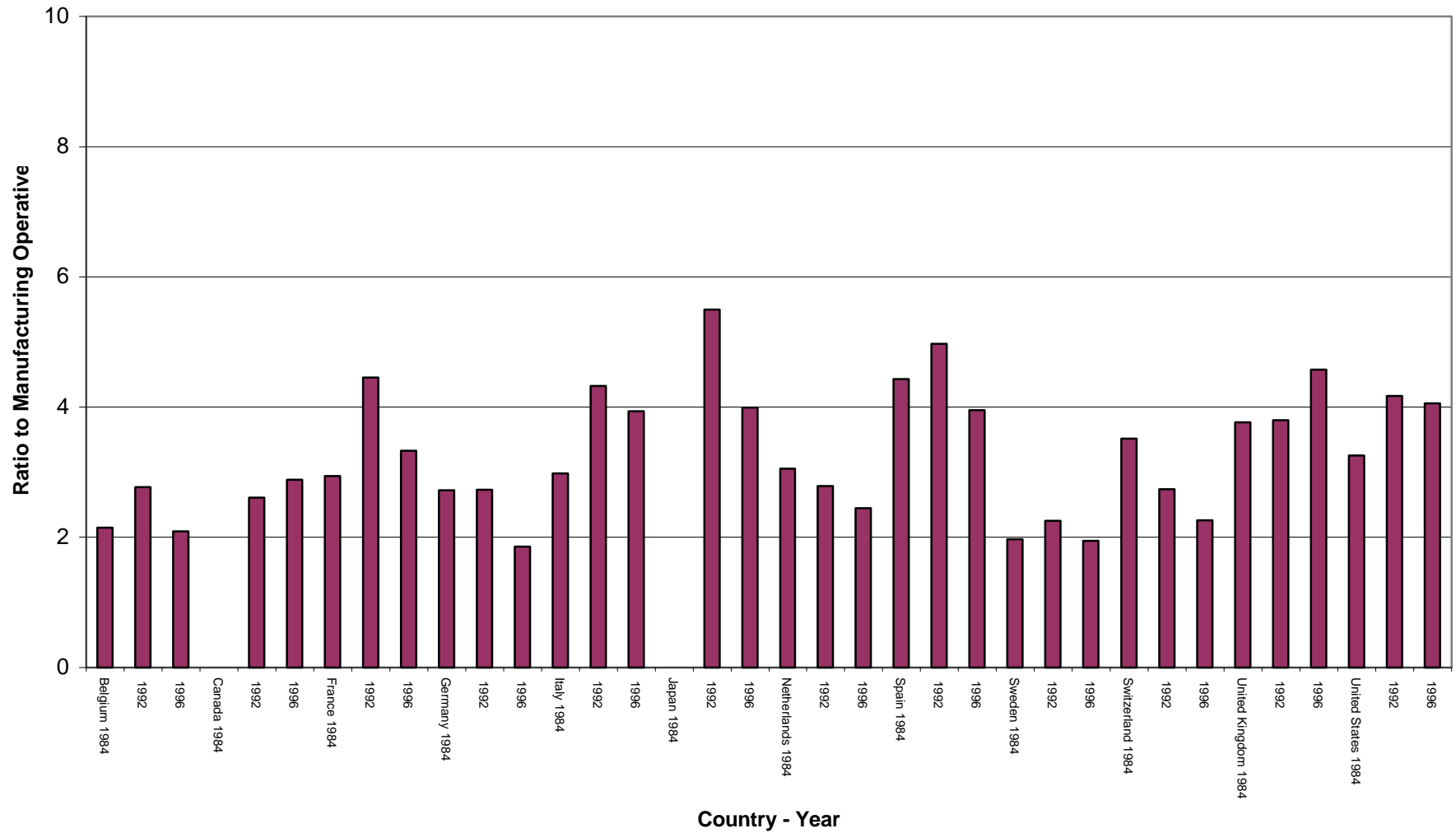
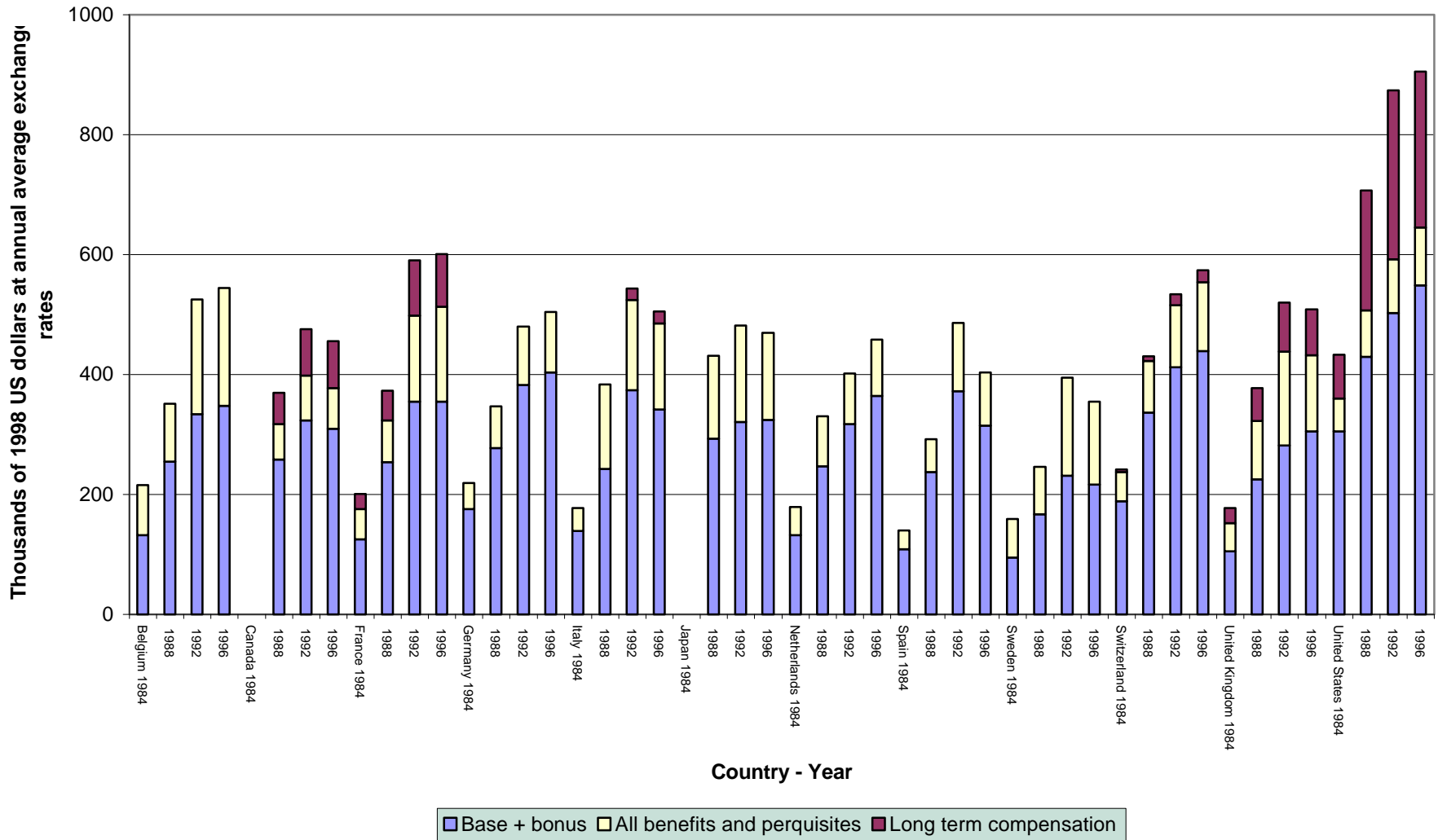


Figure 6

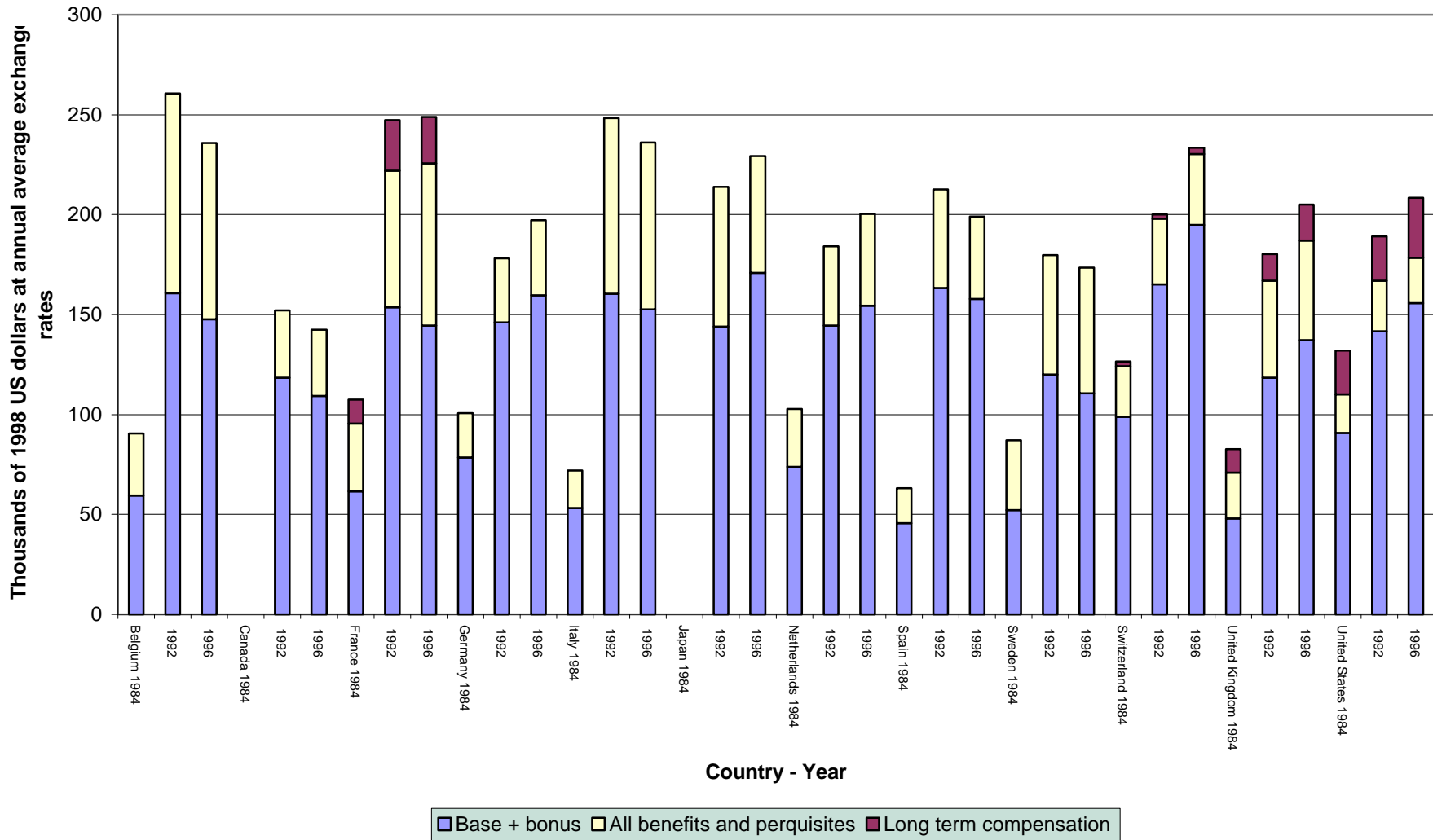
Data Appendix: Supplementary Figures Referenced in the Working Paper

Real Total Compensation of CEOs, by Components (12 OECD Countries 1984-1996)



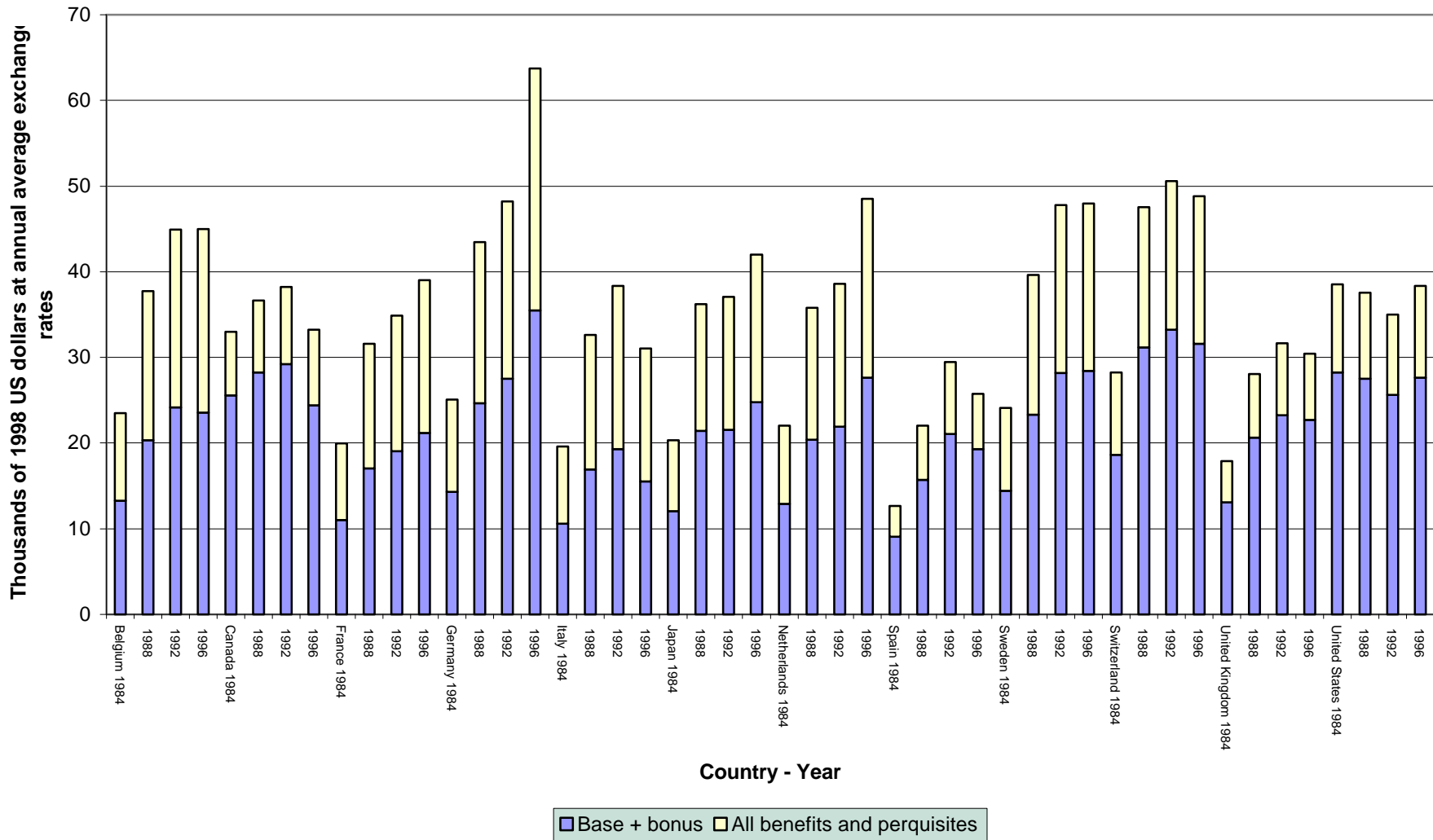
Supplementary Figure A

Real Total Compensation of HRDs, by Components (12 OECD Countries 1984-1996)



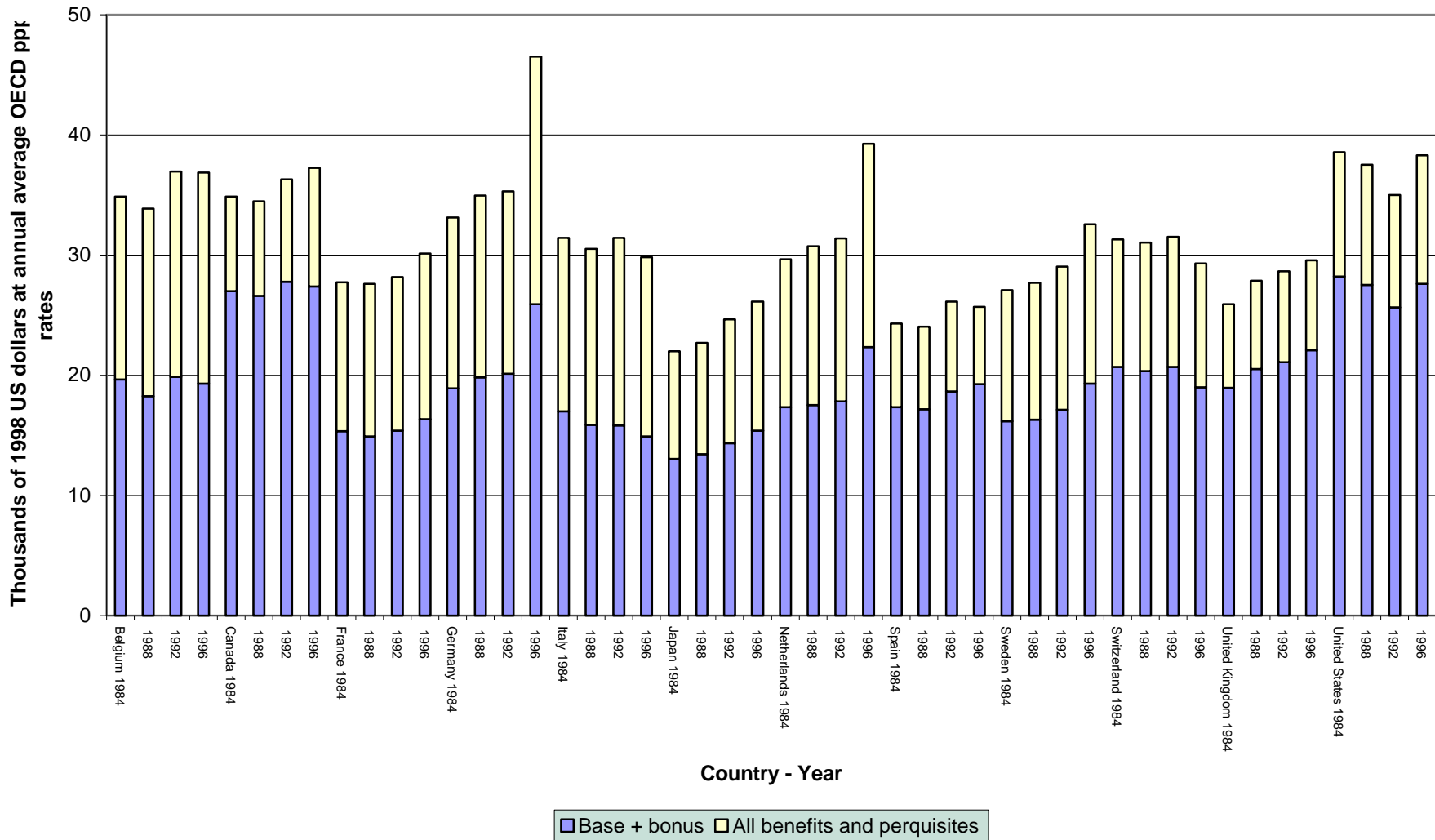
Supplementary Figure B

Real Total Compensation of Manufacturing Operatives, by Components (12 OECD Countries 1984-1996)



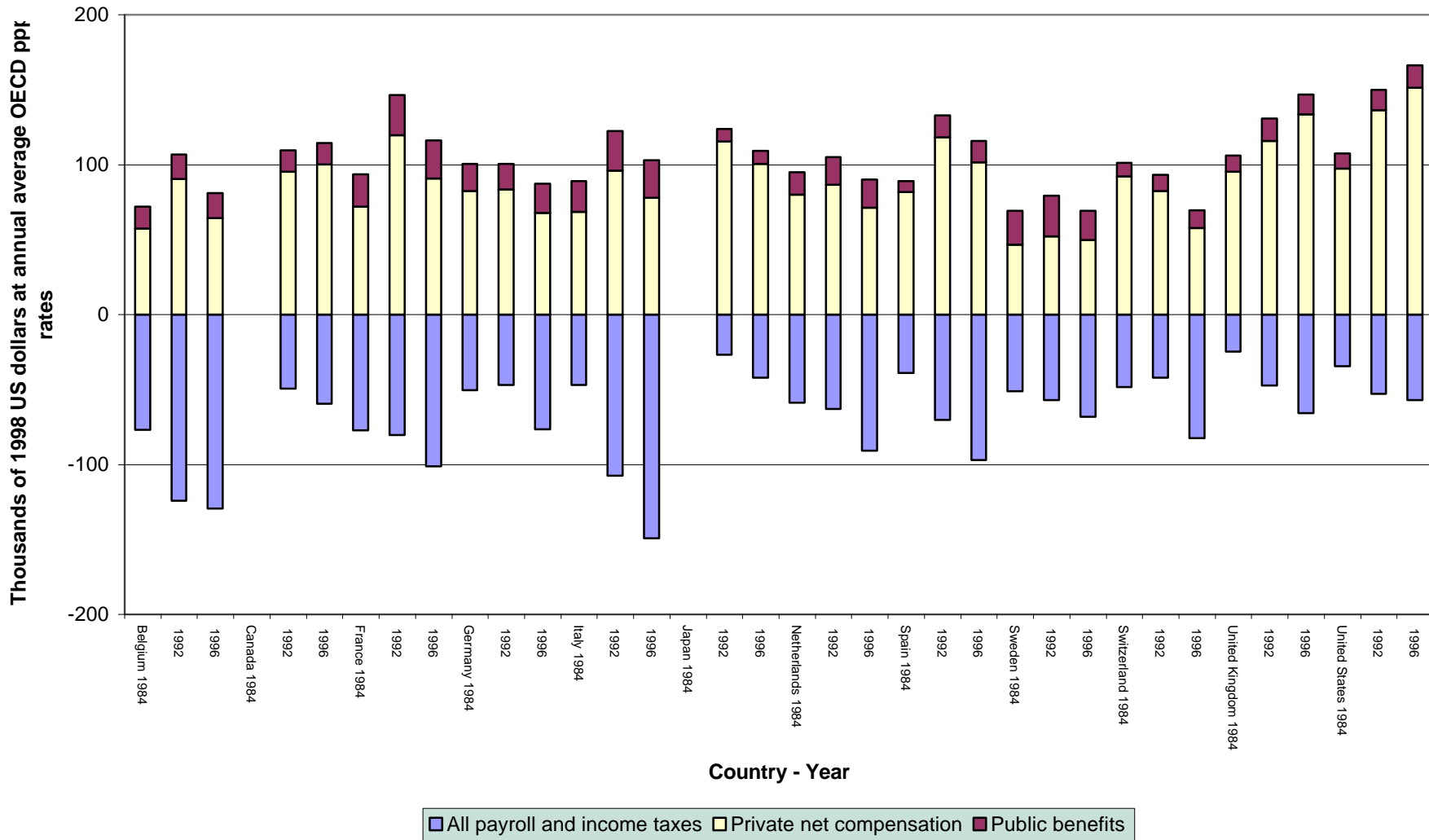
Supplementary Figure C

Total Compensation of Manufacturing Operatives at Purchasing Power Parity Exchange Rates (12 OECD Countries 1984-1996)



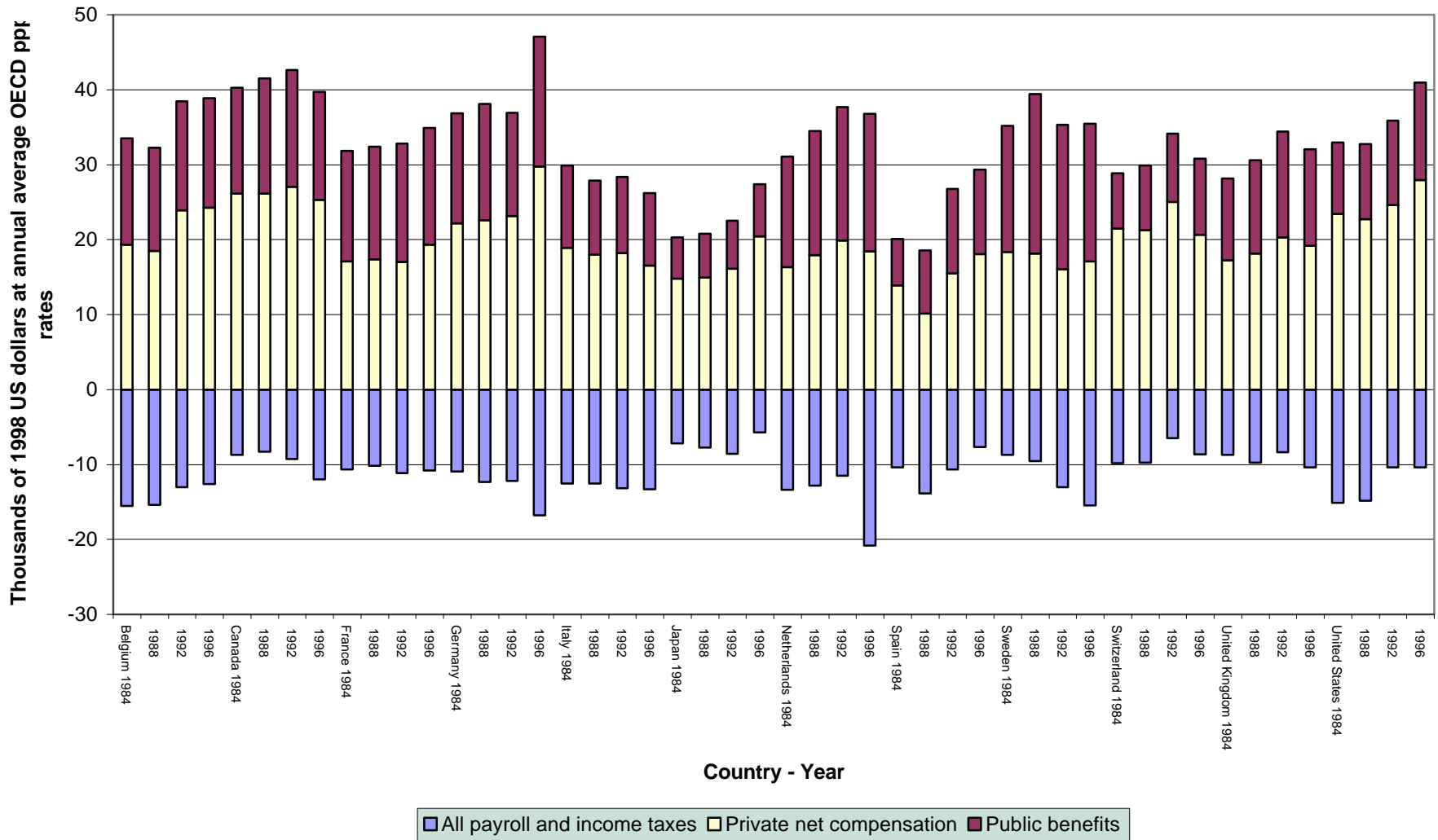
Supplementary Figure D

Total Taxes, Private After Tax Compensation, and Public Benefits for HRDs (12 OECD Countries 1984-1996)



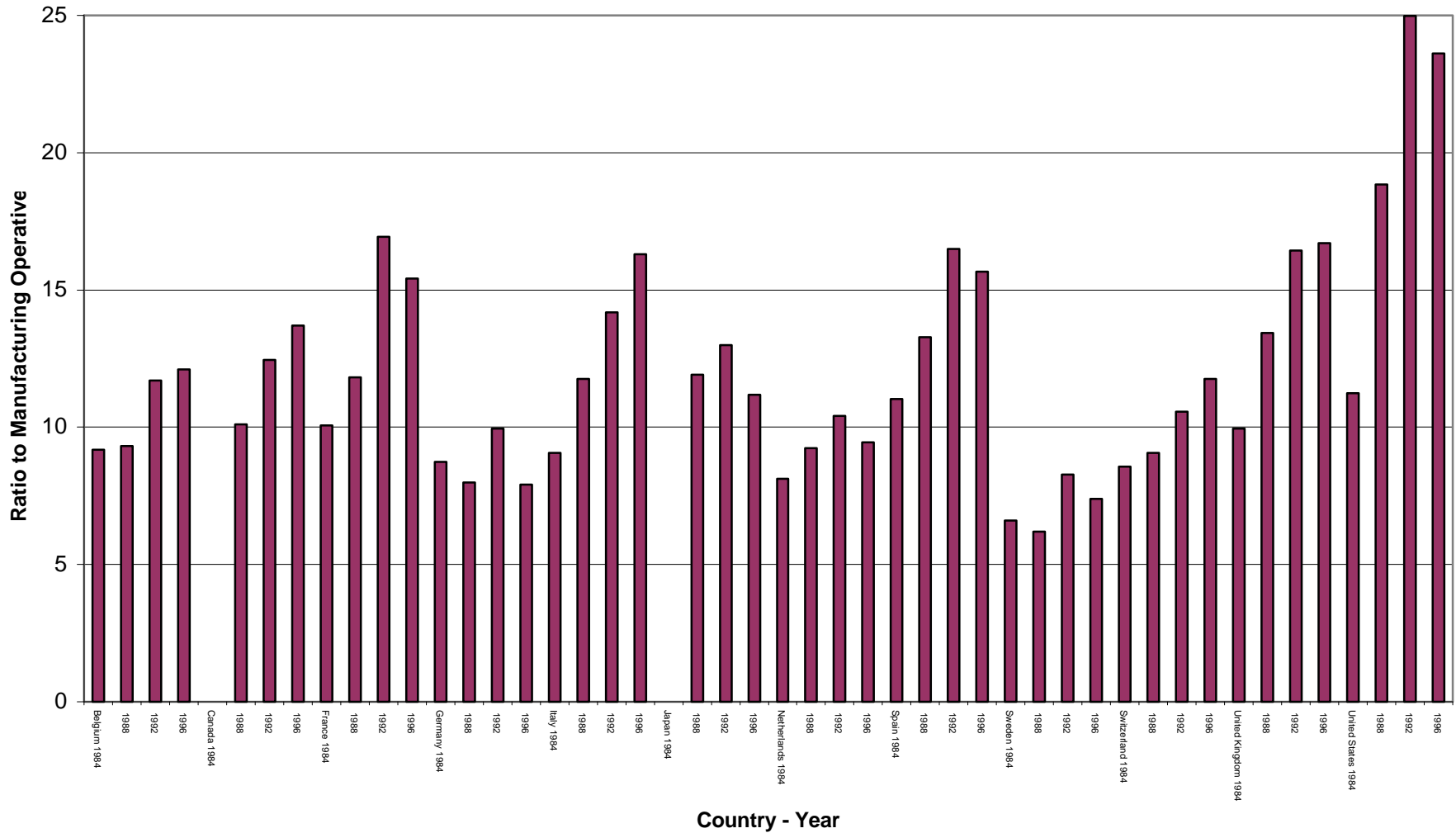
Supplementary Figure E

Total Taxes, Private After Tax Compensation, and Public Benefits for Manufacturing Operatives (12 OECD Countries 1984-1996)



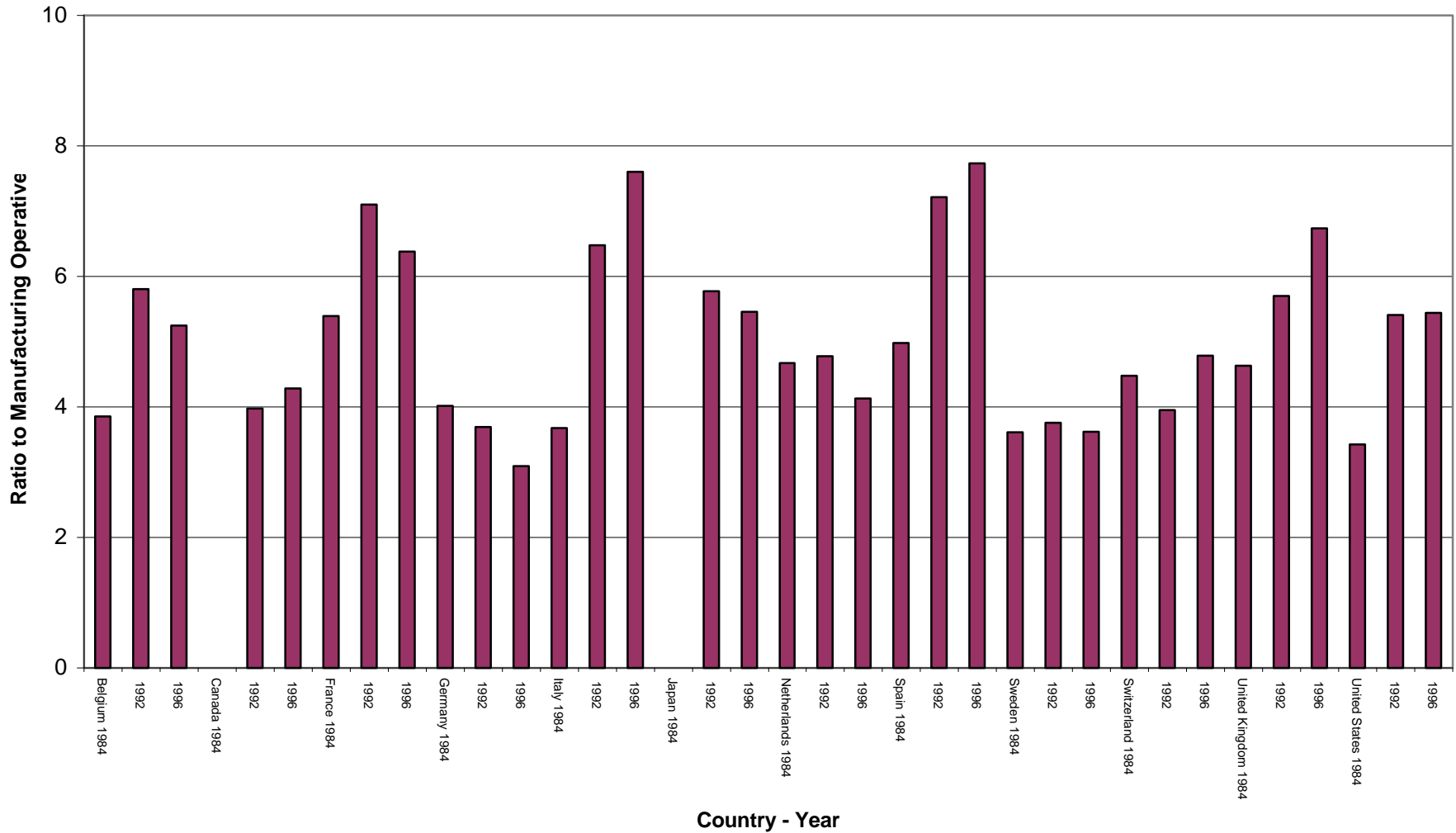
Supplementary Figure F

Ratio of CEO Total Compensation To That Of Manufacturing Operatives (1984-1996)



Supplementary Figure G

Ratio of HRD Total Compensation To That Of Manufacturing Operatives (1984-1996)



Supplementary Figure H