

PRELIMINARY DRAFT—

International Differences in Lean Production, Employee Attitudes, and Productivity¹

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Abstract

We analyze productivity and worker attitudes in five plants in the UK and U.S. belonging to the same multinational producer of automotive sensors and actuators. In particular, we look at the impact of a Value-Added Gainsharing plan (VAG) that was introduced at different times among the four plants, drawing on plant visits, surveys of almost all of the workforce, and confidential financial data.

Our study offers an unusual opportunity to examine the internal operations of a low-wage, non-union firm. We find that the VAG had a one-time impact on productivity in the first plant in which it was introduced (where it replaced a piece rate system and was accompanied by many complementary policies), and a small impact in the later plants, whose complementary policies were haphazard. We find that the UK plant's productivity and worker satisfaction was well below that of the US plants. However, neither our analysis nor interviews with managers suggest that differences in national institutions play a key role in explaining these results.

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I. Introduction

In this paper, we report on a study of US-European productivity differences, focusing on differences in incentive structures. We investigate whether human resource policy changes within a firm in concert with other manufacturing transformations have affected the organization's ability to prosper financially and provide job satisfaction for its employees.

To focus our study, we control for product types and corporate ownership -- all 5 plants we study are owned by the same multinational firm and make similar products (sensors and actuators for automobiles), using similar processes. In particular, we look at the impact of a Value-Added Gainsharing plan (VAG) that was introduced at different times among the four plants. Our analysis draws on multiple plant visits over eight years, surveys of almost all of the workforce, and confidential financial data. Our study thus offers an unusual opportunity to examine the internal operations of a low-wage, non-union firm...

One major issue for our firm has been the appropriate method of compensation to complement its other "high performance" practices for its low wage production workforce. Since 1987, the firm has changed its product market strategy; it now designs its own products (which are complex assemblies of plastic and electronic parts) and modifies them frequently, rather than producing individual electronic components to customer blueprints. It has also vastly increased its quality levels and reduced its inventory. These changes are common in this industry, and result from pressure from the firm's customers, such as Ford and General Motors.

As a result of these product-market changes, the firm has introduced changes in its human resource policies, changing its methods of compensation (as discussed above),

increasing automation, introducing work in groups and (recently) increasing training. In some of the plants, compensation received by production workers has fallen dramatically; in others it has increased slightly. (Wages are now similar at the firms' four US plants, and are less than 40% of the US manufacturing average.)

We have been able to obtain information on the precise dates of the changes in human resource and other changes in manufacturing. The firm has employed a variety of methods of pay (both piece rates and time rates) in plants making similar products in similar ways. It changed these plants over to a plant-wide gain-sharing system at different times. The plants also adopted various aspects of "lean production" (moving toward total quality management and just-in-time inventory policies), at different times. We use these plants as a quasi experiment, to examine the impact of changes in human resource policies on productivity and worker well-being. We will examine the impact on the plants that changed over early, treating the later adopters as a control group, using a time-series cross-section statistical methodology (Bertrand, Duflo, and Mullainathan, 2002 and Athey and Imbens, 2002).

In the next section, we review relevant literature. In Section III, we discuss basic characteristics of the industry and our plants, and the nature and timing of their adoption of the Value-added gain-sharing plan and complementary policies such as automation, worker recognition programs, and training. In Section IV, we discuss our methods, both qualitative (multiple visits to each plant, discussions with both management and workers) and quantitative (time-series and time-series cross-section comparisons of productivity, and cross-section estimates of worker attitudes.). Section V presents results, and Section VI concludes.

II. Review of the Literature

Firm Performance

The impact of human resource practices on organizational performance has received considerable attention from academics for the past 15 years. Starting with a 1987 Research Volume published by the Industrial Relations Research Association entitled *Human Resources and the Performance of the Firm*, many researchers have examined which specific combination of policies matters in affecting the economic performance of the firm (Kleiner, Block, Roomkin, and Saltzman, 1987).

Two major factors have been found to affect firm performance. The single largest factor that personnel economists have focused on has been the impact of various forms and levels of compensation policies on firm performance (Ehrenberg, 1990 and Freeman and Canyon, 2000). Generally the issues have been whether compensation policies like paying individuals based on individual output, called piece-rates, is an ideal form of compensation from the perspective of maximizing firm performance (Seiler, 1984, and Lazear, 2000). On the other hand, some studies have suggested that time rate methods of pay allow the enterprise to increase the number of products produced and thereby increase the value-added production of the enterprise (Freeman and Kleiner, 2005 and Helper and Kleiner, 2003). An alternative to the piece-rate or time rate debate has been the emergence of value added gainsharing or some form of profit-sharing with employees (Kruse, 1993, Kleiner, Helper, and Ren, 2001, and Helper and Kleiner, 2003.).

Although for economists the method and level of compensation are viewed as a central factor in developing the correct type of incentive structures, the results are mixed about

its impact on firm performance. This is largely a result of the inability to correct for the type of firm and the product that is being produced, and as well as how the compensation system interacts with the other human resource and production systems in the firm.

Another type of policy is political participation in running the enterprise, which is commonly known as employee involvement. A number of studies have documented the impact of employee involvement on productivity and firm performance (Appelbaum and Batt, 1994, Appelbaum, Bailey, Berg, and Kalleberg, 2000, Ichniowski, Kochan, Levine, Strauss, 2000). For the most part the above studies, which each been based in a single industry, have shown that employee involvement has increased the productivity of the firm. However, other studies using a national sample have shown very little impact of employee involvement on firm level productivity, but a larger impact of financial participation (Freeman, Kleiner, and Ostroff, 2000, Cappelli and Neumark, 2001). The assessment of the impact of employee involvement needs a more carefully designed study that compares establishments before and after the implementation of employee involvement programs in those plants that have not implemented these types of programs.

An alternative approach to looking just at compensation or just at employee involvement is examining bundles of human resource practices (Tomkis, 1998, MacDuffie, xx; Arthur, xx, Gershenfeld, xxx, and Ichniowski, Shaw, and Prenzushi, xxx). The general approach has been that there is a set of high performance workplace practices (HPWP) that, taken together, result in increasing returns relative to a set of traditional practices that have been used in manufacturing. However, more recent analyses of more nationally representative data has called into question the overall firm performance value of these practices (Black and Lynch, xx, and Cappelli and Neumark,

2001). Econometric case studies of the impact of employee involvement, and total quality management, also show mixed results (Kleiner, Leonard, and Pilarski, 2004, Tako and Jones, 2003). Our study extends the traditional analysis of one plant over time to an analysis of similar plants over time, of which some changed and others did not.

Impacts on the Establishment's Employees

What do employees want out of the employment relationship, and would a change in the method of pay affect employee well-being? A recent survey of American workers in large firms found that U.S. workers want to be employed in establishments where they have a say in the running of the organization. In fact, more than 60 percent of the surveyed workers said they wanted committees in which workers have varying levels of independence from management in deciding work tasks (Freeman and Rogers, 1999). However, these results were for a large sample of employees, and there was little attempt to examine the effect of changes in human resource policies, or to examine these changes for a homogeneous group of workers who were all subject to the same policy transformations.

A volume by the Russell Sage Foundation entitled “The Future of Low-Wage Work” suggested that employees should be considered as part of any overall welfare calculus of impact of changes in human resource policies (Appelbaum, Bernhardt, and Murnane, 2003). Efforts to improve the understanding of the role of policy changes before and after policy implementation would enhance the field's knowledge of the role these policies are likely to have on the employees they are intended to impact. Moreover,

correlates of employee well being are closely tied to actual behaviors such as turnover and absenteeism which have real effects on establishment outcomes (Brief, 1998).

III. Context: The Auto Parts Industry and the Plants We Study

Industry Context

Between the 1930s and the mid-1980s, the “Big Three” U.S. automakers shared a tight oligopoly. A key goal of automakers was to protect their oligopoly profits from suppliers by keeping barriers to entry in their input markets low. Suppliers did not need sophisticated product design, quality, or management capabilities; they were asked only to build simple products to automakers’ blueprints, and quality requirements were not high. Automakers kept large stocks of components, in part as a buffer against attempts by suppliers to hold them up for higher prices. Automakers also had several suppliers of the same part, which facilitated easy switching to another supplier. This system contributed to automaker profits well above the manufacturing average. However, these rent-protection strategies led to a great deal of inefficiency among automakers. Quality was low, and costs were high, due to the costs of buffer stock, designs ill-suited to supplier equipment, and supplier inability and unwillingness to make investments in new technology. In the late 1980s, in order to compete with the quality and low costs offered by Japanese manufacturers, US automakers began to adopt many of their rivals’ supplier relations practices (Helper, 1991, 1992).

In addition, a large gap opened up between wages at suppliers and at assemblers. Unions at GM, Ford, and Chrysler were able to use their power to shut down final assembly to win wage increases, even for workers who made parts. In contrast, entry into

the parts industry (by Japanese firms who came to the US to supply Japanese automakers who had located plants here, and by the threat of parts imported from Mexico) kept wages at independent parts suppliers low. Thus in the 1990s, production worker wages at the Big Three were more than \$20 per hour with good benefits, while they ranged from \$6-15 (with considerably fewer benefits) at parts suppliers. Although direct labor was a small percent of total cost, for example at SP, it was less than 8%, it was particularly salient in auto industry accounting systems.

The need to match Japanese quality levels and the wage gap with workers in lesser developed countries led the major automakers to reduce their degree of vertical integration in three ways: 1) having more components manufactured by outside firms, 2) having the joining of those components (“subassembly”) done by outside firms, and 3) having more design work done by outside firms. (MacDuffie and Helper, 2006).

Firm context

Below we discuss the response to these developments by our firm, which we call SP (for “Small Parts”). SP is a \$600 million manufacturer of electrical and electronic products, such as ignition switches and a product that indicates when a car door is ajar, which are sold largely to vehicle manufacturers (automakers and truck manufacturers). The oldest part of the firm was founded in 1909, and has undergone a number of changes in its markets and products over the years.

SP announced a major change in strategy in 1987 (SP annual report, 1995). The new strategy would involve making money through product differentiation. SP would increasingly design its own products (instead of building to the automakers’ blueprints), do more assembly of parts, produce a wider variety of products, and introduce new

products more frequently. These changes would increase overhead, so the firm also began a policy of looking to acquire firms that made similar products, as a way of achieving economies of scale. At this time, the firm also began to learn about and adopt Japanese innovations in manufacturing, such as just-in-time inventory and total quality management. (See Helper and Kleiner, 2003 for more detail).

In 1997, SP went public in order to gain access to more capital. At the end of 1998, SP bought another firm that designed and manufactured sensors thereby acquiring a plant in rural Ohio and one in suburban Florida. During the 1990s the firm also acquired some foreign operations (Europe, Mexico, and Brazil). In 1999, the firm ended the contract manufacturing operation that had originally formed the core of its business, and focused entirely on parts that the firm designed itself. Thus the firm exemplifies many of the trends that are common in this industry, namely, it has become an expert in the design and manufacture of electronic and electromechanical systems, it has become global, and it has grown dramatically, mostly through acquisitions. Labor costs are low in this firm, averaging about 8 percent of total costs. SP's production employees earn between \$6.75 and \$13.00 per hour plus health and pension benefits, and the gainsharing bonus which has varied between zero and 15 percent of their pay.

The new strategy announced in 1987 was not consistent with SP's existing pay practices, which involved piece rates for some operators and most assemblers, and time rates for other operators and all office and engineering staff. For example, workers on piece rates wanted a large amount of inventory between stations, so that they were not constrained by someone working more slowly than they were. This practice led to long lead times and low quality, both because of the incentive to work as fast as possible and

because the large batches meant that many bad products could be made before they were caught by monitors.

In addition, the emphasis on more complex products and just-in-time delivery work meant that products were produced more in teams, not by individuals, and the greater number of new product introductions increased the probability of “demoralized” piece rates, where the piece payments are out of line with opportunity costs of labor and where the ability of workers to beat the normal rate may vary widely among jobs (Freeman and Kleiner, 1998). In addition, SP wanted to incentivize engineers to spend time doing “design for manufacturing”-- optimizing their designs so that they would be easy to make quickly and without defects.

The company felt that time rates by themselves would not provide enough incentives for avoiding wasteful inventory, error prevention, productivity, and incremental improvement. As a result they implemented a value-added gain sharing plan (VAG). The details of the plan changed over the years, but always involved disproportionate weights for productivity, using a value-added approach, measures of customer satisfaction using returns or defective parts, and deductions for scrap. The initial estimates were established by a consulting firm who worked with the firm’s managers and engineers to establish the VAG formula, and the formula was not widely understood by employees or even much of the management. (This was in contrast to the 50 to 100 percent incentives that was available and widely understood by employees and management under the piece rate system.) For the Massachusetts plants the average VAG bonus averaged almost 10 percent from 1996 through 2001. Under the VAG plan,

everyone in the plant (except for a few top managers, who were on a different, bonus plan with greater economic incentives) received the same percentage of their pay as a bonus.

Management did not implement VAG in all of its plants at once. We suggest that the implementation process can be thought of as a quasi-natural experiment that can allow us to estimate the impacts of gain-sharing on both productivity and worker satisfaction. First, we briefly describe each of the four plants in our study, and then discuss the extent to which it is appropriate to view the change as an experiment.

Method of Pay and Timing of VAG introduction

We examine each of SP's four US plants and one in England. They all produce similar electronic parts for the automotive industry. One plant is in urban Massachusetts, one is in suburban Massachusetts, one is in rural Ohio, and the other US plant is in urban Florida. In Figure 1 we give the timing of the changes in the method of compensation for each of the plants in the firm.

In the urban Massachusetts plant, workers on the individually-paced jobs were paid piece rates from the 1960s until early 1996. The VAG was phased in gradually (by department) between 1993 and 1995; for two years workers were paid the difference between what they would have earned on piece rates and what they did earn from the combination of time rates (which was set at 135% of the old base rate) and VAG (which was typically about 10%). Almost all workers were earning well above the base wage. Most suffered a substantial pay cut, and some lost as much as 40%. However, fewer than 10% of the workers quit as a consequence of the transition in the method of pay and other changes in managerial policies. The suburban Massachusetts facility was established in

1989, and was populated in part by workers from the urban plant. Both work and workers were moved back and forth between the two plants; our data do not allow us to separate these plants.

The Florida and Ohio facilities were acquired by SP in late 1998. At the Florida facility the production employees were paid a time rate. On January 1, 2001, the plant shifted to a value added gainsharing method of pay. During the first few months of the program pay-outs were about 10 percent. However, the national economic downturn which started in the early months of the gain sharing program, reduced the gain sharing amounts to almost zero during the summer months of 2001, but then rebounded to almost 9 percent during the later part of the year.

Workers were also paid an hourly rate at the Ohio facility. This facility did not switch to VAG until Jan 1, 2002.

The UK plant was acquired by SP in March 1999. The workers had been paid a piece rate for many years. At the time of our first visit in January 2003, most of the workers had been transferred from individual piece rates to a time rate plus a bonus based on their work group's performance, and some had been told that they would be paid a time rate plus VAG (a bonus based on plant-wide performance) starting in March 2003..

Adoption of Complementary Policies

As mentioned above, management did not implement VAG by itself, but rather as part of a series of changes in overall strategy. As we discuss below, this strategy was most carefully worked out in the Massachusetts plants where it was first implemented. The rationale for VAG and the coordination with supporting policies were much less well

understood by management or workers in the plants that SP acquired. Below, we discuss these supporting policies in more detail.

Changes in product strategy and process flow. At the time of our first visit in 1995, the Massachusetts urban plant was toward the end of a transition begun in the mid-1980s. It had been a low-volume plant where quality requirements were not high, and where designs were generally dictated by the customer and didn't change often. The new strategy was to become a "high-volume, precision operation", according to Mr. M, the plant manager in 1995. This transition involved changes in many areas:

Product Strategy. SP hired engineers to design products in-house, and dramatically increased the rate at which new products were introduced (50 in 1998) and retired. These products became increasingly sophisticated, and many were patented. For example, a sensor based on the Hall Effect was written up in a technical journal.

Process flow. The older jobs were individually paced, and consisted of a single worker sitting at a machine. She would add one or more pieces to a small assembly and then press a button or foot pedal to fasten the piece via welding or crimping. She would then place the partially-completed product in a box; when the box was full material handlers would move it to workers who would do the next stage.

Management gradually brought in more automated assembly, eliminating individually-paced jobs. Instead, 6-8 workers sat around a circular work cell. Some stations were completely automated; at most stations a worker assisted the machine in assembling the part. When the part was finished, it would be moved (automatically or manually) to the next station. At the last station, the operator would pack the fully-completed part into a box to be shipped directly to the customer. The cell was paced by

the slowest worker. At many of the cells, a lighted overhead sign kept track of the pieces made, and compared it to the pieces that should be made to meet the day's quota. Since there was no buffer between operators, inventory in the cells was dramatically lower (and lead times faster) than under piece rates.

By 2000, these assembly jobs employed the bulk of the work force (see Table 1). There was also a small plastic molding operation, in which workers monitored machines and loaded and unload parts. In the suburban plant there were several cells that were completely automated, and monitored by technicians who had received three months of training and were paid more than the assemblers. Other blue-collar jobs included material handling and shipping and receiving.

Design for manufacturing. The key to the success of the firm, according to Mr. P, was the tight integration of product and process. At the time of the survey, the Massachusetts plants employed over 100 design engineers. They tried to design products that were not only sophisticated (many were patented), but easy to make, and whose quality could be checked automatically, rather than relying on manual inspection (which is less accurate, particularly when thousands of parts must be checked each day). Examples of design for manufacturing included molding in small bumps on the piece whose only function was to help locate the part correctly in a machine (they had no function once the part was made), and simple fixtures that tested for the presence of certain parts (and would not let the operator go to the next step unless all parts were there).

In order to facilitate this integrated approach, in 1995 engineers were re-organized into product teams, who would follow a product all the way from concept to launch. (In

the traditional approach, engineers were organized into functions, such as design engineering and manufacturing engineering; when a product left one stage it was “thrown over the wall” to the next stage, with little communication between groups.

In our 1995 visit, we saw several engineers working with operators to design such “mistake-proofing” mechanisms. In several cases, the work seemed hampered by language barriers; we saw a lot of sign language being used, as the operator and engineer struggled to communicate about quality problems. We saw fewer engineers on the shop floor in our later visits. One reason was that design-for-manufacturing principles had become codified (both by SP and others), so that more of the work could proceed without input from operators. (These principles include ideas such as making sure that parts either are perfectly symmetric, so that orientation doesn’t matter, or are obviously asymmetric, so a fixture can be built that won’t allow work to proceed on an incorrectly oriented part.) This move toward codification was given additional impetus by the fact that the design engineers in Massachusetts were increasingly called on to design parts for SP’s other locations far away (including Europe and Mexico),.

Management recognized that piece rates were not well suited to the new strategy. First, workers on piece rates wanted a large amount of inventory between stations, so that they were not constrained by someone working more slowly than they were. This practice led to long lead times and low quality, both because of the incentive to work as fast as possible and because the large batches meant that many bad products could be made before they were caught by inspectors. Another problem with piece rates was that new product introduction created big risks for both labor (that the rate would be set too stringently) and management (that the rate would turn out to be too easy). As Ms. P. put

it in 2002, “New product development became a hurdle with the piecework system. Employees did not want to work on new product [because they would have to learn a new job, with the risk of lower pay while they figured out shortcuts]. We had a lot of turnover in the plant at this time (late 1980s). There were no good standards for new product and there was no way to introduce new products unless we wanted to throw loose rates on them. This restricted us from doing new products.” Similar issues were reported in the UK plant. (In 2003 we interviewed the person responsible for calculating new piece rates).

Communication about the gain-sharing plan. The gain-sharing plan is quite complicated (the controller in SP’s Boston plant, where gain-sharing had been in place for 7 years, cheerfully told us that there were only 2 people in the company who understood it). Even the basic principles were not well explained by management in most of the plants; levels of understanding seemed particularly low in the acquired plants. Workers who had previously been on piece rates are now compensated by a combination of time rates and the gain-sharing bonus (which ranges from 0-15% of base pay). Experienced workers (over half of the total) in both the US and UK plants reported that they suffered a significant pay cut as a result of introduction of the VAG. Management suggested this was a result of the difficult market for auto suppliers in recent years. Workers who had been on time rates before reported a small pay increase (since they now received the VAG in addition to their base pay).

Impact of VAG introduction on levels of pay, and the pay/effort bargain. The change to VAG had a large impact on both levels of pay, and on the pay/effort bargain as perceived

2 This is a quote from a very useful document, “Progression of Pay for Performance”, that Ms. P wrote for us in February 2000.

by workers. These impacts differed by plant, and the magnitude of the impacts seemed largely unexpected by management.

At the Massachusetts urban plant, getting rid of the piece rate system was not easy. “From 1985 to the early 90s, we started to educate the employees in a series of round table meetings and business meetings that the security they felt they had in the incentive system was hurting the company and hurting them and hurting the quality of the business and that we would have to make changes to the way they made their money.” (Ms. P, 2000). But some mistakes were made. “For our original steering committee, we selected [hourly] people who had trust in the plan—we didn’t have the natural leaders. We had approached it as a control thing with employees,” said Mr. P in 1995.

“The opportunity of expanding to a second plant in 1989 was the first chance of changing the pay system,” according to Ms. P. Workers in this plant, located in a suburb, worked in cells, and were paid an hourly wage. This wage was lower than in the urban plant, since the prevailing wage in the suburb was lower. Thus, it was difficult to get people to help with the start-up, so some were given promotions as an incentive. Piece rates were also gradually phased in at the urban plant, between 1992 and 1996.

Some operators we interviewed in focus groups in 2000 remained upset about the change. Almost all operators worked faster than the standard at which the piece rate was set. Management recognized this by setting the base time wage at 132% of the piece-rate base wage. They also introduced a gain-sharing program (described below) which they thought would pay an additional 10-15%. Managers said later that they did not intend to cut pay (‘except that there were some people making 200% of the base rate, which is just unrealistic”, according to Ms. P in 2002.). However, management was very worried

about setting the rates too high, and locking themselves into a wage that was “too high”³. (In one case, “we underestimated the impact of automating the manual O-ring assembly—it almost killed the plan,” said Mr. P in 1995). The result was that management erred on the conservative side, and 45% of those who had worked under piece rates felt that they had suffered a pay cut. According to management, only about 10% of operators quit due to the transition, however. And newer workers, who hadn’t yet figured out shortcuts on their job (or been assigned to a job with a ‘loose’ rate) benefited; 27% of survey respondents who had worked under piece rates indicated that they made more money now than before. (See Table 1a.) Workers who had been on piece rates were kept at the same hourly pay for a while. However, the fastest workers saw their hourly pay decline \$4-5 per hour (40-50%) over several years. According to management, however, only about 10% of the workers quit during this period.

Wages in 1999 for assemblers were \$10.48/hour in the suburban plant, and \$10.60 per hour in the urban plant (there was no seniority increment). In the urban plant, this was supplemented by a VAG payout of about \$1.00 per hour. The VAG was much less (often zero) in the suburban plant, due mostly to quality problems and secondarily to difficulties in accounting for the time of engineers who worked on products for SP’s other plants (Ms. P, 2002). This pay rate was far below the US manufacturing average of \$14.40 per hour in 1999 (\$15.03 for workers in industrial machinery) (Jacobs, 2000). Benefits (which included paid vacation, medical, and dental) were more generous than in the

³ It seemed that “too high” meant wages more than 15% above the average for unskilled manufacturing workers in the area. (For example, Mr. P said in 1995 that if gain-sharing exceeded 15%, then it was time to cut prices to customers (rather than continue to increase compensation to workers). It is not clear how the 15% figure was arrived at.

average US factory, but did not come close to offsetting the low pay. In addition, the Massachusetts plants are located in an area with a very high cost of living.

Under piece rates, individual operators had a strong incentive to figure out how to do their jobs as quickly as possible. This led to a sustained 2-3% annual productivity improvement over the decades, according to Mr. K, the older manager. But piece rates did not promote the teamwork necessary to meet customers' new demands for just-in-time delivery of high-quality products that changed frequently. Increasingly, jobs were automated. Automation increased precision, but frustrated the efforts of those workers who wanted to work fast. Thus, in the Massachusetts plants, the end of the piece-rate system produced a large decline in average pay. However, this impact on satisfaction was mitigated in part by a perceived decline in work effort required.

At the time rate plants, however, workers perceived that the new management policies (including both VAG and lean production techniques) required a significant increase in effort. Since the VAG payout was generally low in these plants (in Massachusetts suburban, due to quality problems, in Ohio, due to the fact that lean techniques were implemented before the VAG was adopted), pay did not increase much to compensate for this effort.

Workforce recruitment . In the 1990s, the work force at the Massachusetts plants was composed largely of first-generation immigrants. About one-third of the work force was Vietnamese and one-third Cape Verdean. The rest was a mixture of immigrants from other countries, such as Poland, and US-born workers. About 60% was female. The work force was recruited by word of mouth rather than advertising. Many workers were related to each other. There were few blacks though the plant was in a majority-black area. At

the urban location, most workers walked or took public transportation to work. Turnover was low; at the time of our survey two-thirds of the workforce had been at SP for at least four years (table 1).

The Ohio plant was located in a rural part of the state, about 30 minutes from a medium-sized city where most of the managers lived. The company was started in the mid-1960s by a man universally known as Jack, who had innovative ideas for electronics products and a paternalistic management style. Layoffs were done on a voluntary basis, and Jack was often seen on the shop floor until he semi-retired and moved south (where he opened the Florida plant).

Both the Ohio and Florida plants were acquired in 2000 by SP for \$370 million. According to Mr. P, the firm had excellent market positioning, but Jack had not invested in the business in recent years, and operational effectiveness was slipping. Both Mr. P and local managers felt that Jack had negotiated a very good deal for himself, leaving behind a financial burden for the Ohio plant to overcome. There was growing tension between the Ohio managers and SP top management. In contrast to Mr. P's perception, the Ohioans felt that their company was making a good profit, but being dragged down by accounting charges made to reflect what SP felt were its managers' contribution to the business, and financial problems caused by SP's other plants

The Ohio workforce was very different from the Massachusetts plants. Everyone seemed to be native born, and all but a handful were white. The average age was 44, higher than in Massachusetts; about 20% appeared to be over 60. (Management explained that many of them worked to supplement retirement benefits obtained from working on a previous job.) Although there was a core of experienced workers (see table 1), turnover

was very high; 30% of those hired in 2000 had left by the end of the year (quit or were fired). In 2001, the starting wage for an assembler was \$6.85 per hour; after one year this increased to \$7.80; after 3 years to \$8.27. After 12 years, one assembler reported that she made about \$9 per hour. This was supplemented with an annual check that was called “profit-sharing”. The owner allocated a pool of money (based loosely on the past year’s performance) which was divided among the work force based on seniority and wages; the payment was typically equal to about two weeks’ wages. In contrast to the VAG, management did not emphasize the role of workers in affecting the payment, and the size of the bonus pool was subjectively determined.

The Florida plant had many similarities to the suburban Boston plant. It was relatively new, about 15 years old, and was capital intensive. Unlike Boston, the workforce has a large number of retirees who moved to Florida, and found that their retirement income and saving were insufficient. Consequently, the age of production employees was higher in Florida than at the other plants.

The plant manager in Florida Mr. Z said that the plant was built to serve as a semi-retirement location for the founder of the company. Consequently, the plant and the major offices for top management were in separate buildings. The manufacturing plant and its offices were plain with Spartan amenities. The main office complex had carpeted offices with windows, and were generally larger. The corporate meeting rooms and cafeteria were in office complex rather than in the plant.

Although most of the jobs involved watching and adjusting controls on machines and checking for defects, there were many difficult and tedious jobs. These included

packing parts, loading trucks; a particularly daunting job involved putting small round sensors into a hole the size of the eye of a needle for eight hours per day.

The UK plant (actually 3 small plants a mile or so apart) was located in a distant suburb of London, in a gentrifying area where housing prices were rising rapidly. The base wage had not been raised for several years, and the assembler rate of 4.60 pounds in 2002, was not much above the national minimum of 4.20. The former management saw the low wage as the plant's main source of competitive advantage, according to the new management. The base wage was raised to 4.83 per hour on January 1, 2003, with the possibility of a group bonus ranging from 0-40% , with the average at 14%. (In contrast to the VAG, which is plant-wide, this bonus was based on the efforts of one work cell (a dozen or so people). Management's idea was to transition the work force slowly toward a bonus based on larger number of workers, from an individual bonus (piece-rate) to a group bonus, to the VAG, which was to be implemented in spring 2003. The work force was overwhelmingly female ("mostly second earners", according to the HR director), and was about 20% Indian and 5% Chinese.

Quality programs. When we visited the Massachusetts plants again in 1998, it was clear that VAG was the centerpiece of management's strategy to make workers more aware of their impact on plant performance. Management put a lot of effort into figuring out what they considered to be a 'fair' formula (one that would yield a 10-15% payout if things went well). If the payout was too small, workers would be demoralized, if it was too big workers would be getting too much money. Managers also felt the formula needed to change if conditions changed, and so spent a lot of time explaining the changes and justifying them. Initially, the bonus pool was a function of the difference between current

productivity and 1991 productivity, with deductions for defects and bad deliveries. The bonus could not exceed 15%. In 1998, Mr. P told us that they would soon need to revise the benchmark year (“raise the bar”) so the company could meet the commitments it had made to Ford that it would reduce prices in exchange for a long-term contract. Materials and capital costs were not included in the formula, he said, because they were not under the control of most workers. Several mechanisms provided workers the opportunity to increase the bonus pool for everyone, and recognition for doing so. Among them were “The Last Chance Club” for workers who had caught a defect just before it went out the door. One example of a response (in 1995) was a flood of volunteers willing to sort through 80,000 parts to find the 5% that were defective in the 90 minutes before the customer’s truck came, on their own time. (This action avoided a \$1 per part air freight cost.) Members of the Last Chance Club get their names on a plaque in the lunchroom; those so inscribed (including management) seemed genuinely pleased at the honor. (The culprit in the case above turned out to be a vendor that shipped defective parts; this firm was put in SP’s continuous improvement program, in which someone from SP sits down every week with the firm’s president to monitor progress.) The gainsharing also played an important role in changing engineers’ incentives; ‘it used to be like pulling teeth to get engineers to leave their new products and solve problems on the floor. We need to leverage our 30% overhead as well as our 5% direct labor,’ said Mr. P in 1995. However, Mr. P observed in 1999 that the VAG seemed successful in getting on-time delivery, but not quality.

There were several mechanisms for management to communicate to employees. These built on some management communication initiatives started in the 1980s. Union

avoidance was the initial motivation for these initiatives, according to Mr. K., a semi-retired manager now in his 80s who had worked at the plant since the 1950s. (There had been several organizing drives in the past, but none since about 1987, a development he attributed to Mr. P's efforts to address problems quickly.) There are quarterly meetings with supervisors, monthly meetings with hourly workers (these are attended one or two representatives from each department, chosen by management) and quarterly meetings to discuss the gain-sharing results.

In 1998, management decided that materials and capital costs should be included in the VAG formula, so as to avoid the problem that the company might owe a large bonus even though it did not make any profit due to large investments or materials price increases.⁴ (In contrast, Lincoln Electric, another firm with a large incentive pay component, borrowed money to pay the bonus in a year when high worker productivity was combined with materials price increases and losses on acquisitions). The VAG formula became so complicated that "only three people in the company understand how it is calculated," said Ms. P. . However, almost all shop workers had a basic understanding that low productivity, defects, and delivery mistakes would cost them money. (However, especially in the early months of the program, some of the efforts made by workers seemed to go far beyond the individual monetary benefit they received (a defective part would cost each worker about \$1).

In 1995, there were continuous improvement teams in which 10-15% of work force participated. These were not in evidence in later visits. Instead, in 1998, the plants focused on obtaining ISO 9000 quality certification; there was some involvement by workers in writing their own job descriptions. In 2000, the plants undertook a Six Sigma

⁴ The 15% cap on the payout was also lifted at this time. (It was never a binding constraint.)

initiative, which was still going on in 1992. This program involves training supervisors and management as “Six Sigma black belts” (or green belts in the case of supervisors); they learn techniques for reducing inventory and lead time, and for analyzing quality data. Operators join with supervisors and engineers to improve line layout, but according to one supervisor I talked with, they contribute very few useful ideas. Overall, the improvement efforts have helped the urban plant to reduce costs by 3% every year since 1986. (Interestingly, this figure is similar to the 2-3% productivity improvement that Mr. K said that operators on piece rates achieved.) At the time of survey, the plants seemed to be placing less emphasis on suggestions to change the process, and more on training to take over supervisory functions, and avoid mistakes. This last is in response to quality problems that have meant the VAG payout in the suburban plant was zero in the year preceding the survey. (The urban plant continued to average 7-10%).

The efforts to set up complementary programs that would allow workers to have an influence on plant performance was much less consistent in the other plants. In the UK, there was no such effort. In Florida, there was an effort to train workers to avoid defects. We attended a company meeting where the emphasis was on the costs to the company of defective parts. The key message was that small numbers of defects can lead to large costs that harm the VAG bonus to production employees. The emphasis during the meeting was for employees to attempt to catch mistakes, rather than think of innovations. There were occasional meetings where

In Ohio, the main improvement activity at the time of our visits was the “War on Waste” program (WOW). This program was led by an engineer (Mr. S.), who was truly an evangelist for lean production. In 1994, he had gotten the plant enrolled in a program

sponsored by the Toyota Supplier Support Program, even though the plant has never had Toyota business. Several Toyota engineers had helped the plant with projects to improve the flow of product through the plant. According to Mr. S's calculations, WOW has saved the plant 2-3% of sales in the two years since its inception. Almost all of the ideas seem to be generated by technicians and engineers. "We don't involve operators enough. We do it hardly at all—this is a failing." Mr. S did what he could to encourage participation, believing that "People want recognition, not more pay. You could increase pay and still have dissatisfied employees." Participation in small ways is rewarded; about 10% (by rough estimate) of operators were wearing a WOW T-shirt or using a WOW pencil on the day we conducted the survey. However, this program was really the brainchild of Mr. S, who called himself "the Wizard of WOW"; he received little reinforcement for his efforts from top management. When SP re-organized the management bonus pool after acquiring the company, Mr. S was no longer included, leading to a significant cut in pay and status for him.

IV. Methods

Plant Visits and Surveys

We visited each of the Massachusetts plants three times, in 1995, 1998, and 2000, and the urban plant again in 2002. We visited the Ohio and Florida plants each 3 times in 2002, and the UK plant 3 times in 2003. At each visit, we spoke with managers and toured the plant. As part of the survey process, we conducted focus groups with workers (without management present), and talked with workers as they filled out the surveys. We also made a presentation of our findings to the management of each plant.

Estimation Strategy

Our efforts to isolate the impact of the VAG on productivity and satisfaction involve two types of tests. First, we do a before and after comparison of a) the Massachusetts plants, and b) the Florida plant. Second, we use the plants as controls for each other. We compare the MA plants and the Florida plant for 1996 to 2000 to the Ohio and UK plants. We also compare Florida and Ohio for the year 2001, a period in which Florida had adopted VAG, but Ohio had not. In a similar manner we use the UK facility as a control for the other plants. Finally, we aggregate all the plants and time periods to examine the potential impacts of VAG.

In order to suggest that this was a quasi-natural experiment, we will need to show that the plants are similar except for the adoption of VAG. The production processes at all five plants are quite similar, involving assembly of small, complex electronic and plastic-molded parts. These areas of the five plants are remarkably similar. All plants also have in-house engineering. The level of productivity at the Massachusetts plants is higher than at the other ones, but this is due largely to the greater productivity of engineers there; these engineers increasingly design products to be produced at SP's other plants as well. Engineers made up a relatively constant 13% of the workforce in Boston, and nonproduction workers ranged from 25-30%. In addition, the Ohio, Florida, and UK establishments each had plastic molding departments, while Boston did not. Assembly worker jobs and pace of work are remarkably similar across plants, according to the management groups.

V. Results

Worker and Establishment Characteristics

In Table 1 we present a summary of the characteristics of the employees in the four U.S. establishments. We find that there is some diversity among the four establishments in the type of jobs performed. For example, there are more assemblers in the Massachusetts establishments relative to the Ohio and Florida ones. Further, there are more part-time employees in the Massachusetts plants than in either Ohio or Florida. Since the Florida establishment is relatively new, it is not surprising to find that there are fewer employees with 10 or more years of experience than at the other plants.

In Table 2, we estimate the impact of the changes relative to other plants in the same company that produce largely the same product. Since the capital to labor ratio is high in these plants, only a small part of the change can be attributed to human resource policy changes. Furthermore, the basic means of the difference in difference values do not account for factors like capital or general trends, which are likely to influence plant level performance.

In order to control for the potential shortcomings of these basic results, in table 3 we provide regression estimates using the Florida plant as the comparison plant relative to the Ohio establishment, and Massachusetts relative to Florida. Our estimates for the variable (Florida x “after”) are the estimates of the coefficient on the implementation of the policy, and it shows if the policy change mattered. [Our estimates show that for most of the estimates the change to a VAG method of pay and its complementary practices in Boston resulted in an increase in the various measures of firm performance, ranging from productivity, gross profits, and operating profits, as long as a time counter is not included. In Table 3 we highlight the impact of VAG on productivity; see Appendix tables for the other measures.

The difference between results with and without time trend suggests that even in Boston, the impact of the VAG was sufficient to keep the plant on the same improvement path it had been on before, but was not great enough to move the plant onto a more steeply-sloped improvement path. An interpretation more generous to VAG (and the one preferred by the firm's managers) was that all productivity improvement since 1995 should be attributed to it (including improvements due to increasing capital and to increasing design intensity). The argument is that because under piece-rate any change to the production process requires re-rating the job and risks for both profits and wages, these improvements would have been very difficult to make under the old system.

None of the only comparisons between the Florida plant and the Ohio plant showed a significant increase in VAG.

Table 5a suggests one reason why VAG was effective in improving firm performance in Boston, but not elsewhere. In our worker satisfaction survey, we also asked several questions about workers' perception of the adoption of productivity-enhancing policies, such as clear feedback to employees, and investigation of root causes of defects. As the table shows, Boston scores significantly higher on each of these measures than any of the other plants. Our argument is that these complementary policies are key to allowing workers to actually make changes that will result in a larger VAG payout. Where these policies are not present, workers may want to increase productivity to increase their bonus, but they lack the tools to do so.

All of the U.S. plants were more productive than the one in the U.K. As we discuss below, we think this is due mostly to managerial policies and not much a result of country-specific regulations or culture..

When we aggregate all the plants by month in Appendix Table 2 we find that the VAG policy implementation was positive on productivity in both specifications and increased productivity by about 10 percent in the more conservative specification. The impacts on profits were generally positive but not precisely estimated. The results suggest that VAG provides stronger incentives than time-rate pay or piece rates.

What Affects Employee Satisfaction?

We find that worker satisfaction varies a great deal by plant. However, the UK plant averages are significantly lower than the averages for the US plants. Workers who perceived that they made more money under VAG were more satisfied. Workers who reported working harder under VAG also were more satisfied (the causality here may be reversed.)

The basic survey instrument we used to examine employee satisfaction was the Minnesota Satisfaction Survey (MSS). We then we added questions to examine the impact of the pay systems in each plant. The baseline questions were of a Likert-type 5 point scale. The MSS has been used by industrial psychologists for almost 50 years to gauge employee satisfaction. We also asked questions of the employees about their tenure with the company, type of job, and pay policies.

In our attempt to examine the determinants of satisfaction we distinguish between a number of factors that go beyond the effect of the policies of the company. From the research literature in psychology we know that there are individual differences that impact job satisfaction (Arvey et. al. 1991). Moreover, the specific question asked of the respondents is also of importance, the central questions about job satisfaction measure different qualities as attachment to the job, quality of supervision and other attributes.

Consequently these factors should be accounted for in any attempt to examine what is under the control of the firm versus other exogenous factors. Even though the overarching policies adopted by the firm were at the plant level, group or team effects are also likely to influence satisfaction with work (Judge, Thoreson, Bono, and Patton, 2001). Finally the policies at the plant are also likely to impact employee satisfaction.

In Table 3 we show how much of the variation in total satisfaction can be explained by the more than 2000 employees of SP who responded to the satisfaction survey. Not surprisingly, the greatest part of satisfaction can be explained by individual factors, or the person effect. This explains about 40 percent of overall job satisfaction. All the other factors are statistically significant but small in comparison to the individual differences. The smallest factor is the plant of employment, which can only explain about one percent of the total variation in overall satisfaction. Although plant level policies may be statistically important, they would be considered small by any standard metric.

The Job Satisfaction of Immigrants

At the inner city Boston and suburban plant we were able to gather more detailed information on the job satisfaction of employees. We were informed that a high percentage of the employees were immigrants from Vietnam and Cape Verde, and could not speak or write in English. Consequently, we translated our questionnaire into Vietnamese and Portuguese; respondents chose the language in which they wanted to take the survey. Thus, we are able to differentiate individuals in the plant by their degree of assimilation to English. In addition, we compare the degree of satisfaction with work with English-reading and writing individuals within the plant to persons whose main

language is Vietnamese and Portuguese. Further we compare their level of satisfaction to persons in the other plants whose main language is English.

The results of the mean answers to questions we posed in the questionnaire are presented in Table 4 by language and plant. We also give a difference in means test result for persons in the four plants by language. The English speakers in the Boston facilities were the least satisfied. In six of the eight categories their responses were statistically significantly below the means of the other plants. In contrast the mean values of the Vietnamese language takers were generally above the mean. The persons from Cape Verde, who took the questionnaire in Portuguese, were usually below the mean, but the results were not statistically significant.

By probing these results more closely, we find that Vietnamese language speakers were also less likely to perceive themselves as having many labor market opportunities relative to persons who were literate in English or Portuguese. For example for the question “It would be hard for me to find another job that provides the pay and benefits that this one does.” the individuals who answered the question in Vietnamese said that they would have the most difficulty with a mean value of 3.2. In contrast persons who answered in English had a mean value of 2.7 and person who answered in Portuguese had a mean value of 3.0. Persons who were fluent in English perceived their labor market opportunities as the best among the three groups.

We also examined the level of self reported “cooperation” or “getting along” among the three groups of individuals who took the survey in the different languages. The persons answering in the Vietnamese language scored a relatively high level of satisfaction in getting along with co-workers and in their higher measured respect for co-

workers. For example the mean value for the 5-point scale was 3.6 and 3.7 for Vietnamese and 3.2 and 3.3 for the English and 3.2 and 3.6 for Portuguese. Similarly Vietnamese and Portuguese survey takers had higher levels of pride in working for the company. On the scale the average level was 3.6 for English, 3.9 for Vietnamese and 4.0 for Portuguese.

We also estimated a regression equation of the determinants of employee satisfaction with controls for type of job, shift worked of the employee, and time at the company. We found that English speakers in the Boston facilities were significantly less satisfied than the other two groups even after the addition of these controls.⁵

Did the Change in HR practices Affect Overall Satisfaction?

As part of the effort to examine the overall effects of the HR practices on employee satisfaction we examine the change in the method of pay on employee satisfaction. Next, we examine the relative impacts of working harder and making more money on overall satisfaction.

In Table 5 we show the impact of the change in the HR practices on the change in satisfaction. For the mean employee at SP the impact was generally small. However, the satisfaction of employees who changed from time rates to VAG (ie, mean values of 3.11 and 3.03) were higher than employees who changed from piece rates to VAG (mean values of 3.04 and 2.88). This may be due to the cut in pay that persons who were under piece rates experienced after switching to the VAG formula.

⁵ About 10% of those who took the survey in English did so not because they were fluent in English, but because we had not translated the survey into their language. (The largest such group was from Poland; they worked through the questionnaire diligently, with dictionaries and help from co-workers.) Thus, the differential labor market opportunities for fluent English speakers are probably greater than our estimates.

In Table 6 we show the coefficient estimates from a regression equation where the dependent variable is the change in satisfaction and the independent variable is the response to working harder under the new system and the increase in pay. In all cases the values for the independent variables are statistically significant. Not surprisingly, the values for increasing pay is about five times larger than for working harder. Working harder seems to increase job satisfaction, perhaps tied to the strong view about having pride in the company, but having more pay is of considerably greater importance.

Although there seem to have been small impacts of the changes to a VAG system of pay on productivity and employee satisfaction, data from the firm suggest that profitability increased, especially when compared to the industry. SP's profitability increased in part because of the firm's ability to become a "full service" supplier to auto firms, but also because the plants that were paid by piece rate methods were able to offer more diverse new products that had higher profit margins (Freeman and Kleiner, 1998). In addition, worker's compensation costs at the urban plant were cut in half after the move away from piece rates, for a savings of \$200,000 per year (an amount equal to 10% of the direct labor payroll).⁶

VI. Conclusions

As Tables 3 and 4 show, changing to VAG increased productivity even in the most restrictive specification. Introduction of the VAG also produced a one-time profit increase in Boston. We argue that this was due to a) change from piece rate allowed introduction of new products more quickly, and allowed inventory reduction b)

⁶ According to data provided by the company, workers' compensation expenses incurred averaged \$203,000 per year from 1996-99 (after the transition to gain-sharing was completed), and \$413,000 from 1989-1995. (These figures are uncorrected for inflation, or the growth in hours worked over this period, similar-sized adjustments that move in opposite directions.)

management undertook a lot of complementary activities (explained how the VAG worked, created the Last Chance Club), and c) stable work force. The impact of the pay cut from getting rid of piece rates was offset by the reduction in work effort required. However, the VAG did not put the Boston plant on a new path for increased profitability (as shown by the results with time trend). The reason is that management did not continue to deepen the efforts for continuous improvement, and also, as the company got more geographically spread out, the ability of product designers to see how their products actually got made was reduced.

Introducing the VAG at the Ohio and Florida did not have an impact on profits because a) time rates had not frustrated implementation of new products b) the VAG was not well explained to workers or supported by complementary efforts at continuous improvement from top management c) workers perceived that they were being asked to work a lot harder (faster pace, more pressure for quality) for little to no extra pay. Introducing VAG in Britain had no effect, despite piece rates, because of the abysmal efforts by mgt to explain the VAG, lack of complementary efforts and perceived increased effort/pay.

National differences

We find it hard to attribute the differences we found (lower worker satisfaction and lower productivity in the UK plants) to national institutions. We did not hear complaints from managers (many of whom were familiar with conditions in the US) about restrictive work rules, and did not observe any differences in work rules—management in all plants seemed to have complete freedom to assign workers anywhere in the plant. The US plants had made a commitment to workers to avoid layoffs. This was

especially true in the two acquired plants; the previous owner made it known that he had a year's worth of salaries in the bank, which he used to cushion downturns. The UK plants had no such commitments.

Rather we believe that the diversity of outcomes is a reflection in large part of sample selection bias. SP chose a low-productivity UK plant to buy, because SP believed that their management skills would allow the US firm to turn around the UK firm so that it returned economic value greater than its cost of purchase. A similar logic was evident in the purchase of the Ohio and Florida plants, which also had lower productivity than Boston. A variety of sources attested to the low quality of the British management team: SP top executives, workers we interviewed, and our own observation of disorganization, poor communication, and capricious behavior. Pay levels had not kept pace with inflation, and were significantly below the national and regional averages for manufacturing.

However, these plants' productivity levels did not catch up to Boston's; in fact, the differential increased. In part this could be due the larger research and development that takes place in the Boston facilities, and the early introduction of higher profit margin products in these plants. Following their introduction in the Boston facility the products are then introduced in other plants in the company's system.

Another reason for the lack of productivity convergence has to do with SP's lack of experience as a multiplant firm. The firm's strategy was based on buying up underperforming plants with similar products, and then introducing the innovations made in the Boston plant to the new locations. However, while SP management was quite skilled in the Boston plant, they appeared not to have learned how to communicate with

(or incentivize) other management teams. Management satisfaction in the acquired plants was quite low, and in our visits we heard much grumbling about top management's lack of understanding of their situation.

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We did find one issue that is linked to institutions: access to immigrant labor and other workers with limited alternatives.. Across all of our plants, access to alternative employment was negatively correlated with satisfaction. We found this result both directly (satisfaction was negatively correlated with answers to our question about how easy it would be to find an equivalent or better job) and indirectly. In the Massachusetts plants, we translated the survey into Portuguese and Vietnamese; those who took the survey in these languages were more satisfied than those whose English skills were good enough to take the survey in English. In England, we observed that immigrant workers expressed more satisfaction in interviews.

The case of SP suggests the following generalizations:

1. Managers often introduce new plans without a) understanding the importance of complementary efforts⁷, or b) thinking thru the incentive effects on workers (they are more concerned with making sure they don't pay 'too much', and fall victim to the multi-task problem (they pay too much attention to minimizing costs that can easily be measured, while ignoring costs that are harder to measure, or that would constrain management autonomy if measured, like overhead).

⁷ This is true even of highly successful managers. By most measures, SP has been a financially successful company. Although the second half of 2000 and 2001 were tough years and profits were relatively low, this was true for almost all firms in the auto industry. In other years, the firm's return on equity was between 12 and 20%. SP achieves this performance without being a particularly high-productivity operation; value added per shop worker at the Ohio plant is only \$70,000, not far above the median for component producers, according to bench marking data from the Industrial Technology Institute.

2. it is possible to introduce a kind of 'lean from above', that mimics some of the Toyota results on inventory and quality by having management do much of the continuous improvement efforts that are done by workers at Toyota. SP has focused on inventory reduction and having engineers design for manufacturing. These efforts have allowed SP to use a relatively unskilled, low-paid work force to produce at low cost. SP has not, on the other hand, placed much emphasis (particularly recently) on broad-based participation where ideas for continuous improvement come from both line workers and engineers). There are outlets for the ambitious other than union organizing or griping, such as team leader positions and participation in programs such as WOW, or the Last Chance Club. But the 'mistake-proofing' is sufficiently successful that a moderately motivated person can do the job successfully.

Particularly in the acquired plants, it seems that the company has changed the pay/effort bargain with workers (consciously or not). The work used to be moderately paced, allow one to sit down, and jobs were secure. Future pay increases are at risk with VAG, and the introduction of work cells means that workers rotate jobs and work standing up—a drawback for the older workers that have formed a significant part of the plant's work force.

What are the benefits of SP for workers? One way to characterize them is that "workers at SP do fairly well compared to their alternatives".

An optimist would emphasize the "do well " part, pointing out that SP's wages are high by world standards, and that SP's worker satisfaction levels are not much below national averages, and that many SP workers stay there for a long time. From the

perspective of SP employees, it seems there are several reasons why many stay. First, the firm pays good benefits, including health care, pension, and paid vacation. The extra pay provided by the VAG is important. In the Massachusetts suburban plant applications for openings fell dramatically after the VAG pay out fell from almost 7% to zero. Second, the firm has found work forces that perceive themselves as having few labor market options. The firm hired many immigrants in Massachusetts, retirees and other rural workers in OH, and older workers and retirees in Florida. Third, in both Massachusetts plants the sense of community provided by working with others of the same ethnic group, and sometimes the same family, in a plant that is perceived as well managed provides many first generation Americans a sense of economic and cultural security .

A pessimist would also agree that "workers at SP do fairly well compared to their alternatives"—but would focus on how bad the alternatives are. In this view, the worker satisfaction measures capture mostly that workers don't feel they can do much better.

Even with the VAG, SP pays well below the standards of a “living wage” adopted by many American cities. The VAG bonus pool is calculated very carefully by management, and many safeguards are put in to avoid too large a payout. However, the entire annual expenditure for the VAG incentive for the 200 shop floor workers in the urban plant is about \$200,000—the salary of one top manager. From this point of view the impact of the changes in product and HR strategies is to give managers and stockholders more new products without paying a higher wage (and in the case of the urban plant, paying a lower wage). Workers report that they work harder, and now that they work for a public company rather than a paternalistic owner, they are subject to

layoffs. However, at least the firm survives, offering a fairly high probability of continued employment.

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Exhibit 1: Time line of introduction of Value-Added Gain-sharing (VAG)

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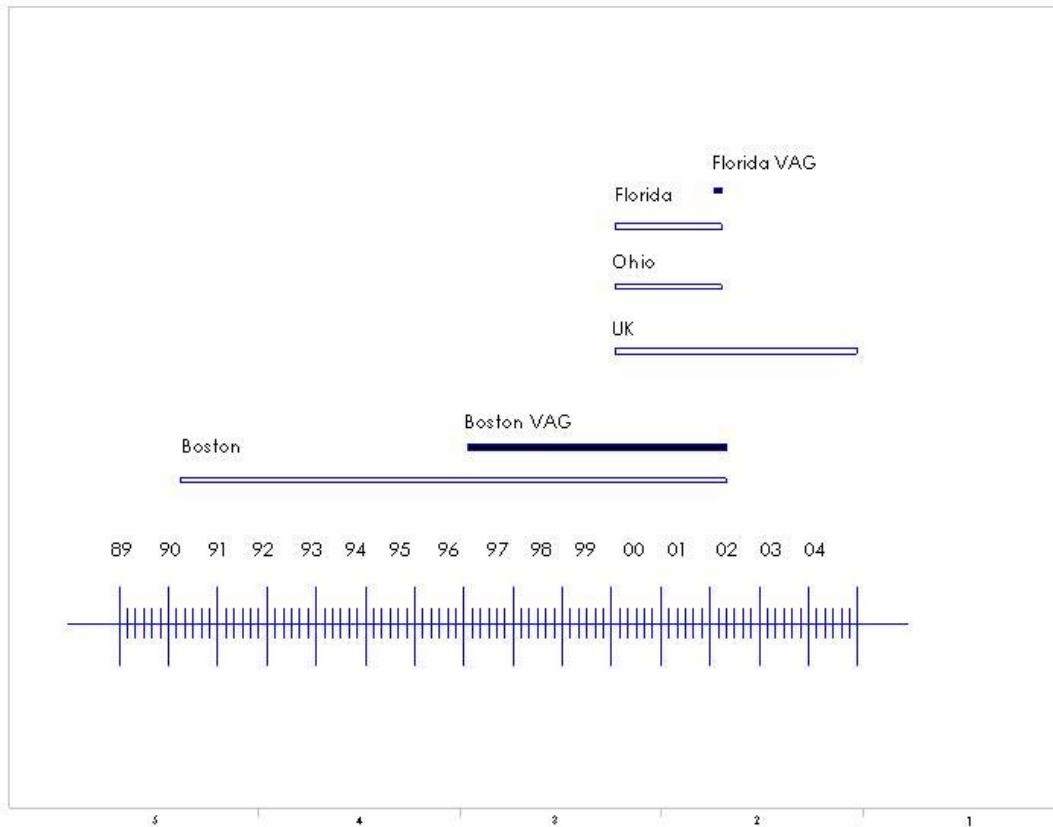


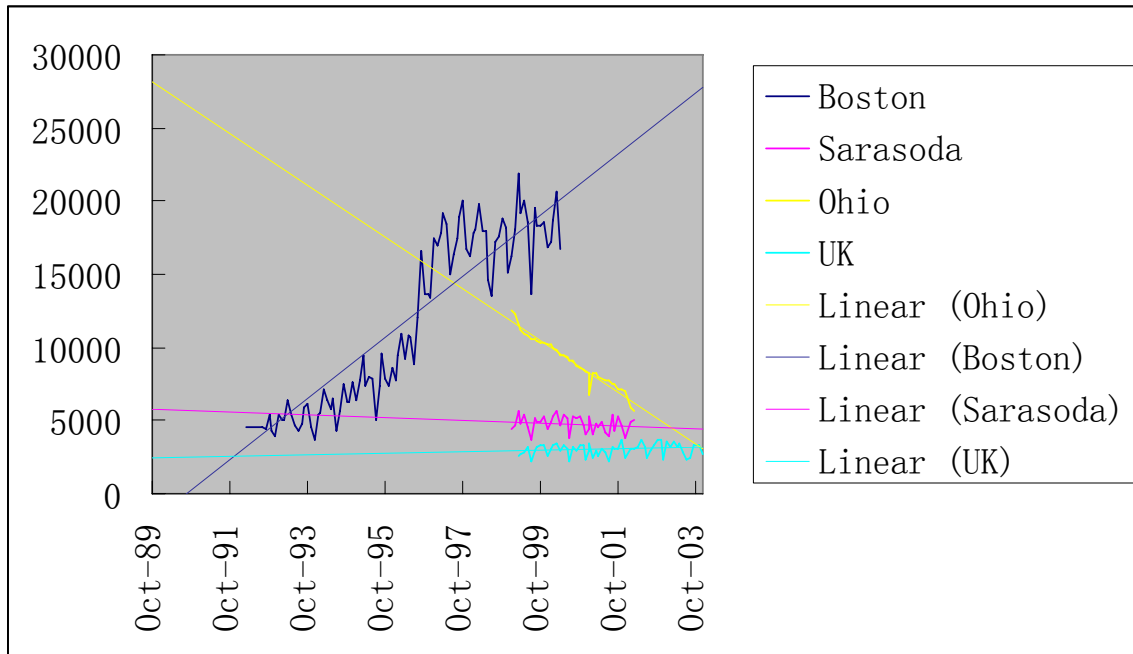
Exhibit 2. summary results

Plant and Year of Survey	Satisfaction	Asset Per Employee (000)'s	Profit Per Employee (000)'s	Labor Cost Per Employee (000)'s
Boston 2000	3.24 (0.93)	98.42 (2.84)	5.71 (0.77)	0.70 (0.14)
Florida 2001	3.37 (0.80)	55.37 (4.98)	1.84 (0.46)	0.77 (0.16)
Ohio 2000	3.26 (0.84)	38.02 (2.41)	3.75 (0.59)	0.61 (0.06)
UK 2003	2.68 (0.79)	25 (1.00)	1.09 (0.29)	1.04 (0.11)

Note:

1. Overlapped time periods: March 1999 to April 2000
2. Satisfaction here are the combination of survey questions 2, 5, 7, 9, 10, 11, 13, 14, and 15, on a 1-5 scale.
3. All in US dollars

Exhibit 3. summary chart of sales



Note: “Sarasoda” = plant in Sarasota, FL.

Table 1: Production Employees Characteristics at SP

	N	% Assemblers	% Part-time	% less 1 year	% 1 to 4 years	% 4 to 6 years	% 6 to 10 years	% more than 10 years
Mass. Urban	233	63	17	12	27	14	12	36
Mass. Suburban	285	71	13	12	33	26	13	16
Ohio	615	55	0.6	4	35	17	20	25
Florida	482	44	1.1	17	37	18	22	7

Table 2. Estimates of the Results of Changes from TimeRate/Piece-Rate to VAG Relative to No Change

<u>Net Sales Per Employee</u>	Before (log value)	After (log value)	Difference	Difference in- Difference
Florida (Changed from Time-rate to VAG from January 2001)	2.051	2.118	6.93%	
<i>Ohio</i> (No Change in January 2001)	2.224	2.244	2.02%	4.91

<u>Gross Profit Per Employee</u>	Before (log value)	After (log value)	Difference	Difference in Difference
Florida (Changed from Time-rate to VAG from January 2001)	0.508	0.421	-8.33%	
<i>Ohio</i> (No Change in January 2001)	1.263	1.165	-9.33%	1.0

<u>Operating Profit Per Employee</u>	Before (log value)	After (log value)	Difference	Difference in-Difference
Florida (Changed from Time-rate to VAG from January 2001)	0.114	-0.742	-57.51%	
<i>Ohio</i> (No Change in January 2001)	1.016	0.881	-12.63%	-44.89

<u>Material Cost Per Employee</u>	Before (log value)	After (log value)	Difference	Difference in-Difference
Florida (Changed from Time-rate to VAG from January 2001)	0.834	0.900	6.82%	
<i>Ohio</i> (No Change in January 2001)	1.249	1.177	-6.95%	13.77

Table –Continued

<u>Net Income Per Employee</u>	Before (log value)	After (log value)	Difference	Difference in-Difference
Florida (Changed from Time-rate to VAG from January 2001)	0.114	-0.790	-59.51%	-33.44
<i>Ohio</i>	1.007	0.705	-26.07%	
(No Change in January 2001)				

<u>Value Added Per Employee</u>	Before (log value)	After (log value)	Difference	Difference in-Difference-
Florida (Changed from Time-rate to VAG from January 2001)	1.714	1.754	4.081%	1.997
<i>Ohio</i>	1. 1.714	1.813	6.078%	
(No Change in January 2001)				

Note: data for Florida and Ohio plants drawn from January 1999 to March 2002.

<u>Net Income Per Employee</u>	Before (log value)	After (log value)	Difference	Difference in-Difference
Massachusetts (Changed from Piece-rate to VAG from 1996)	0.101	0.967	137.7%	
Florida (No Change in 1996)	-2.268	-0.915	211.1%	73.4

Note: data for Florida and Massachusetts plants drawn from Oct. 1989 to December 2000.

Table 3. Time-Series Cross-Section Models

<u>BOSTON vs OHIO</u>	Log Value Added per Employee	Log Value Added per Employee
Lagged Log Value Added per Employee	---	0.09 (0.09)
Log Assets per Employee	-0.00 (0.03)	-0.00 (0.03)
Boston	0.22*** (0.04)	0.20*** (0.04)
After	-0.04 (0.06)	-0.03 (0.07)
Boston*After	0.26*** (0.07)	0.23*** (0.08)
Adjusted R^2	0.62	0.62
N	135	134

<u>BOSTON vs UK</u>	Log Value Added per Employee	Log Value Added per Employee
Lagged Log Value Added per Employee	---	0.16** (0.08)
Log Assets per Employee	0.32* (0.18)	0.28 (0.18)
Boston	0.76*** (0.24)	0.62** (0.25)
After	-0.10* (0.05)	-0.06 (0.05)
Boston*After	0.31*** (0.06)	0.24*** (0.07)
Adjusted R^2	0.95	0.95
N	156	154

<u>FLORIDA vs OHIO</u>	Log Value Added per Employee	Log Value Added per Employee
Lagged Log Value Added per Employee	---	0.07 (0.12)
Log Assets per Employee	-0.11* (0.06)	-0.11* (0.06)
Florida	-0.06	-0.05

	(0.05)	(0.05)
After	0.24* (0.13)	0.25* (0.13)
Florida*After	-0.04 (0.07)	-0.04 (0.07)
Adjusted R^2	0.12	0.10
N	76	75

<u>FLORIDA vs UK</u>	Log Value Added per Employee	Log Value Added per Employee
Lagged Log Value Added per Employee	---	0.21** 0.10
Log Assets per Employee	0.09 (0.11)	0.04 (0.10)
Florida	0.78*** (0.10)	0.64*** (0.12)
After	-0.04 (0.05)	-0.04 (0.05)
Florida*After	-0.06 (0.18)	0.01 (0.17)
Adjusted R^2	0.86	0.87
N	97	95

<u>OHIO vs UK</u>	Log Value Added per Employee	Log Value Added per Employee
Lagged Log Value Added per Employee	---	0.15 (0.10)
Log Assets per Employee	0.02 (0.03)	0.02 (0.03)
Ohio	0.96*** (0.05)	0.81*** (0.11)
Adjusted R^2	0.88	0.88
N	95	94

<u>ALL PLANTS</u>	Log Value Added per Employee	Log Value Added per Employee
Lagged Log Value Added per Employee	---	0.71*** (0.04)
Log Assets per	0.22***	0.07***

Employee	(0.02)	(0.02)
	0.76***	0.20***
Boston	(0.05)	(0.05)
	0.31***	0.08*
Florida	(0.05)	(0.04)
	0.49***	0.13***
Ohio	(0.05)	(0.04)
	0.07	0.02
VAG	(0.05)	(0.03)
Adjusted R^2	0.74	0.88
N	271	268

Notes:

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Standard errors in parenthesis

Value Added = Net Sales – Material Cost – Labor Cost

Boston monthly data from March, 1992 to April, 2000

Florida monthly data from January, 1999 to March, 2002

Ohio monthly data from March, 1999 to March, 2002 (value added data also available for February, 1999)

UK monthly data from March, 1999 to December, 2003

Boston introduced VAG in January, 1996

Florida introduced VAG in January, 2001

Table 4. **Time-Series Models**

<u>BOSTON</u>	Log Value Added per Employee	Log Value Added per Employee
VAG	0.22*** (0.03)	0.18*** (0.04)
Log Assets per Employee	0.09 (0.18)	0.09 (0.18)
Lagged Log Value Added per Employee	---	0.17* (0.10)
Adjusted R^2	0.40	0.41
N	98	97

<u>FLORIDA</u>	Log Value Added per Employee	Log Value Added per Employee
VAG	0.14 (0.15)	0.15 (0.15)
Log Assets per Employee	-0.07 (0.09)	-0.08 (0.09)
Lagged Log Value Added per Employee	---	0.19 (0.17)
Adjusted R^2	0	0
N	39	38

Notes:

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Standard errors in parenthesis

Value Added = Net Sales – Material Cost – Labor Cost

Boston monthly data from March, 1992 to April, 2000

Florida monthly data from January, 1999 to March, 2002

Boston introduced VAG in January, 1996

Florida introduced VAG in January, 2001

Table 5a. Complementary policies to improve productivity

	Boston	Florida	Ohio	UK
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
In my work unit, people have a clear understanding of their roles and responsibilities	3.66 (1.12)	3.37*** (1.18)	3.42*** (1.15)	3.14*** (1.17)
I regularly get communication from my supervisor (or group leader) about my performance	3.26 (1.34)	2.91*** (1.24)	2.89*** (1.28)	2.58*** (1.26)
When an external customer (like Ford or Chrysler) finds a problem, I learn about it	3.62 (1.15)	3.28*** (1.24)	3.13*** (1.23)	3.08*** (1.17)
When a problem is found in my work unit, we change our procedures to make sure the problem does not happen again	3.97 (1.06)	3.55*** (1.12)	3.43*** (1.09)	3.31*** (1.20)

Table 5: Impact of Working in the establishments on net income per employee

	DF	Sum of Squares	Mean Square F Value		Pr > F
Model	128	253.65	1.98	2.23	0.0003
time	126	150.64	1.20	1.34	0.0968
Place	2	103.01	51.50	57.86	<.0001
Error	63	56.08	0.89		
Corrected Total	191	309.73			
R ²	0.82				

Note: The ANOVA sample include employee financial data from Massachusetts, Florida, and Ohio Plant.

Table 6: Impact of Working on Piece Rates on Job Satisfaction of Production Employees in the Massachusetts Establishments*

	Job Satisfaction	
	(1)	(2)
Piece Rate	0.24 (0.24)	0.24 (0.24)
Vietnamese	0.38 (0.16)*	0.26 (0.16)
Cape Verde	0.11 (0.17)	0.02 (0.17)
Tenure Less Than 1 Year	0.05 (0.21)	0.13 (0.22)
Tenure Between 1 and 6 Years	0.26 (0.14)	0.23 (0.14)

Lack of Other Jobs		0.22 (0.05)**
Adj. R ²	0.02	0.07
N	361	361

*Standard errors are in parenthesis.

Table 8: Impact of Changes in Satisfaction after moving to VAG*(assembler only)

<u>From Piece Rate to VAG</u> <u>MASS.</u>	Change in Job Satisfaction after VAG	Change in Job Satisfaction after VAG
Working Harder Under VAG	0.20** (0.08)	
Making more money Under VAG		0.55*** (0.08)
Making Suggestions	-0.02 (0.07)	0.01 (0.06)
Vietnamese	0.76*** (0.28)	0.29 (0.26)
Cape Verde	0.23 (0.29)	-0.23 (0.27)
Adj. R ²	0.07	0.29
N	131	127

<u>From Time Rate to VAG</u> <u>MASS.</u>	Change in Job Satisfaction after VAG	Change in Job Satisfaction after VAG
Working Harder Under VAG	0.41*** (0.08)	
Making More Money		0.51*** (0.08)
Making Suggestions	-0.01 (0.06)	0.02 (0.06)
Vietnamese	0.53** (0.23)	0.30 (0.22)
Cape Verde	0.31 (0.27)	0.27 (0.25)
Adj. R ²	0.18	0.29
N	146	145

<u>From Time Rate to VAG</u> <u>FLORIDA</u>	Change in Job Satisfaction after VAG	Change in Job Satisfaction after VAG
Working Harder Under VAG	0.47*** (0.07)	
Making More Money		0.49*** (0.07)
Making Suggestions	0.03 (0.05)	0.09* (0.05)
Adj. R ²	0.22	0.25
N	158	161

*Standard errors are in parenthesis

<u>From Piece Rate to VAG</u>	Change in Job Satisfaction	Change in Job Satisfaction
<u>UK</u>	after VAG	after VAG
Working Harder Under VAG	0.53*** (0.08)	
Making More Money		0.58*** (0.07)
Making Suggestions	-0.05 (0.06)	-0.05 (0.06)
Adj. R ²	0.30	0.36
N	110	110

<u>From Time Rate to VAG</u>	Change in Job Satisfaction	Change in Job Satisfaction
<u>UK</u>	after VAG	after VAG
Working Harder Under VAG	0.61*** (0.07)	
Making More Money		0.73*** (0.08)
Making Suggestions	0.10* (0.06)	-0.12** (0.05)
Adj. R ²	0.41	0.45
N	97	98

Table 9: Perception of Employees on the Shift in Compensation on Overall Pay (Massachusetts)

Urban Massachusetts (from piece rate to VAG)

	Making more money under VAG (%)	Working Harder Under VAG (%)
Strongly Disagree	26.21	18.42
Disagree	22.76	13.16
Neither agree or Disagree	25.52	23.68
Agree	14.48	25.00
Strongly agree	11.03	19.74

Urban Massachusetts (from time rate to VAG)

	Making more money under VAG (%)	Working Harder Under VAG (%)
Strongly Disagree	18.92	14.19
Disagree	11.49	12.26
Neither agree or Disagree	36.49	34.19
Agree	21.62	29.68
Strongly agree	11.49	9.68

Suburban Massachusetts (from piece rate to VAG)

	Making more money under VAG (%)	Working Harder Under VAG (%)
Strongly Disagree	20.23	11.45
Disagree	21.97	9.77
Neither agree or Disagree	28.32	34.48
Agree	17.92	24.71
Strongly agree	11.56	16.67

Suburban Massachusetts (from time rate to VAG)

	Making more money under VAG (%)	Working Harder Under VAG (%)
Strongly Disagree	13.17	9.36
Disagree	21.95	18.23
Neither agree or Disagree	31.71	31.53
Agree	22.44	30.05
Strongly agree	10.73	10.84

Florida

	Making more money under VAG (%)	Working Harder Under VAG (%)
Strongly Disagree	11.31	11.83
Disagree	25.82	23.66
Neither agree or Disagree	32.82	36.83
Agree	23.73	21.65
Strongly agree	6.87	6.03

UK (from piece rate to VAG)

	Making more money under VAG (%)	Working Harder Under VAG (%)
Strongly Disagree	30.00	23.03
Disagree	24.00	25.66
Neither agree or Disagree	35.33	37.50
Agree	6.00	6.58
Strongly agree	4.67	7.24

UK (from time rate to VAG)

	Making more money under VAG (%)	Working Harder Under VAG (%)
Strongly Disagree	26.67	20.59
Disagree	19.26	22.06

Neither agree or Disagree	45.19	40.44
Agree	8.15	10.29
Strongly agree	0.74	6.62

Table 10: Making More Money after VAG* (Assemblers only)

<u>From Piece Rate to VAG-MASS.</u>	Making More Money after VAG	
Working Harder Under VAG	0.26***	(0.08)
Making Suggestions	-0.06	(0.07)
Vietnam	0.90***	(0.26)
Cape Verde	0.90***	(0.28)
Adj. R ²	0.15	
N	127	

<u>From Time Rate to VAG-MASS.</u>	Making More Money after VAG	
Working Harder Under VAG	0.46**	(0.08)
Making Suggestions	-0.04	(0.06)
Vietnam	0.65***	(0.21)
Cape Verde	0.23	(0.25)
Adj. R ²	0.26	
N	145	

<u>From Time Rate to VAG - UK</u>	Making More Money after VAG	
Working Harder Under VAG	0.57***	(0.08)
Making Suggestions	0.03	(0.06)
Adj. R ²	0.32	
N	110	

<u>From Time Rate to VAG -UK</u>	Making More Money after VAG	
Working Harder Under VAG	0.53***	(0.07)
Making Suggestions	0.05	(0.05)
Adj. R ²	0.37	
N	98	

<u>From Time Rate to VAG - FLORIDA</u>	Making More Money after VAG
Working Harder Under VAG	0.47*** (0.07)
Making Suggestions	-0.06 (0.05)
Adj. R ²	0.21
N	158

3. * Standard errors are in parenthesis

Appendix

Table a2: Impact of Working on Piece Rates on Job Satisfaction of Production Employees in the Massachusetts Establishments*- Rasch Measure of Job Satisfaction

	Rasch Measure of Job	Rasch Measure of Job
	Satisfaction	Satisfaction
	(1)	(2)
Piece Rate	0.09 (0.20)	0.11 (0.20)
Vietnamese	0.33** (0.14)	0.19 (0.14)
Cape Verde	0.04 (0.14)	-0.04 (0.14)
Tenure Less Than 1 Year	0.27 (0.18)	0.36** (0.18)
Tenure Between 1 and 6 Years	0.28** (0.12)	0.28** (0.12)
Lack of Other Jobs		0.23*** (0.04)
Adj. R ²	0.03	0.11
N	376	358

*Standard errors are in parenthesis.

Appendix Table 1. Time Series Cross Section Regression Results

<u>BOSTON vs OHIO</u>	Log Sales per Employee	Log Sales per Employee
Log Assets per Employee	-0.07* (0.03)	-0.06 (0.04)
Boston	0.69*** (0.08)	0.13*** (0.04)
After	0.02 (0.07)	-0.08 (0.08)
Boston*After	0.08 (0.09)	0.51*** (0.08)
Time Trend	Yes	No
R ²	0.78	0.69
N	142	142

<u>BOSTON vs OHIO</u>	Log Gross Profit per Employee	Log Gross Profit per Employee
Log Assets per Employee	-0.12** (0.05)	-0.11* (0.06)
Boston	0.70*** (0.13)	0.03 (0.06)
After	0.09 (0.10)	-0.03 (0.11)
Boston*After	-0.13 (0.14)	0.39*** (0.12)
Time Trend	Yes	No
R ²	0.50	0.38
N	141	141

<u>BOSTON vs OHIO</u>	Log Operating Profit per Employee	Log Operating Profit per Employee
Log Assets per Employee	-0.22** (0.11)	-0.19 (0.12)
Boston	1.02*** (0.28)	-0.36*** (0.13)
After	0.11 (0.22)	-0.14 (0.24)
Boston*After	-0.40 (0.30)	0.66** (0.26)
Time Trend	Yes	No
R ²	0.34	0.19
N	141	141

<u>BOSTON vs UK</u>	Log Sales per Employee	Log Sales per Employee
Log Assets per Employee	0.28 (0.18)	-0.43** (0.19)
Boston	1.31*** (0.22)	1.50*** (0.26)
After	0.05 (0.06)	-0.26*** (0.06)
Boston*After	-0.01 (0.10)	0.70*** (0.07)
Time Trend	Yes	No
R ²	0.95	0.93
N	163	163

<u>BOSTON vs UK</u>	Log Gross Profit per Employee	Log Gross Profit per Employee
Log Assets per Employee	0.06 (0.41)	-0.88** (0.39)
Boston	2.58*** (0.49)	2.85*** (0.53)
After	0.24* (0.14)	-0.17 (0.12)
Boston*After	-0.39* (0.23)	0.52*** (0.14)
Time Trend	Yes	No
R ²	0.89	0.88
N	160	160

<u>BOSTON vs UK</u>	Log Operating Profit per Employee	Log Operating Profit per Employee
Log Assets per Employee	-1.38 (0.98)	-2.92*** (0.88)
Boston	5.68*** (1.16)	6.25*** (1.17)
After	-0.17 (0.33)	-0.80*** (0.27)
Boston*After	-0.07 (0.54)	1.34*** (0.31)
Time Trend	Yes	No
R ²	0.78	0.76
N	148	148

<u>FLORIDA vs OHIO</u>	Log Sales per Employee	Log Sales per Employee
Log Assets per Employee	-0.18*** (0.07)	-0.11* (0.06)
Florida	-0.10** (0.05)	-0.14*** (0.05)
After	0.20 (0.12)	0.20 (0.12)
Florida*After	-0.01 (0.07)	0.02 (0.07)
Time Trend	Yes	No
R ²	0.34	0.28
N	76	76

<u>FLORIDA vs OHIO</u>	Log Gross Profit per Employee	Log Gross Profit per Employee
Log Assets per Employee	-0.30** (0.13)	-0.24** (0.11)
Florida	-0.66*** (0.09)	-0.69*** (0.09)
After	0.32 (0.22)	0.31 (0.22)
Florida*After	-0.06 (0.13)	-0.03 (0.11)
Time Trend	Yes	No
R ²	0.72	0.71
N	76	76

<u>FLORIDA vs OHIO</u>	Log Operating Profit per Employee	Log Operating Profit per Employee
Log Assets per Employee	-0.26 (0.39)	-0.32 (0.35)
Florida	-0.84*** (0.28)	-0.81*** (0.27)
After	0.42 (0.70)	0.42 (0.69)
Florida*After	-0.76* (0.40)	-0.78* (0.39)
Time Trend	Yes	No
R ²	0.43	0.43
N	74	74

<u>FLORIDA vs UK</u>	Log Sales per Employee	Log Sales per Employee
Log Assets per Employee	-0.09 (0.09)	0.14 (0.11)
Florida	0.85*** (0.09)	0.52*** (0.10)
After	-0.04 (0.04)	-0.05 (0.05)
Florida*After	0.07 (0.14)	-0.12 (0.18)
Time Trend	Yes	No
R ²	0.87	0.79
N	97	97

<u>FLORIDA vs UK</u>	Log Gross Profit per Employee	Log Gross Profit per Employee
Log Assets per Employee	-0.39 (0.26)	-0.13 (0.26)
Florida	1.39*** (0.26)	1.01*** (0.23)
After	-0.15 (0.12)	-0.15 (0.13)
Florida*After	0.49 (0.42)	0.27 (0.43)
Time Trend	Yes	No
R ²	0.59	0.55
N	95	95

<u>FLORIDA vs UK</u>	Log Operating Profit per Employee	Log Operating Profit per Employee
Log Assets per Employee	-0.79 (0.71)	-0.28 (0.68)
Florida	2.84*** (0.71)	2.11*** (0.63)
After	-0.50 (0.41)	-0.49 (0.41)
Florida*After	0.49 (1.15)	0.07 (1.16)
Time Trend	Yes	No
R ²	0.45	0.41
N	81	81

<u>OHIO vs UK</u>	Log Sales per Employee	Log Sales per Employee
Log Assets per Employee	-0.09*** (0.03)	0.00 (0.03)
Ohio	1.01*** (0.05)	0.82*** (0.05)
Time Trend	Yes	No
R ²	0.89	0.83
N	95	95

<u>OHIO vs UK</u>	Log Gross Profit per Employee	Log Gross Profit per Employee
Log Assets per Employee	-0.17** (0.07)	-0.08 (0.07)
Ohio	1.95*** (0.13)	1.76*** (0.11)
Time Trend	Yes	No
R ²	0.83	0.82
N	93	93

<u>OHIO vs UK</u>	Log Operating Profit per Employee	Log Operating Profit per Employee
Log Assets per Employee	-0.29* (0.16)	-0.09 (0.15)
Ohio	3.36*** (0.29)	2.96*** (0.25)
Time Trend	Yes	No
R ²	0.77	0.75
N	81	81

Appendix Table 2 Aggregate Plant estimates of the Impact of VAG

<u>All Plants</u>	Log Sales per Employee	Log Sales per Employee
Log Assets per Employee	0.14*** (0.02)	0.14*** (0.02)
VAG	0.10* (0.06)	0.28*** (0.04)
Boston	1.00*** (0.09)	0.67*** (0.04)
Florida	0.26*** (0.05)	0.17*** (0.05)
Ohio	0.49*** (0.05)	0.47*** (0.05)
Time Trend	Yes	No
R ²	0.77	0.75
N	278	278

<u>All Plants</u>	Log Gross Profit per Employee	Log Gross Profit per Employee
Log Assets per Employee	0.16*** (0.04)	0.15*** (0.04)
VAG	0.05 (0.10)	0.18** (0.07)
Boston	1.53*** (0.15)	1.29*** (0.07)
Florida	0.41*** (0.09)	0.34*** (0.09)
Ohio	1.22*** (0.08)	1.21*** (0.08)
Time Trend	Yes	No
R ²	0.74	0.74
N	275	275

<u>All Plants</u>	Log Operating Profit per Employee	Log Operating Profit per Employee
Log Assets per Employee	0.12 (0.09)	0.12 (0.09)
VAG	-0.16 (0.25)	0.14 (0.17)
Boston	2.39*** (0.38)	1.84*** (0.18)
Florida	0.92*** (0.23)	0.78*** (0.21)
Ohio	2.04*** (0.20)	2.01*** (0.20)
Time Trend	Yes	No
R ²	0.47	0.47
N	259	259
