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How Can We Develop Enough Skills for a Robust Manufacturing Industry?

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Introduction

Skills drive productivity, competitiveness, and incomes. Economic growth is heavily dependent on the growth in human capital. According to Eric Hanushek and Ludger Weissmann (2015), raising the quality of skills of a workforce can generate a substantial payoff in economic growth. What they see as important is cognitive skills and not simply increases in schooling. Another conventional view is that educational attainment is a good proxy for skills. Goldin and Katz (2008) argue increases in schooling in the U.S. have not kept pace with the growth in technological change that U.S., thereby resulting in slow growth in incomes and rising economic inequality.

Notwithstanding the broad consensus connecting skills and economic growth, we see less agreement on whether the current work force is sufficiently skilled for current and future jobs and careers. Some academics, consulting firms, and managers argue that the weak skills of many American workers as leading to skill shortages and limiting potential economic growth (Deloitt 2011; Carnevale, Smith and Strohl 2010). News articles often highlight skill shortages, especially in construction, manufacturing, and health care (Campoy 2015; Sparshott 2015). One striking indication of a skills gap or mismatch is that German companies operating in the United States identify job skills as a key challenge to their success in the U.S. and have encouraged the German Embassy to start a "Skills Initiative" to identify and share information about best practices in sustainable workforce development.[1] Most of the German and Swiss companies concerned about skills are in the manufacturing industry. The decline in U.S. unemployment rates could increase the severity of skill shortages. A recent McKinsey report highlights skill

[1] See http://www.germany.info/skillsinitiative for more detail.

shortfalls in Europe as well, indicating that 74 percent of education providers were confident that their graduates were prepared for work, but only 38 percent of youth and 35 percent of employers agreed. Manufacturers have been especially outspoken about skill shortages.

Others reject the skill shortage hypothesis and assert that skills in the United States are not in short supply (Cappelli 2015; Abraham 2015; Osterman and Weaver 2014). Cappelli argues that the skill mismatches arise primarily because the average worker and job candidate have *more* education than the current job requires. Osterman and Weaver focus on manufacturing and find that, "…three quarters of manufacturing establishments do not show signs of hiring difficulties." However, they also find shortfalls in high level math and reading and that these shortfalls predict the level of long-term vacancies. Further, their analysis took place in 2012, before the sharp increases in manufacturing employment.

In defining gaps, one must ask what is meant by skills. Often, the debate deals primarily with academic skills and educational attainment (Carnevale, Smith and Strohl 2010), when employers are primarily concerned about occupational competencies and such employability skills as communication, teamwork, allocating resources, problem-solving, reliability and responsibility. A Houston staffing agency recently reported that 60% of job seekers are disqualified because of weak basic skills or testing positive for drugs (Campoy 2015). In Houston, builders reported not finding enough workers with appropriate occupational skills, such as carpenters, electricians, plumbers, and other craftsman (Sparshott 2015)

Too often, the skills debate fails to focus on the level and quality of occupational skills. While the Osterman-Weaver survey examined both the need for academic skills (math, reading, and writing) and employability skills (communication, teamwork, and problem-solving), it did

not ask about satisfaction with the quantity and quality of occupational skills. Perhaps, manufacturing companies that complain about skills are especially concerned about whether they can find enough workers who have mastered relevant occupations.

The presence of a skills mismatch and what skills are lacking are clearly relevant to discussions of employer-led training. After all, if workers with the requisite skills are readily available in the job market, what is the need for employer training or indeed any training?

In fact, the issue is complex. A common assumption in debates about skill gaps is that the distribution of jobs is fixed, independently of the system for educating and training workers to fill the jobs. Suppose, instead, that the job distribution depends at least partly on the products of the education and training system. In this case, when the emerging skills from the system are weak, firms can respond by developing positions with limited skills, productivity, and wages. Alternatively, a system that turns out workers with high skills can attract employers to offer jobs requiring skills and productivity.

The comparative benefits of the skill development approach used in Germany and Switzerland may be responsible for the ability of these two countries to maintain manufacturing employment at rates well above those in the U.S. As Figure 1 highlights, the share of jobs in manufacturing in Germany is double the percentage of manufacturing jobs in the U.S. Switzerland employs nearly one in four workers in manufacturing or construction, while only about one in seven U.S. workers are employed in these goods-producing industries. Thus, while skill gaps suggest a weakness in the training system, education and training might be suboptimal even without significant skill gaps.

This paper examines key workforce issues in manufacturing. It begins with an analysis of manufacturing employment, especially the workforce directly involved in production. After looking at issues arising with the skills and aging of workers, the focus shifts to the methods of training workers in occupational skills. I argue that U.S. public policies should do much more to emphasize work-based learning and apprenticeship approaches and deemphasize the "academic only" approach embedded in the college-for-all philosophy. While some high school career and technical education (CTE) programs, community and career colleges perform well, most suffer from low graduation rates and weak linkages with employers. In contrast, apprenticeship programs are far more cost-effective. They generate higher gains in earnings and improved productivity, all at substantially lower cost than community or career colleges. Policymakers are beginning to understand the strengths of apprenticeship but public support remains tilted to college programs and away from work-based programs.

What Are the Manufacturing Jobs?

Manufacturing companies require workers in a diverse array of occupations. As Table 1 shows, production occupations make up the majority of jobs, but just barely. However, about two of three jobs are in production, transportation and material moving, or installation, maintenance, and repair occupations. Average annual salaries in manufacturing are only slightly higher than salaries in all payroll employment.

Turning to specific occupations within these three broad categories, we note that about 300,000 jobs are occupied by welders; nearly 500,000 are jobs for electronic repairs and installation; nearly 200,000 for wood workers; and 76,000 plant and systems operators. In the transportation field within manufacturing industries, nearly 200,000 drive motor vehicles,

including 126,000 who operate heavy and/or tractor-trailer trucks. Some are highly specialized. For example, about 90,000 work in jobs called “paper goods machine setters, operators, and tenders.” These individuals set up, operate, or tend paper goods machines that convert, sawing, corrugating, banding, wrapping, boxing, stitching, forming, or sealing paper or paperboard sheets into products. Many of the concerns about shortfalls in manufacturing positions have been concentrated in skilled production occupations, including relatively specialized skills. In addition, often managerial occupations require some skills related to the production processes.

Job and Earnings Patterns in Indiana Manufacturing

Technical change and stagnant real growth have sharply reduced the role of manufacturing employment in the economy. Between 1988 and 2008, the share of jobs in manufacturing dropped from 17 percent to about 10 percent. The 2008-2010 recession hit manufacturing hard in all states. Jobs declined by 15 percent in manufacturing but only 5 percent overall.

In Indiana, the manufacturing sector has proved somewhat more resilient than in the nation as a whole. While manufacturing jobs in Indiana declined since 1998 by nearly 25 percent, this reduction was lower than the national decline of 38 percent. Moreover, after 2009, Indiana manufacturing jobs rose by over 12 percent, nearly recovering all the losses in the recession. The 12 percent growth in Indiana manufacturing jobs from 2009-2014 was triple the 4 percent growth nationally. Figure 2 shows the far stronger performance in retaining manufacturing jobs in Indiana, as compared to Illinois. In 1998, Illinois boasted 30 percent more jobs than Indiana. By 2014, Illinois manufacturing jobs were only 13 percent higher than in Indiana, even though the Illinois population is double the population of Indiana.

The wage advantage in Indiana manufacturing appears far higher than for the nation as a whole. The national data, based on surveys conducted by the Bureau of Labor Statistics, show manufacturing wage levels are relatively similar to wages in the private economy. In sharp contrast and according to data drawn from employer quarterly earnings reports (for the unemployment insurance system) and compiled by the U.S. Census Bureau, monthly manufacturing earnings in Indiana are one-third higher than monthly earnings in all other industries. As of the third quarter of 2014, the earnings of Indiana workers in manufacturing averaged $4,707 ($56,548 on an annual basis). In contrast, monthly earnings for Indiana workers in all other industries averaged only $3,379 ($40,548 on an annual basis). It is difficult to explain whether the differences relate to the data or to some special attribute of Indiana. The earnings advantage is especially high among those without a BA degree. For example, high school dropouts averaged $47,500 on an annual basis in manufacturing jobs but only $32,500 in all other sectors. Thus, Indiana manufacturing companies provide good jobs, especially to workers in the sub-baccalaureate market.

Who Are Indiana's Manufacturing Workers?

The employment and wage records compiled by the U.S. Census provide information on the age, ethnicity, sex, and education composition of manufacturing and non-manufacturing employment in Indiana. The minority share in Indiana manufacturing mirrors the minority share in all employment, at about 14 percent. However, black workers are underrepresented and Hispanic workers are overrepresented. Over 70 percent of manufacturing workers are men; in contrast, men make up only 47 percent of workers in all other industries. Overall, manufacturing workers are considerably older than the average worker. Over 50 percent are

over 45 years old, compared to 42 percent of all non-manufacturing workers. The aging of the manufacturing workforce is a potential concern, especially with a continuing need for older workers to mentor younger workers and to pass on the accumulated knowledge that long-term experience brings.

The education picture is mixed. The share of manufacturing workers with a BA degree is lower than the comparable share of non-manufacturing workers (16.3 vs. 19.5 percent). However, non-manufacturing industries employer a much higher share of younger workers who have not yet completed their education. The vast majority of manufacturing workers—about 64 percent—have a high school diploma and not college (34 percent) or some college but no BA (30 percent). Unfortunately, we lack data on the share of manufacturing and other Indiana workers with some valued occupational credential, such as a license or apprenticeship completion.

Is manufacturing experiencing skill shortages or skill mismatches?

The question about shortages is often not well-articulated. To an economist, markets resolve shortages by increasing prices, thereby increasing the supply and lowering the demand until the supply-demand equilibrium is reestablished. However, this step presupposes the fully flexible wages and requires time for the market to adjust. Wages may not be flexible even in non-union firms because changing the wages of some occupations may affect the wages of other occupations in ways detrimental to the firm. Wage increases large enough to attract workers into the field may be infeasible for firms competing against foreign suppliers. Thus, whether because of time or short-term wage inflexibility, firms may experience shortages of particular classes of workers.

A second possibility is that firms are able to hire for a particular occupation but they find that the quality of workers in the market for the relevant occupation is not sufficient to achieve high levels of quality, quantity, and innovation. Firms "make do" with the available workers. At the time of hiring, firms may not even have sufficient information to determine whether the job applicant will meet the expected qualifications. In selected manufacturing positions, including welders, millwrights, mill operators and skilled electro-mechanical workers, the quality of the worker can be highly variable. Certainly, employers report great difficulty finding someone who can master the field.

A third possibility, highlighted above, is that the small number of well-trained workers in key manufacturing occupations limits the investment by U.S. and especially foreign companies. Several German and Swiss companies have pointed to a weakness in this segment of the labor market as a barrier to expanding their operations in the U.S. These manufacturing companies are attracted by the low energy costs in the U.S. but are deterred by the absence of a well-developed system for training high skilled workers to master various manufacturing occupations.

Without a mechanism for training a sufficient number of skilled workers, a variety of manufacturing operations may simply not take place in the U.S. Alternatively, good jobs may be replaced by high cost automation of procedures. In either case, economists looking at the market might not be able to observe a shortage, but the failure of a well-structured training system ends up wiping out high quality manufacturing jobs in the U.S.

Do Community and Career Colleges Crowd Out Employer Training for Occupational Skills?

Compared with many countries, U.S. employers fall well short in the provision of occupational training for young people. Apprenticeship programs in Germany, Switzerland, Austria, Australia, and increasingly in the United Kingdom are widespread, often reaching over 50 percent of young people. In the U.S., apprenticeship training registered with the Department of Labor takes place at later ages and for only about 2-3% of a cohort and less than 0.2 percent of the workforce. In sharp contrast, apprenticeships make up 3.7% of the employed population in Australia, 3.7% in Germany, 2.6% in Canada, 1.8% in England, and 1.7% in France.

U.S. apprenticeships generally involve adults and are concentrated in the industrial and commercial construction industries. Completing an apprenticeship typically requires 3-4 years of work-based learning and classroom instruction. In the construction occupations, employer investments are substantial and apprentices gain highly respected credentials. However, partly because of the decline in construction employment, the number of civilian registered apprenticeships has fallen sharply, from 450,000 in 2007 to 315,000 in 2014. Increases in apprenticeships within branches of the military have partly offset this decline, rising from 52,000 in 2008 to 95,000 in 2014.[2] Many apprenticeships take place outside the registered system, but national data on these unregistered apprenticeships are minimal.

Why are employers not doing more to "grow their own"? To staff a work force with occupational and other key skills and knowledge, firms decide on a "make or buy" approach. Some choose to "buy" by hiring workers from the market or private or public education and training programs. Others choose to "make" by sponsoring training to bring workers up to high-level qualifications. Economists have theorized that financing general (occupational)

[2] These data come from the Office of Apprenticeship, http://www.doleta.gov/OA/data_statistics.cfm.

training will not be cost-effective because of the risk of poaching, as other firms hire away the trained workers. Since the added productivity makes workers more valuable both inside and outside the firm, firms financing the training will be unable to recoup their investment by paying the newly trained worker a wage less than his or her newly enhanced level of productivity. Competitors will hire the worker away from the company providing training or bid up the trained worker's wage to the new productivity level.

For some firms, the low levels of company training relates to the erosion of lifetime employment and the reduced job tenure, limiting the ability of firms to recoup their training investments. An older literature (Piore and Doeringer 1971) looked closely at segmented labor markets, where some employers choose to train, hire from within, and keep workers for long periods, while others operate mostly on the spot market, hiring and firing frequently and providing little training. Researchers find that organizations that are large, promote from within, and have formalized job structures provide more worker training. Moreover, Osterman (1995) shows that organizations make tradeoffs between training existing workers and hiring workers with previously developed skills and that organizations train more when they use flat hierarchies, worker involvement, and teamwork and devolve decision making to the line level. Still, even in manufacturing jobs, while experience is critical and job durations are longer than in other industries, it is still tempting to try to hire from the market or from providers of occupational training, such as community colleges or career colleges.

Since the benefits of developing general skills go mainly to individuals and cannot be easily captured by firms, government and individual funding of investments in skills seems appropriate. After all, it is the worker, not any one firm, who should benefit from added

occupational skills. Policymakers may accept the notion that it is unreasonable to ask employers to bear the costs of general training if they cannot recoup the benefits because of concerns about other firms "poaching" workers.

In years past, the public high schools provided at least some occupational training through vocational education programs (now relabeled career and technical education programs). But high school CTE programs have been on a declining path, despite strong evidence for quality programs in Career Academies and some regional vocational schools (Kemple 2008).

Instead, the "go to" institutions expected to conduct occupational training are the community and career colleges. These programs offer two-year associates' degrees (AA) and certificates in a variety of occupational fields. The occupational fields for AA degrees vary from health professions, to computer and engineering-related fields, and to general business degrees. For-profit career colleges offer a wider array of fields, though the single largest fields are in the health professions. In 2012-2013, public and private programs of less than two years awarded 171,000 certificates in health care, 47,000 in various business fields, 38,000 in personal and culinary services, 26,000 in law enforcement, and 24,000 in transportation and materials moving (mostly truckers). Overall, public and private institutions granted nearly 1 million certificates and about 1 million AA degrees.

Whether by intention or not, government spending on the career programs provided by community and career colleges dwarfs any government support for apprenticeship and other work-based learning programs. Just in Pell grants aimed at helping low- and moderate-income individuals attend college, the federal government spends about $8 billion on community and

career colleges. Additional government spending on community and career colleges comes from state and local funding, government job training dollars, as well as from federal loan programs. Overall, outlays by community and career colleges are in the range of $65 to nearly $80 billion. The cost per student ranges from about $10,000 to over $20,000.

What are the results? As Harry Holzer (2012) points out, the outcomes are often weak, with low completion rates (especially for low-income and minority students) and too many students stuck in remedial classes. Even when students earn a degree, many are mismatched for jobs in most demand and employers are often dissatisfied with their workplace skills and their ability to apply what they have learned. In a highly school-based system, there are few mechanisms for assuring a close linkage between employer demand and skill development.

Although the evidence shows earnings gains accrue to workers who earn an AA degree or a certificate, graduation rates from these programs are quite low, especially for publicly-funded two-year programs. For those first-time and full-time students entering degree or certificate programs in 2010 at two-year postsecondary institutions, about 29 percent graduated within 150 percent of the normal period of the program. In the case of public two-year programs, typically community colleges, the graduation rate was only 19.5 percent overall and only 10.8 percent among black students. For-profit programs boast a 63 percent graduation rate, but earnings gains for these students are often modest.

From the standpoint of manufacturing employers, community and career colleges are generally failing to penetrate key skill development fields. Very few quality programs provide the kind of high level occupational training used in manufacturing. Moreover, students in community and career colleges rarely access the work-based learning that comes with training

and on-the-job work experience. Only in the health care professions is work-based learning typically embedded in the AA or certificate programs. This weakness may be one reason why empirical evidence indicates the earnings gains from programs linked with work-based learning outperform school-based career programs.

There are generally weak interactions between U.S. employers and educational institutions. Although some community colleges and private training providers offer tailored training to firms, educational institutions are generally not well connected to employers, not even in career and technical education (CTE) programs. Nonetheless, employers often expect high schools, community colleges, and career colleges will provide the training individuals require for effective work in specific occupations. Yet, many come away disappointed in the results.

Why Should Employers Train?

One rationale for providing general training is the role of imperfect and asymmetric information. Employers providing training are often in a better position to judge the worker's productivity than are outside employers (Katz and Ziderman 1990). In their landmark article, Acemoglu and Pischke (1999) provide a theoretical rationale for employer occupational training, demonstrating how firms can optimize their hiring and training strategies in several ways, depending on the structure of the labor market and the potential permanence of the jobs. They also cite imperfect information and other market imperfections that can allow employers to pay trained workers less than the gain in their productivity without losing them to other firms. One reason is that the employers providing the training are in a better position to judge the worker's productivity than are outside employers. An employer knows only a modest

amount about workers when they enter the firm. One way of learning more is to observe how they learn, especially on the job. Another possibility is that general skills complement specific skills. As a result, increasing general skills raises workers' ability to use their specific skills. Interestingly, transparent skill standards could erode the information advantage for employers (Greeenhalgh 2002).

Imperfect information might be a reason to offer tuition benefits. Sorting workers with similar paper qualifications is difficult. But when tuition benefits are offered, the applicants with more interest in learning relative to other applicants with the same paper qualifications are more likely to apply and use the general training. These workers may have more motivation and an unmeasured skills advantage. Cappelli (2004) finds evidence to support the notion that workers who take up tuition benefits are more effective than other workers with the same observed characteristics.

With respect to skill upgrading, employers can limit training to workers most likely to benefit and to stay with the organization. Recognizing that some critical occupational skills can only be learned at the workplace, employers may choose to undertake some training while collaborating with educational institutions and coalitions of organizations in the same industry. Because hiring costs, skill requirements, and the best methods for learning relevant skills vary across occupations and industries, we would expect training patterns differ as well.

Still another issue is risk and uncertainty. Typically, employer investments in training are generally irreversible. Employers cannot take back knowledge or require reimbursements from workers after the fact. This irreversibility, combined with uncertainty about productivity outcomes from training, has implications for evaluating employer returns to training

investments (Jacobs 2007). In particular, the standard present value calculations do not necessarily serve as the correct guide. Instead, in an investment decision under uncertainty and irreversibility, one should take into account the option value of the additional trained worker. When the training is completed, the firm has the option but not the obligation to hire the trained worker and/or utilize the skills learned from training. This option value raises the firm's returns and increases the likelihood that they will invest in training. Leuven and Oosterbeek (2001) consider firm-specific investments in on-the-job training. Given uncertainty about the productivity returns from irreversible investments in particular workers, the firm's investment creates a real option that is especially valuable.

A recent paper by Blatter et al. (2015) highlights the incentive to train stemming from hiring costs that are high and that rise with the number of hires. The authors cite evidence that the costs of a skilled hire can be one to two quarters of wages. Using data from Switzerland, they find that a one standard deviation increase in average hiring costs is associated with more than half of a standard deviation increase in internal training in the form of added apprenticeship positions.

Employer-led training helps deal with the gaps between what is learned at school and how to apply these and other skills at the workplace and in the context of particular occupations. An extensive body of research documents the high economic returns to workers resulting from employer-led training (Bishop 1997; Veum 1999; Booth 1991;, Booth 1993). Transferring skills to the workplace works best with supervisory support, interactive training, coaching, opportunities to perform what was learned in training, and keeping the training relevant to jobs (Pelligrino and Hilton 2012). Several studies find training usually benefits firms

and yields external benefits, including gains for subsequent employers and for the public in avoidance of disasters as well as network externalities (as more are training in a common means of communication). In Britain, for example, a sophisticated panel study found that a 1% point increase in training is associated with about a 0.6% increase in industry productivity and a 0.3% increase in hourly wages. The productivity effect of training is twice as large as the wage effect, implying that existing studies have underestimated the benefits of training by focusing on wages. Moreover, the government generally gains by paying little for the training while reaping tax benefits from the increased earnings of workers.

Firms can benefit in several ways from employer-led training. At least as far back as 1962, learning by doing has been incorporated into models of economic growth (Arrow 1962). Bauernschuster, Falck, and Heblich (2009) document one mechanism affecting the firm and the economy: a positive impact of employer-led training on innovation. Using data on other firm characteristics as well as an identification strategy for causal inference, the authors find that a 10 percentage point increase in training intensity translates into an 11 percentage point higher propensity to innovate. Several studies show positive impacts of general training on firms' productivity and profitability (Barrett and O'Connell 2001; Bassi and McMurrer 2004; and Hanssen 2007).

The accounting treatment of human capital investments is one potential barrier to employer-led training. Training investments, like other investments, incur costs in one year, but accrue benefits accrue over several years. In the case of physical investments, the income statement does not assign the full costs of the investment in the year the purchase occurs, but rather only those costs that reflect the amount of the asset used up during the current year's

activity. In contrast, human capital investments undertaken in a particular year are fully expensed in that year. This policy reduces the after-tax costs of financial incentives for training. On the other hand, investments in human capital are not reflected in the balance sheet as an asset. As a result, the accounting information shows companies investing in human capital showing lower profits that would an accurate measure of the performance of firms.

Why Are Apprenticeship and Other Employer Training Programs So Limited in the U.S.?

One way to enhance occupational skills of U.S. manufacturing workers is to expand apprenticeship and other employer training programs. The financial returns to firms vary, but many recoup their investment within the apprenticeship period and others see their investment pay off after accounting for reduced turnover, recruitment, and initial training costs. Generally, the first year of apprenticeships involves significant costs, but subsequently, the apprentice's contributions exceed his/her wages and supervisory costs. Most participating firms view apprenticeships as offering certainty that all workers have the same high level of expertise and ensuring a supply of well-trained workers during sudden increases in demand and to fill leadership positions. Why has this approach not reached scale in the U.S.?

The best answer is—we haven't tried. While government spending on career-focused community and career colleges is in the range of at least $30-$40 billion per year, the budget for apprenticeship from federal and state sources is well under $50 million per year. In Ohio and Indiana, the U.S. Office of Apprenticeship has perhaps one or two individuals in charge of overseeing, marketing, and auditing apprenticeship programs. The U.S. is a laggard in supporting the academic/theoretical components of apprenticeship. Nearly every other

country with a robust apprenticeship system subsidizes at least the theoretical, usually school-based component of apprenticeship.

In some cases, state apprenticeship agencies have limited the scope of apprenticeship. In about half the states, employers register their programs directly with the federal Office of Apprenticeship. In another half, they at least begin by going through state apprenticeship agencies. Often, the agencies look at apprenticeships almost entirely through a construction lens. In doing so, they may take a long time to approve shorter apprenticeships that lack some components common in construction. In the case of California, the agency chose not to approve proposals on grounds that the state already had sufficient programs for a particular profession.

It is common for observers to attribute the low rates of apprenticeship in the U.S. to cultural and historical factors, arguing that the U.S. lacks the tradition of guilds and of respect for many trades and that parents steer their children toward college and away from apprenticeships. Some economists assume that firms have chosen rationally not to develop apprenticeships and ask the following question: "…if it makes sense for firms to hire apprentices, why aren't they doing so today?" The assumption of rationality is generally a powerful explanation and one that requires special evidence to overcome.

One test of this rationale for low use of apprenticeships is to examine how firms respond to learning about apprenticeships and how they can affect business operations. Another barrier to overcome is the absence of a well-specified system, with clear standards and government extensively providing relevant classroom-based instruction, limits apprenticeship expansion.

Two recent developments can be thought of as natural experiments testing the potential role of marketing, increasing information and technical assistance. If firms have been behaving with knowledge and self-interest in choosing not to offer apprenticeships, then changes in marketing, information, and technical assistance would presumably do little to stimulate firms to alter their hiring and training practices. However, if firms respond positively to marketing, information, and technical assistance by expanding apprenticeships, then firms can be convinced of the value added by apprenticeships. Put another way, just because firms did not see apprenticeships as profitable in the past does not necessarily mean that firms will not provide apprenticeships in the future when providing with appropriate tailored information about how valuable apprenticeships can be to the firm.

The interventions in South Carolina within the U.S. and England show that many companies can be persuaded to provide apprenticeship training, once the information and organization skills become available. South Carolina's successful example involved collaboration between the technical college system and a special unit devoted to marketing apprenticeship. With a state budget for Apprenticeship Carolina of $1 million per year as well as tax credits to employers of $1,000 per year per apprentice, the program managed to stimulate more than a six-fold increase in registered apprenticeship programs and a five-fold increase in apprentices. Especially striking is that these successes – including 4,000 added apprenticeships – took place as the economy entered a deep recession and lost millions of jobs. The costs per apprentice totalled only about $1,250 per apprentice calendar year, including the costs of the tax credit. Although apprentices often can access South Carolina's Technical College system and attend at

low cost sensible alternative for the classroom component, generally, the public sector in the U.S. pays little or nothing for the academic component of apprenticeships.

The marketing involved both statewide campaigns but more importantly sales and technical expertise provided to individual firms. The program provides free consulting so that firms learn how apprenticeships can work well in their organizations. The staff is made up of people with an excellent ability to listen to firms about their needs and, where appropriate, sell firms on how to build a talent pipeline through the use of apprenticeships. Apprenticeship Carolina works closely with the Economic Development units in trying to persuade firms that locating in South Carolina will allow them access to a good training system involving technical colleges and a structure for learning about and expediting apprenticeship training.

The director of Apprenticeship Carolina reports that once employers fully understand apprenticeship training, it becomes easy to convince them to start apprenticeship programs at their firm. In fact, once firms meet with an official representative from Apprenticeship Carolina, about 70-80 percent of firms have started apprenticeship programs.

Britain's success in expanding apprenticeships from about 150,000 in 2007 to over 500,000 in 2013 offers another example for how policies can stimulate apprenticeships, even among firms that previously had no interest in and little knowledge about apprenticeships. The National Apprenticeship Service and industry skill sector councils have provided national marketing and general information. Leaders from all political parties have strongly endorsed apprenticeship expansion. In addition, the British government has offered incentives to local training organizations to persuade employers to create apprenticeships. In addition, England's

apprenticeship system builds to some extent on the concepts and language of the National Vocational Qualification system.

As in South Carolina, England relies heavily on sales units within these training organizations to work closely with individual employers as a kind of retail marketing. Since 2007, private sector training providers and Further Education colleges (FE) persuaded over 100,000 companies to adopt apprenticeship training. Incentives are provided to small and medium enterprises at a rate somewhat higher the South Carolina tax credit. For all employers, the government pays a proportion of the training costs for apprentices, depending on their age; 100 percent of the training costs if the apprentice is 16-18, 50 percent of the training costs if the apprentice is 19-24, and up to 50 percent of the training costs if the apprentice is aged over 25. The results in England show that providing firms with useful information, help in making the transition, and funding for at least the related courses, many firms will start or increase apprenticeship programs.

In September 2015, the U.S. Department of Labor announced grants totaling $175 million to fund 46 projects to stimulate the development of apprenticeship opportunities in non-traditional occupations.[3] Although no grantees in Indiana won funding, the Illinois Manufacturers Association was awarded a $3.9 million grant to fund advanced apprenticeships. The Illinois consortium will be working with the German Chamber of Commerce of the Midwest and a public community college. Indiana manufacturers should look to this project and other manufacturing-oriented apprenticeship projects for lessons on how to stimulate more apprenticeships in manufacturing. Another organization worth including in the effort to expand

[3] See http://www.dol.gov/apprenticeship/grants.htm.

the number of highly skilled workers is the National Institute for Metalworking Skills. It has already developed skills standards and certification programs and accredits training programs for machinists and other precision manufacturing occupations.

Overall, the evidence is strong that it is feasible to stimulate firms to hire and train apprentices at scale even in countries without the cultural traditions and labor regulations that are said to be prerequisites for a robust apprenticeship system. Moreover, the apprenticeship expansions are likely sustainable given the results showing high returns to firms that use apprenticeship as a major part of their talent management strategies.

Employer-Led Training and School-Based Vocational Education

Several promising models that are emerging offer much closer linkages between employers and education and training providers. Georgia and Wisconsin now operate youth apprenticeship programs that provide opportunities to 16 to 19 year-olds. Both programs have been operating since the mid-1990s. In Georgia, 143 out of 195 school systems currently participate in the apprenticeship program serving 6,776 students. State funding pays for coordinators in local school systems and sometimes for required courses not offered in high schools. During their freshman and sophomore years, high school students learn about the possibility of joining the apprenticeship program as juniors and seniors. Students can then apply to participate in a structured program of at least 2,000 hours of work-based training and 144 hours of related coursework. The fields vary widely from energy to information technology, manufacturing, and transportation and logistics. Apprentices not only receive their high school diploma, but also a postsecondary certificate or degree, and certification of industry-recognized competencies applicable to employment in a high-skill occupation.

Educators, employers, parents and students play key roles. High schools are responsible for recruiting and counseling students, supporting career-focused learning, and assisting in identifying industry partners. Postsecondary schools participate in developing curriculum and dual credit arrangements. Businesses offer apprenticeship positions, provide each apprentice with a worksite supervisor, and ensure that apprentices gain experience and expertise in all the designated skills. The worksite supervisors must participate in mentor orientation and training so that they can serve as coaches and role models. Parents must sign an educational training agreement and provide transportation for the student. Finally, apprentices must maintain high levels of attendance and satisfactory progress in classes (both academic and career-oriented) and in the development of occupational skills at the worksite.

Youth apprentices in Georgia have higher rates of graduation from high school than comparable youth. Although there has been no rigorous evaluation of the Georgia program, participation has been growing among both companies and students. Employers report high levels of satisfaction with the apprentices and the apprenticeship program. Over 95 percent say the program has been highly beneficial to the company and that they would recommend the program to other companies. Participating companies report good quality student performance in problem-solving and communication skills. Despite these positive outcomes, there has been no long-term follow-up to determine impacts on employment, earnings, and post-secondary education.

The Wisconsin program offers one-to-two year apprenticeship options to 2,500 high school juniors or seniors, requiring from 450 to 900 hours in work-based learning and two to four related occupational courses. The program draws on industry skill standards and awards

completers with a Certificate of Occupational Proficiency in the relevant field. Some students also receive technical-college academic credits. Recently, Wisconsin's Bureau of Apprenticeship Standards has been tasked with integrating youth apprenticeship into the state's adult registered apprenticeship program.

Wisconsin youth apprenticeships are in food and natural resources, architecture and construction, finance, health sciences, tourism, information technology, distribution and logistics, and manufacturing. Recently, Wisconsin's Bureau of Apprenticeship Standards has been tasked with integrating youth apprenticeship into the state's adult registered apprenticeship program. Each broad field includes subfields specified with detailed skill standards. In health, for example, the broad pathways are therapeutic services, health informatics, and ambulatory support services. All pathways require core employability skills and knowledge of the health industry and safety in the job. Skill standards for therapeutic services pathway include dental assistant, medical assistant, nursing assistant, and pharmacy assistant. Health informatics involves operating all the software and managing the records for a medical office. Ambulatory support service modules cover imaging, other laboratory work, client services, dietary assistance, optometry, and physical therapy. Students in Wisconsin's Transportation, Distribution, and Logistics pathway acquire an extensive array of skills for supply chain management and mobile equipment maintenance. The equipment maintenance areas include collision repair, auto and light truck systems, and diesel technician. Within each of these areas, there are several units, covering topics from engine repair to electronic systems.

Several German companies with operations in the U.S., in collaboration with Swiss-American and American companies, regional high schools and community colleges, have played

central roles in creating high quality apprenticeship programs, mainly in manufacturing (Kamm and Lerman 2015). The occupations range widely, including tool and die maker, welding, CNC machinist, mechatronics engineering. States with significant programs include North Carolina, South Carolina, Florida and Michigan.

Renewed interest in quality high school CTE programs is evident as well, with potential company partners (Brody 2015). In New York City, which recently started 13 occupation-focused high schools, students can learn career relevant skills in areas ranging from police and fire, television production and graphic design, commercial diving, using 3-D printers, freight logistics, culinary arts, welding, and accounting. One serious concern about these schools is the limited emphasis on work-based learning and the achievement of certified mastery in an occupation. A second worry is illustrated by the comments of New York City's deputy chancellor of education that the schools "…are not vocational programs in any way, shape or form", thereby downgrading the objective of helping young people directly enter rewarding careers.

Where to Go From Here

Indiana's expanding manufacturing industries offer a great opportunity not only for Indiana's firms but also for Indiana's workers. In all likelihood, for Indiana to take most advantage of the opportunities to expand manufacturing, Indiana will have to improve its system for occupational training in manufacturing careers and for upgrading existing workers. Apprenticeships offer the most cost-effective method for achieving a high skill workforce. The evidence drawn from several countries is that apprenticeship is a profitable investment for firms and workers.

So what can Indiana do to expand apprenticeship? Government and industry leaders need to campaign at the local and national level to encourage public support for apprenticeship programs. Success requires an effective "retail" sales and technical support effort. Staff of the government office or the intermediary organization that is marketing apprenticeship must convince firms that apprenticeships are good for business and must teach most businesses how to build an apprenticeship program. Once employers begin to adopt apprenticeship, they will likely continue to do so, thereby providing post-secondary training and education at a modest cost. Also, Indiana can help firms to seamlessly coordinate their training with relevant courses, can provide incentives for firms to hire and train apprentices in the work-based components required for occupational competence and credentials, and can encourage educational institutions to take account of work-based learning in granting credits for degree programs. The state should experiment with alternative models for marketing apprenticeships to at the individual firm level and to remove obstacles to their participation.

A scaled-up apprenticeship system in Indiana will go a long way toward improving productivity in existing manufacturing firms, attracting new manufacturing firms, and expanding opportunity for young people by widening the routes to rewarding careers.

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Table 1: Occupational Distribution of U.S. Manufacturing Jobs: May 2014

Occupation	Employment	% of Jobs	Annual Salary
Production Occupations	6,245,820	51.6%	$36,140
Office and Administrative Support Occupations	1,120,020	9.3%	$38,610
Transportation and Material Moving Occupations	967,080	8.0%	$32,250
Architecture and Engineering Occupations	781,370	6.5%	$81,010
Management Occupations	691,330	5.7%	$122,990
Installation, Maintenance, and Repair Occupations	609,250	5.0%	$49,100
Business and Financial Operations Occupations	457,960	3.8%	$71,210
Sales and Related Occupations	374,910	3.1%	$62,960
Computer and Mathematical Occupations	280,550	2.3%	$93,860
Construction and Extraction Occupations	190,840	1.6%	$47,070
Life, Physical, and Social Science Occupations	114,090	0.9%	$69,110
Other	267,530	2.2%	
Total, All Manufacturing Occupations	12,100,750	100.0%	$48,610
Total, All Occupations	135,128,260		$47,230

Source: U.S. Bureau of Labor Statistics, http://www.bls.gov/oes/current/naics2_31-33.htm

Figure 1: Germany & Switzerland Outpace the U.S. in Manufacturing Jobs: 2014

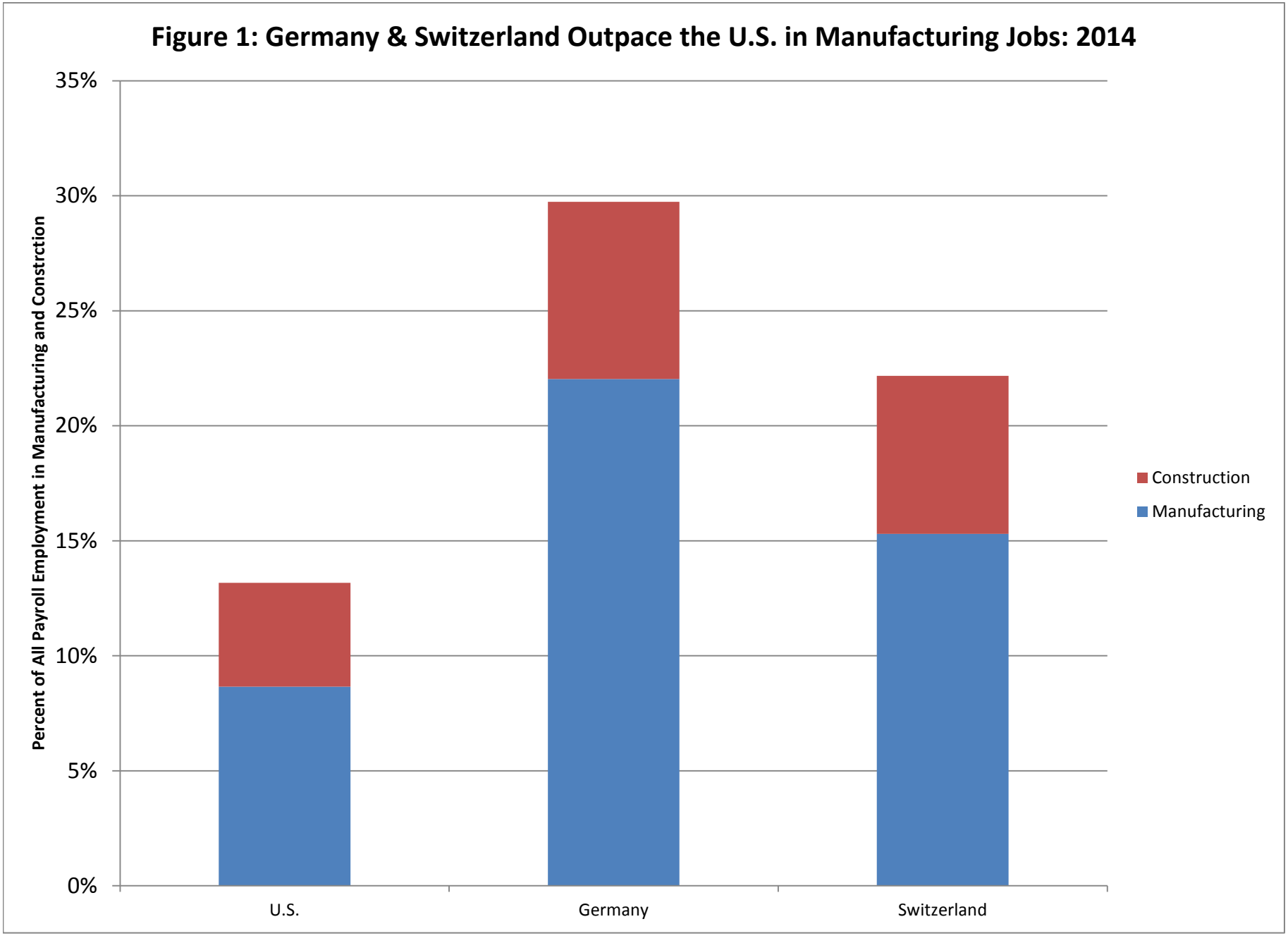
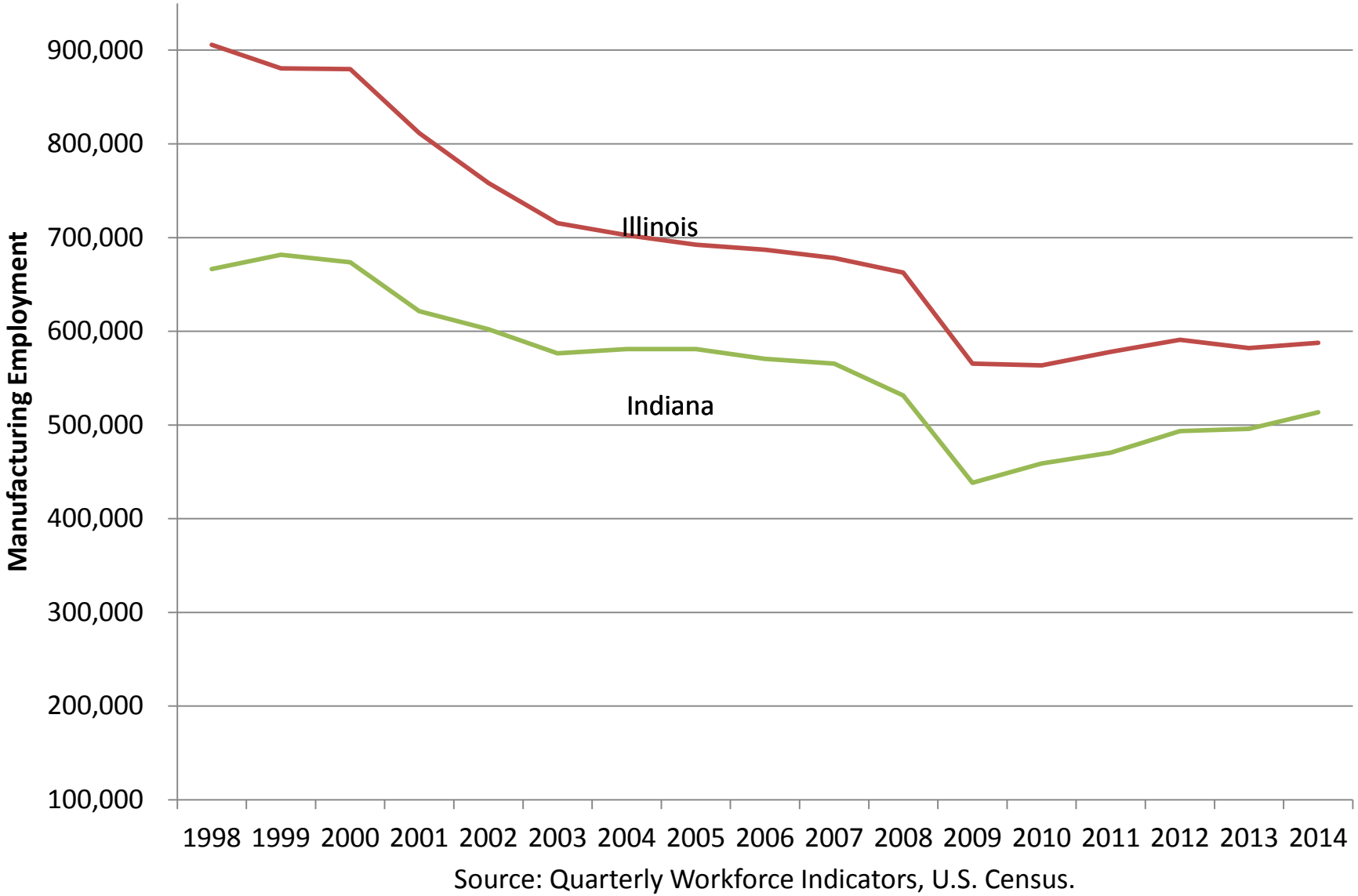


Figure 2: Indiana Manufacturing Retains A Higher Share of Jobs Than Illinois



Source: Quarterly Workforce Indicators, U.S. Census.