D'Acunto, Francesco; Weber, Michael; Yang, Shuyao

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Manpower Constraints and Corporate Policies*

Francesco D'Acunto,† Michael Weber‡ and Shuayo Yang§

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Abstract

Manpower constraints are the pervasive lack of specialized high- and low-skill workers, irrespective of the wage firms might offer. For a panel of German firms, we show manpower-constrained firms have 5% higher capacity utilization and 21% longer backlog of orders (measured in months). They are 15% more willing to increase their capital expenditures, and 4% more willing to grow their employment in the following year. Manpower constraints vary substantially over time and across industries, being higher on average in traditional maufacturing industries and lower in high-tech industries. For identification, we exploit the fall of the Berlin Wall in 1989, and the subsequent differential fluxes of Eastern immigrants across Western states, which followed the pre-existing patterns of Eastern German immigration immediately after WWII. We construct a *Manpower Constraint (MPC) Index* calibrating the loadings on firm-level financials that are also available in commonly used data set for US, European, and Asian firms. Our results help inform relevant debates such as the reform of immigration policies and the investment in public and private education for low-skilled workers.

JEL classification: J21, J31, J61, G31, G32

Keywords: Investment, Skilled Workers, Immigration Policies, Education Policies, Economic Growth.

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†R.H.Smith School of Business, University of Maryland, College Park, MD, USA. e-Mail: fdacunto@rhsmith.umd.edu

‡Booth School of Business, University of Chicago, Chicago, IL, USA and NBER. Corresponding author. e-Mail: michael.weber@chicagobooth.edu.

§Ifo Institute, Munich, Bavaria, Germany. e-Mail: Yang@ifo.de.

I Introduction

Frictions in financial markets and labor markets limit firms' ability to invest, produce, and ultimately maximize profits. Manpower constraints—the pervasive lack of high-skill and low-skill specialized workers, irrespective of the wages firms might offer—are an important friction whose effects have been largely understudied because they are hard to detect. Any allocation of specialized workers across firms could be an unconstrained or constrained equilibrium in the labor market.

Financial constraints face a similar detection and measurement problem, but can be relaxed more easily than manpower constraints. Money is fungible and can be redistributed across firms and space contrary to people and skills. Building up skills and training infrastructures takes time and skilled people cannot be moved where demand for them exists. Workers are surprisingly unwilling to respond to incentives to move (Moretti, 2012). Manpower constraints might therefore represent a large obstacle to firms' activities.

The supply of high-skilled and low-skilled specialized workers is also tied to heated policy debates. Immigration policies can restrict or enlarge the supply of specialized workers available in a country. Quotas on H-1B visa availability in the United States are a prime example of an immigration policy that shapes the supply of specialized workers. Moreover, training and education of specialized workers is a public good that firms can barely provide to workers, because workers can leave the firm at any time. The supply of public and private education programs, such as associate degrees, determines the quality of skills workers build up before joining firms.

We study the effect of manpower constraints on corporate policies with unique data, in which we observe *directly* whether firms declare they face a shortage of specialized workers with the needed skills, and hence cannot hire specialized workers irrespective of the wage they would offer. The data are a proprietary semester-level panel of 2,000 German firms from 1980 to 2001, operating in manufacturing, construction, and trade. These firms constitute a representative sample of German businesses, to which the ifo Institut asked a large set of questions ranging from existing corporate policies and expectations about future economic conditions to expected changes in corporate policies.

In our baseline analysis, we exploit the cross-sectional variation in the likelihood firms are manpower constrained at any point in time throughout our sample period. Manpower-constrained firms have 5% higher capacity utilization, 21% longer backlog of orders (measured in months), are 15% more willing to increase their capital expenditures in the following year, and are 4% more willing to grow their employment in the following year,[1] after partialling out semester, state, and industry fixed effects, as well as controlling directly for whether firms declare that they are subject to financial constraints. Financial constraints might be related to employment policies, and we need to disentangle the case in which a firm does not hire additional workers because of the lack of capital—a demand-side story—instead of the lack of workers available—our supply-side story.

Because this is the first paper that observes the incidence of manpower constraints, we investigate in detail the characteristics of manpower-constrained firms. In the median industry (*Wood Processing*), 15% of firms are manpower constrained at least once throughout our sample period. Large variation in the presence of manpower constraints exists across industries, and manpower constraints are more likely in traditional manufacturing industries and wholesale trade than in specialized and high-tech industries. For instance, 33% of the firms in *Manufacturing of beverage products* are manpower-constrained, whereas only 6% of firms in *Chemical industry* and 8% of firms in *Aviation and Aerospace* are manpower constrained. The incidence of manpower constraints also varies largely over time. In our sample, about 15% of firms were manpower constrained in 1980 and in 1990, 5% were manpower constrained in 1985, and 3% in 1996.

Unobservables correlated with the likelihood a firm is manpower constrained might also explain the different corporate policies and performance of manpower-constrained firms compared to other firms. To address these endogeneity concerns, we exploit a natural experiment to obtain quasi-exogenous variation in the relaxation of German firms' manpower constraints. We consider the fall of the Berlin Wall in 1989, and the subsequent mass migrations of Eastern German workers into Western Germany (Fuchs-Schündeln and Schündeln, 2005). Eastern German workers were highly specialized in traditional manufacturing tasks, which is the expertise that manpower-constrained firms in our

[1]The survey asks firms about their employment policy regarding all employees, and not just specialized workers.

sample are looking for. Eastern Germans migrated into areas in which relatives and friends had settled before the Berlin Wall was built. The bombings during WWII affected the supply of housing in Germany which determined the settlement of such relatives and friends. Bombings during WWII therefore determined the spatial diffusion of Eastern German refugees during the 1950s, and also of Eastern Germans escaping communism after the fall of the Berlin Wall (Burchardi and Hassan, 2013). Consistent with our interpretation of the natural experiment, the share of firms that declare they are manpower constrained decreased from 14% in 1990 to 4% in 1991 and 3% in 1992, and stayed below or around 5% until the end of our sample, in 2001.

Our identification strategy is an instrumental-variable approach, which uses the variation in the yearly cumulative inflow of Eastern German immigrants across Western German states (*Bundesländer*) to instrument for the share of firms that are subject to manpower constraints in each Western state over time. We observe immigration fluxes at the state level, and hence to avoid unduly interpreting within-state firm-level observations as independent, we construct our instrument at the state level as opposed to the firm level.

The identifying assumption we make is that the extent of the influx of Eastern German workers after the fall of the Berlin Wall affected firms' policies only through the relaxation of their manpower constraints, and not through other channels. The main threat to this exclusion restriction is the fact that the fall of the Berlin Wall created a new free market to which Western firms could supply a large range of products that previously did not exist in the East. The formal political and monetary reunification of Germany followed. This threat is not relevant to our identification strategy, because *all* Western firms, in any state, were exposed to the opening of the new market to the same extent, whereas we exploit variation in the influx of Eastern immigrants across states. This point is the crucial reason why we do not design a difference-in-differences strategy based on the relaxation of manpower constraints within firms before and after 1989. If we did so, we would be unable to disentangle the effect of the fall of the Berlin Wall on manpower constraints from the effect of the opening of a new market for Western firms.

A related concern with our exclusion restriction might be that the increase in local population after a large influx of Eastern workers also changed the size and characteristics

of the local markets and demand within Western states, which was likely to affect firms in states with a larger influx of immigrants more than firms in other states. This concern is not relevant in our case, because if anything a larger influx of immigrants would have increased the demand local firms had to satisfy, and hence would have increased their capacity utilization, backlog of orders, willingness to invest in capital expenditures and of hiring additional workers in the following year even more. To the contrary, if the influx of immigrants relaxed manpower-constrained, as our identification strategy assumes, local firms should have decreased their capacity utilization and backlog of orders, and could have finally invested in new machines that the additional workers could operate, hence reducing their willingness to invest in capital expenditures in the following year.

We show in the first stage that our instrument is relevant. In the second stage, we confirm the baseline positive effects of manpower constraints on capacity utilization, backlog of orders, willingness to invest, and willingness to grow employment. The magnitudes of the instrumental-variable estimates are similar to the magnitudes in the baseline analysis, which suggests that the endogeneity concerns when using the survey-based measure do not bias significantly the OLS estimates in one direction.

Observing the incidence of manpower constraints is not possible in commonly used data sets for US, European, and Asian firms. At the same time, progress in the detection and measurement of manpower constraints would allow deeper investigations into the effects of this type of labor-market constraints on firm- and industry-level outcomes, productivity, and ultimately economic growth. We therefore exploit the subsample of firms for which we observe balance-sheet financials to construct a *Manpower Constraint (MPC) Index*.

The logic of our MPC index is similar to the Kaplan-Zingales index for financial constraints. We use a logit specification to run predictive regressions of the likelihood that firms in our sample declare they are manpower constrained onto their age, SG&A, trade accounts payable, trade accounts receivable, and inventories. Once we control for these five dimensions, we find other financials are unrelated to the likelihood of manpower constraints. We then interpret the estimated coefficients on each of these variables as the loadings one can apply to different samples of firms to obtain a measure of the extent of

manpower-constraints which firms face. Based on this procedure, we compute the MPC Index as follows:

$$MPC\ Index = 0.16 \times Age + 0.23 \times \frac{SG\&A}{Assets} - 0.26 \times \frac{A/P}{Assets} + 0.39 \times \frac{A/R}{Assets} + 0.40 \times \frac{Inventories}{Assets}.$$

We run a comparative analysis of manpower constraints and financial constraints (which we kept constant throughout the main analysis in the paper), and we find that, as expected, the factors that predict manpower constraints are different from those that predict financial constraints.

Overall, our results investigate the effect of manpower constraints on corporate policies in a setting which allows us to observe the incidence of manpower constraints directly, and to obtain quasi-exogenous variation in the strictness of manpower constraints based on a natural experiment. We then construct an index, the MPC index, which is based on predicting the manpower-constrained status of firms with financials that are commonly available outside our setting, and which can hopefully help future research investigate the effects of manpower constraints on other micro-level and macro-level outcomes.

A Related literature

This paper contributes to three strands of literature. First, it belongs to the research that tries to measure the extent and severity of external constraints on corporate decision-making. The problem of measuring financial constraints has produced a large literature in finance (Fazzari et al. (1988), Kaplan and Zingales (1997),Fazzari et al. (2000), Kaplan and Zingales (2000), Farre-Mensa and Ljungqvist (2015)). To the best of our knowledge, no paper has tackled the problem of providing proxies for firms' manpower constraints, likely because providing such measures would prove even tougher than for financial constraints. Any labor allocation across firms could be a constrained or unconstrained outcome of the labor market. Our paper contributed to this literature by providing a direct measure of manpower constraints based on firms' survey responses. In order to allow researchers

using other data to proxy for the extent of manpower constraints of the firms they study, we construct a Manpower-constraint (MPC) Index, based on the loadings of a dummy for being manpower constrained on firm-level balance-sheet financials.

To study the effect of financial constraints on firm-level outcomes overcoming the issue of measuring financial constraints, studies on financial frictions usually exploit quasi-exogenous variation in the relaxation of unmeasured financing constraints (e.g., see Jayaratne and Strahan (1996)). Most related to our paper is Chava, Danis, and Hsu (2016), who exploit the staggered introduction of Right-to-Work laws across US states on corporate investment. This literature inspires our paper, which similarly documents the baseline effects of manpower constraints arising from inefficiencies in labor markets on corporate policies, and uses a source of quasi-exogenous variation in the relaxation of such friction for identification. Different from earlier work, we do observe directly in the data whether firms declare they face manpower constraints, and we do not need to proxy for constraints using observable information.

Second, this paper contributes to the strand of research that studies the effects of immigration policies on firm-level productivity and labor market equilibria (Borjas (2014)). Recent contribution to this large literature include Peri et al. (2015), who exploit H-1B visa lotteries to estimate the effects of inflows of specialized workers on city-level outcomes. Kerr et al. (2016) discuss the selection of specialized-worker inflows, and their effects on productivity and growth. Our paper uses quasi-exogenous variation in the immigration flows of specialized workers to study the effect of relaxing manpower constraints on corporate policies.

Third, the paper speaks to the literature on the effects of education policies on the quality of the workforce available to firms, both in the short and long term. Gennaioli, LaPorta, Lopez-de Silanes, and Shleifer (2012) use a unique panel data set of regional characteristics worldwide to show that higher education is related to higher development across space, and the role of the education of managers is particularly relevant to development. D'Acunto (2016) finds that the cross-sectional variation in basic education levels across European regions persisted for centuries, and that firms in regions with a more educated low-skill workforce innovate and invest more than other regions. This

paper shows that the availability of specialized low-skill workers is a crucial yet neglected source of flexibility in firms' investment and growth plans.

II Data

Our data consist of a panel of German firms we observe from 1980 to 2001. The panel is a representative sample of German firms, which is surveyed each month by the ifo Institut, Munich (DE) under the *Business Expectations Panel* (BEP) project. The panel includes manufacturing, trade, and construction companies. The aim of the ifo Institut is to collect firm-level expectations regarding one-year firm-level policies as well as economy-wide variables, such as the unemployment rate and GDP growth. The ifo Institut uses this information to construct a monthly index of business sentiment in Germany called *ifo Business Climate Survey*, which is a leading macroeconomic indicator in Germany. Parts of the survey are used for the official German Business Sentiment index of the Directorate General for Economic and Financial Affairs of the European Commission. Consistent with ifo Institut's aims, researchers have mainly used the data to address questions in Macroeconomics (e.g., see Bachmann et al. (2013)). We merge information from the BEP with data in the *Business Investment Panel*, which asks a representative sample of German firms questions about their corporate policies and investment plans every six months. Additional details and characteristics of the data we use are described by Seiler (2012).

Although the ifo Institut has been running the survey continuously up to the present day, we do not use observations after 2001, because the survey stopped asking about manpower constraints. One drawback of the BEP is balance sheet variables are not collected for the vast majority of firms in the panel, because the aim of the ifo Institut is not the use of data for research in finance or productivity. Instead, as mentioned above, the ifo Institut uses the survey information to construct a business sentiment index of German firms. Balance sheet variables and financials are only available for 9% of the sample. Therefore, in our baseline analysis, we do not control for financial dimensions, but we find all our results are robust for controlling for financials in the subsample of

firms for which we observe them.

The unique question in the BEP we use in our analysis asks whether firms think they face manpower constraints. In the official English translation of the BEP questionnaire, question 3.2.29 is titled *"constraints: lack of manpower."* The translated question reads as follows:

"Our domestic production activities are currently constrained by the lack of skilled labour."

In our analysis, we define a dummy variable that equals 1 if a firm in the panel responds "Yes" to the question above, and equals 0 otherwise.

Figure 1 describes the variation of manpower constraints across manufacturing subsectors. In the figure, we define manpower-constrained as a firm that declares that they are manpower constrained at any point in time covered by the survey. Substantial heterogeneity in the incidence of manpower constraints exists across manufacturing subsectors. In the median industry, that is, *Wood Processing*, 15% of firms declare they are manpower constrained at least once over the sample period. The share of manpower constraints is highest in the *Manufacture of beverages* (33%) and lowest in the *Chemical industry* (6%).[2] Interestingly, manpower constraints are more common in traditional industries, such as *Wholesale*, *Printing and coping*, and *Mechanical engineering* than in high-tech industries, such as *Shipbuilding and Aerospace* and *Other manufacturing*. Low-skill specialized workers, as opposed to high-skill specialized workers, seem to drive the presence of manpower constraints. This fact is consistent with the results in Labor Economics and Economic Geography that low-skill workers are substantially less likely to move across space than high-skill workers, and the results in Education Economics that building up basic and specialized skills in the broader population takes decades.

Figure 2 describes the variation of manpower constraints over time. In the figure, we define as manpower-constrained a firm-year observation that declares that they are manpower constrained. The incidence of manpower constraints varies dramatically over

[2]The share reaches 100% in the *Mining support service activity* sector, but because we only observe two firms in this sector, we do not use them in the analysis. All results are virtually unchanged when we use these additional two firms in the analysis.

time. In our sample period, the fraction of firms that declare that they are manpower constrained peaks in 1981 and in 1990, when it equals 15% in the overall population of firms. The fraction reaches its local minimum point in 1983, when it equals 2%. The fraction of manpower-constrained firms in the German economy stays around 5% in the second half of the 1980s, as well as in the late 1990s/early 2000s.

III Baseline Analysis

After having described the characteristics of manpower-constrained firms in our sample, we move on to analyze the effects of manpower constraints on a set of corporate policies.

The baseline analysis exploits the panel structure of the data to measure the correlation between manpower-constrained status at the firm level at each point in time and the firm's contemporaneous and prospective policies. Exploiting the variation in manpower-constrained status within firms over time is crucial to our baseline analysis. If we were only comparing manpower-constrained firms and unconstrained firms in the cross section, unconstrained firms would not represent appropriate counterfactuals for constrained firms. Better-managed and efficient firms—dimensions we cannot detect in the data—might be manpower constrained because they are better at satisfying demand than unconstrained firms, and hence cannot expand more without acquiring unconstrained firms or waiting for such firms to layoff workers. The panel structure of the data allows us to compare manpower constraints and corporate policies within firms, and use the unconstrained firms as a counterfactual for shocks on the demand side, which will affect both constrained and unconstrained firms similarly.

For the corporate policies contemporaneous to the detection of manpower-constrained status, we focus on dimensions that capture the extent of utilization and over-utilization of corporate resources. Specifically, we look at capacity utilization and the backlog of orders that firms have not yet fulfilled, measured in months. Firms in our sample might declare that they are manpower constrained because they are less efficient and productive than other firms, and hence high-skill and low-skill specialized workers would obtain higher salaries and bonuses in other firms. In this case, manpower-constrained firms would face

lower demand than other firms, and hence should have a shorter backlog of unfulfilled orders and lower capacity utilization. At the same time, manpower-constrained firms might be facing higher demand than they can fulfill, because they are more efficient or produce better products than competitors. In this case, manpower-constrained firms should produce at or above capacity, and should have a longer backlog of orders than other firms.

For the prospective corporate policies, we consider firms' willingness to grow in the following year in terms of both capital expenditures and employment base. If lower efficiency determines manpower constraints, constrained firms should not be willing to invest or grow more in the short term, because they would anyway be unable to use additional resources effectively. If higher efficiency determines manpower constraints, instead, firms are constrained in their growth, and hence should be willing to invest more in capital expenditures and in employment in the short term. Note that employment policies are not tautological. As argued above, being manpower constrained does not necessarily imply that the firm might want or need to hire more workers, and hence to grow.

A Univariate Analysis based on Raw Data

Before moving to our multivariate analysis, we look at the raw data in Figure 3. This figure focuses on capacity utilization as an example of the four policies described above. We plot the density of capacity utilization separately for firms that declare they are manpower constrained (solid curve) and firms that are unconstrained (dashed curve). The vertical lines are set at the mean of the capacity utilization distribution for each group.

Consistent with the over-utilization notion described above, the average capacity utilization of manpower-constrained firms is 95%, whereas the average of unconstrained firms is 82%. The figure also shows that the density of capacity utilization is more skewed toward the 100% boundary for constrained firms than for unconstrained firms. An alternative way to see that manpower-constrained firms are more likely to produce at full capacity than other firms consists of comparing the share of firms that hit the 100% boundary in the manpower-constrained and unconstrained distributions. The share

of manpower-constrained firms is higher, and the manpower-constrained curve lies above the unconstrained curve for all values above 90%. The raw data described in Figure 3 show that, before partialling out any firm-, industry-, time-, or location-characteristic of firms, manpower-constrained firms have higher capacity utilization than unconstrained firms.

The fact that manpower-constrained firms have higher capacity utilization than unconstrained firms also acts as a validation of our measure of manpower constraints. Because the measure is based on corporate executives' answers to a survey in which they have no incentives to tell the truth, one might be worried that our measure captures noise or even false claims. Instead, many firms whose corporate executives declare that they are manpower constrained are indeed working at capacity or above capacity.

B Multivariate Analysis

Our baseline multivariate specification is as follows:

$$\begin{aligned} Corporate\ Policy_{i,t,k,s} = \alpha + \beta Manpower\ Constrained_{i,t,k,s} \\ + \gamma Financially\ Constrained_{i,t,k,s} + \eta_t + \eta_k + \eta_s + \epsilon_{i,t,k,s}, \end{aligned} \tag{1}$$

where $Corporate\ Policy_{i,t,k,s}$ is one of the two contemporaneous policies or two prospective policies describe above for firm i in semester t in sector k and state s; $Manpower\ Constrained_{i,t,k,s}$ is a dummy that equals 1 if firm i declares they are manpower constrained in semester t; $Financially\ Constrained_{i,t,k,s}$ is a dummy that equals 1 if firm i declares they are financially constrained in semester t; and η_t, η_k, and η_s are full sets of semester, industry, and state fixed-effects.

For capacity utilization and backlog of orders, the dependent variable is continuous, and we estimate equation (1) by ordinary-least-squares. We cluster standard errors at the firm level. For the prospective willingness to invest in capital and labor, the dependent variable equals 1 if the firm declares they want to invest, and 0 otherwise. We therefore estimate equation (1) in a probit specification, and we report marginal effects estimated at the mean value of the independent variables. Standard errors clustered at the firm

level are estimated with the delta method.

Table 1 reports the results for estimating equation (1) when the outcome variables are two policies contemporaneous to the presence of manpower constraints – order backlog (columns (1)-(3)) and capacity utilization (columns (4)-(6)). The dependent variables are standardized. Order backlog is the backlog of orders unfulfilled by the company measured in months. Columns (1)-(3) show that manpower-constrained firms have a 0.25-standard-deviations-higher backlog of orders, which is about 21% of the mean backlog of manpower-constrained firms in our sample. The estimates are similar if we include the full set of fixed effects or not. In columns (4)-(6), manpower-constrained firms' capacity utilization is 0.26-standard-deviations higher than for unconstrained firms. This amounts to 5% of the mean value of capacity utilization of manpower-constrained firms in our sample. The magnitude and statistical significance of the estimates are again similar whether or not we absorb systematic shocks that affect all firms equally each semester, systematic time-invariant characteristics across industries and across states.

Results for contemporaneous corporate policies are consistent with the notion that manpower-constrained firms are more efficient, or face a higher demand, than other firms, and hence the lack of specialized workers makes them operate above capacity by over-utilizing their existing resources.

Table 2 also estimates equation (1), but the outcome variables are prospective policies, that is, firms' reported willingness to invest in capital expenditures and to hire new workers in the year following the detection of manpower constraints. All columns report the marginal effects for estimating equation (1) with a probit specification. Indeed, the estimated association between manpower-constrained status and prospective policy outcomes are in line with our interpretation of the contemporaneous policy outcomes. In columns (1)-(3), manpower-constrained firms are 15% more likely to declare that they want to invest in capital expenditure in the following year, and the association is stable across specifications that restrict the variation differently. In columns (4)-(6), manpower-constrained firms are 4% more likely to declare they want to invest in employment to grow in the following year.

Overall, our baseline results suggest that manpower-constrained firms operate at

higher capacity than other firms, they face larger amounts of unfulfilled demand as suggested by their order backlogs, and they want to invest more in capital expenditures and employment in the short term.

IV Instrumental-Variable Strategy

The baseline analysis accounts for time-invariant systematic differences across industries and across German states, as well as time-varying and seasonal shocks that affect all German firms in the same semester. At the same time, unobservable firm-level characteristics that vary within states and within industries over time might determine both firms' manpower-constrained status and their contemporaneous and prospective corporate policies, and hence hinder a causal interpretation of our baseline results. For instance, the managers of manpower-constrained firms might be more efficient than other managers. Efficient managers would produce better products at better conditions, absorbing all available specialized workers in their local economy and attracting higher demand, and hence working at higher capacity than other firms.

Reverse causality might also explain our baseline findings. Firms that face higher demand work at higher capacity, and become manpower constrained once they absorb all the specialized workers available in the local economy.

Addressing these identification concerns requires that we find a source of exogenous variation in the extent to which a limited availability of workers constrains firms' production and investment, which is orthogonal to other demand- and supply-side shocks that firms might face.

To obtain a source of quasi-exogenous variation in the extent to which manpower constraints bind, we exploit a natural experiment that resembles a quasi-random influx of specialized workers into Western German states at different levels across space. The natural experiment is the fall of the Berlin Wall in 1989. Fuchs-Schüdeln and Schündeln (2005) and Burchardi and Hassan (2013) used the fall of the Berlin Wall and the subsequent reunification of Western and Eastern Germany as a natural experiment to study precautionary savings and the economic impact of social ties.

Although the *Deutsche Demokratische Republik* (DDR), the previous East Germany, had shown signs of economic and social crisis for a few years, the fall of the Berlin Wall and its consequences were largely unexpected by Germans on either side of the Wall, even if the Cold War rhetoric proposed a deterministic view of this event. For instance, the Western press suggested the passionate "Tear Down This Wall!" speech in which US President Ronald Reagan called for the fall of the Berlin Wall in 1987 was a milestone that helped the actual fall of the Wall. Instead, the speech went largely ignored by the German press and politicians on both sides of the Wall, including the West. Three-term German Chancellor Angela Merkel provided another vivid suggestion that the fall of the Berlin Wall was a largely unexpected event when she revealed in 2009 that she was taking a sauna and then having beers in East Berlin while the border was opened on the Eastern side. Even claims that US cultural influences in 1989 directly affected the fall of the Wall seem unrealistic. For instance, many believe that the Scorpion's song "Wind of Change" was crucial to the revolts of East German youngsters conducive to the fall of the Wall. But "Wind of Change" was recorded in Los Angeles in 1990, and released as a single album in 1991, well after the Wall had already fallen.

The fall of the Berlin Wall determined mass migrations of Eastern German workers into Western Germany. Eastern German workers were highly specialized in manufacturing jobs, which is the expertise firms in our sample would need most. For our identification, the crucial feature of this shock is Eastern Germans moved into areas in which relatives and friends had settled before the construction of the Berlin Wall. These relatives and friends could only settle in areas of Western Germany in which the supply of housing was less destroyed during WWII. Bombings during WWII therefore determined the spatial diffusion of Eastern German refugees during the 1950s, and also of Eastern Germans escaping communism after the fall of the Berlin Wall.

Consistent with our interpretation of the natural experiment, the share of firms that declare they are manpower constrained decreased from 14% in 1990 to 4% in 1991 and 3% in 1992, and stayed below or around 5% until the end of our sample in 2001.

Our identification strategy is an instrumental-variable approach, which uses the variation in the yearly cumulative fluxes of Eastern immigrants across Western German

states to instrument for the share of firms that are subject to manpower constraints in each Western state over time. We observe immigration fluxes at the state level, and hence, to avoid unduly interpreting within-state firm-level observations as independent, we construct our instrument at the state level as opposed to the firm level. Below, we discuss why a difference-in-differences strategy at the firm level would be inappropriate to our setting.

The IV strategy consists of the following equations:

$$\begin{aligned} Share\ Manpower-constrained_{i,k,t,s} = \alpha + \beta Cum\ Inflow\ Immigrants_{t,s} \\ + \gamma Fin\ Constrained_{i,t,k,s} + \eta_t + \eta_k + \eta_s + \epsilon_{i,t,k,s}, \end{aligned} \tag{2}$$

$$\begin{aligned} Corporate\ Policy_{i,t,k,s} = \alpha + \beta Share\ \widehat{Manpower-constrained}_{i,k,t,s} \\ + \gamma Fin\ Constrained_{i,t,k,s} + \eta_t + \eta_k + \eta_s + \epsilon_{i,t,k,s}. \end{aligned} \tag{3}$$

Equation (2) is the first stage, in which we predict the share of manpower-constrained firms in state s and semester t for firm i operating in industry k. Equation (3) is the second stage, in which we predict the corporate policies of the same set of firms using the share of manpower-constrained firms instrumented in the first stage.

The identifying assumption (exclusion restriction) is that the extent of the influx of Eastern German workers after the fall of the Berlin Wall affected firms' policies only through the relaxation of their manpower constraints, and not through other channels.

A Validity of the Instrument

The main threat to the exclusion restriction underlying our strategy is the fact that the fall of the Berlin Wall created a new free market to which Western firms could supply a large range of products that previously did not exist in the East. The formal political and monetary reunification of Germany followed. This threat is not relevant to our identification strategy, because *all* Western firms, in any state, were exposed to the opening of the new market to the same extent, whereas we exploit variation in the influx of Eastern immigrants across states. This point is also the reason why we do not design a

difference-in-differences strategy based on the relaxation of manpower constraints within firms before and after 1989. If we did so, we would be unable to disentangle the effect of the fall of the Berlin Wall on manpower constraints from the effect of the opening of a new market for Western firms.

A related concern is that the increase in local population after a large influx of Eastern workers also changed the size and characteristics of the local markets and demand within Western states, which was likely to affect firms in states with a larger influx of immigrants more than firms in other states. We believe this concern is not relevant in our case because, if anything, a larger influx of immigrants would have increased the demand for the goods of local firms, and hence would have increased their capacity utilization, backlog of orders, willingness to invest in capital expenditures, and of hiring additional workers in the following year even more. To the contrary, if the influx of immigrants relaxed manpower constraint, as our identification strategy assumes, local firms should have decreased their capacity utilization and backlog of orders, and could have finally invested in new machines which the additional workers could operate, hence reducing their willingness to invest in capital expenditures in the following year.

As we argued above, the influx of Eastern German immigrants after the fall of the Wall followed the patterns of migrations of Eastern migrants that relocated to Western states after WWII, before the construction of the Wall. Because the availability of non-bombed housing stock determined post-WWII migration patterns, we argue that the spatial diffusion of immigrant fluxes was quasi-exogenous. At the same time, one might be concerned that Western German firms that started after WWII might have faced different local market conditions based on the number of immigrants in the areas in which they operated. Firms might have also selected into areas with more or less migrants based on unobservable characteristics that also affected their tendency to become manpower constrained and their corporate policies after 1980. To address this concern, we repeat our IV analysis on the subsample of firms in our sample that were founded before WWII and survived throughout the war. This subsample includes about half of the firms in our sample.[3] Our results are similar if we focus on this subsample of firms.

[3]Note German corporations have high survival rates, and high average age. The oldest firm in our sample was founded in 1258 AD.

B First- and Second-stage Results

Table 4 reports the results for estimating equation (2) and equation (3) by two-stage least squares for the contemporaneous corporate policies (columns (1)-(4)), and by two-stage probit estimation for the prospective corporate policies (columns (5)-(8)). The sample period is all the years between 1990 and 2001. As for the first stage, the results show our instrument is relevant, because across all outcomes the first-stage F-statistics are above 150 in each specification.

As for the second stage, the IV results confirm our baseline multivariate analysis across all corporate policies. Manpower-constrained firms operate at higher capacity utilization, have longer backlogs of orders, and are more willing than unconstrained firms to invest in capital expenditures and in employment in the short run. The magnitude of the effects cannot be directly compared with the baseline multivariate analysis, because in the baseline analysis the main independent variable is a dummy that equals 1 if the firms is manpower-constrained, whereas in the IV analysis the main independent variable—the share of manpower-constrained firms in each Western German state instrumented with the cumulative influx of Eastern German immigrants after the fall of the Berlin Wall—is continuous.

Our sample covers the period 1980-2001. The fluxes of Eastern Germany immigrants were substantial in the first few years after the fall of the Wall, but lower in the subsequent years. We therefore repeat our IV analysis limiting the sample between 1990 and 1994, so that we capture only the few years in which Eastern German migration was at its spike, and our migration fluxes are not driven by dimensions possibly different from the fall of the Berlin Wall. We show the results for this estimation in Table 5, and we confirm our IV results in this subsample.

V Manpower-Constraint Index

Our analysis so far focused on the effects of manpower constraints on the corporate policies of German firms between 1990 and 2001. This setting allows us to observe which firms are manpower constrained directly, as well as to obtain quasi-exogenous variation in the

likelihood firms are manpower-constrained across Western German states in an internally-consistent identification strategy.

To the best of our knowledge, this is the first paper that observes directly whether firms declare they face manpower constraints. We are also unaware of other survey- or administrative-based evidence that includes this information in the US, other European countries, or Asia. At the same time, progress in the detection and measurement of manpower constraints would allow deeper investigations into the effects of this type of labor-market constraints on firm- and industry-level outcomes, productivity, and ultimately economic growth.

To allow scholars to proxy for the incidence of manpower constraints in settings different from the one we study, we therefore exploit the subsample of firms in our sample for which we observe balance-sheet financial variables to construct a *Manpower Constraint (MPC) Index*.

Our MPC index is inspired by the Kaplan-Zingales (KZ) index for financial constraints. Similar to KZ, we run predictive logistic regressions of a dummy that equals 1 if the firms declares it is manpower constrained on a set of financials that are available in databases scholars in Finance and Accounting commonly use. We estimate the marginal effects of each financial on the likelihood of manpower constraints, and propose these marginal effects as loads on the same financials scholars can use to proxy for the likelihood of manpower constraints at the firm level.

Specifically, we estimate the following specification with a logit regression:

$$\begin{aligned} Pr(MPC == 1)_{i,t,k,s} = \Phi(\alpha \times Age_{i,t,k,s} + \beta \times \frac{SG\&A}{Assets}_{i,t,k,s} + \gamma \times \frac{A/P}{Assets}_{i,t,k,s} \\ + \delta \times \frac{A/R}{Assets}_{i,t,k,s} + \zeta \times \frac{Inventories}{Assets})_{i,t,k,s}), \end{aligned} \tag{4}$$

where Age is the firm's age at time t, $\frac{SG\&A}{Assets}$ is SG&A expenses scaled by total assets, $\frac{A/P}{Assets}$ and $\frac{A/R}{Assets}$ are the firm's accounts payable and accounts receivable scaled by total assets, and $\frac{Inventories}{Assets}$ is the amount of inventory scaled by total assets. We focus on these five firm-level financials, because we find that after controlling for these five dimensions, no other observable financials of the firms in our sample are associated significantly with

their manpower-constrained status.

We then interpret the estimated coefficients on each of these variables as the loads which one can apply to different samples of firms in order to obtain a measure of the extent of manpower constraints that firms face. Based on this procedure, the following expression is the MPC Index, where we report the loadings associated with each financial variable, with stars that indicate the significance level of the test-statistic for the null hypothesis that the marginal effect from equation (4) equals zero:

$$\begin{aligned} MPC\ Index = 0.16^{**} \times Age + 0.23^{***} \times \frac{SG\&A}{Assets} - 0.26^{**} \times \frac{A/P}{Assets} \\ + 0.39^{***} \times \frac{A/R}{Assets} + 0.40^{***} \times \frac{Inventories}{Assets}. \end{aligned} \tag{5}$$

Financial constraints have been heavily studied over the last two decades. Financial constraints and manpower constraints should not be highly correlated, because dimensions like the supply of finance that firms can access, the amount of collateral they can pledge, and the uncertainty of firms' investment projects should determine the likelihood of whether firms face financial constraints. Instead, under our interpretation, manpower constraints depend on the supply of specialized workers in the economy, which individual firms can barely control.

To assess the extent to which financial constraints and manpower constraints capture different concepts, we exploit the logit setup in equation (4) to obtain a similar index for financial constraints. Our aim is to compare the loads of financial constraints to the financials that explain manpower constraints with the loadings of manpower constraints on the same financials. Below are the loadings for financial constraints:

$$\begin{aligned} Financial\ Constraints = 0.10 \times Age - 0.13 \times \frac{SG\&A}{Assets} + 0.11 \times \frac{A/P}{Assets} \\ - 0.05 \times \frac{A/R}{Assets} + 0.23^{*} \times \frac{Inventories}{Assets}. \end{aligned} \tag{6}$$

As expected from the fact that financial constraints are a different economic object than manpower constraints, all the loadings in equation (6) are not different from zero statistically, and the signs of three of the five loadings are different from the ones we estimated for manpower constraints, as reported in expression (5).

VI Conclusions

We exploit a unique panel of German firms from 1980 to 2001, in which we observe *directly* whether firms declare they face manpower constraints—the pervasive lack of high-skill or low-skill specialized workers, whatever the wage firms might offer—to describe the characteristics of manpower-constrained firms, as well as the effects of manpower constraints on a set of contemporaneous and prospective corporate policies.

We find that manpower-constrained firms operate at capacity utilization, have a longer backlog of orders, and are more willing to invest in capital expenditures and in employment in the short term. We confirm these results in an instrumental-variable strategy that exploits the quasi-exogenous fluxes of Eastern German specialized workers across Western German states after the fall of the Berlin Wall in 1989.

We the use a logic analogous to the Kaplan-Zingales index for financial constraints, and propose a Manpower Constraint (MPC) Index, which proxies for the likelihood that a firm is manpower constrained, and is readily applicable to firms in data sets that include balance sheet financial variables.

The results in this paper are a first step towards our understanding of the prevalence of manpower constraints, the characteristics of manpower-constrained firms, and the effects of manpower constraints on corporate policies. Future research in Finance and Accounting should delve deeper into this important yet neglected friction to firm-level operations.

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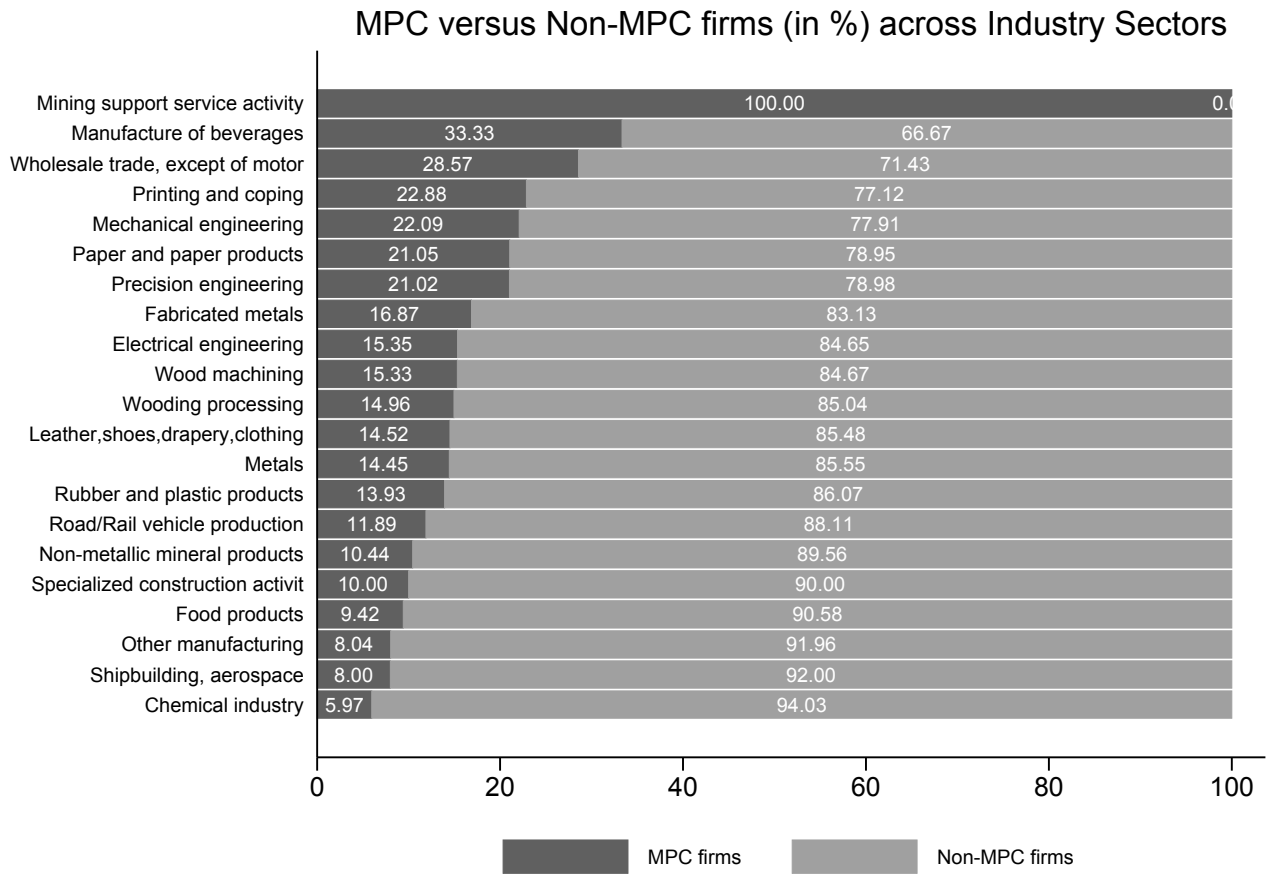
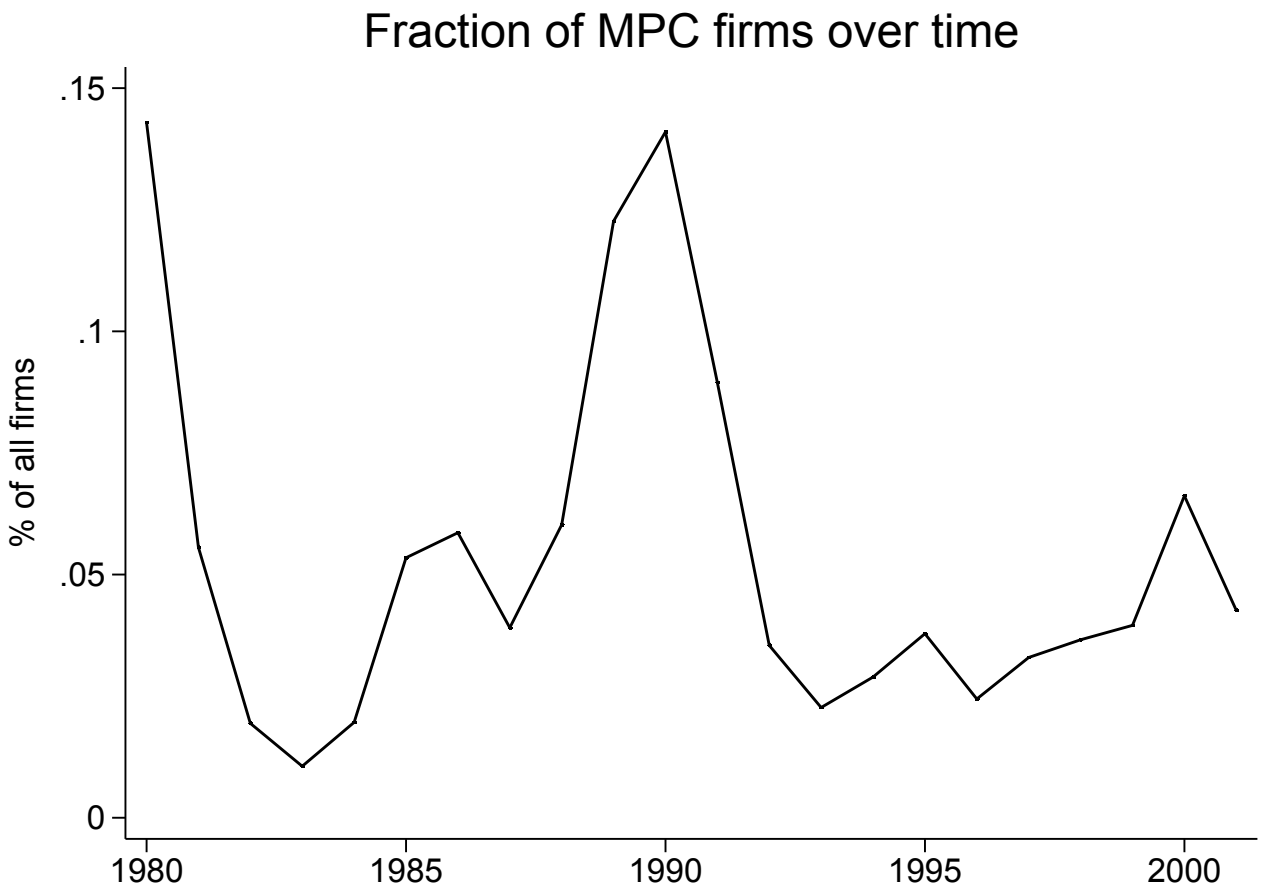
Figure 1: **Manpower-constrained Firms by Industry**



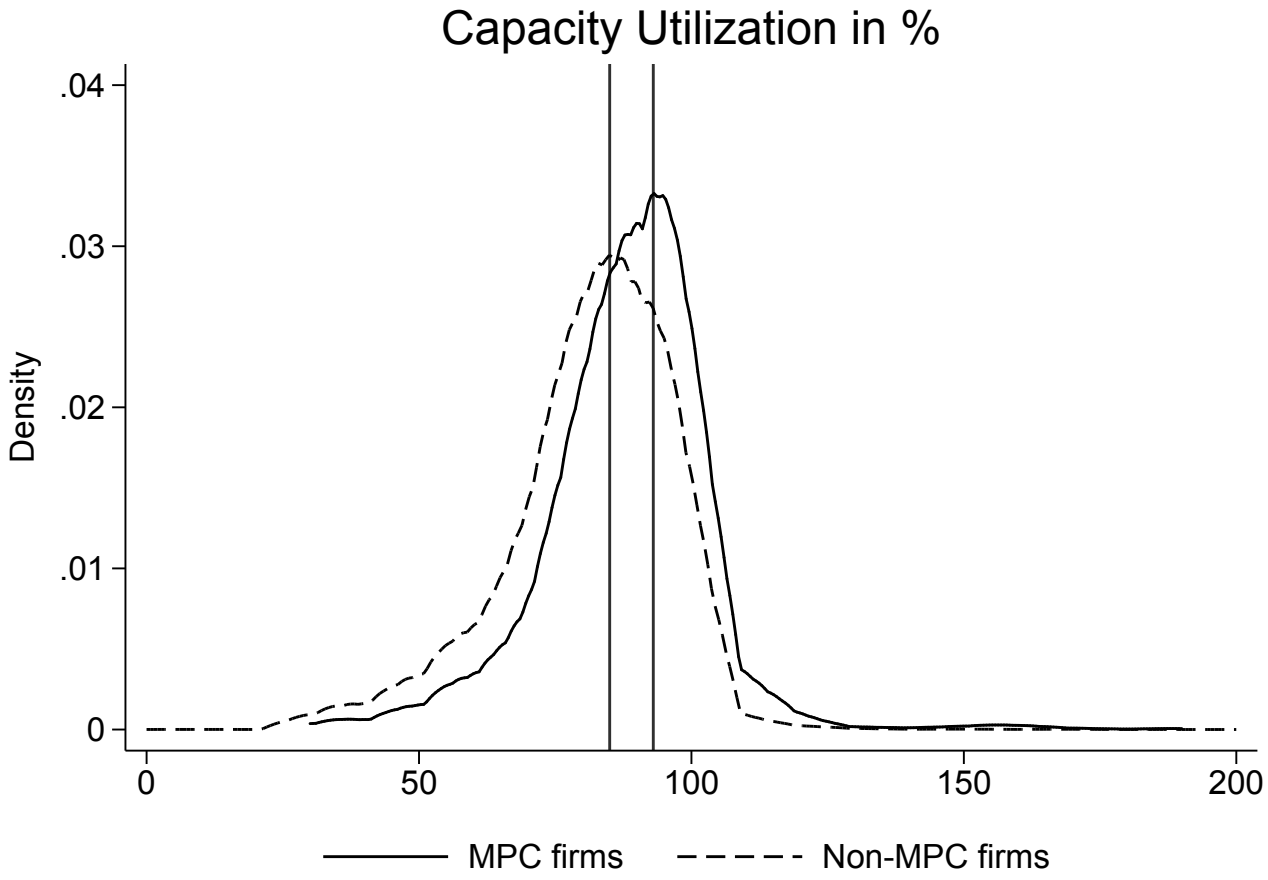
This figure describes the fraction of firms in our sample that ever declare being manpower-constrained and the share of unconstrained firms in each industry. Our sample is the Business Expectations Panel (BEP) run by the ifo Institut in Munich (DE) since 1980. We look at the period 1980-2001, during which the BEP asked corporate executives if they agreed with the following sentence: "Our domestic production activities are currently constrained by the lack of skilled labour".

Figure 2: **Manpower-constrained Firms by Year**



This figure describes the fraction of firms in our sample that declare being manpower-constrained for each year between 1980 and 2001. Our sample is the Business Expectations Panel (BEP) run by the ifo Institut in Munich (DE) since 1980. We look at the period 1980-2001, during which the BEP asked corporate executives if they agreed with the following sentence: "Our domestic production activities are currently constrained by the lack of skilled labour".

Figure 3: **Manpower Constraints and Capacity Utilization: Raw Data**



This figure plots the densities of capacity utilization in percentage points for two groups of firms in our sample, that is, manpower-constrained firms (solid line) and unconstrained firms (dashed line). Our sample is the Business Expectations Panel (BEP) run by the ifo Institut in Munich (DE) since 1980. We look at the period 1980-2001, during which the BEP asked corporate executives if they agreed with the following sentence: "Our domestic production activities are currently constrained by the lack of specialized labor".

Table 1: **Panel Regressions of Order Backlog and Capacity Utilization on Manpower Constraints**

This table reports the results for estimating the following linear equation:

$$Y_{i,t} = \alpha + \beta \times MPC_{i,t} + X'_{i,t} \times \gamma + \eta_t + \eta_j + \eta_k + \epsilon_{i,t},$$

where $Y_{i,t}$ is either the order backlog or capacity utilization on self-reported manpower constraints, other covariates, $X'_{i,t}$ and a set of semester, sector, and state fixed effects. The sample period is the first semester of 1980 until the second semester of 2001. Manpower constraints are self-reported in the German IFO Business Climate Survey.

	Order Backlog			Capacity Utilization		
	(1)	(2)	(3)	(4)	(5)	(6)
Manpower Constraints	0.35^{***}	0.25^{***}	0.25^{***}	0.30^{***}	0.26^{***}	0.26^{***}
	(8.89)	(7.06)	(7.01)	(6.20)	(5.72)	(5.69)
Fin Constraints	-0.07	-0.08	-0.08	-0.44^{***}	-0.45^{***}	-0.45^{***}
	(-1.32)	(-1.69)	(-1.76)	(-9.04)	(-9.84)	(-9.87)
West	0.10^{*}	0.11^{**}		0.22^{***}	0.19^{***}	
	(2.29)	(2.67)		(5.64)	(4.67)	
Const	-0.06	0.86^{***}	0.74^{**}	-0.02	-0.01	-0.25
	(-1.16)	-17.66	-3.19	(-0.33)	(-0.20)	(-0.77)
Sector FE		X	X		X	X
State FE			X			X
Semester FE	X	X	X	X	X	X
Nobs	66,060	65,958	65,958	68,511	68,409	68,409
Adjusted R^2	0.02	0.21	0.21	0.07	0.10	0.10

t-stats in parentheses

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

Table 2: **Panel Regressions of Hiring and Investment Intensions on Manpower Constraints**

This table reports the results for estimating the following probit regression:

$$Y_{i,t} = \alpha + \beta \times MPC_{i,t} + X'_{i,t} \times \gamma + \eta_t + \eta_j + \eta_k + \epsilon_{i,t},$$

where $Y_{i,t}$ is a dummy variable which either equals 1 if a firm reports it wants to either hire or investment in the next 12 months compared to the current 12 months, other covariates, $X'_{i,t}$ and a set of semester, sector, and state fixed effects. The sample period is the first semester of 1980 until the second semester of 2001. Manpower constraints are self-reported in the German IFO Business Climate Survey. The table directly reports marginal effects.

	Want Hire More			Want Invest More		
	(1)	(2)	(3)	(4)	(5)	(6)
Manpower constraints	0.40***	0.40***	0.40***	0.04**	0.03*	0.03*
	(13.41)	(12.98)	(13.03)	(2.67)	(2.10)	(2.08)
Financial constraints	−0.01*	−0.01*	−0.01*	−0.03	−0.03	−0.02
	(−2.12)	(−2.21)	(−2.23)	(−0.78)	(−0.75)	(−0.70)
West	−0.01*	−0.01*		0.09***	0.09***	
	(−2.38)	(−2.30)		(3.94)	(4.00)	
Sector FE		X	X		X	X
State FE			X			X
Semester FE	X	X	X	X	X	X
Nobs	74,695	74,421	74,421	61,819	61,819	61,819

t-stats in parentheses

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

Table 3: **Panel Regressions of Firm Outcomes on Manpower Constraints (State-level Variation)**

This table reports the results for estimating the following linear/ probit regression:

$$Y_{i,t} = \alpha + \beta \times MPC_{k,t} + X'_{i,t} \times \gamma + \eta_j + \eta_k + \epsilon_{i,t},$$

where $Y_{i,t}$ is the order backlog in months in columns (1)-(2), capacity utilization in columns (3)-(4), a dummy variable which either equals 1 if a firm reports it wants to either hire (columns (5)-(6)) or investment (columns (7-(8))) in the next 12 months compared to the current 12 months, on the change in self-reported manpower constraints from before to after the German reunification, other covariates, $X'_{i,t}$ and a set of sector, and state fixed effects. The sample period is the first semester of 1980 until the second semester of 2001. Manpower constraints are self-reported in the German IFO Business Climate Survey. The table directly reports marginal effects.

	Order Backlog		Capacity Utilization		Want Hire More		Want Investment More	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Relative MPC	0.005***	0.0047***	0.0081***	0.0081***	0.00071***	0.00072***	0.00057**	0.00059**
	(13.64)	(13.45)	(23.07)	(23.27)	(11.87)	(12.18)	(2.96)	(3.07)
Fin Constraints	−0.05	−0.27	−0.23	−0.35				
	(−0.12)	(−0.56)	(−0.57)	(−0.83)				
Const	−0.2	0.08	−0.28	−0.42				
	(−0.99)	(0.35)	(−0.76)	(−1.10)				
State FE		X		X		X		X
Sector FE	X	X	X	X	X	X	X	X
Nobs	19,359	19,335	20,159	20,135	21,241	21,146	15,752	15,752
Adj R2	0.0164	0.2459	0.0393	0.0761				

t-stats in parentheses

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

Table 4: **Panel Regressions of Firm Outcomes on Instrumented Manpower Constraints (State-level Variation)**

This table reports the results for estimating the following linear/ probit regression:

$$Y_{i,t} = \alpha + \beta \times MPC_{k,t} + X'_{i,t} \times \gamma + \eta_j + \eta_k + \epsilon_{i,t},$$

where $Y_{i,t}$ is the order backlog in months in columns (1)-(2), capacity utilization in columns (3)-(4), a dummy variable which either equals 1 if a firm reports it wants to either hire (columns (5)-(6)) or investment (columns (7-(8))) in the next 12 months compared to the current 12 months, on the change in self-reported manpower constraints from before to after the German reunification instrumented by the influx of people from Eastern Germany, other covariates, $X'_{i,t}$ and a set of sector, and state fixed effects. The sample period is the first semester of 1980 until the second semester of 2001. Manpower constraints are self-reported in the German IFO Business Climate Survey. The table directly reports marginal effects.

	Order Backlog		Capacity Utilization		Want Hire More		Want Investment More	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Relative MPC	0.0094***	0.0064***	0.0077***	0.0077***	0.034***	0.035***	0.0028	0.0031
	(6.45)	(4.70)	(5.44)	(5.47)	(16.25)	(16.71)	(1.77)	(1.96)
Fin Constraints	−0.05	−0.27	−0.23	−0.35				
	(−0.11)	(−0.56)	(−0.57)	(−0.83)				
Const	−0.2	0.078	−0.28	−0.42	−2.26***	−1.41***	−0.79***	−0.83***
	(−1.00)	(0.34)	(−0.76)	(−1.10)	(−6.90)	(−3.62)	(−9.60)	(−9.07)
State FE		X		X		X		X
Sector FE	X	X	X	X	X	X	X	X
Nobs	19,359	19,335	20,159	20,135	21,241	21,146	15,752	15,752
Adj R2	0.0094	0.2448	0.0392	0.0761				
F-Stat	3380.1	3253.3	4303.47	4250.74				

t-stats in parentheses

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

Table 5: **Panel Regressions of Firm Outcomes on Instrumented Manpower Constraints (State-level Variation, around Reunification)**

This table reports the results for estimating the following linear/ probit regression:

$$Y_{i,t} = \alpha + \beta \times MPC_{k,t} + X'_{i,t} \times \gamma + \eta_j + \eta_k + \epsilon_{i,t},$$

where $Y_{i,t}$ is the order backlog in months in columns (1)-(2), capacity utilization in columns (3)-(4), a dummy variable which either equals 1 if a firm reports it wants to either hire (columns (5)-(6)) or investment (columns (7-(8))) in the next 12 months compared to the current 12 months, on the change in self-reported manpower constraints from before to after the German reunification instrumented by the influx of people from Eastern Germany, other covariates, $X'_{i,t}$ and a set of sector, and state fixed effects. The sample period is the first semester of 1980 until the second semester of 1994. Manpower constraints are self-reported in the German IFO Business Climate Survey. The table directly reports marginal effects.

	Order Backlog		Capacity Utilization		Want Hire More		Want Investment More	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Relative MPC	0.0060***	0.0060***	0.010***	0.010***	0.017***	0.018***	0.0054***	0.0054***
	(12.25)	(14.10)	(24.04)	(24.60)	(13.10)	(13.26)	(6.77)	(6.77)
Fin Constraints	−0.88	−0.81	−1.64***	−1.74***				
	(−1.79)	(−1.89)	(−3.73)	(−4.02)				
Const	0.11	0.64*	−0.09	−0.08	−2.15***	−0.38	−0.83***	−0.79***
	(0.88)	(2.01)	(−0.82)	(−0.25)	(−5.43)	(−0.75)	(−6.33)	(−5.46)
State FE		X		X		X		X
Sector FE	X	X	X	X	X	X	X	X
Nobs	6,680	6,672	7,285	7,277	7,545	7,295	5,442	5,442
Adj R2	0.0274	0.2562	0.0753	0.1121				
F-Stat	6,6327.63	6,6076.28	71,427.61	71,067.18				

t-stats in parentheses

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