Demand Uncertainty and Outsourcing

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Abstract

It has been theorized that businesses are more likely to outsource when demand uncertainty is large in order to gain flexibility in production. We provide the first firm-level test of this hypothesis, making use of unique longitudinal data on Australian manufacturing. We find an asymmetric relationship between outsourcing and demand fluctuations. Firms outsource in response to negative demand shocks but do not use outsourcing in response to positive shocks. We find that firms hoard capital, but not labor, in advance of expected sales increases. Outsourcing seems to be concentrated amongst those firms who acquired capital in expectation of a sales increase. For most firms, outsourcing is related to both high levels of hiring and firing. The one exception is firms with moderate levels of unionization who appear to use outsourcing to shed jobs.

Keywords: Outsourcing, Demand Uncertainty, Labor Adjustment, Unions, Capital Hoarding.

JEL Codes: D22, L21, L24, L6.

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1 Introduction

The motivation for this paper is to use firm-level data to examine the relationship between demand uncertainty and outsourcing. A variety of theories have been put forward suggesting that outsourcing might be correlated with demand uncertainty as outsourcing provides one way for firms to cope with large unexpected changes in demand. Evidence of such correlation at an aggregate, industry level has been provided in some studies, but ours is the first study, to our knowledge, that uses firm-level data to examine this hypothesis.

The longitudinal nature of our data is essential in addressing our research question. Firms are asked at each point in time what they expect future sales to be one year from now. Firms in the panel are then observed a year later and their actual realized sales can be observed and compared with their prior expectations.

The first question we address is whether there is a relationship between outsourcing and a firm's ability (or inability) to predict future sales. We find a very strong relationship, but one that is asymmetric. When firms underestimate future sales, we observe little propensity to outsource. However, when firms overestimate future sales, we find a strong propensity to outsource. This is particularly pronounced for those firms who expected sales growth. It thus seems that manufacturing firms are more likely to use outsourcing to deal with shortfalls in expected sales rather than to deal with greater than expected sales. This is an important finding and a novel contribution of our paper.

In the second part of the paper, we attempt to use other data about firms to better understand the motivation for and nature of outsourcing. We begin by examining patterns of labor hiring across different types of firms. Do firms who expect sales to pick up hire labor in advance? Are firms that outsource in response to negative demand shocks having to get rid of labor that was hired in anticipation of increased sales? Do the patterns of job creation and destruction differ across firms that outsource and those that don't? Perhaps surprisingly, we primarily answer these questions in the negative. Consistent with labor being a flexible input, firms do not appear to hire in advance of expected sales increases. Amongst those firms that expected sales increases and were subsequently disappointed, we find slightly more net job destruction amongst the firms that outsource. However, we find that both hiring and firing are larger amongst firms that outsource. The story is thus more complicated than

simply shedding jobs. The one group of outsourcing firms that does show significant job destruction are firms with rates of unionization between 11 and 75 per cent. Outsourcing may be playing a role in firms' achieving increased labor flexibility.

We then turn our attention to firms' use of capital. Firms appear to engage in capital hoarding in advance of expected sales increases. However, when negative demand shocks hit, they do not sell their capital, but rather appear to remain optimistic about the possibility of future sales increases and a recovery of demand. Firms that subsequently outsource are much more likely to have acquired equity financing in expectation of sales increases.

In summary, outsourcing as a response to demand fluctuations seems primarily concentrated amongst firms that expected higher sales but were disappointed. For these firms, outsourcing primarily seems to be a response to having secured equity financing in expectation of higher sales. Outsourcing is related to overall job loss within the firm only for those firms with moderate rates of unionization (11 to 75 per cent).

In what follows, we begin by discussing the background and literature around demand uncertainly and outsourcing. We devote the third section to discussion of our data. The fourth section examines the relationship between demand uncertainty and outsourcing and the fifth section looks at the behavior of firms who expect increases in sales and the subsequent motivations for outsourcing. We conclude in section six.

2 Background

The issue of demand uncertainty and outsourcing has been studied mostly in the context of real options models and primarily in the business and management literature. In an early work, Kamien & Li (1990) portray subcontracting as an alternative to inventory and price management as a capable means of production smoothing when demand for a firm varies over time. Where Kamien & Li (1990) consider the stream of future demands deterministic, Van Mieghem (1999) introduces a real options model of outsourcing with stochastic demand and is able to generate a positive relationship between the variance of demand and the level of outsourced input that is procured. Van Mieghem (1999) submits that outsourcing is desirable in uncertain demand conditions because "... [it] allows for short term capacity adjustment in the face of temporal demand variations." Kouvelis & Milner (2002) consider the environment

where both supply and demand are hit by stochastic shocks and find the same positive relationship between the variance of demand fluctuations and the level of outsourcing, whereas in their findings an increase in the variance of supply capacity prompts the reverse response and effectively dissuades outsourcing. Alvarez & Stenbacka (2007) develop a real-options model that has implications for firm heterogeneity. Their analysis implies that an increase in demand fluctuations increases both the intensive margin of outsourcing and the extensive margin by pushing firms to outsource earlier and in larger proportions.

Despite the interest that the topic has attracted in theoretical studies, empirical evidence is scant, owing to the fact that it is not possible to construct firm-level measures of demand uncertainty using most available data. The only relevant study that we are aware of is presented by Abraham & Taylor (1996). They use industry-level indicators for the seasonality and cyclicality of fluctuations in demand and show that in industries where demand has more seasonality or cyclicality, some jobs such as janitorial services and machine maintenance are less likely to be outsourced, whereas accounting jobs tend to be contracted out with higher probabilities in these industries. Abraham & Taylor (1996) then hypothesize that such discrepancy might be originating from differences in the flexibility to shift certain tasks towards off-peak periods. They also acknowledge that due to their inability to measure demand fluctuations at a more disaggregate level, they are likely to miss certain details. In this paper, we use a dataset in which firms report expectations of future sales and utilize the longitudinal nature of the data to form an idiosyncratic measure of firm-level demand uncertainty that can be used not only to test the predictions made in the theory but also to explore in more detail our understanding of how firms outsource in the face of demand shocks. These are the two main contributions of our paper.

3 Data

We use the Business Longitudinal Survey (BLS) from the Australia Bureau of Statistics (ABS) for our study. The data are an unbalanced panel of Australian firms surveyed from 1994–95 to 1997–98.[1] The data is unique in providing us with traditional economic infor-

[1]The fiscal year in Australia begins on July 1st and ends on June 30th the next year, hence, covers two years.

mation about individual firms (e.g. employment, sales, exports, innovation), but also about future sales expectations of firms.[2] In addition, the data reports whether a firm has contracted out any jobs during the year that used to be done by its own employees. The combination of these variables along with the longitudinal aspect of the data provides us with an ideal platform to study the linkage between demand expectations, actual demand outcomes and outsourcing decisions.

The data is available to researchers in a Confidentialised Unit Record File (CURF) in which the ABS has taken steps to protect the confidentiality of individual firms such as adding small amounts of noise to numerical values and providing certain data items in bins rather than as continuous variables. Importantly, the data excludes, again for reasons of confidentiality, all firms with more than 200 employees. Thus, our results can be taken as applying for small and medium size enterprises which, within Australia, account for the vast majority of businesses. The ABS Count of Businesses (Cat.No.8165.0) shows that about 99% of Australian businesses are smaller than 200 employees.

For the initial, cross-sectional sample of 1994–95, the ABS stratified businesses by industry and size and randomly selected firms within each stratum using the Australian business register. The total sample size is about 13,000 firms. Each firm in the sample is weighted in such a way that the sum of weights is equal to the total population of the stratum. To form the panel data set, the ABS further stratified firms by innovation status, export activities and growth in sales and kept about 6,400 firms as the continuing panel. Firms identified as showing innovative, export, or growth activities were over-sampled to form half of the continuing sample. The other half was selected from the remaining firms. Sampling weights for the panel, which we use in all of our descriptive statistics and regression models below, are provided which reflect this selection procedure. In every succeeding year a sample of 500 firms are added to the panel to compensate for attrition as firms exit or stop responding.

The data covers firms from a broad spectrum of industries such as manufacturing, construction, and financial services. So that we can compare our work to other benchmark studies, we restrict our attention to the manufacturing sector (ANZSIC 2x). The industry code for some firms is suppressed in the confidentialised file as ANZSIC 20 (unknown man-

[2]Full information on the available data items is available in the Technical Manual, ABS Catalogue Number 8141.0.15.001 at `http://www.abs.gov.au`.

ufacturing) to protect the identity of the firm. We replace this missing value code with the industry code reported in past or future years, assuming that industry is time invariant. For those for whom we have no reported industry code at any point in the panel, we include them in Miscellaneous Manufacturing (ANZSIC 29). So this category is a mix of uncategorized and unknown manufacturing.

We use the longitudinal aspect of the data. The panel covers four years from 1994-1995 to 1997-1998. Our firm-level demand uncertainty variable (described in more detail below) is constructed for three years as we combine one year's expectations with a subsequent year's realized sales. Outsourcing information is not available in the final year, 1997-1998, so our regression models are restricted to two yearly observations (1995-1996 to 1996-1997) using three years (1994-1995 through 1996-1997) of data for each firm. We estimate our models on the balanced sample over these three years to avoid the complexity of modeling entry and exit. In line with this, we drop firms that report zero sales and employment in any year because we are unable to distinguish between continuing businesses that fail to respond and exiting firms. Our results thus strictly apply to continuing firms.

The decision of the firm to outsource ($OUTS$) is a key variable in our analysis. In the survey, firms are asked "During the financial year, did this business contract out activities previously done by its own employees?" The question generates a yes/no answer about outsourcing but provides no information about how many jobs or which type of jobs were outsourced.[3] In what follows, we first analyze the outsourcing decision and then in the second part of our analysis, we use other survey information to attempt to understand how the outsourcing was implemented and which types of jobs were affected.

Columns one to three of Table 1 show the composition by two-digit industry sector of the analysis sample of 1,354 manufacturing firms used in the paper. Columns four through six present the percentage of firms in each industry by year who responded that they undertook outsourcing. The last two columns of Table 1 are described in the next subsection.

[3]From other sources, we know that most jobs contracted out during this time period were services such as maintenance, janitorial, catering and transportation jobs. Also, outsourcing is almost exclusively domestic–see Bakhtiari (2014).

ANZSIC	Description	#Firms	% Outsourcing 1994–95	% Outsourcing 1995–96	% Outsourcing 1996–97	Average Error	IQR[a] Error
21	Food, Beverages and Tobacco	144	8.3	4.9	6.9	-0.091	0.198
22	Textile, Clothing, Footwear and Leather	112	8.9	9.8	11.6	-0.083	0.247
23	Wood and Paper Products	70	8.6	7.1	7.1	-0.114	0.234
24	Printing, Publishing and Recorded Media	94	12.8	13.8	6.4	-0.063	0.174
25	Petroleum, Coal, and Chemical Products	171	5.9	8.8	6.4	-0.176	0.192
26	Non-metallic Mineral Products	59	8.5	8.5	5.1	-0.053	0.233
27	Metal Products	187	12.3	4.8	7.0	-0.031	0.253
28	Machinery and Equipment	338	14.2	8.6	6.8	-0.158	0.256
29	Miscellaneous Manufacturing	179	11.2	10.6	9.5	-0.084	0.200
2x	Manufacturing	1,354	10.8	8.4	7.5	-0.100	0.224
	Total Number of Firm–years	4,062					

Table 1: The composition of manufacturing in the analysis sample.
[a]Inter-quartile range

3.1 Measurement and variable construction

In this section, we elaborate on the construction of the variables used in our analysis.

Average Non-managerial Wages

Firms report aggregate wages. We build a measure of average non-managerial wage as follows

$$AWAGE = \frac{WAGE + COMP + SUPER}{EMP + 2MAN}.$$

$COMP$ and $SUPER$ are the worker compensation and superannuation (retirement fund) payments by the firm during the year. The BLS is rather detailed in reporting the number of employees and provides the numbers of managerial (MAN) and non-managerial (EMP) employees separately. The ABS reports on Earnings and Hours (Cat.No.6306.0) indicate that managerial pay in Australia is on average about twice as large as that of non-managerial workers over the years 1994–98. The number of managers and owners is thus multiplied by two in our average wage calculation.[4]

Expectations

In the BLS, each firm reports at time t the percentage it expects sales to grow from time t to $t+1$. Let's call this quantity $EXPECT_{t+1}$. Using the percentage, one can easily construct expected sales at time $t+1$ as projected at time t, or $E_t[SALES_{t+1}]$. The longitudinal nature of the data also makes it possible to observe the actual sales in $t+1$. Using both the actual and projected sales, one can compute the percentage error in the projection of future sales. For firm j at time $t+1$ the error is computed as

$$ERROR_{j,t+1} = \frac{SALES_{j,t+1} - E_t[SALES_{j,t+1}]}{SALES_{j,t+1}}, \tag{1}$$

in which sales are in nominal terms. A positive value for $ERROR$ indicates that the firm experienced higher than expected sales, whereas a negative value for $ERROR$ means that the firm fell short of achieving its sales expectations in $t+1$. Average values of $ERROR$ across the three years of data are reported by industry in the second last column of Table 1. On average, across all years and industries, firms slightly over-predict future sales by 10 per cent.

[4] We include owners as wage earners because, in the data, many working owners are being paid handsomely by their own business (especially observed among businesses with zero or one employee), possibly as a strategy to cut business taxes.

variable	Mean	Std.Dev.	1st Qrtl.	Median	3rd Qrtl.
$EXPECT_{t+1}$	0.093	1.188	0	0	0.1
if $EXPECT_{t+1} > 0$	0.260	1.665	0.05	0.10	0.21
if $EXPECT_{t+1} < 0$	-0.176	0.170	-0.26	-0.13	-0.05
$ERROR_{t+1}$	-0.100	0.933	-0.131	-0.001	0.094
if $ERROR_{t+1} > 0$	0.148	0.156	0.042	0.107	0.201
if $ERROR_{t+1} < 0$	-0.331	1.258	-0.274	-0.129	-0.046
N			4,062		

Table 2: Weighted descriptive statistics for the variables of sales projection and sales growth.

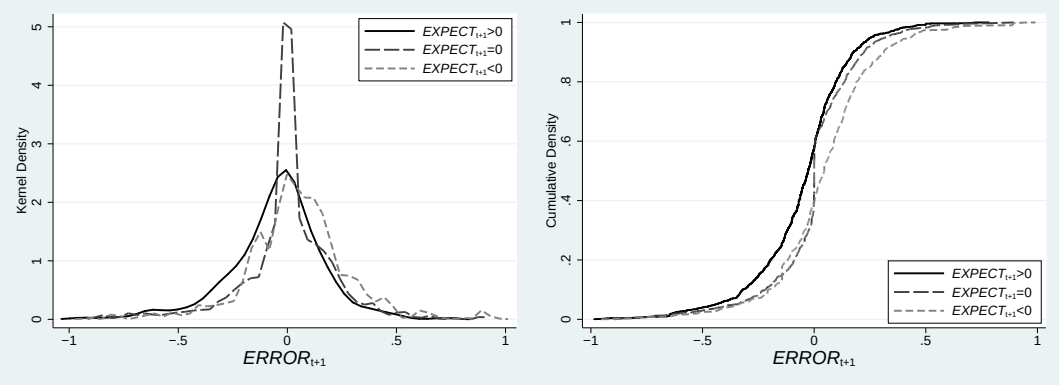
We also present in the last column of Table 1 the inter-quartile range by industry of firms' prediction errors as a measure of industry-level demand uncertainty. The correlation, at the industry level, between this measure and average outsourcing is basically zero (-0.04) and statistically insignificant.[5] Thus, interestingly, our data does not demonstrate the industry-level correlation between outsourcing and demand uncertainty noted by Abraham & Taylor (1996).

Table 2 summarizes the distributions of $EXPECT$ and $ERROR$. In line with the observations from Table 1, on average, firms expected a 9 per cent increase in sales but these expectations fell short by 10 per cent. Table 3 shows the percentage of firms by the sign of their initial expectations and the sign of the error in their expected sales relative to their actual, realized sales. The figures in the table again reveal a general sense of optimism among firms, as 53 per cent of the sample expected positive growth in sales from the current to the following year. Almost 60 per cent of these firms (31.4 per cent of the total sample) were disappointed and realized less sales than expected. On the other hand, for the 21 per cent of firms who expected a decrease in sales, over 60 per cent of them (13.1 per cent of the full sample) realized higher sales than expected. Note that $ERROR_{t+1} > 0$ means that sales were higher than expected, not that sales necessarily were higher than the previous year. One would expect no firms to have *exactly* zero change in sales from year on year and the 1.3 per cent of firms in this category probably represents rounding by firms when reporting

[5] We find similar results using other measures of uncertainty.

	$ERROR_{t+1}$		
$EXPECT_{t+1}$	< 0	$=0$	> 0
< 0	8.2	0	13.1
$=0$	11.2	1.3	13.2
> 0	31.4	0	21.6
			N =4,062

Table 3: The (weighted) percentage of observations by expectations of sales at time $t+1$ and errors in the predicted change in sales



(a) (b)

Figure 1: The non-parametric distribution of prediction errors for firms that expected sales to grow, not change and fall.

sales.

Figure 1 provides more information about the distribution of prediction errors in sales split by whether firms expected sales to increase, stay the same, or decrease. Panel (a) shows that the standard error of prediction errors ($ERROR$) is large for those firms who expect sales to either increase or decrease and it is quite small for those who expect sales to be unchanged. This is consistent with firm growth being associated with sales uncertainty. In panel (b) we plot the corresponding cumulative distributions to illustrate more clearly the ranking of firms in their ability to forecast future sales by highlighting the order of stochastic dominance in the distributions of error. One can see the relationship already remarked upon in Table 3. Firms that expect sales to increase are more likely to over-estimate the size of the increase; they are stochastically dominated by the other groups. Those who expect sales to

		$EXPECT_{t+1}$			
$EXPECT_t$	$ERROR_t$	< 0	$=0$	> 0	N
< 0		26.1	28.0	45.9	568
$= 0$		25.3	28.3	46.4	688
> 0		17.7	23.5	58.8	1,452
				Total	2,708
> 0	< 0	17.3	25.2	57.6	858

Table 4: Firm expectations of sales changes at time $t+1$ by expectations at time t. The last row is the subset of firms who expected positive sales growth at time t but who were disappointed. $t = 1994-95, 1995-96$.

decrease are more likely to over-estimate the size of the decrease; they almost stochastically dominate the other groups. (They stochastically dominate the other two groups for positive values of $ERROR_{t+1}$, see Figure 1; but for values less than zero the distribution is similar to that for firms that did not expect sales to change.) Thus, those that expect sales growth are more likely to realize a negative value of $ERROR_{t+1}$ and those that expect sales to fall are more likely to realize a positive value of $ERROR_{t+1}$.

One remarkable point about firms with positive expectations is that they are not immediately discouraged by a shortfall in expected sales but keep their hopes high for the longer-term. This point is illustrated in Table 4, in which each row shows the transition probabilities to each expectation category at time $t+1$ based on the expectation at time t. About 60% of firms with positive expectations at t keep on expecting growth at $t+1$. Even conditioning on less than expected growth (the last row) does not change this pattern.

4 Demand and Outsourcing

Does the ability of a firm to accurately predict its future sales influence its outsourcing decision? Figure 2 shows how outsourcing propensity changes with the prediction errors. The picture suggests a monotonic and negative relationship in which falling short of predicted sales is related to outsourcing. A higher likelihood of outsourcing is seen among those firms with larger (in absolute value) negative prediction errors. On the other hand, over-achieving prior expectations does not seem to instigate much outsourcing.

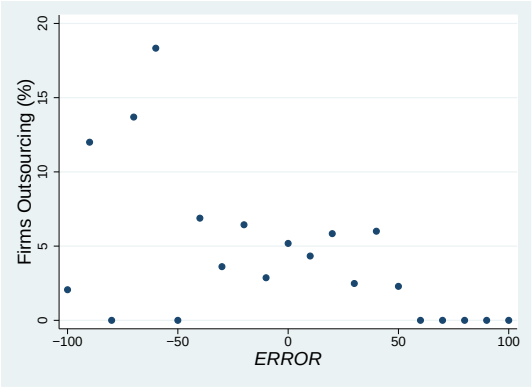


Figure 2: The fraction of firms outsourcing by the intervals of sales prediction error. Error is discretized into bins of length 10%. Error and outsourcing are both time $t+1$ quantities.

Comparing these findings to those of Abraham & Taylor (1996), we find that our conclusions are slightly more nuanced. Abraham & Taylor (1996) find that increased uncertainty at the industry level is correlated with increased outsourcing for some tasks. We observe that firm-level uncertainty matters for outsourcing, but only if it results in realized outcomes that are worse than firms expected. Uncertainty associated with outcomes that are much better than firms expected seem to have a *negative* impact on the propensity to outsource. Hence the rather inconclusive evidence about the relationship between outsourcing and demand uncertainty from Table 1 hides a strong, but asymmetric relationship.

To explore whether the relationship in Figure 2 is driven by a relationship between prediction errors and outsourcing or simply a function of the influence of other variables, we adopt a regression strategy. Given the Boolean nature of our outsourcing information, we use a Probit model to test whether the relationship remains negative in the presence of additional controls and confounding factors. Let $OUTS^*_{ji,t+1}$ denote a firm's (unobserved) level of incentive to outsource in $t+1$. Then, our specifications takes the form

$$OUTS^*_{ji,t+1} = \alpha_0 + \alpha_1 ERROR_{ji,t+1} + X_{jit}\beta + \tau_t + \epsilon_{jit}. \tag{2}$$

The specification above indicates that the incentive for firm j in manufacturing subsector i to outsource at time $t+1$ is driven by the firm's ability to predict its $t+1$ sales one year in advance, as well as other firm level characteristics at time t. The lagged nature of

the equation is especially useful in attenuating any possible endogeneity.[6] The effects of aggregate economic conditions on outsourcing propensity are absorbed by the time dummies τ. ϵ_{jit} contains both firm-level and other unobserved effects.

Due to the presence of these firm-level fixed effects, the ϵ_{jit} can still be correlated across time. The panel extends for very few years and including firm dummies will produce inconsistent coefficient estimates, owing to the nonlinear nature of the problem (Heckman, 1981). We take a more structural approach by assuming that the firm fixed effects depend on a few time-invariant firm characteristics reported in the data. The structure of the fixed-effects model we will be using is

$$\epsilon_{jit} = Z_j\gamma + \mu_{ji} + \eta_{jit}, \tag{3}$$

in which Z is a set of time-invariant firm characteristics, which in our case includes whether the firm has a major decision maker, if it is a family business and whether the firm is incorporated. The specification also includes industry dummies, μ_{ij}, to control for cross-industry variation. We assume that the remaining unobservables, η_{jit}, are mean zero and i.i.d disturbance terms.

To compose the set of covariates, we mostly follow Abraham & Taylor (1996) and include the log of average wage for non-managerial workers[7], and two dummies indicating whether the firm has 25–50% union membership among its employees ($UNION25-50$) or more than 50% union membership ($UNION > 50$).[8] Abraham & Taylor (1996) argue that higher worker wages can be an incentive for outsourcing as a cost-cutting measure. They also posit that firms with a large number of union workers among their ranks outsource those jobs in an attempt to gain more flexibility in adjusting labor. However, very high levels of union membership can hinder that strategy if unions wield too much power over business decisions. In view of the findings by Breunig & Bakhtiari (2013) that innovation-oriented firms are more likely to outsource in order to focus on R&D, we include a dummy that indicates whether the firm innovated a new product or process in time t ($INNOVAT_t$). Finally, we include a dummy indicating whether the firm outsourced in time t, to further account for possible

[6] It may be that there are unobserved factors at time $t+1$ that affect both the outsourcing decision and the realized sales but the inclusion of lagged firm characteristics which at least partially determine those unobserved factors should help to mitigate this endogeneity.

[7] We actually use $\log(1 + AWAGES)$, because some of the single-owner businesses do not pay any wages.

[8] This data is provided by the ABS in slightly less aggregated bins but our results don't change if we use a larger number of categories.

inter-temporal correlations in outsourcing activity.

Equation (2) is estimated using a maximum likelihood approach and the average marginal effects are reported in Table 5. The first column of results is estimated by excluding the fixed effect structure of (3). The second column of results includes the fixed-effect structure, and the addition of the fixed effects does not seem to have any distinguishable effect on the estimated marginal effect of the prediction error. In both cases, the effect of error in sales projections on the propensity to outsource is negative and statistically significant. In other words, a shortfall in the expected sales is a significant factor in making an outsourcing decision. The larger the shortfall, the higher the likelihood that a firm opts for outsourcing.

At this point, we are also concerned about the direction of causality. Desired outcomes and gains from outsourcing might simply not materialize as a result of misplaced expectations from an outsourcing relationship or because of unforeseen circumstances.[9] Therefore, one could argue that a firm's under-performing sales might be driven by outsourcing itself. We test the robustness of our results to such endogeneity bias by employing a set of instruments. The main challenge of using instruments is to find 'good' instruments; i.e instruments which are highly correlated with the prediction error but not correlated with the outsourcing decision. In the available variables in the BLS, we could identify two particular questions that are useful in building appropriate instruments. In one question, firms report whether their advertising expenditures significantly decreased/did not change much/ or significantly increased from last year. We assign the variable ADV as a multinomial variable and include it as a set of dummies that represent the set of responses to the advertising question. Changing advertisement expenditure surely affects sales and their projection, but we are not aware of any work that makes a strong link between advertising and outsourcing.[10] Firms also report in the BLS whether they have a documented business plan ($BUSPLAN$) for the coming year. It can be argued that firms with a documented business plan are better organized and are poised to make more accurate and less faulty sales projections. Having a documented business plan, however, does not necessarily suggest a bias either towards or against outsourcing.

There are other candidate instruments for which the exclusion restrictions seem more

[9]For a case-study of some outsourcing misadventures see Peisch et al. (1995).

[10]One possibility is that the activity that is outsourced is advertising itself. This may invalidate the instrument and we also estimate the model without this instrument as described below.

Variable	Probit	Probit	IV Probit	Probit	Probit
$ERROR_{t+1}$	-0.006***	-0.006***	-0.277***		
	(0.001)	(0.001)	(0.028)		
$ERROR^{-}_{t+1}$				-0.005***	
				(0.001)	
$ERROR^{+}_{t+1}$				-0.032***	
				(0.010)	
$ERROR_{t+1} \times DEC_{t+1}$					0.001
					(0.016)
$ERROR_{t+1} \times NCHG_{t+1}$					-0.005
					(0.054)
$ERROR_{t+1} \times INC_{t+1}$					-0.048***
					(0.008)
$OUTS_t$	0.097***	0.093***	0.090***	0.093***	0.738***
	(0.004)	(0.004)	(0.009)	(0.004)	(0.029)
$\log(1 + AWAGE_t)$	0.017***	0.020***	0.050***	0.019***	0.154***
	(0.002)	(0.002)	(0.004)	(0.002)	(0.019)
$UNION_t 25 - 50$	0.021***	0.024***	0.033***	0.024***	0.192***
	(0.006)	(0.006)	(0.007)	(0.006)	(0.051)
$UNION_t > 50$	-0.017***	-0.012**	-0.006	-0.012**	-0.099**
	(0.006)	(0.006)	(0.007)	(0.006)	(0.047)
$INNOVAT_t$	0.031***	0.029***	0.026***	0.029***	0.230***
	(0.003)	(0.003)	(0.005)	(0.003)	(0.024)
Firm Fixed-Effect		✓	✓	✓	✓
Log Likelihood	-8,000.8	-7,916.6	-55,130.3	-7,914.1	-7,915.3
χ^2	1,504.0	1,637.4	1,602.2	1,650.7	1,660.9
p-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
χ^2 Endog.			155.5		
p-value Endog.			[0.000]		
N	2,708	2,708	2,708	2,708	2,708

Table 5: Average marginal propensities to outsource in $t + 1$. Numbers in parentheses are robust standard errors. *** and ** indicate significance at 1% and 5% levels. χ^2 for endogeneity tests for the significance of the correlation coefficient between the disturbances in the instrumental and main equations.

Variable	Significantly Decreased	No Significant Change	Significantly Increased
Advertisement	133	1,988	587
Productivity	2	1,642	1,064
Range of Products	51	1,633	1,024
	Yes	**No**	
Has Documented Business Plan?	993	1,715	
			$N = 2{,}708$

Table 6: Counts of firm–years for each instrument.

questionable than for the above two variables. In the BLS, firms also report, in the same fashion as before, whether their productivity decreased/stayed the same/ or increased from last year, which we use to construct a multinomial variable $PROD$ which we represent by a series of dummy variables. Firms also report whether their range of products changed in the same way, leading to the multinomial variable $RANGE$. Both variables affect the accuracy of sales projection by adding some element of uncertainty. Their relationship with outsourcing, however, is not obvious; for instance, a drop in productivity might be a positive influence on outsourcing according to some existing evidence (Pieri & Zaninotto, 2013, for instance), but the effect of an increase or no change in productivity is at best ambiguous. Similarly, the product cycle theory of Vernon (1966) raises the possibility that an increase in the range of products might push some firms to outsource the production of older products. On the other hand, no change or a reduction in product range has no certain implications for outsourcing. Table 6 provides the distribution of responses to the questions that we use to construct our instruments.

We estimate our model using an instrumental variables Probit approach with three separate sets of instruments: (1) ADV and $BUSPLAN$ only; (2) all four instruments from Table 6; (3) $BUSPLAN$ only. In column four of Table 5 we report the results using the first of these instrument sets. Using either the set with all four instruments or using only $BUSPLAN$ produce results that are not statistically significantly different than those presented here so we suppress them from the table. As is often found with instrumental variable estimation, both the coefficient estimates and the standard errors increase substantially rel-

ative to the standard Probit model. We still find a significant and negative effect of sales prediction errors on outsourcing. Given that the instrumental variable estimates did not overthrow our conclusions from the fixed effects Probit model of column 3, this simpler specification remains our preferred set of estimates for this model. We view the instrumental variables estimates, with their fundamentally untestable assumptions, as a robustness check on this preferred specification.

In column five of Table 5 we present results from a model which is identical to the fixed effects model of column (3) except we allow the relationship between prediction error and outsourcing to be different when prediction errors are positive or negative. The negative relationship between outsourcing propensity and prediction errors is stronger when firms are positively surprised in sales expectations. Here, and elsewhere, there is no evidence than outsourcing is being used by firms to deal with unexpected, *positive* excess demand.

This far, it seems that lower than expected sales could incite outsourcing. However, it is not clear whether prior expectations regarding sales growth or contraction also play a role. For instance, firms that expected growth in sales might be grossly disappointed when they actually lose sales and react by outsourcing. On the other hand, it is possible that firms with a negative view of future sales are not surprised at all by a lower than expected sales and do not take any specific action in response to the negative shock. To scrutinize this hypothesis, we run the same Probit model, but make a distinction between firms based on their prior expectations about the sign of future sales growth. We do this by interacting $ERROR_{t+1}$ with an indicator for whether firms expected sales to grow (INC), stay about the same ($NCHG$), or shrink (DEC). The last column in Table 5 presents these results. We find that prior expectations do matter. Firms that expected no change or decreasing sales do not show a higher propensity to outsource if their predication errors are negative. The reaction to negative prediction errors appears to be driven by those firms who had positive prior expectations. When a firm expected growth in sales, then for every percentage decrease in the prediction error (i.e. when realized sales are less than predicted), firms are about 5% more likely to outsource on average.

In this section we have attempted to establish, at the firm level, the relationship between demand uncertainty and outsourcing. In summary, firms who realize sales less than expected

are much more likely to outsource than those who do not. Firms who realize sales greater than expected are very unlikely to outsource. And, the reaction of outsourcing in response to realized sales being less than expected is primarily driven by those firms who expected sales to grow and were subsequently disappointed in their sales expectations. In the next section, we use other available data to try to disentangle the role that outsourcing might play in firms' responses to sales shocks and the relationship between outsourcing and other important firm characteristics.

5 Firm responses to sales expectations and shocks: possible motivations for outsourcing

As we show above, firms' prior expectations about sales matter in how they respond to sales shocks (defined as unanticipated changes in sales based upon the variable $ERROR_{j,t+1}$ as defined in equation 1 above). Thus, in this section we look at how firm investments in labor and capital differ by their expectation of future sales. We then examine whether outsourcing is a response to prior decisions about labor or capital.

5.1 Labor

Abraham & Taylor (1996) argue that outsourcing is more prevalent within industries where demand fluctuates because outsourcing gives firms flexibility in adjusting the number of workers and hours quickly as demand changes. The argument works along the same lines as the production smoothing incentives for outsourcing proposed by Van Mieghem (1999). Under the auspices of outsourcing, firms have the option to use the service of contracted labor during periods of demand boom, then easily reduce or cease the contracted service when demand falls.

The first question we ask is about the influence of firm expectations on hiring behavior. Did firms hire extra labor in anticipation of increasing sales? Table 7 reports the average levels of job flows in firms at time t, before sales at $t+1$ have been realized. The objective is to see whether firms that expected growth in sales from t to $t+1$ hired and hoarded labor in advance. We split firms into four groups: those that expected sales growth and were

disappointed with lower than expected growth (row 1); those that expected sales growth and who had growth greater than anticipated (row 2); and those that expected no change in sales (row 3). Firms who expected sales to shrink are reported in the fourth row.

In the BLS, firms report the number of employees that were newly hired ($HIRE$) and the number of employees that ceased to be employed ($CEASE$) during each year. The difference is the net change in the number of employees in a firm during the year:

$$NET_t = HIRE_t - CEASE_t. \tag{4}$$

If the net change is positive, then the firm has created jobs. If the change is negative, jobs have been destroyed.

Table 7 provides four insights. First, there is not much difference in job flows between the two sets of firms that expected growth (rows 1 and 2). Firms that expected growth and did better than expected added about 0.49 workers on average whereas those who expected sales growth and were disappointed added about 0.36 workers. This provides some evidence that our error measure (defined in equation (1) above) is capturing at least some unexpected shocks to demand. The fact that those firms whose expectations were more than realized have larger employment growth than those whose expectations were disappointed could be seen as evidence that firms who realized greater than expected growth had stronger expectations and thus hired more in advance; however, this difference is not statistically significant.

Secondly, the evidence for labor hoarding amongst firms that expect growth is fairly slight. Average net job growth across the two groups that expected sales increases is about 0.41, only a modest increase. Thirdly, firms who expected sales to shrink did take action in advance to reduce their net work force by 1.15 individuals on average, a statistically significant decrease. Lastly, firms that expected no change in sales actually recorded a small (but statistically significant) decrease in workers of 0.21. This may reflect an increase in labor productivity or a shift in capital intensity.

We examine the interaction between net job growth and outsourcing in Table 8. We consider four types of firms: firms that expected sales growth and were disappointed, split by whether they subsequently outsourced (row 1) or not (row 2); firms that outsourced when sales were better than expected (row 3), averaged across all firms irrespective of prior

$EXPECT_{t+1}$	$ERROR_{t+1}$	$HIRE_t$	$CEASE_t$	NET_t	N
> 0	< 0	3.415	3.057	0.357	978
		(0.107)	(0.095)	(0.058)	
> 0	> 0	3.356	2.870	0.486	631
		(0.112)	(0.103)	(0.065)	
$= 0$		1.567	1.777	-0.209	427
		(0.094)	(0.111)	(0.069)	
< 0		3.014	4.162	-1.148	672
		(0.108)	(0.135)	(0.086)	
				Total	2,708

Table 7: Average job flows in firms of different types prior to the realization of future demand. Numbers in parentheses are standard errors. All averages are significant at 1% level. $t = 1994 - 95, 1995 - 96$.

expectations; and, in row 4, firms that expected sales reductions averaged across all types of realized sales changes.[11]

Based upon the results of section 4 above, we are particularly interested in those firms who expected sales increases but were disappointed. As we can see in the first two rows, firms within that group that outsourced have significant and negative net job growth. The firms that didn't outsource had an insignificant change in job growth. Even more interestingly, those firms that outsourced hired *more* than the firms that did not. The difference in net job growth between these two groups is -0.18 whereas the difference in hiring is 1.09. So while outsourcing is clearly related to job destruction there is something more complicated going on because it is also related to increased hiring. In rows (3) and (4) of the table we see that other types of outsourcing firms also combine high rates of net job destruction with high rates of hiring. The evidence points to a strategy by outsourcing firms to replace their workers rather than simply to reduce their numbers. Such a strategy would also be consistent with the evidence presented in Table 4 above. Firms remain positive about the future, so they are not just shedding jobs but, more importantly, re-configuring employment.

It is difficult to directly address this hypothesis with our data. However, we can explore the relationship between net job change and other firm characteristics to see if there is firm heterogeneity hidden by the average numbers presented in Table 8. Figure 3 shows the

[11] Thirty-seven firms are counted in both row three and row four as there is some overlap in these two groups.

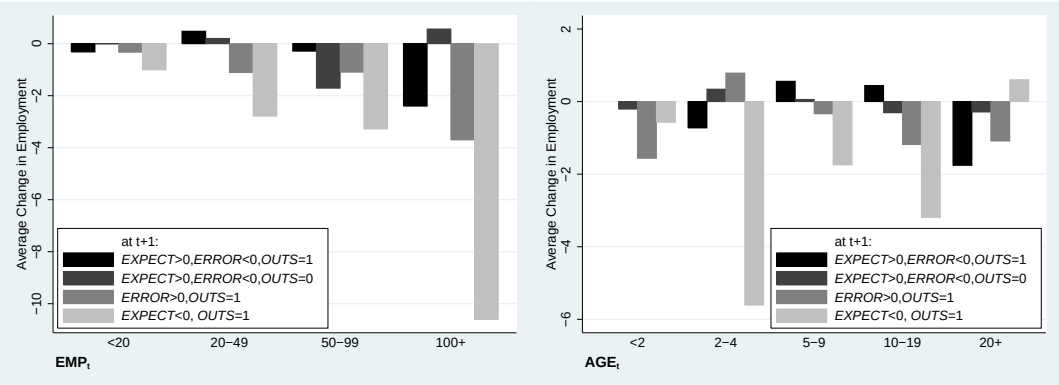
	Type of Firm						
	$EXPECT_{t+1}$	$ERROR_{t+1}$	$OUTS_{t+1}$	$HIRE_{t+1}$	$CEASE_{t+1}$	NET_{t+1}	N
(1)	> 0	< 0	✓	3.956***	4.185***	-0.229**	81
				(0.222)	(0.204)	(0.117)	
(2)	> 0	< 0		2.866***	2.911***	-0.045	897
				(0.062)	(0.061)	(0.038)	
(3)		> 0	✓	3.951***	4.566***	-0.614***	93
				(0.250)	(0.276)	(0.106)	
(4)	< 0		✓	3.694***	5.836***	-2.142***	61
				(0.303)	(0.420)	(0.291)	

Table 8: Average job flows in firms of different types. Numbers in parentheses are standard errors. *** and ** indicate significance at 1% and 5% levels, respectively. $t + 1 = 1995 - 96, 1996 - 97$.

average net change in employment by the four firm types defined in Table 8 split by firm size as measured by number of employees, firm age and union membership.

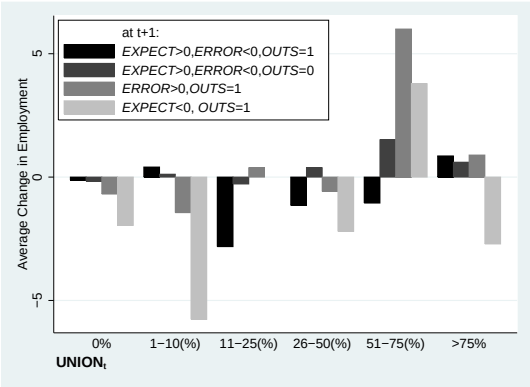
In panel (a), firms of each type are separated by size, where size is classified as less than 20 employees, 20 to 49 employees, 50 to 99 employees, and 100 employees or above. Focusing on our target firms (those that expected sales increases but were disappointed) represented by the two more heavily shaded bars in the graph, we do not observe any major difference in net employment change between those firms that outsourced and did not outsource. Again, we see that firms with negative expectations do reduce size significantly as they outsource and larger firms have more scope to outsource more. Repeating the same exercise by firm age in panel (b) also does not reveal any strong differences in net job growth by outsourcing within our target group. Below, we explore the unconditional relationships in this graph through a regression that allows us to control for confounding variables.

Classifying firms by union membership, however, highlights an important distinction between those target firms that outsource and those that don't. The percentage of union workers in the BLS is reported in bins of 0%, 1-10%, 11-25%, 26-50%, 51-75%, and 75% and above. The figure shows that the outsourcing firms in our target group are distinct from the non-outsourcing firms in our target group in that they reduce employment by a much larger proportion when the level of unionization in the firm is between 11% and 75%. Firms with medium levels of unionization seem to be using outsourcing to shed jobs after experiencing a



(a) By Size Group

(b) By Age Group

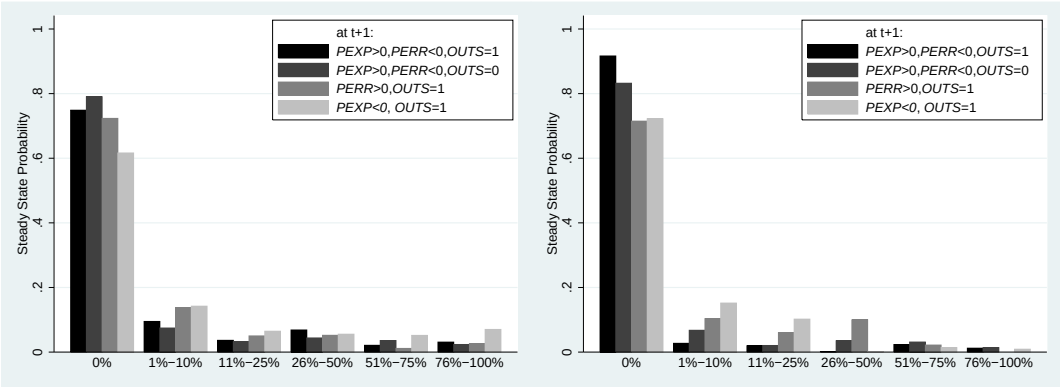


(c) by Union Membership

Figure 3: The average net change in the number of employees for different types of firms.

negative sales shock. This could be an attempt to gain more flexibility in labor adjustment by reducing the number of union employees in their ranks. This picture is not supported among firms with more than 75% union membership, which are slightly increasing employment. One could speculate that business decisions among these firms are more aligned with union demands than business interests, hence, the reason for the unexpected direction of net job change.

To further examine whether union reduction may be playing a role in the size adjustments detected above, particularly among the outsourcing firms in our target group, we look at one-year transitions among the bins of union membership rates reported in the data. We find the fraction of firms of each type that move from one bin to another, and using them we form a Markov transition matrix. The availability of union membership in bins limits our ability



(a) Initial Distribution (b) Steady State Distribution

Figure 4: The distributions of union membership among different types of firms (a) initially and (b) in the steady state.

to accurately track all movements. But as we show below it is still possible to draw some inferences. We investigate the direction of change by finding the steady-state distribution of the Markov transition matrix and comparing it to the initial distribution of union membership that is readily obtained from the data.

Figure 4 illustrates the initial and steady-state distributions by the different types of firms studied above. Any shift in the mass of firms to the left or right indicates a shifting strategy across firms on average. We find that the outsourcing firms in our target group are the firms that shift the largest mass of the distribution to where union membership is zero, while effectively leaving not many firms in the other bins over the long run. These firms are followed by the other target firms that did not outsource. The shift in the distribution seems to be in the opposite direction when looking at the outsourcing firms that experienced positive growth or expected a drop in sales. Firms in our target group appear to be pursuing a strategy of moving away from unionization, particularly when they are also outsourcing.

5.1.1 Working hours

Firms may adjust labor inputs through other mechanisms, not just by changing the number of employees. In practice, firms may change hours of operation or introduce reduced working shifts and in the short run avoid transaction costs of hiring and firing. Where unions are present, this strategy becomes an effective alternative to labor adjustment on the extensive

	Type of Firm					
	$EXPECT_{t+1}$	$ERROR_{t+1}$	$OUTS_{t+1}$	$HOURS_{t+1}$	$\Delta HOURS_{t+1}$	N
(1)	> 0	< 0	✓	56.4 (0.920)	-0.24 (0.492)	81
(2)	> 0	< 0		49.6 (0.232)	-2.25 (0.177)	897
(3)		> 0	✓	55.6 (0.846)	2.90 (0.640)	93
(4)	< 0		✓	55.4 (1.288)	3.44 (0.978)	61

Table 9: Average number of hours and days of operation. Numbers in parentheses are standard errors. All numbers are statistically significant except hours change in row 1. $t + 1 = 1995 - 96, 1996 - 97$.

margin. To explore this, we look at hours and days of operation. The BLS reports the average number of hours per day and the average number of days per year a firm operated. As a note of caution, the information relates to the operation of the firm and not the workers who might be working in different shifts. For example, some firms report that they are operating 24 hours per day, seven days per week. Given this cautionary note, we compute the average number of hours per week a firm operated ($HOURS$) and report the results in Table 9. We also report the year-on-year change in average operating hours per week.

Outsourcing firms operate longer hours than non-outsourcing firms. What is not clear from these numbers is whether these firms generally operate longer hours owing to some unobserved cause, or is it their response to the outcome of their expectations? If we look at hours changes, we can see that firms in our target group that do not outsource are in fact reducing operating hours by about two hours in response to the negative shock. For other outsourcing firms in the last two rows of the table, the change in the number of hours is mostly upwards and in the opposite direction of changes in employment that we observed in Table 8. If we can interpret these changed operating hours as changed work hours, this is evidence that these firms reduce employment but increase work hours for those who stay employed.

In conclusion, similar to our results in Section 5, the outsourcing firms in our target group do not behave the same as other types of outsourcing firms that significantly increase hours.

Amongst firms who failed to realize increased sales expectations, the firms that outsource also behave different than those who do not. The non-outsourcing firms reduce work hours whereas the outsourcing ones do not. This provides additional supporting evidence that adjusting the extensive or intensive margins of labor size, *per se*, does not take priority for these firms in dealing with a demand shortfall.

5.2 Capital

From the previous section, it appears that firms with positive expectations of sales growth did not hoard labor in advance. This accords with the treatment of labor in many structural models as a flexible input. Labor can be adjusted fairly quickly, so firms can wait until the first indications of sales growth appear before they proceed with a wave of hirings. Capital stock, however, cannot be adjusted as quickly. Funding needs to be raise in advance, and investment has to be made early enough so that the capital becomes operational when demand arrives. In this section, we investigate if firms moved in advance to secure the funding for capital in anticipation of sales growth. In particular, we are interested to see if firms who expected sales to grow, but were disappointed (our target group) show different patterns of capital acquisition and accumulation.

We have information about the amount and source of equity financing acquired by firms each year. The value of equity financing is reported in bins. We use this information to look at the distribution of equity finance acquired by firms and investigate if there is a correlation between financing, sales outcomes, and outsourcing. Table 10 reports the distribution by breaking down firms into the same four types used in Table 8.

Firms in our target group that subsequently outsource stand out. Nearly half of these firms acquired some level of equity financing prior to the realization of their sales. For all other groups, only about 10 per cent acquired equity financing. The outsourcing strategy may be related to the capital acquisition strategy of these firms. One story that is consistent with the data is that some optimistic firms invested heavily in capital in expectation of increased sales and outsourcing provided a strategy to cope with these business losses. Given that firms are optimistic about long-term prospects, outsourcing will potentially do less long-term damage than selling off capital and provides a strategy to smooth over rough times that

Value of equity acquired in t	$EXPECT_{t+1} > 0$ $ERROR_{t+1} < 0$ $OUTS_{t+1} = 1$ (%)	$EXPECT_{t+1} > 0$ $ERROR_{t+1} < 0$ $OUTS_{t+1} = 0$ (%)	$ERROR_{t+1} > 0$ $OUTS_{t+1} = 1$ (%)	$EXPECT_{t+1} < 0$ $OUTS_{t+1} = 1$ (%)
zero	53.1	90.0	92.7	84.5
0–$20,000	8.5	1.9	–	–
$20,001–$50,000	20.3	2.8	2.6	–
$50,001–$100,000	–	1.0	–	–
$100,001–$500,000	8.2	3.2	4.1	14.6
$500,001–$1,000,000	8.2	0.1	–	–
$1,000,000+	1.6	1.0	0.6	1.0
	χ^2=667.2***			
No.Obs.	81	897	93	61

Table 10: The distribution of firm–years as a function of the level of equity finance acquired in $t-1$ prior to outsourcing and by type. The mean value of equity is computed by using the middle of each bin as the value for the bin. The value of the last been is set to $2mil. *** indicate significance at 1% level. $t = 1994 - 95, 1996 - 97$.

preserves the possibility of doing better in the future.[12]

5.3 Regression Tests

The net reduction in employment by our target firms appeared, in Section 5.1 above, to be union related. To examine this relationship further and to test whether confounding factors might be responsible for this relationship, we estimate a simple regression model where we control for things that we think might affect the relationship. We estimate

$$NET_{ij,t+1} = \sum_{k1} a_{k1} TYPE_{ijt} \times UNION_{ijt} + bFAMILY_{ij} + \sum_{k2} c_{k2} EQVALUE_{ijt} + \mu_{ij} + \nu_{ijt}. \tag{5}$$

where $TYPE$ is a set of dummies indicating the types in Table 8 and $UNION$ is a set of dummies for each bin of Figure 3(c). We are studying net change in employment by type and union membership, hence, we use an interaction of the two sets of dummies. $FAMILY$ indicates whether the firm is a family-run business, which may behave differently from others. $EQVALUE$ is a set of dummies indicating the value of equity acquired by the firm in order to check if changes in employment are driven by a change in the capital intensity of the firm rather than sales outcomes. These dummies correspond to the bins in Table 10. Finally, a set of industry dummies are included to take away any confounding that could result from structural changes in particular subsectors. Table 11 reports the estimated coefficient for the interaction between $TYPE$ and $UNION$.

The coefficients generate similar results to those observed in Figure 3 in the absence of the controls. In particular, after controlling for any confounding, the outsourcing firms belonging to our target group are reducing their number of employees between 1.5 to 3 employees if the level of union membership is from 11% to 75%. There is no indication that non-outsourcing firms in our target set are reducing employment. Finally, firms that expected sales to fall in the future are reducing their workforce regardless of the level of unionization.

The coefficients on equity reveal that firms that acquired low levels of equity were more likely to reduce employment, while firms that acquired high levels of equity increased em-

[12] We also looked at the source of equity financing for these firms and there is no particularly strong pattern.

$TYPE$			Union Membership in $t-1$					
$EXPECT_t$	$ERROR_t$	$OUTS_t$	None	1-10%	11-25%	26-50%	50-75%	75%+
>0	<0	✓	-0.034	0.200	-2.827	-1.253	-1.232	0.820
			(0.164)	(0.447)	(0.719)	(0.535)	(0.947)	(0.783)
>0	<0		-0.250	-0.008	-0.344	0.407	1.496	0.662
			(0.056)	(0.152)	(0.228)	(0.196)	(0.216)	(0.265)
	>0	✓	-0.314	-2.428	-0.822	-0.580	0.000	4.980
			(0.182)	(0.423)	(0.902)	(0.558)	(0.000)	(1.459)
<0		✓	-2.095	-5.808	0.110	-2.395	4.107	-2.702
			(0.230)	(0.471)	(0.699)	(0.756)	(0.781)	(0.671)
The rest			0	-0.009	0.119	-0.390	-1.412	-1.485
				(0.121)	(0.145)	(0.154)	(0.153)	(0.157)

Table 11: Estimated coefficients from OLS regression with change in employment as dependent variable. Numbers in parenthesis are standard errors. * indicates significance at least at 10% level.

ployment. This reflects the complementarity between labor and capital. Adding controls for firm age and firm size does not change the results presented in Table 11.

6 Conclusion

Previous evidence about the relationship between outsourcing and demand uncertainty has relied on industry aggregate data. In this paper, we examine the hypothesis that outsourcing is related to demand uncertainty by using unique, longitudinal, firm-level data. We uncover a slightly more complicated story. First of all, firm expectations matter. Firms that realize sales growth less than expected are much more likely to outsource than other firms. So it is not uncertainty per se that drives outsourcing, but rather disappointment with expected sales. In particular, firms that expected positive sales growth and subsequently experienced growth that was less than expected are much more likely to outsource than other firms.

There is no simple relationship between disappointment with sales expectations and net job growth. In fact, on average, firms that expected sales growth and were disappointed experienced net growth in employment. However, those firms that outsource are different and experience small amounts of net job loss while simultaneously experiencing fairly high levels of new hiring. The one group of firms that outsource who experience net job destruction are

those firms that were disappointed in their sales expectations and had moderate to relatively high unionization rates (between 11 and 75 per cent.) So outsourcing may be a strategy for firms to gain flexibility with their workforce. This strategy may not be available to firms with unionization rates over 75 per cent where union power might be insurmountable.

In general, firms who expected increased sales do not hire much labor in advance. This may be because labor is a flexible input as many economic models assume. Alternatively, it could be that because of high costs of hiring and firing (due to unionization or government regulations) firms prefer to wait to observe sales increases before hiring more labor.

Firms who outsource after sales disappointments are strongly characterized by their acquisition of equity financing prior to realizing their future sales. Amongst those firms that experience sales disappointment, only 10 per cent of the firms that do not outsource had acquired equity financing in expectation of increased sales. For those who outsource, it is almost 50 per cent.

Our paper is exploratory and suggestive of many future avenues of research. Is this asymmetric response of outsourcing to demand fluctuations a feature of other times and places? Outsourcing is often discussed in the context of managing labor inputs, but we show evidence that there may be a link to capital inputs and equity financing in particular. The non-linear relationship between job destruction and unionization is perhaps not surprising and further research on the link between outsourcing and unionization would be interesting. The high rates of hiring for firms that outsource are suggestive of firms re-thinking their business model or reconfiguring their labor force. We can conlcude, in any case, that simple models which treat outsourcing as a cost cutting strategy based upon job destruction clearly fail to capture the richness and complexity of how firms use outsourcing to respond to unexpected events.

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