Employment Adjustment and Financial Constraints – Evidence from Firm-level Data

Gregor Bäurle, Sarah M. Lein and Elizabeth Steiner

SNB Working Papers
18/2017

SCHWEIZERISCHE NATIONALBANK
BANQUE NATIONALE SUISSE
BANCA NAZIONALE SVIZZERA
BANCA NAZIUNALA SVIZRA
SWISS NATIONAL BANK

Legal Issues

ISSN 1660-7716 (printed version)
ISSN 1660-7724 (online version)

Employment Adjustment and Financial Constraints – Evidence from Firm-level Data*

Gregor Bäurle[†], Sarah M. Lein[‡] and Elizabeth Steiner[§]

December 19, 2017

Abstract

Firms adjust their employment to changes in output. But they tend to adjust employment only partially. Typically, labor is hoarded in downturns and subsequently firms have to hire less in upturns. Investment in labor hoarding may therefore be influenced by factors that impede investments, such as financial constraints. Using firm-level data, we show that financial constraints increase the sensitivity of employment to fluctuations in output considerably. When output changes, financially constrained firms resize their labor force substantially more than firms that have abundant funding. Limited internal funding opportunities turn out to be just as important as the reduced access to external finance. The strongest impact, however, is observed when internal and external constraints occur jointly. In that case, firms lay off two-and-a-half times more employees than unconstrained firms. The amplifying effect of financial constraints is similar in upturns and downturns, implying that financially constrained firms not only reduce their workforce more when demand decreases, but they also hire more labor when demand increases.

JEL classification: E24, E3

Keywords: Financial constraints, employment, labor hoarding

*We thank Simon Gilchrist, Sandra Hanslin, Christian Hepenstrick, George Sheldon and Rolf Scheufele for insightful discussions and suggestions as well as Markus Däppen for his help and knowledge regarding the data. We thank the participants at the SNB Brown Bag Seminar and the EEA conference 2016 in Geneva for useful comments and suggestions. The views, opinions, findings, and conclusions or recommendations expressed in this paper are strictly those of the author(s). They do not necessarily reflect the views of the Swiss National Bank. The SNB takes no responsibility for any errors or omissions in, or for the correctness of, the information contained in this paper.

[†]Swiss National Bank, Economic Analysis, e-mail: gregor.baeurle@snb.ch

[‡]University of Basel, e-mail: sarah.lein@unibas.ch

[§]Swiss National Bank, Economic Analysis, e-mail: elizabeth.steiner@snb.ch

1 Introduction

Employment typically rises in booms and decreases in recessions. But firms adjust their employment only partially. That is, they 'hoard labor' in downturns and subsequently hire less in upturns. Labor hoarding can be the optimal response of firms facing labor market frictions, because of the costs associated with hiring and firing staff. Employers confronted with a temporary drop in output retain more employees than they actually require because they expect to need those workers again in the future.

While there is ample evidence of the existence of labor hoarding in the aggregate, much less is known about the reasons why some firms lay off more labor than others in a recession. In this paper, we analyze the role of financial constraints on the differences in firm-level employment adjustment. Recently, the large layoffs during the Great Recession have triggered interest in the relationship between firms financing conditions and employment. The reduced capability of banks to lend was shown to be an important determinant of firms' employment adjustment decisions during and after the recession (Benmelech, Bergman, and Seru, 2011).

This paper focuses on financial constraints stemming not from the reduced ability of banks to supply loans but from the reduced ability of firms to borrow. We analyze how constraints to internal funding, such as low liquidity and low profits, as well as constraints to external funding, such as low collateral or a small balance sheet, influence the firms reaction to changes in output.

In analyzing labor hoarding in combination with financial constraints, our paper links two strands of the literature. The large and long-standing macro-labor literature, on the one hand, sees adjustment costs as important in explaining employment dynamics (see overview in Biddle, 2014). The concept of labor hoarding became an integral part of the labor market literature with the seminal contribution of Solow (1964). He argued that important costs are associated with adjustments in employment. These costs include not only direct costs, such as redundancy costs and the costs for searching, hiring and training new staff, but also indirect costs, such as the reduced motivation of the remaining staff or the risk of losing market share if demand were to pick up suddenly, leaving a firm without enough staff to meet the higher demand.

The macro-finance literature, on the other hand, analyzes the influence of financial constraints on investment in capital. Indeed, labor hoarding has an investment-like feature: the costs of hoarding labor in the short term are higher than the average unit costs. In other words they lower labor productivity. These costs have to be carried in the present. By contrast, the gains of labor hoarding materialize in the future, when demand picks up, in the form of lower labor adjustment costs, such as lower recruiting and training costs. Like investment decisions, labor hoarding does not immediately generate returns. No contemporaneous pay-off can be used to pay the wages. This timing mismatch between the costs of and the gains from labor hoarding has to be financed and, presumably, the financial health of a firm will impact on its ability to hoard labor, as it does on investment in physical capital. When financial constraints become binding, firms will not be able to hoard as much labor as otherwise desired.

While the effect of financial constraints on the joint dynamics of investment and output has been extensively analyzed (see, for example, Fazzari, Hubbard, and Petersen, 1988, Bernanke, Gertler, and Gilchrist, 1996), there is less evidence about the influence of financial constraints on the adjustment of employment to variations in output. Recent contributions concentrate mostly on the supply of credit as a measure of financial constraints: Chodorow-Reich (2014) shows that the health of firms' lenders had a significant impact on firm-level employment. Duygan-Bump, Levkov, and Montoriol-Garriga (2015) demonstrate that the probability of becoming unemployed in the aftermath of the Great Recession was higher if an employee worked in an industry with high external financial dependence. Basci, Baskaya, and Kilinc (2011) show that exogenous increases in credit spreads significantly decrease employment.

A few studies look at the impact of financial constraints, which stem not from a restricted supply of credit from the lender side but from a restricted ability to borrow on the firm side. Using data on US manufacturing firms from 1959 to 1985, Sharpe (1994) shows that small firms and firms with high leverage reduce employment more rapidly in economic downturns.[1] These findings confirm the analysis of Cantor (1990), who

[1] Calomiris, Orphanides, and Sharpe (1994) extend this analysis to study the response of inventory

documents that employment expenditures and sales are more volatile for highly leveraged firms. Furthermore, Funke, Maurer, and Strulik (1999), Ogawa (2003) and Drakos and Kallandranis (2006), looking at the dynamic effect of leverage on labor demand, all confirm that leverage is an important determinant of employment. Two recent papers have examined this topic further. Giroud and Mueller (2017) show that demand shocks during the Great Recession had large effects on employment at firms with high leverage. This suggests that such firms do not have the financing capabilities to hoard labor, which is in line with the findings reported in this paper. Further, Balleer, Gehrke, Lechthaler, and Merkl (2016) document, using German data, that the availability of short-time working subsidies dampens the decline in aggregate employment in a recession. Such subsidy schemes can be seen as an additional source of financing that relaxes financial constraints, increasing the ability to hoard labor in a recession. Our results go a step further and look at the development over the entire business cycle. We show that constrained firms which lay off more labor in a downturn will hire more labor during a subsequent upturn.

To estimate the impact of financial constraints on employment adjustment, we use a large panel of firm-level balance-sheet data broadly drawn from the population of Swiss firms. The panel does not select in favor of publicly listed firms, unlike many data sets using firm-level balance-sheet information. This is an important advantage: publicly listed firms are arguably often larger firms and have better access to external finance. Moreover, the data cover not only manufacturing but also most goods and services-producing industries, which represent approximately 70% of Swiss GDP and 80% of full-time employment.

Using Swiss data has a specific advantage: In many countries, firms' employment adjustment behavior is affected by strict labor market legislation. Employment protection rules hamper the flexibility of changes in employment. Thus, a sluggish reaction of firms' labor demand to shocks in those countries may not reflect optimal behavior against the backdrop of high labor adjustment costs with legal restrictions. Switzerland, by contrast, has one of the most flexible labor markets in the world, with relatively few regulations regarding the hiring and laying off of staff.[2] Working with Swiss data, we can therefore largely assume that our results reflect firms' hoarding behavior related to search and training costs and

accumulation and investment based on the same data set.

[2]See Tella and MacCulloch (2005), for example.

not to a country's labor legislation.

Our results show that financial constraints considerably increase the sensitivity of employment to fluctuations in output. When output changes, financially constrained firms resize their labor force substantially more than firms that have abundant funding availability. In particular, firms with low liquidity and low profits, as well as firms with a small balance sheet, have to lay off substantially more workers during downturns. Low collateral also has an impact, but the effect is weaker. The strongest impact is observed when internal and external constraints occur jointly. The amplifying effects of financial constraints are quite similar in upturns and downturns. Financially constrained firms not only reduce their workforce more when demand decreases, but they also hire more labor when demand increases. Our results are therefore consistent with the view that financial constraints hamper the labor hoarding ability of firms. Taken to the macro level, we show that up to 25% of the variance in aggregate employment can be explained by financial constraints.

We find further that the effect of financial constraints on labor hoarding is more pronounced for firms paying high wages. High-wage firms hoard more labor, suggesting that high-wage employees are associated with higher hiring and firing costs. Moreover, we conduct a set of tests that support the causal interpretation and confirm the robustness of our results.

The next section discusses our empirical model. Section 3 describes the firm-level data used in our analysis. The estimation results are discussed in Section 4 and the macroeconomic implications in Section 5. Robustness checks are shown in section 6.

2 An empirical model of labor demand

To motivate our empirical estimation equation, we rely on the adjustment cost model originally proposed by Nickell (1987), which is the basis of many empirical labor demand studies. As also noted in Giroud and Mueller (2017), there is currently no theoretical model linking labor hoarding to financial constraints.[3]

[3]Therefore, the model below should be considered as providing some motivation for the empirical equation rather than as giving the empirical equation a strong structural interpretation or providing a microfoundation for a theoretical model. An alternative approach to motivate the empirical equation would be to allow the flow of vacancies in Davis, Faberman, and Haltiwanger (2013) to vary with financial constraints at the firm level.

The underlying assumption is that adjustment of labor is costly due to both firing and hiring costs. When demand changes, current and discounted future adjustment costs are taken into account to maximize the present value of the firm's earnings. In Nickell (1987)'s formulation, the optimal log-labor demand $e_{i,t}$ of firm i in period t is

$$e_{i,t} = \mu e_{i,t-1} + (1-\mu)(1-\alpha\mu)E_t \sum_{j=0}^{\infty} (\alpha\mu)^s e^*_{i,t+j} \tag{1}$$

with $e^*_{i,t}$ being short-term equilibrium employment, defined as optimal employment in the absence of adjustment costs.[4] The coefficient μ is primarily a function of productivity parameters and adjustment costs. The higher the adjustment cost, the slower the adjustment to the short-term equilibrium will be. The coefficient α is inversely related to the real interest rate. The lower the real interest rate, the more weight is given to future equilibrium employment.

Following a negative demand shock leading to a decrease in $e^*_{i,t}$, labor demand remains above $e^*_{i,t}$ in the period in which the shock occurs. There are two reasons for this. First, adjustment costs are assumed to be convex, such that a one-time adjustment of the labor force generates higher costs than a series of small adjustments cumulating to an reduction of the same magnitude.[5] Second, if a demand shock is temporary, a complete downward adjustment in labor would have to be fully reversed when the demand shock fades. Because labor adjustment is costly, it is optimal for firms to adjust their labor only partially when a demand shock is expected to be temporary. In this case, firms hoard labor.

To derive an observable model from the above equation, some assumptions on the determinants of $e^*_{i,t}$ have to be imposed. A typical empirical specification (see, e.g., Ottawa 2004) makes $e^*_{i,t}$ a function of log-demand $y_{i,t}$ and log-wages $w_{i,t}$. Assuming stochastic processes for these variables and adding other exogenous factors $X_{i,t}$, the following empirical specification for the change of employment demand is obtained:

$$\Delta e_{ti} = \tilde{\gamma}_n \Delta e_{i,t-1} + \tilde{\gamma}_y \Delta y_{i,t} + \tilde{\gamma}_w \Delta w_{i,t} + \tilde{\beta} X_{i,t} + \epsilon_{i,t} \tag{2}$$

[4]This formulation is obtained based on quadratic adjustment cost using a log-linear approximation.
[5]Blatter, Muehlemann, and Schenker (2012) document that hiring costs are convex in Switzerland.

The coefficients in this equation are related to α, μ, and the properties of the stochastic process for the exogenous variables.

Now consider the case in which financial frictions imply higher cost of financing. The interest rate in the labor demand equation (1) is then larger. As a result, future misalignment with equilibrium employment and, therefore, future adjustment costs are discounted with a larger factor, and the concurrent adjustment is more complete. Generally speaking, the higher the costs of financing, the less firms value future adjustment costs versus today's labor costs and the less a firm will hoard labor. Labor market frictions and financial frictions thus work in opposite directions. While higher labor adjustment costs lead to a reduction in cyclical employment fluctuation, financial constraints reinforce them. In the following section, we provide firm-level measures of such constraints and subsequently describe how these measures are incorporated into equation 2.

3 Data Description

We use a large panel of firm-level balance-sheet and income-statement data stretching from 1998 to 2013, placed at our disposal by the SFSO (Swiss Federal Statistical Office). Our data set comprises $74,065$ observations at an annual frequency, including $16,338$ firms. The data are collected at the firm level and not, as is often the case, at the plant level. It is an unbalanced panel, that is, we do not observe every firm for all 16 years. However, the sample is a comprehensive draw from the population of Swiss firms, including all industries of the economy, except the financial and public sectors. The SFSO collects data for all large firms on an annual basis. Smaller firms might be replaced in the sample from time to time, with firms from the same industry and similar characteristics. The data set has an advantage over more-frequently used data, such as Compustat, in that it contains both large market-listed and very small firms. The latter do not have to publish their balance sheets or income statements. This is important, as the latter are likely to be particularly prone to limitations in external sources of financing.

Employment is defined in full-time equivalent (FTE) units in logs denoted by $e_{i,t}$. This information is supplied by the firms in the sample when sending their balance sheets and

Table 1: Sample statistics

	Observations Total	Firms	*Employment* average per firm	*Value added* average per firm
Whole sample	74065	16338	181	33080
Industries				
Business Serv. 1	5066	1397	126	34113
Business Serv. 2	1991	612	218	20124
Construction	6644	1570	140	14546
Education	1299	350	106	10964
Energy	3113	547	97	39184
Entertainment	1942	519	80	12381
Health	3390	899	101	8287
IT	3043	768	212	56274
Manuf. Pharma	618	112	635	500871
Manuf. Invest.	13766	2488	176	26447
Manuf. Watches	3428	644	254	20238
Manuf. Other	8690	1579	139	49131
Mining	612	115	46	8852
Rest. Hotels	3580	785	116	9008
Trade	13038	3176	232	40820
Transport	3845	777	378	51981

Notes: Employment is the number of full-time equivalents (FTE). Business Services 1 (Real estate activities, legal, accounting, management, architecture, engineering activities, scientific research and development, other professional, scientific and technical activities), Business Services 2 (Administrative and support service activities), Construction, Education (not including public schools), Energy (Energy supply, water supply, waste management), Entertainment (Arts, entertainment, recreation and other services), Health (Human health and social work activities), IT (Information and communication), Manufacturing of pharmaceutical goods, Manufacturing of investment and intermediate goods, Manufacturing of watches (Watches, computer, electronic and optical products), Manufacturing of other goods, Mining (Mining and quarrying), Restaurants and Hotels (Accommodation and food service activities), Trade (Retail and wholesale trade, repair of motor vehicles and motorcycles), Transport (Transportation and storage).

income statements to the SFSO. The log of value output, $y_{i,t}$, is measured by subtracting intermediate goods expenditure from total sales, which is the official calculation of the SFSO for value added. Our dataset also includes wages, $w_{i,t}$, which are measured as total wage expenditures divided by employment. It also includes physical capital, which we measure by its book value in the balance sheet. Table 1 lists the number of observations, the number of firms, the average full-time employment and the average output per firm for each industry, which are the key variables in our empirical section.

Furthermore, the dataset contains information that can be used to construct firm-specific measures of external and internal financial constraints. External financial constraints are factors that hinder firms from obtaining funds from outside investors and lenders. A firm faces internal financial constrains if it is unable to bridge a drop in demand by using internal funds.

In the spirit of Kaplan and Zingales (1997), we classify firm-year observations as financially constrained or unconstrained, depending on their values of indicators constructed from their balance sheets. For our baseline equations, we define an indicator for a financially unconstrained firm-year observation and a financially constrained observation. We use several measures of financial health of a firm and define a constrained (unconstrained) firm as a firm with value above (below) the median value of the constraint indicator. In the empirical section, we first analyze the effect of each constraint separately and then also for combinations of several constraints per firm.

We define two measures of external constraints. For our first measure, we use the size of a firm's balance sheet (Bernanke, Gertler, and Gilchrist, 1996, Gertler and Gilchrist, 1994). The idea behind using size as a financial constraint is related to the costs of asymmetric information. Firms with a small balance sheet tend to have had little experience in the credit market, and there is limited available information on their creditworthiness. In contrast, information on firms with large balance sheets is much more available. Our second measure is the amount of collateral a firm owns. We define collateral as the sum of a firm's structures (buildings and land) and machines per unit of outstanding debt. Because it is riskier to lend to firms with low collateral, these firms have limited or more-costly access to external finance.

Second, we derive two different indicators for internal constraints. The data come from firms' income statements. Our first measure is liquidity defined as the ratio of sales to labor costs, following Aghion, Farhi, and Kharroubi (2015). Because profits are usually regarded as the main source of internal funding for investment, including investment in labor hoarding, our second measure is the level of profits, defined as EBIT (earnings before interest rates and taxes) per unit of output, which is a measure of a firm's profitability.

The medians and the standard deviations of our constraint indicators are listed in Table 2. The first row shows statistics for all observations and the rows below by the 16 industries.

Table 2: Constraint variables

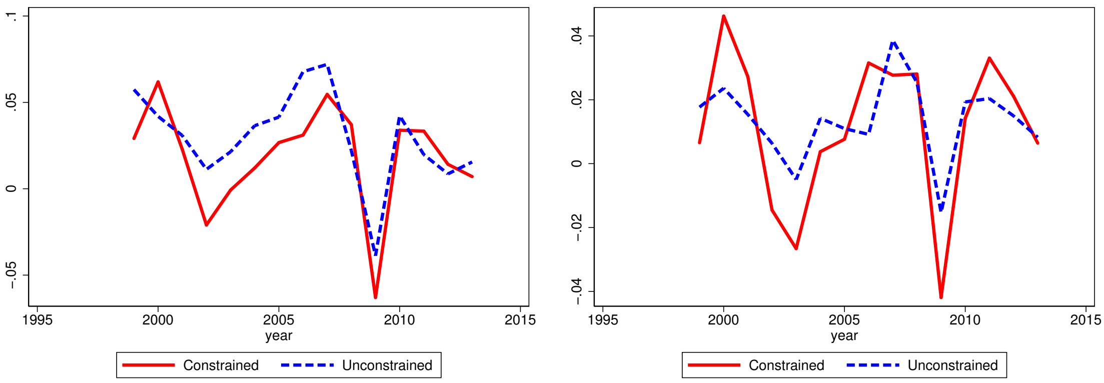
	Liquidity		*Profitability*		*Collateral*		*Bal.Sheet*	
	Md	Sd	Md	Sd	Md	Sd	Md	Sd
Whole sample	2.75	24.18	0.30	0.11	0.49	4.42	14310	1482181
Within industries								
Business Serv. 1	1.72	6.70	0.10	0.28	0.18	3.86	12177	662295
Business Serv. 2	1.86	3.38	0.07	0.16	0.16	0.67	6385	118884
Construction	2.25	1.64	0.07	0.10	0.36	0.58	11168	63570
Education	1.30	0.97	0.04	1.13	0.38	1.48	8075	29358
Energy	5.97	51.57	0.26	0.24	1.32	19.76	31065	722144
Entertainment	1.90	2.06	0.07	0.18	0.56	1.13	6225	136773
Health	1.27	0.44	0.04	0.18	0.84	3.65	5948	27814
IT	2.23	4.49	0.09	0.37	0.16	0.78	12147	978099
Manuf. Pharma	3.65	15.57	0.25	1.10	0.66	1.16	66739	8705574
Manuf. Invest.	2.94	3.39	0.13	0.24	0.56	1.01	19571	233431
Manuf. Watches	3.03	2.64	0.10	0.16	0.64	0.87	12297	142928
Manuf. Other	2.82	4.96	0.15	0.27	0.39	0.84	23288	991043
Mining	3.60	2.60	0.18	0.20	0.97	2.01	14026	31332
Rest. Hotels	2.19	0.80	0.09	0.29	0.91	1.30	7217	50212
Trade	5.95	50.04	0.17	0.24	0.29	0.67	19540	1521905
Transport	2.50	9.05	0.08	0.16	0.76	1.44	16605	4341944
Between industries								
Industr.-means	3.42	3.30	0.12	0.08	0.75	1.12	50699	406424

Notes: This table reports summary statistics for the constraint variables. Md denotes the median and sd the standard deviation. Firms are classified into industries according to the SFSO definition. Figures 4-11 in the Appendix show the distributions of these variables.

These figures show that the heterogeneity across industries as well as within individual industries is very large. In the last row shows the medians and standard deviations across industries, which are simply the medians and standard deviations of the entries in the 16 rows above. The between-industry variation is low compared to the within-industry variation, showing that in order to capture the whole scope of heterogeneity within an economy, it is useful to employ firm-level data.

To illustrate the aggregate dynamics of the key variables, that is, changes in output and changes in employment, we show the average growth in employment and in output of our sample over time. We distinguish between constrained and unconstrained firms (Figure 1 - in red firms that are classified as constrained and in the blue firms with no constraints). Taking the example of a liquidity constraint, we illustrate the aggregate dynamics. While the fluctuations in output growth are similar for both constrained and unconstrained firms, growth in employment fluctuates markedly more for constrained firms. Moreover,

Figure 1: Average growth in employment and output for constrained and non-constrained firms (1999-2013)



(a) Output

(b) Employment

Notes: The panel on the left shows average output growth for liquidity constrained firms (solid red line) and for unconstrained firms (dashed blue line). The right panel shows average employment growth. The averages are built using firm-level growth rates weighted by the number of full-time equivalents.

there is a clear difference in the decline in employment during the Great Recession, where constrained firms reduce employment by 1.5%, while constrained firms reduce employment by 4.2%, thus more than twice as much. This figure motivates our analysis of the impact of financial constraints on the intertwinement of employment and output.

4 Empirical analysis and results

Before turning to the main results, we discuss the estimation methodology and some definitions in the following sections.

4.1 Specification and estimation methodology

Against the backdrop of the labor demand model outlined in section 2, we allow the adjustment to the equilibrium labor demand to depend on the existence of financial constraints. To gain a complete picture of the channels financial constraints work through, we distinguish between external financial constraints, $Ext_{t-1,i}$, and internal financial constraints, $Int_{t-1,i}$. Thus, the response of employment to changes in demand in equation

2, γ_y, is a function of our measures of financial constraints,

$$\tilde{\gamma}_y = \gamma_y + \gamma_{y,ext} Ext_{i,t-1} + \gamma_{y,int} Int_{i,t-1} \tag{3}$$

To take into account that changes in output might influence measures of financial constraints, we include their value at the beginning of the period if stock variables are used (balance sheet) or in the previous period if flow variables are used (income statements).[6] Combining equation (3) with equation (2), we obtain the baseline specification of our empirical model:

$$\begin{aligned} \Delta e_{ti} &= \tilde{\gamma}_n \Delta e_{i,t-1} + \gamma_y \Delta y_{i,t} + \gamma_{y,ext} Ext_{i,t-1} \Delta y_{i,t} + \gamma_{y,int} Int_{i,t-1} \Delta y_{i,t} \\ &\quad + \tilde{\gamma}_w \Delta w_{i,t} + \tilde{\beta} X_{i,t} + \epsilon_{i,t}, \end{aligned} \tag{4}$$

where Δe_{ti} is the log-change in employment, $\Delta y_{i,t}$ the log-change in output (value added), and $\Delta w_{i,t}$ the average wage in a firm (total wage payments divided by FTE).[7]

Our focus is on the estimates of $\gamma_{y,ext}$ and $\gamma_{y,int}$. However, in principle, financial constraints should interact not only with the reduction in demand but also with all variables in the model. To keep the equation neat, further interaction terms have been left out in our baseline specification. We checked the robustness of our results for the extended specifications, where we interact with additional control variables, and found only very minor differences (see Section 6). Furthermore, it would be conceivable that the internal and external financial constraints reinforce each other, motivating a version of (3) augmented with the interaction term $\gamma_{y,ext,int} Int_{i,t-1} Ext_{i,t-1}$. However, the estimate of $\gamma_{y,ext,int}$ turned out to be very small and mostly statistically insignificant. Therefore, our baseline

[6] This is also convenient from an empirical point of view, as it ensures that the classification of a firm's financial constraints is not directly influenced by the contemporaneous change in its labor force.

[7] An elasticity of employment with respect to an output of less than unity implies procyclical labor productivity and might indicate that firms hoard labor (Biddle, 2014), even though procyclical labor productivity might also be a result of other mechanisms. Using changes in housing prices to estimate demand shocks, as in Giroud and Mueller (2017), has the advantage over our setup that the response of employment is more closely tied to changes in demand. Below, we show that changes in output, which are likely to be temporary, yield similar results as our baseline estimates, suggesting that using output as a measure of $\Delta y_{i,t}$ tends to capture temporary changes in demand. Given that both approaches show that financial constraints impede labor hoarding, the results presented in this paper corroborate the findings in Giroud and Mueller (2017) and show that they also have implications for labor productivity, as discussed in the conclusion.

specification is (3) plugged into (2).

$X_{i,t}$ includes various other explanatory variables. Because the financial constraints may have a direct effect on the changes in employment, $Int_{i,t-1}$, $Ext_{i,t-1}$. Furthermore, $X_{i,t}$ includes the change in the firm's capital stock. In the literature, one finds strong evidence that financial constraints influence investment. If constrained firms are forced to disinvest, labor-capital complementarities could cause firms to reduce their labor force. Because we want to concentrate only on the direct impact of financial constraints on employment, we follow Benmelech, Bergman, and Seru (2011) and control for these effects using the change in the firm's capital stock.[8] We also include the capital-stock-to-FTE ratio in $t-1$ to control for the impact of different levels of capital intensity between firms.

Moreover, we include industry-fixed effects and industry-fixed effects interacted with the measures of financial constraints in order to control for industry-specific characteristics that might arguably influence the degree of labor hoarding. Time-fixed effects enter the equation to control for changes in aggregate employment growth. In a robustness analysis, we also include sector-specific time trends and firm fixed effects.

To take possible asymmetric responses to a change in output into account, we estimate our empirical model for observations with a negative change in output and observations with a positive change in output separately. That is, we estimate separate coefficients for upturns and downturns. In each case, we estimate four alternative specifications using combinations of internal and external financial constraints.

4.2 Baseline estimates

The impact of a one percent decrease in output on employment using equation (4) is displayed in Table 3. The upper panel 1) shows the estimated results of $\tilde{\gamma}_y$ for the four different combinations of financial constraints. The direct impact of a one percent decline in output is given by γ_y on the first line. $\gamma_{y,int}$ is the marginal effect of being internally constrained, and $\gamma_{y,ext}$ the marginal effect of being externally constrained.

[8]The capital stock is also part of the labor demand equation used by, e.g., Nickell (1984), Burgess (1988) and, more recently, Nickell (1999).

Column (1) shows the results for estimates including liquidity as a measure of internal constraint and collateral as a measure of external constraint. Financially unconstrained firms reduce employment by only 0.15% in response to a one percent decline in output, with an elasticity significantly below one, which suggests that unconstrained firms hoard labor (column 1). If a firm is liquidity constrained, this elasticity increases by a factor of two, compared to the unconstrained firms. If the firm is collateral constrained, the firm lays off 0.04 percentage points more employment than an unconstrained firm, implying that constrained firms decrease their employment by approximately one-third more than an otherwise unconstrained firm.

All measures of internal and external constraints show that firms with financial constraints hoard less labor. Columns (2), (3) and (4) report the results for other measures and combinations of constraints, including profitability as an internal constraint and the size of the balance sheet as an external constraint. The estimates of $\gamma_{y,int}$ and $\gamma_{y,ext}$ indicate that all four measures of financial constraints, taken alone, have a detrimental impact on employment adjustment. While the impact of low collateral is somewhat lower, the other constraints have a substantial impact.

The estimates above are based on regressions including both the external and the internal constraint indicators. They thus have a conditional interpretation, that is, the coefficient on the internal constraint is for a firm that is not externally constrained. Firms might be faced with both forms of financial constraints. To give a simple illustration of the elasticities for unconstrained and constrained firms, in panel 2), we report the coefficient for the unconstrained firms in the first row, which is identical to the coefficient γ_y in panel 1). The second row shows the elasticity for a firm that is only internally constrained (the sum of γ_y and $\gamma_{y,int}$), the third the elasticity of a firm that is only externally constrained (the sum of γ_y and $\gamma_{y,ext}$), and the last row the coefficient of a firm, which is both externally and internally constrained. The latter is based on a regression that includes an interaction between the external and internal constraints in addition to including the two constraints separately. We then report the sum of γ_y, $\gamma_{y,int}$, $\gamma_{y,ext}$, and this interaction term.

Panel 2) shows that a firm's employment elasticity is between 0.15% and 0.18% if it is unconstrained (first row). Internal and external constraints lead to a marked rise in this elasticity (second and third rows), as discussed above. Firms with internal and external financial constraints reduce labor more than twice as much as unconstrained firms. Panel 3) shows that the share of firms being internally as well as externally constrained is not negligible. Depending on the specification, the share of firms with both constraints accounts for 22% - 30%.

Table 3: Employment elasticities and financial constraints in downturns

1) Employment elasticity for unconstrained firms and marginal effects of financial constraints				
Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
γ_y	0.154	0.183	0.153	0.167
	(0.012)***	(0.012)***	(0.009)***	(0.009)***
$\gamma_{y,int}$	0.171	0.166	0.127	0.126
	(0.016)***	(0.017)***	(0.017)***	(0.017)***
$\gamma_{y,ext}$	0.042	0.028	0.121	0.129
	(0.015)***	(0.015)*	(0.017)***	(0.017)***
R^2	0.335	0.357	0.342	0.363
2) Implied employment elasticity $\tilde{\gamma}_y$ depending on financial constraints				
Unconstrained	0.154	0.183	0.153	0.167
Only internally	0.325	0.349	0.280	0.294
Only externally	0.196	0.211	0.274	0.296
Internally and externally	0.367	0.378	0.401	0.422
3) Number of observations				
Unconstrained	6316	7193	8825	9165
Only internally	6347	5470	4369	4029
Only externally	6760	6727	4254	4758
Internally and externally	5446	5479	7424	6920

Notes: The first panel 1) on the top shows the response in employment to a one percent decline in output. The direct impact of a one percent decline in output is given by γ_y on the first line. $\gamma_{y,int}$ is the marginal effect of being internally constrained, and $\gamma_{y,ext}$ the marginal effect of being externally constrained. Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Panel 2) reports the sum of the interaction coefficients (standard deviations have been excluded, all except the lowest entry in row (2) are signficiant at the one percent level). The last panel shows the number of observations for each specification. Covariates are not included in the table. See Table 13 for full regression output.

In an upturn, financial constraints could theoretically have either a dampening or an enhancing impact on employment elasticity. In the first case, the rationale is straightforward: Like in a downturn, financial constraints dampen labor demand when demand increases. In this case, the marginal effects of financial constraints are negative, and constrained firms have lower implied elasticities than unconstrained firms, implying that firms with financial constraints lay off more labor in a downturn and take on less in an upturn.

The second case is based on the idea that labor hoarding is a cyclical phenomenon with an investment character: firms keep on more labor than necessary in a downturn so that they will not have to hire as much new staff in the subsequent upturn. Financially constrained firms, however, are unable to hoard enough labor and are forced to lay off more staff than desired in a downturn, and they have to re-hire more labor for each percentage point rise in output in an upturn. The interaction terms have positive coefficients, and the implied employment elasticity is higher than that of unconstrained firms, both in a downturn and in an upturn. In this case, financial constraints amplify the fluctuations of employment and weaken those of labor productivity.

The data confirm the second hypothesis. The results are displayed in Table 4. The estimates of $\gamma_{y,int}$ and $\gamma_{y,ext}$ are all significantly positive, with similar elasticities as for downturns. Consequently, the implied elasticity of employment is in all cases lower for unconstrained firms than for constrained firms. This implies that it is the financially constrained firms that trigger the cycles on the labor market and lead to more comovement between employment and output. In contrast, a weak cyclicality of employment in the aggregate, caused by strong labor hoarding, would be a sign of financially healthy firms.

The result that financially constrained firms hoard less labor line up with the interpretation of Giroud and Mueller (2017), who show that employment in establishments of firms with higher leverage respond more elastically to the decline in US housing prices between 2006 and 2009. We show, in addition, that the financially constrained firms also hire more labor during a consequent upturn, which corroborates the interpretation of employment adjustment in terms of a labor hoarding concept. Furthermore, it is shown here that internal constraints are even more important than external constraints, suggesting that labor hoarding is mostly financed through retained profits and less through additional leverage.

Table 4: Employment elasticities and financial constraints in upturns

1) Employment elasticity for unconstrained firms and marginal effects of financial constraints				
Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
γ_y	0.183	0.207	0.176	0.189
	(0.013)***	(0.013)***	(0.011)***	(0.011)***
$\gamma_{y,int}$	0.125	0.075	0.078	0.039
	(0.017)***	(0.016)***	(0.017)***	(0.016)**
$\gamma_{y,ext}$	0.051	0.038	0.146	0.157
	(0.016)***	(0.016)**	(0.017)***	(0.017)***
R^2	0.334	0.333	0.343	0.344
2) Implied employment elasticity $\tilde{\gamma}_y$ depending on financial constraints				
Unconstrained	0.183	0.207	0.176	0.189
Only internally	0.308	0.282	0.254	0.288
Only externally	0.234	0.245	0.321	0.346
Internally and externally	0.359	0.320	0.399	0.385
3) Number of observations				
Unconstrained	8159	8365	11343	10811
Only internally	9367	9161	6638	7170
Only externally	8740	7697	5561	5254
Internally and externally	8224	9267	10954	11261

Notes: The first panel 1) on the top shows the response in employment to a one percent increase in output. The direct impact of a one percent decline in output is given by γ_y on the first line. $\gamma_{y,int}$ is the marginal effect of being internally constrained, and $\gamma_{y,ext}$ the marginal effect of being externally constrained. Standard deviation in parentheses, $***p < 0.01$, $**p < 0.05$, $*p < 0.1$. Panel 2) reports the sum of the interaction coefficients (standard deviations have been excluded, all except the lowest entry in row (2) are signficiant at the one percent level). The last panel shows the number of observations for each specification. Covariates are not included in the table.

Is employment adjustment asymmetric, that is, stronger in a recession than in a boom? Table 5 reports the difference between the coefficients estimated for upturns and for downturns to evaluate whether a decline in employment in a downturn is completely offset in a subsequent upturn or whether some firms permanently reduce or increase employment. The differences are only significant for the marginal effect of internal constraints. The negative sign means that internally financially constrained firms re-hire less labor in an upturn than they laid off in a previous downturn. Compared to the impact during a downturn, this feature is economically small.[9] Nevertheless, it still suggests that there

[9]This finding is not at odds with an asymmetric behavior of employment over the business cycle, as documented, e.g., by Kohlbrecher and Merkl (2016) for the US. Our results even provide some support for asymmetric changes in employment over the Swiss business cycle. This is because there is some evidence

are some permanent effects and that a subsidy on labor hoarding might be beneficial for long-term employment trends, as suggested in Giroud and Mueller (2017).

Table 5: Asymmetry between upturn and downturn

Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
γ_y	0.029	0.024	0.023	0.021
	(0.018)	(0.018)	(0.014)	(0.015)
$\gamma_{y,int}$	-0.046	-0.092	-0.049	-0.087
	(0.021)**	(0.023)***	(0.024)**	(0.024)***
$\gamma_{y,ext}$	0.009	0.010	0.025	0.029
	(0.020)	(0.022)	(0.024)	(0.024)

Notes: This table reports the difference between the coefficients for upturns and downturns reported in Tables 3 and 4, where we subtract the coefficient for the downturn estimates from that of the upturn estimates. A negative and significant coefficient implies that a firm lays off more staff with a one percent decline in output than it hires with a one percent increase in output (and a positive coefficient vice versa). Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

In the following subsections, we refine our results. We first quantify the impact of the wage level on fluctuations in employment. Next, we look at the effect of financial constraints at different levels of their distribution and then we test the transitory feature of labor hoarding.

4.3 Low-wage versus high-wage firms

The wage level is likely to influence labor hoarding behavior. However, it is a priori unclear whether firms in the high-wage segment hoard more or less labor than firms in the low-wage segment. There are two opposing effects. On the one hand, adjustment costs are probably higher for high-wage jobs, firstly because firing costs are set to be higher owing to higher redundancy payments and more-generous dismissal conditions. Furthermore, because the wage level should be determined by a worker's productivity, high-wage jobs will probably require higher hiring costs and higher initial training costs. For example, Blatter, Muehlemann, and Schenker (2012) provide evidence that hiring cost as a share of wage costs are higher in occupations with higher skill requirements. This means that the costs of laying off high-wage jobs might be larger than those of laying off low-wage jobs.

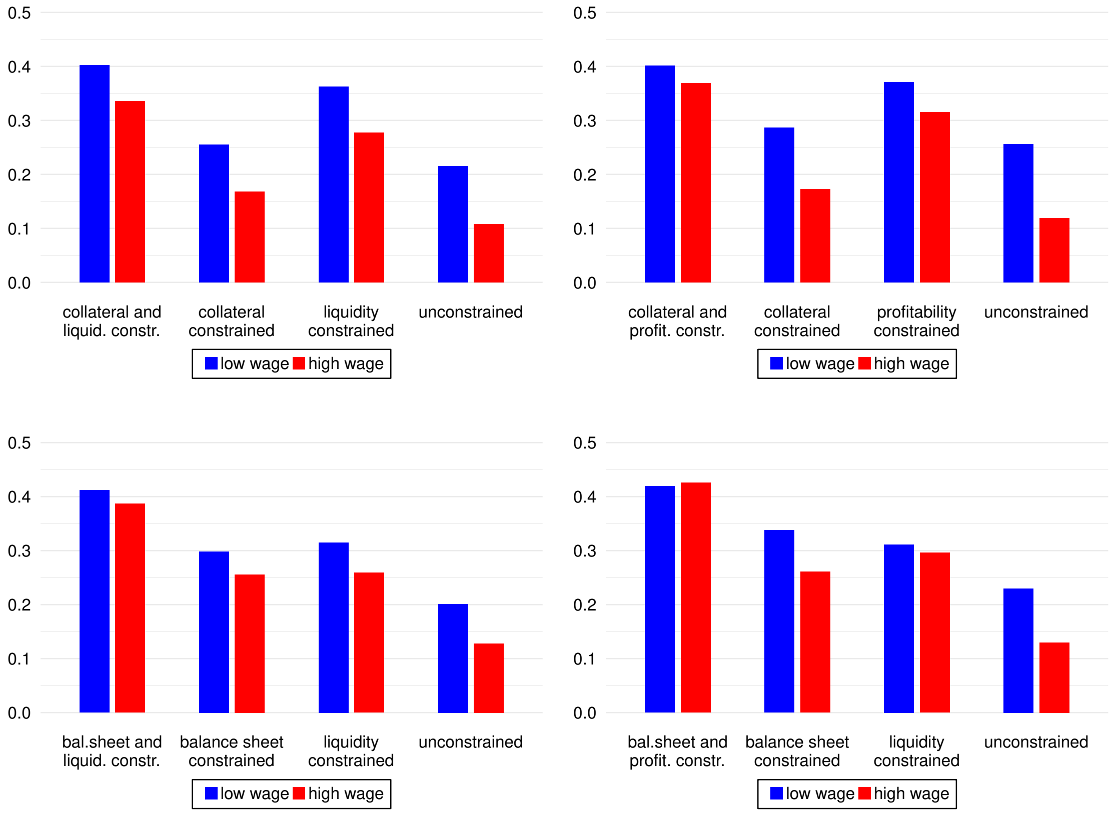
pointing to asymmetric business cycles in (detrended) Swiss GDP (Detken, 2002). Given our results of a quite-symmetric elasticity, these asymmetries in output changes would then translate into asymmetries in employment changes.

On the other hand, dismissing a worker with a high wage decreases wage expenditures more than dismissing a worker with a low wage. This means that the costs of laying off high-wage jobs are larger than those of laying off low-wage jobs.

We therefore split our sample at the median firm-level average wage. In our data set, we do not have wage data per employee, only the average wage per firm. Therefore, we cannot distinguish between different jobs within the same firm. Thus, the classification by firm-level average wage, which we use for this exercise, is only a proxy. Especially for firms with very heterogeneous remuneration schemes, the average can be misleading. Nonetheless, the results in Figure 2 show a clear picture: the employment elasticities of high-wage firms (grey bars) are, for almost all specifications, lower than those for low-wage firms (black bars). This suggests that the first channel dominates, i.e., in the high wage segment, hiring and firing costs tend to be relatively more important than the wage savings.

Figure 2 shows a further feature: The effect of financial constraints is smaller for firms paying low wages. Indeed, the labor elasticity of a low-wage firm increases by a factor 1.7 to 2.0 depending on whether it is unconstrained or doubly constrained, while for high-wage firms, it triples. In the specification balance sheet-profitability (bottom right), unconstrained high-wage firms have a labor demand elasticity of 0.13, compared to 0.23 for the low-wage firms. If the firm has a small balance sheet combined with low profitability, the implied labor elasticity of the low-wage firm will be 1.8 times higher, while for the high-wage firm, it will be 3.3 times higher. In fact, the implied elasticity will reach 0.42 for both low-wage and high-wage firms. Thus, high-wage firms hoard labor only if they dispose of sufficient funding. If they are financially constrained, the hoarding behavior becomes very similar to that of firms in the low-wage segment.

Figure 2: Employment elasticities during a downturn and financial constraints by wage level



Notes: Red bars represent the high-wage firms and the blue bars the low-wage firms. The two bars in the first column represent the implied labor elasticity for doubly constrained firms measured by $\gamma_y + \gamma_{y,int} + \gamma_{y,ext}$, the two bars in the second column represent externally constrained firms measured by $\gamma_y + \gamma_{y,ext}$, the two bars in the third column represent internally constrained firms measured by $\gamma_y + \gamma_{y,int}$and the two bars in the fourth column represent the labor elasticity for non-constrained firms measured by γ_y.

4.4 Marginal effects at different points of the distribution

Up to now, we have estimated the impact of a firm being constrained compared to a firm not being constrained. In a next step, we analyze the impact of financial constraints on employment for a finer grid. This gives information on whether the impact of financial constraints on employment is evenly distributed. Thereafter, we estimate the equation using continuous data. This allows us to gain a more detailed picture of the marginal effects of financial constraints.

For the finer breakdown, we construct six equally sized bins. The baseline regression is estimated separately six times (once for each bin) for all eight specifications shown in

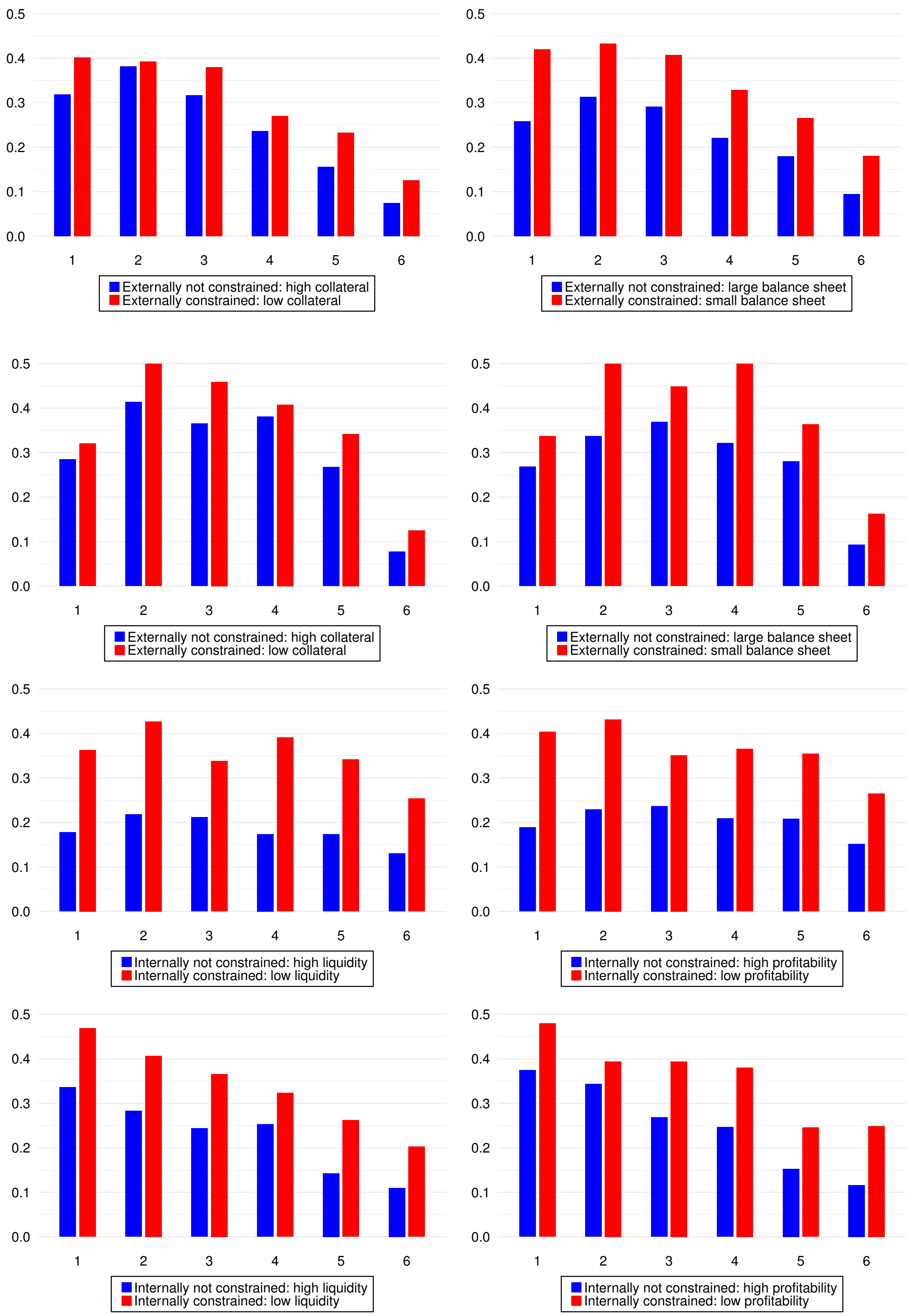
Figure 3, which therefore results in 32 separate estimates.

The upper left chart in Figure 3 shows the results for the specification in which the liquidity constraint is combined with the collateral constraint. Note that liquidity is divided into six bins, while the collateral constraint remains a binary variable. The first bin contains the lowest sixth of the distribution, i.e., the most liquidity-constrained firms, while the sixth bin contains the less liquidity-constrained firms, i.e., the firms with the most-abundant liquidity. The grey bars represent the impact of a one percent decrease in output for firms that are not collateral constrained, i.e., that have high collateral, and the black bars represent the impact for firms that are collateral-constrained, i.e., that have low collateral.

All charts in Figure 3 show that firms lay off more labor if they are doubly constrained (black bars are larger than the grey bars). Thus, the results of the baseline specification are confirmed in this exercise. The bars tend to decrease from the first to the sixth bin. This indicates that the results shown in the previous section are not driven by the tails of the distributions.

However, Figure 3 also shows that financial constraints do not have a linear influence on employment. The decrease is monotonic only in the upper end of the distribution (bins 4-6). At the lower end, where firms are more constrained (bins 1-3), the pattern is not clear-cut. Actually, the size of the balance sheet is the only constraint that is monotonic throughout the whole distribution. This suggests that the exact level of the constraining factor is not very relevant for values below the median of the annual distribution. These results indicate that our binary classification with the median as the threshold in the baseline specification is a sound choice. The coefficients of a linear specification would not be robust, depending on the point in the distribution.

Figure 3: Employment elasticities during a downturn for a finer classification of financial constraints



Notes: The blue bars represent the impact of a one percent decrease in output on employment for a given bin if a firm is not constrained otherwise as mentioned by the number of the bin. The red bars include the additional impact of a second constraint. Bin (1) contains the lowest sixth of the distribution of a given constraint, i.e., the most-constrained firms, while bin (6) contains the most-unconstrained firms.

We illustrate this feature with a linear estimation complemented by a piece-wise estimation. The impact of financial constraints on employment based on a linear specification is shown in Table 6. Section 1) shows the results for the whole sample of firms. The coefficients of the interaction terms, $\gamma_{y,int}$ and $\gamma_{y,ext}$, are significant in most cases and have the correct sign.[10] The results of the piece-wise estimation are shown in Section 2) for firms that are constrained more than the median and in Section 3) for firms constrained less than the median. The results for the constrained firms show that only two of the eight coefficients are positive and significant, namely, those two that measure the marginal impact of a change in the size of the balance sheet. This confirms the results discussed above. Importantly, it certifies that it is not possible to measure the marginal effects of constraints on employment for firms in the lower part of the distribution. In contrast, the coefficients for the less-constrained firms are mostly significant, and all are positive, reflecting the monotonicity seen in Figure 3 for the upper range of the distribution.

[10]Financial constraints are defined as the deviation of the annual mean from the firm-specific measure of constraint. Therefore, lower liquidity, profitability, collateral or balance sheet lead to a rise in the measure of constraint and should, in turn, lead to a larger adjustment in employment. Thus, the coefficient of the interaction terms, $\gamma_{y,int}$ and $\gamma_{y,ext}$, should be positive.

Table 6: Employment elasticities during a downturn in a linear specification

1) Marginal effects of financial constraints - all firms				
Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
γ_y	0.243	0.257	0.273	0.282
	(0.008)***	(0.015)***	(0.008)***	(0.011)***
$\gamma_{y,int}$	0.001	0.031	-0.001	-0.066
	(0.000)*	(0.094)	(0.000)***	(0.087)
$\gamma_{y,ext}$	0.005	0.005	0.056	0.053
	(0.001)***	(0.001)***	(0.005)***	(0.008)***
2) Marginal effects of financial constraints - constrained firms				
γ_y	0.430	0.300	0.435	0.332
	(0.071)***	(0.044)***	(0.053)***	(0.026)***
$\gamma_{y,int}$	-0.011	-0.346	-0.022	-0.229
	(0.018)	(0.079)***	(0.018)	(0.146)
$\gamma_{y,ext}$	-0.043	0.060	0.040	0.056
	(0.073)	(0.063)	(0.018)**	(0.017)***
3) Marginal effects of financial constraints - non-constrained firms				
γ_y	0.181	0.381	0.179	0.336
	(0.014)***	(0.037)***	(0.016)***	(0.0268)***
$\gamma_{y,int}$	0.002	0.509	0.000	0.404
	(0.003)	(0.106)***	(0.000)**	(0.079)***
$\gamma_{y,ext}$	0.004	0.004	0.025	0.008
	(0.001)***	(0.060)**	(0.007)***	(0.010)

Notes: This table reports the coefficients of a regression, where financial constraints are not classified as a zero/one variable, as in our baseline estimates, but instead as a continuous variable. We report results for all firms in panel 1) and for the firms that are classified as financially constrained in our earlier specification in panel 2) and the ones that are classified as unconstrained in our baseline estimate in panel 3). Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

4.5 Transitory feature of labor hoarding

We have shown that financial constraints have a substantial influence on employment because they hamper the ability of firms to hoard labor. In this subsection, we focus on the transitory feature of labor hoarding. The expected persistence of a downturn plays a crucial role in the labor hoarding behavior of firms. If firms believe that the downturn is temporary, downsizing their labor force will entail future re-hiring costs, so the incentives to hoard labor are high. If, however, firms associate the change in demand with permanent developments, they will have an incentive to more or less completely adjust their labor force to the lower level of output.[11]

We test whether the results above are influenced by firms that adjust their employment to permanent changes in demand. To do this, we re-estimate the baseline equation using only those observations for which we have an indication that the firm expects the downturn, respectively, the upturn, to be temporary. We use the sum a firm spends on temporary work to capture the cyclical movement of employment: because temporary work is quickly available and easily reversible, it will be used by firms as a buffer to regulate their labor force when they assume the fluctuations in demand are set to be temporary. In contrast, it would be inefficient for employers to take on temporary work for a permanent job because the retention level is generally low and the fixed costs of work-related training are therefore less worthwhile (Booth, Francesconi, and Frank, 2002). Thus, if firms assume that an increase in demand is permanent, they will hire permanent workers, while if an upturn is seen to be temporary, it will be more attractive to take on temporary workers. Accordingly, if firms expect a downturn to be temporary, they will try to keep as much as possible of their permanent labor force and diminish their costs by reducing temporary work with no redundancy pay (Dolado, García-Serrano, and Jimeno, 2002).

We assume, therefore, that when an upturn (decline) in output falls together with a rise (decline) in temporary work, the firm believes that the fluctuations in demand are temporary. We proceed by looking at the sub-set of the sample, where changes in output fall together with a change in temporary work and the two move in the same direction. Because the costs for temporary work only amount to 1.5% of total labor costs on average, it is fair to claim that the total change in employment is not influenced in a meaningful way by changes in the costs for temporary work.[12] Because not all firms employ temporary work, this exercise reduces the sample to approximately $12,000$ observations.

Table 7 displays the results for a one percent decrease in output. The results are very

[11] Baily, Bartelsman, and Haltiwanger (2001) analyze the cyclicality of labor productivity, focusing on the impact of a transitory demand shock. They measure the transitory shocks as the deviation of downstream demand from the linear trend.

[12] See Table 14 in the Appendix. The share of temporary work is quite homogenous across industries, ranging from 0.5% (restaurants and hotels) to 1.7% (business services, manufacturing of investment goods), with the exception of construction, where 6% of employment expenditures are temporary. However, industry effects should not influence our results, because we control for industry-fixed effects and we include interactions between the industry-fixed effect and the financial constraint indicator.

similar to the results shown in Table 3. This suggests that the influence of financial constraints on employment applies to the cyclical component of labor adjustment.[13]

Table 7: Employment elasticities during a temporary downturn

1) Employment elasticity for unconstrained firms and marginal effects of financial constraints				
Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
γ_y	0.158	0.204	0.175	0.197
	(0.027)***	(0.027)***	(0.019)***	(0.019)***
$\gamma_{y,int}$	0.192	0.171	0.131	0.117
	(0.031)***	(0.037)***	(0.033)***	(0.037)***
$\gamma_{y,ext}$	0.068	0.042	0.186	0.192
	(0.031)**	(0.034)	(0.035)***	(0.035)***
2) Implied employment elasticity $\tilde{\gamma}_y$ depending on financial constraints				
Unconstrained	0.158	0.204	0.175	0.197
Only internally	0.351	0.374	0.306	0.313
Only externally	0.227	0.246	0.361	0.388
Internally and externally	0.419	0.417	0.492	0.505

Notes: The first panel 1) on the top shows the response in employment to a one percent decline in output for firms, which decrease temporary workers during the decline in output. The direct impact of a one percent decline in output is given by γ_y on the first line. $\gamma_{y,int}$ is the marginal effect of being internally constrained, and $\gamma_{y,ext}$ the marginal effect of being externally constrained. Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Panel 2) reports the sum of the interaction coefficients (standard deviations have been excluded, all except the lowest entry in row (2) are significant at the one percent level). Covariates are not included in the table.

5 Macroeconomic implications

Our final point is to estimate how large the macroeconomic impact of financial constraints is on employment growth. We take our firm-level findings to the macro level by means of a counterfactual analysis. We estimate a counterfactual aggregate employment growth series excluding the impact of financial constraints on the labor hoarding behavior of firms. First, at the firm level, we exclude the impact of financial constraints by deducting the interaction terms combining the financial constraints and output growth, as in equation (4), from actual employment. Then, these firm-level counterfactual growth rates are weighted with the number of employees of each firm and added up to an aggregate counterfactual growth

[13]The results for an increase in output can be found in Table 15 in the Appendix. The figures also show that, when output increases, the coefficients are qualitatively similar to those of the baseline equation.

series.

The results of this exercise show that the effect of financial constraints on labor hoarding is quantitatively important for aggregate employment too. Table 8 shows the percentage reduction in the variance of the counterfactual compared to actual aggregate employment. Depending on the specification, the variance of the aggregate employment growth would be 17% to 26% lower if internal and external constraints had not influenced the scope of firms' labor hoarding. As seen in all previous estimates, the impact is smaller when only a single constraint is taken into account.

Table 8: Reduction in variance of the counterfactual compared to actual aggregate employment

Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
Excluding impact of only internal constraints	-20.57	-14.83	-15.07	-10.95
Excluding impact of only external constraints	-6.85	-6.15	-4.86	-6.57
Excluding impact of internal and external constraints	-26.41	-20.43	-19.37	-17.07

The Great Recession is a good example to illustrate the impact of financial constraints on employment growth: Aggregate employment of the firms included in our sample increased by 2.7% in 2008, when the economy was still growing dynamically, shortly before the recession set in. In 2009, it decreased by 2.7%.[14] The fluctuations in employment would have been smaller if the firms had faced no liquidity and no collateral constraints. The counterfactual would have increased by 2.4% in 2008 and decreased by 2.0% in 2009. Thus, while aggregate employment growth decreased by 5.4% from peak to trough, our counterfactual only decreased by 4.4%. For the other combinations of constraint measures the change in employment growth between 2008 and 2009 lies between 4.7% and 4.8%.

This example describes the impact of financial constraints on the labor hoarding behavior of firms well: financial constraints are not the cause for employment cycles, but they do influence the size of their fluctuations.

[14]These figures do not coincide exactly with the official labor statistics (the payroll survey and the labor force survey) because the source is different and some sectors such as public administration and financial services are not included in our data set. However, the overall development is similar.

6 Robustness

In this section, we conduct two tests to provide evidence for our causal interpretation of the results. First, financial constraints might be correlated with firm-level unobserved heterogeneity. We therefore use an exogenous component of the balance sheet to measure changes in financial constraints, and we obtain similar results as above. Second, we use industry-level aggregates to test whether the results are driven by the endogeneity of firm-level output.

6.1 Exogeneity of financial constraints

First, we address the possibility that financially constrained firms decrease their employment disproportionably in a downturn, not because of their financial constraints but because of an unobserved firm-endogenous feature correlated with the financial situation.[15] We therefore construct a measure of variations of the balance sheet from net financial income. As outlined below, it is unrelated to idiosyncratic factors and should be unpredictable (as long as stock prices are unpredictable), such that a variation in the return from net financial assets reflects exogenous changes in the financial constraints.

To do so, we divide our measure of profits in two categories: firms' operative profits and firms' financial profits. Besides the profits stemming from firms' normal activities (operative profits), our data set includes firms' financial income (which consists of the income from holding financial assets) and firms' write-downs on financial assets. Financial income and write-downs occur when firms hold financial assets that gain or lose in value, or the firm receives a dividend payment on their financial assets. According to Swiss accounting standards, these include only profits or losses with variable returns, which are arguably unpredictable. Fixed interest payments or interest income have a separate position on the balance sheet, and we exclude them from net financial income. Thus, short-term changes in the net income from financial assets are mainly driven by financial market developments and are therefore not influenced by the single firm's operative management

[15] In Section 6, we show that firm-fixed effects do not influence the results. This implies that time-invariant firm-specific features are not relevant for our analysis. It is, however, possible that time-variant, firm-endogenous characteristics play a role.

decisions or by other unobserved factors influencing the firms' labor demand.[16]

Because the share of financial profits in total profits is usually small, and therefore, we cannot clearly distinguish how much financial constraints change due to changes in financial assets, we perform this estimation with a linear specification. Our analysis in Section 4.4 suggests, however, that small changes only have an effect in the upper half of the distribution, where financial constraints have a monotonic impact on employment (see Figure 3). Thus, we reduce our sample to the upper half of the distribution, where we can use a linear specification. Furthermore, because not all firms have financial income or write-downs, the sample is reduced to $2,700$ observations in this analysis.

We estimate the following equation including both financial profitability ($ProfFin_{i,t-1}$) and operative profitability ($ProfOp_{i,t-1}$):

$$\tilde{\gamma}_y = \gamma_y + \gamma_{y,fin} ProfFin_{i,t-1} + \gamma_{y,op} ProfOp_{i,t-1} \tag{5}$$

Table 9 shows the estimated coefficients, confirming that firms with larger financial or operating profits (less constrained) adjust employment during a downturn by less than constrained firms. The coefficients of the two interaction terms for financial an operating profits are not significantly different from each other.[17] Thus, a one percent decline in financial profits has a qualitatively similar effect on labor hoarding as a one percent decline in operating profits, suggesting that the internal financial constraints hindering labor hoarding are not solely a result of unobservable idiosyncratic factors, which might influence both profits and employment. Together with the fact that net financial profits are arguably exogenous to firm's idiosyncratic shocks, as argued above, we interpret this as evidence that the financial situation causally impacts labor hoarding behavior.

[16]Statistically, the output share of operating profits and financial profits are uncorrelated.

[17]Indeed, they look remarkably similar. We tested whether this is spuriously due the specification of the financial constraint as profits relative to output by using a 'placebo specification' with a simulated random variable. We found no significant effect of such a variable. Furthermore, if we do not exclude the half of the distribution of firms with low profitability, the effect becomes somewhat smaller, as expected. However, the result that the impacts of financial and operative profits are not significantly different from each other remains robust.

Table 9: Employment elasticities during a downturn with exogenous variations in internal constraint

γ_y	0.353
	(0.037)***
$\gamma_{y,fin}$	-0.464
	(0.107)***
$\gamma_{y,op}$	-0.423
	(0.088)***

Standard deviation in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Notes: Estimated effect of internal constraints measured by financial profits ($\gamma_{y,fin}$) and operating profits ($\gamma_{y,op}$) separately. Financial profits are only components of the balance sheet, which are exogenous to firm's productivity or idiosyncratic shocks. Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

6.2 Exogeneity of output

The within-industry heterogeneity is substantial, as shown in Table 2. Thus, the use of firm-level data, for both the dependent and the explanatory variables, ensures that this within-industry dispersion is fully taken into account in the estimated results. The drawback, however, is that changes in firm-specific employment could affect output. If such changes are correlated with the financial situation, this may bias our results. To investigate this more closely, we have replicated our estimation with changes in output defined at a higher aggregation level, i.e., at the industry-level, as in Aghion, Farhi, and Kharroubi (2015). As they argue, the use of explanatory variables at a higher aggregation stage reduces the scope for reverse causality because the changes in employment of an individual firm will not influence the characteristics of a whole industry.

The impact of a decrease in industry-level output on firm-level employment is displayed in Table 10. Generally, the estimates are less precise compared to the baseline specification. This is not surprising, given that average fluctuations at the industry level hardly reflect the very heterogeneous developments at the firm level. However, the interaction terms with the various financial constraint variables are, in most cases, qualitatively and quantitatively consistent with the results using firm-level output. Thus, the results support that our baseline equation is correctly specified and is probably not strongly influenced by reverse causality. In particular the liquidity measure as internal financial constraint is clearly robust to these changes. We therefore put most emphasis on the internal liquidity constraint in our interpretation of the general findings.

Table 10: Employment elasticities during a downturn with industry-level value-added

1) Employment elasticity for unconstrained firms and marginal effects of financial constraints				
Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
γ_y	0.075	0.152	0.145	0.192
	(0.072)	(0.073)**	(0.070)**	(0.070)**
$\gamma_{y,int}$	0.205	0.071	0.193	0.055
	(0.060)***	(0.056)	(0.061)***	(0.057)
$\gamma_{y,ext}$	0.106	0.086	-0.005	0.036
	(0.054)*	(0.054)	(0.059)	(0.059)
2) Implied employment elasticity $\tilde{\gamma}_y$ depending on financial constraints				
Unconstrained	0.075	0.152	0.145	0.192
Only internally	0.281	0.223	0.338	0.247
Only externally	0.181	0.237	0.140	0.228
Internally and externally	0.386	0.309	0.333	0.283

Notes: The first panel 1) on the top shows the response in employment to a one percent decline in output, now measured by industry-level value added instead of firm-level value added. The direct impact of a one percent decline in output is given by γ_y on the first line. $\gamma_{y,int}$ is the marginal effect of being internally constrained, and $\gamma_{y,ext}$ the marginal effect of being externally constrained. Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Panel 2) reports the sum of the interaction coefficients (standard deviations have been excluded, the liquidity constraint remains always significant at the 1% level, the collateral constraint at the 10% level). Covariates are not included in the table.

6.3 Unobserved heterogeneity and industry trends

In the following, we conduct several estimates with alternative specifications to test the robustness of our results.

First, we test whether the inclusion of industry-level trends influences the reaction of employment to a change in output. For this purpose, we add industry-time-fixed effects to our baseline equation (column 2 in Table 11). The results show that the inclusion of industry-time-fixed effects has practically no impact on the marginal effect of financial constraints on employment.

In the baseline specification, we assumed that by introducing industry-fixed effects, the unobserved heterogeneity caused by time independent factors had been sufficiently controlled for. This approach seemed reasonable, as we are working with an unbalanced sample of firms in which the industries remain constant over time, while the universe of firms changes from year to year. By emphasizing industry-specific characteristics, however, we may have omitted firm-specific unobserved fixed effects that could be correlated with the regressor. To test this, we re-estimate the baseline equations using firm-fixed effects instead of industry-fixed effects (column 3). The estimate results are practically identical to the baseline results, indicating that there are no further time-independent factors that should be included in equations. Furthermore, we test whether the reaction of employment to a change in output differs across sectors, and we find robust results (column 4).

As already discussed, in a dynamic model such as ours, at least the lagged dependent variable might be correlated with the error term. The problem is typically addressed by using a GMM estimate, as proposed by Arellano and Bond. (1991) (column 5). The application of this estimator yields a slightly more pronounced effect of the financial constraints. The small difference between the estimates of the coefficients of interest is likely due to the fact that the autocorrelation of our dependent variable is quite contained , and with 16 years of data, the time-series dimension of our data set is reasonably large.[18]

[18] We use three lagged values of $\Delta e_{t-1,i}$ as a basis for the moment conditions. We test the validity of instruments using the Hansen statistic, and we test for remaining second-order autocorrelation in the first difference of the error term. Neither test points to misspecification; see Table 16 in the Appendix.

Table 11: Employment elasticities during a downturn in alternative specifications

Specification	(1) Baseline	(2) Industry-time -fixed effects	(3) Firm-fixed effects	(4) Industry-output interaction	(5) GMM-based estimate
Measure of constraints: Collateral and Liquidity					
γ_y	0.154	0.148	0.156	0.188	0.120
	(0.012)***	(0.014)***	(0.014)***	(0.050)***	(0.023)***
$\gamma_{y,int}$	0.171	0.171	0.166	0.147	0.190
	(0.016)***	(0.015)***	(0.019)***	(0.018)***	(0.028)***
$\gamma_{y,ext}$	0.042	0.042	0.046	0.035	0.077
	(0.015)***	(0.016)***	(0.018)***	(0.015)**	(0.028)***
Measure of constraints: Collateral and Profitability					
γ_y	0.183	0.178	0.191	0.235	0.151
	(0.012)***	(0.015)***	(0.014)***	(0.045)***	(0.022)***
$\gamma_{y,int}$	0.166	0.163	0.146	0.140	0.195
	(0.017)***	(0.015)***	(0.020)***	(0.017)***	(0.028)**
$\gamma_{y,ext}$	0.028	0.028	0.031	0.023	0.062
	(0.015)*	(0.015)**	(0.018)*	(0.016)	(0.028)***
Measure of constraints: Balance sheet and Liquidity					
γ_y	0.153	0.147	0.171	0.188	0.131
	(0.009)***	(0.011)***	(0.012)***	(0.048)***	(0.019)***
$\gamma_{y,int}$	0.127	0.125	0.133	0.107	0.137
	(0.017)***	(0.016)***	(0.020)***	(0.019)***	(0.030)***
$\gamma_{y,ext}$	0.121	0.122	0.116	0.116	0.152
	(0.017)***	(0.016)***	(0.021)***	(0.017)***	(0.034)***
Measure of constraints: Balance sheet and Profitability					
γ_y	0.167	0.162	0.179	0.220	0.149
	(0.009)***	(0.011)***	(0.011)***	(0.045)***	(0.019)***
$\gamma_{y,int}$	0.126	0.123	0.111	0.106	0.147
	(0.017)***	(0.020)***	(0.020)***	(0.017)***	(0.029)***
$\gamma_{y,ext}$	0.129	0.131	0.129	0.117	0.159
	(0.017)***	(0.021)*	(0.021)***	(0.017)***	(0.031)***

Notes: The first panel on the top shows the response in employment to a one percent decline in output, for collateral and liquidity constraint measures for internal and external constraints, respectively. The direct impact of a one percent decline in output is given by γ_y on the first line. $\gamma_{y,int}$ is the marginal effect of being internally constrained, and $\gamma_{y,ext}$ the marginal effect of being externally constrained. Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The panels below repeat the same for different constraint definitions, as indicated in the panel headers. The columns indicate the estimation strategy. In column (1) we repeat our baseline estimates, in column (2) we include industry and time fixed effects, in column (3) firm-fixed effects, in column (4) we include an interaction term between the industry fixed effect and the change in output as a control. In column (5) we use GMM with three lagged values (starting from $t - 2$ of the change in employment for the moment conditions.

In our baseline specification, we left out several interaction terms in order to keep the number of coefficients small. While from a theoretical point of view, financial constraints should interact with all variables in the model, the baseline equation includes only the interaction terms of the financial constraints with the demand shock and the industry-fixed effects. We have conducted robustness tests including the interaction terms of financial constraints with the following further variables: the change in employment in $t-1$, the change in wages in t, the change in capital stock in t and the capital-stock-to-FTE ratio in $t-1$. These interaction terms are in some specifications significant, but the coefficients are very small and the impact on labor elasticity is minor. The results of these estimates are reported in Table 12.

Table 12: Employment elasticities during a downturn, including interaction terms with other variables included in the equation

Specification	(1) Baseline	(2) Interaction with $\Delta e_{i,t-1}$	(3) Interaction with $\Delta w_{i,t}$	(4) Interaction with change in capital stock	(5) Interaction with capital-stock -to-FTE-ratio
Measure of constraints: Collateral and Liquidity					
γ_y	0.154	0.154	0.147	0.155	0.155
	(0.012)***	(0.012)***	(0.12)***	(0.012)***	(0.012)***
$\gamma_{y,int}$	0.171	0.172	0.192	0.171	0.172
	(0.016)***	(0.016)***	(0.16)***	(0.016)***	(0.016)***
$\gamma_{y,ext}$	0.042	0.042	0.039	0.040	0.043
	(0.015)***	(0.015)***	(0.015)***	(0.015)***	(0.015)***
Measure of constraints: Collateral and Profitability					
γ_y	0.183	0.183	0.177	0.184	0.183
	(0.012)***	(0.012)***	(0.012)***	(0.012)***	(0.012)***
$\gamma_{y,int}$	0.166	0.167	0.190	0.166	0.165
	(0.017)***	(0.017)***	(0.018)***	(0.017)***	(0.017)***
$\gamma_{y,ext}$	0.028	0.028	0.025	0.026	0.030
	(0.015)**	(0.015)*	(0.015)	(0.015)*	(0.015)**
Measure of constraints: Balance sheet and Liquidity					
γ_y	0.153	0.152	0.140	0.152	0.153
	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***
$\gamma_{y,int}$	0.127	0.127	0.144	0.126	0.128
	(0.017)***	(0.017)***	(0.017)***	(0.017)***	(0.017)***
$\gamma_{y,ext}$	0.121	0.122	0.134	0.122	0.121
	(0.017)***	(0.017)***	(0.017)***	(0.017)***	(0.017)***
Measure of constraints: Balance sheet and Profitability					
γ_y	0.167	0.167	0.155	0.167	0.167
	(0.009)***	(0.009)***	(0.009)***	(0.009)***	(0.009)***
$\gamma_{y,int}$	0.126	0.126	0.146	0.126	0.126
	(0.017)***	(0.017)***	(0.018)***	(0.017)***	(0.017)***
$\gamma_{y,ext}$	0.129	0.130	0.142	0.30	0.129
	(0.017)***	(0.017)*	(0.017)***	(0.017)***	(0.017)***

Notes: The first panel on the top shows the response in employment to a one percent decline in output, for collateral and liquidity constraint measures for internal and external constraints, respectively. The direct impact of a one percent decline in output is given by γ_y on the first line. $\gamma_{y,int}$ is the marginal effect of being internally constrained, and $\gamma_{y,ext}$ the marginal effect of being externally constrained. Standard deviation in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The panels below repeat the same for different constraint definitions, as indicated in the panel headers. The columns indicate the estimation strategy. In column (1) we repeat our baseline estimates, in column (2) we interact financial constraints with the lagged change in employment, in column (3) with the change in the average wages, in column (4) with the change in the capital stock, and in column (6) with the K/E ratio. We report the coefficients as in our baseline estimates, not the controls. The interactions are therefore not reported here, but can be requested from the authors.

7 Conclusions

This paper documents the role of financial constraints in employment adjustment using firm-level data from balance-sheet and income statements, including firm-level employment statistics. The data are a sample from the universe of Swiss firms, including all industries of the economy, except the financial and public sectors. Also included are very small firms, which typically do not publish their economic figures. We find that the adjustment of firms' employment to changes in output depends on their financial situation. Firms with limited funding availability resize their labor force more strongly than firms that have abundant funding availability. Financially unconstrained firms are able to hoard more labor.

Our setup allows us to go into further detail. We show that not only are external financing constraints an important factor, but the availability of internal funding, in particular, has a large influence. The strongest effect is observed if internal and external constraints occur jointly. A further non-linearity arises as the marginal effect of financial constraints decreases with a deteriorating financial situation, and it is generally smaller for firms paying low wages. This result suggests that it is particularly costly to lay off workers with higher wages, who tend to be more-skilled workers.

The amplifying effects of financial constraints are quite similar in upturns and downturns. Financially constrained firms not only decrease their employment more when output decreases, but they also increase their employment more strongly when output increases. Our results are therefore consistent with the view that financial constraints impede the labor hoarding behavior of firms, because firms that hoard labor during a downturn do not hire as much labor in an upturn. We furthermore show that this effect is relevant for aggregate employment, suggesting that employment would have declined by around two thirds of its actual decline during the Great Recession if financial constraints would not have hindered labor hoarding. This implies that financially constrained firms contribute disproportionately to the comovement between employment and output. In contrast, a weak cyclicality of employment, caused by strong labor hoarding, is largely driven by financially healthy firms.

These results complement the large body of literature on the role of financial constraints on investment, where financial constraints are typically found to increase the sensitivity of investment to shocks. Through this channel, financial frictions are found to amplify the propagation of shocks to the macroeconomy. Our results suggest that a similar mechanism works through the labor market and that the depth of financial frictions is potentially important to understand labor hoarding, confirming and extending the findings in Giroud and Mueller (2017). As we look at the response of employment to changes in output, our results have implications for the cyclicality of labor productivity. In particular, an economy with more financially healthy firms would be characterized by more cyclical labor productivity. An interesting avenue for future research would be to look at the strong increase in the cyclicality of labor productivity documented in Fernald and Wang (2016) and to evaluate the role of firms' improved financial health and reduction in financial constraints.

References

Aghion, P., E. Farhi, and E. Kharroubi (2015): "Liquidity and growth: The role of counter-cyclical interest rates," BIS Working Paper 489, Bank for International Settlements.

Arellano, M., and S. Bond. (1991): "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations.," *Review of Economic Studies*, 58, 270–297.

Baily, M. N., E. J. Bartelsman, and J. Haltiwanger (2001): "Labor productivity: Structural change and cyclical dynamics," *Review of Economics and Statistics*, 83(3), 420–433.

Balleer, A., B. Gehrke, W. Lechthaler, and C. Merkl (2016): "Does short-time work save jobs? A business cycle analysis," *European Economic Review*, 84(C), 99–122.

Basci, E., Y. S. Baskaya, and M. Kilinc (2011): "Financial shocks and industrial employment," Working Papers 1112, Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

Benmelech, E., N. K. Bergman, and A. Seru (2011): "Financing labor," Discussion paper, National Bureau of Economic Research.

Bernanke, B., M. Gertler, and S. Gilchrist (1996): "The financial accelerator and the flight to quality," *The Review of Economics and Statistics*, 78(1), 1–15.

Biddle, J. E. (2014): "The cyclical behavior of labor productivity and the emergence of the labor hoarding concept," *Journal of Economic Perspectives*, 28(2), 197–212.

Blatter, M., S. Muehlemann, and S. Schenker (2012): "The costs of hiring skilled workers," *European Economic Review*, 56, 20–35.

Booth, A. L., M. Francesconi, and J. Frank (2002): "Temporary jobs: Stepping stones or dead ends?," *The Economic Journal*, 112(480), F189–F213.

Burgess, S. M. (1988): "Employment adjustment in UK manufacturing," *The Economic Journal*, 98(389), 81–103.

Burnside, C., M. Eichenbaum, and S. Rebelo (1993): "Labor hoarding and the business cycle," *Journal of Political Economy*, 101(2), 245–273.

Calomiris, C. W., A. Orphanides, and S. A. Sharpe (1994): "Leverage as a state variable for employment, inventory accumulation, and fixed investment," *NBER Working Paper*, (4800).

Cantor, R. (1990): "Effects of leverage on corporate investment and hiring decisions," *Federal Reserve Bank of New York Quarterly Review*, 15, 31–41.

Chodorow-Reich, G. (2014): "The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis," *The Quarterly Journal of Economics*, 129(1), 1–59.

Davis, S. J., R. J. Faberman, and J. C. Haltiwanger (2013): "The Establishment-Level Behavior of Vacancies and Hiring," *The Quarterly Journal of Economics*, 128(2), 581–622.

Detken, A. (2002): "Nonlinearities in Swiss macroeconomic data," *Swiss Journal of Economics and Statistics (SJES)*, 138(I), 39–60.

Dolado, J. J., C. García-Serrano, and J. F. Jimeno (2002): "Drawing lessons from the boom of temporary jobs in Spain," *The Economic Journal*, 112(480), F270–F295.

Drakos, K., and C. Kallandranis (2006): "Modelling labour demand dynamics beyond the frictionless environment," *Labour*, 20, 699–720.

Duygan-Bump, B., A. Levkov, and J. Montoriol-Garriga (2015): "Financing constraints and unemployment: Evidence from the Great Recession," *Journal of Monetary Economics*, 75, 89–105.

Fazzari, S. M., R. G. Hubbard, and B. C. Petersen (1988): "Financing constraints and corporate investment," *Brookings papers on economic activity*, 1988(1), 141–206.

Fernald, J. G., and J. C. Wang (2016): "Why Has the Cyclicality of Productivity Changed? What Does It Mean?," *Annual Review of Economics*, 8(1), 465–496.

Funke, M., W. Maurer, and H. Strulik (1999): "Capital structure and labour demand: Investigations using german micro data," *Oxford Bulletin of Economics and Statistics*, 61(2), 199–215.

Gertler, M., and S. Gilchrist (1994): "Monetary policy, business cycles, and the behavior of small manufacturing firms," *The Quarterly Journal of Economics*, 109(2), 309–340.

Giroud, X., and H. M. Mueller (2017): "Firm Leverage, Consumer Demand, and Employment Losses During the Great Recession," *The Quarterly Journal of Economics*, 132(1), 271–316.

Kaplan, S. N., and L. Zingales (1997): "Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?*," *The Quarterly Journal of Economics*, 112(1), 169–215.

Kohlbrecher, B., and C. Merkl (2016): "Business Cycle Asymmetries and the Labor Market," IZA Discussion Papers 9816, Institute for the Study of Labor (IZA).

Levine, O., and M. Warusawitharana (2014): "Finance and Productivity Growth: Firm-level Evidence," Finance and Economics Discussion Series 2014-17, Board of Governors of the Federal Reserve System (U.S.).

Nickell, S. (1984): "An investigation of the determinants of manufacturing employment in the United Kingdom," *The Review of Economic Studies*, 51(4), 529–557.

——— (1987): "Dynamic models of labour demand," in *Handbook of Labor Economics*, ed. by O. Ashenfelter, and R. Layard, vol. 1, chap. 09, pp. 473–522. Elsevier, 1 edn.

——— (1999): "How does financial pressure affect firms?," *European Economic Review*, 43, 1435–1456.

Ogawa, K. (2003): "Financial distress and employment: The Japanese case in the 90s," *NBER Working Paper*, (9646).

Sharpe, S. A. (1994): "Financial market imperfections, firm leverage, and the cyclicality of employment," *American Economic Review*, 84(4), 1060–1074.

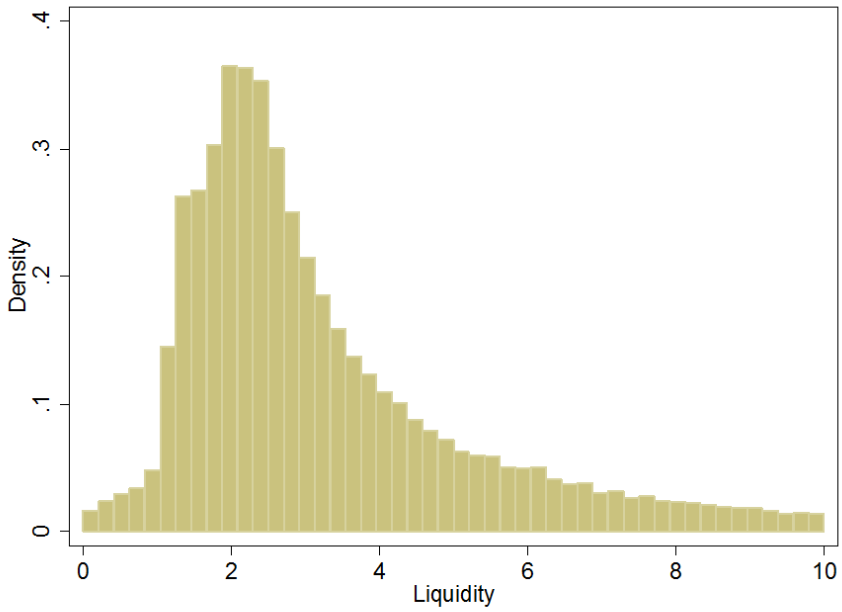
Solow, R. (1964): "Draft of presidential address on the short run relation of employment and output," *David M. Rubenstein Rare Book and Manuscript Libary, Duke University, Box 70, Folder 1964, dated 1964.*

Tella, R. D., and R. MacCulloch (2005): "The consequences of labor market flexibility: Panel evidence based on survey data," *European Economic Review*, 49(5), 1225 – 1259.

8 Appendix

8.1 Descriptive statistics

FIGURE 4: LIQUIDITY, 1999-2013



Notes: Distribution of firms' liquidity (sales to labour costs ratio)

Figure 5: Liquidity, by industry, 1999-2013

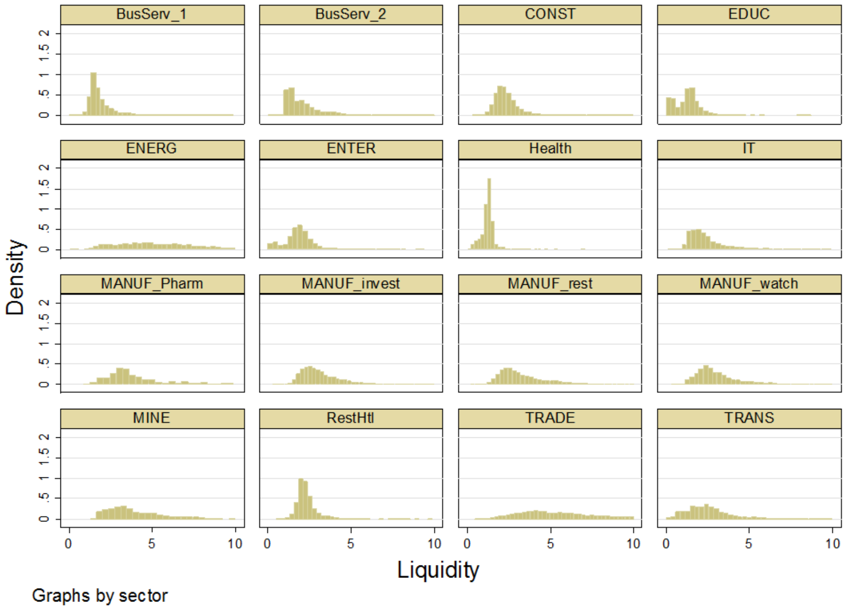
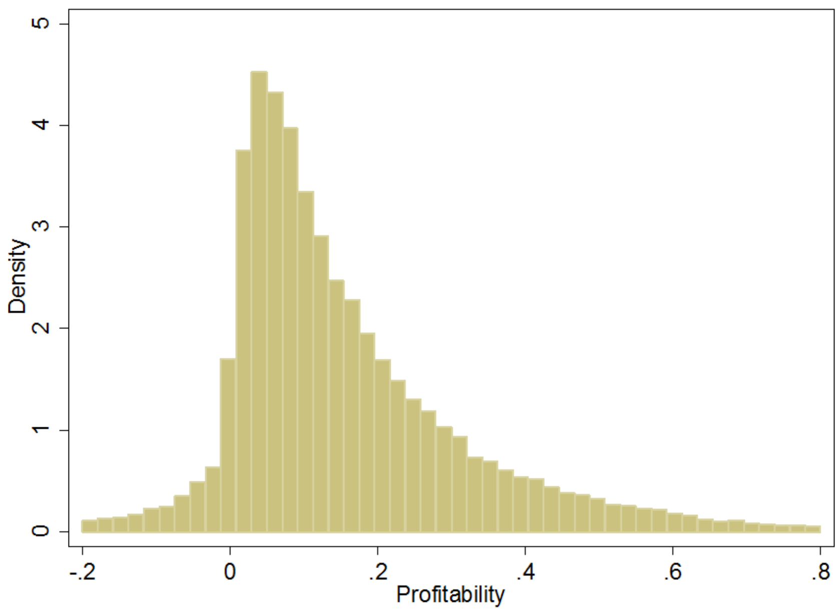


Figure 6: Profitability, 1999-2013



Notes: Distribution of firms' profitability (EBIT to value added ratio)

Figure 7: Profitability, by industry, 1999-2013

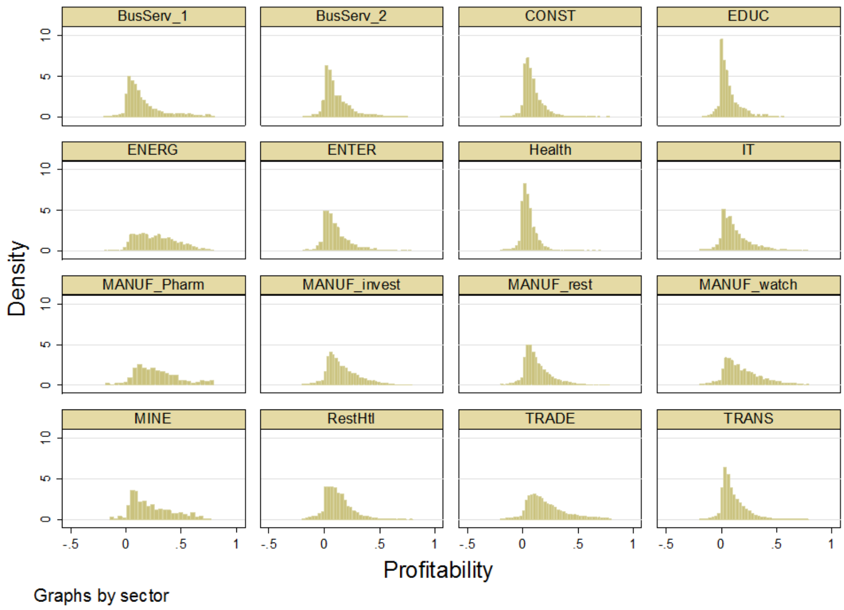
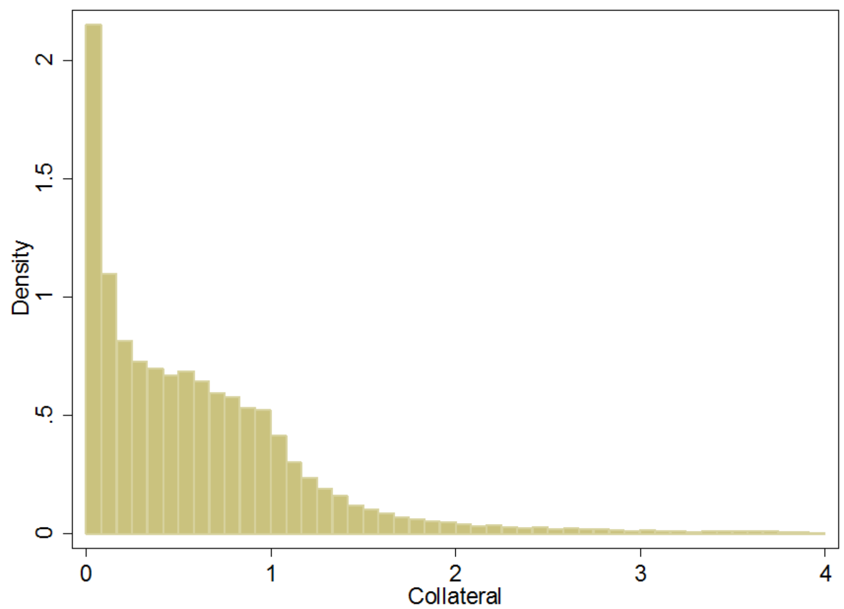


Figure 8: Collateral, 1999-2013



Notes: Distribution of firms' collateral (sum of a firm's structures (buildings and land) and machines per unit outstanding debt)

Figure 9: Collateral, by industry, 1999-2013

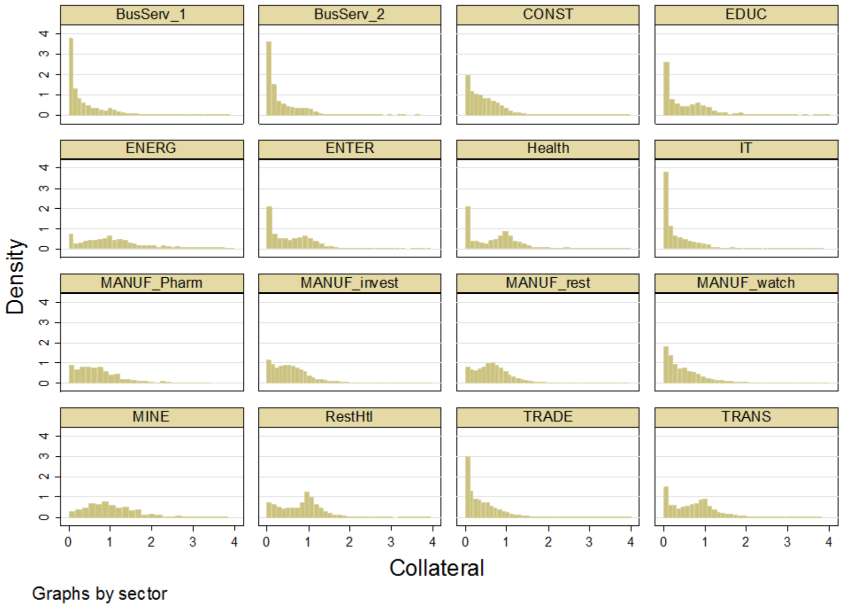
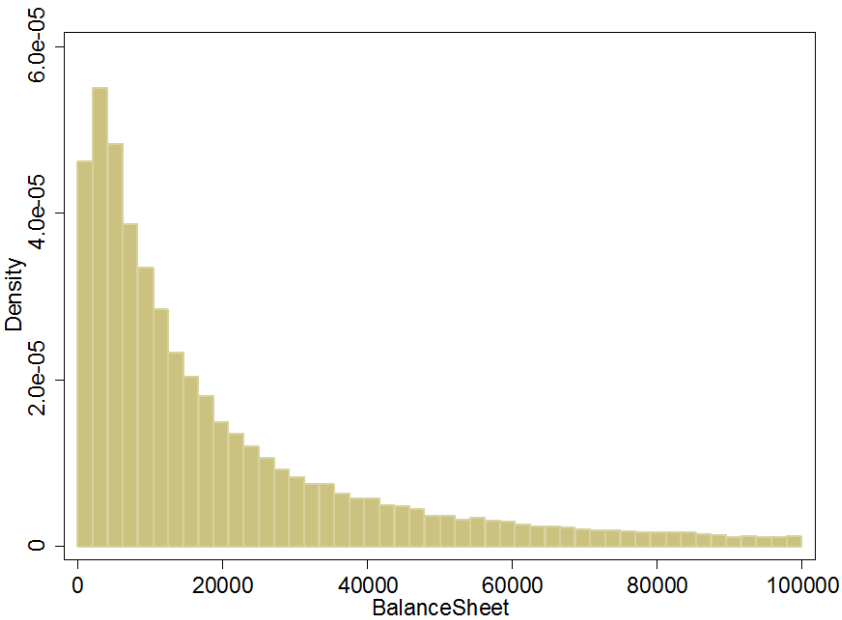


Figure 10: Size of balance sheet, 1999-2013



Notes: Distribution of the size of balance sheet (in 1000 CHF)

Figure 11: Size of balance sheet, by industry, 1999-2013

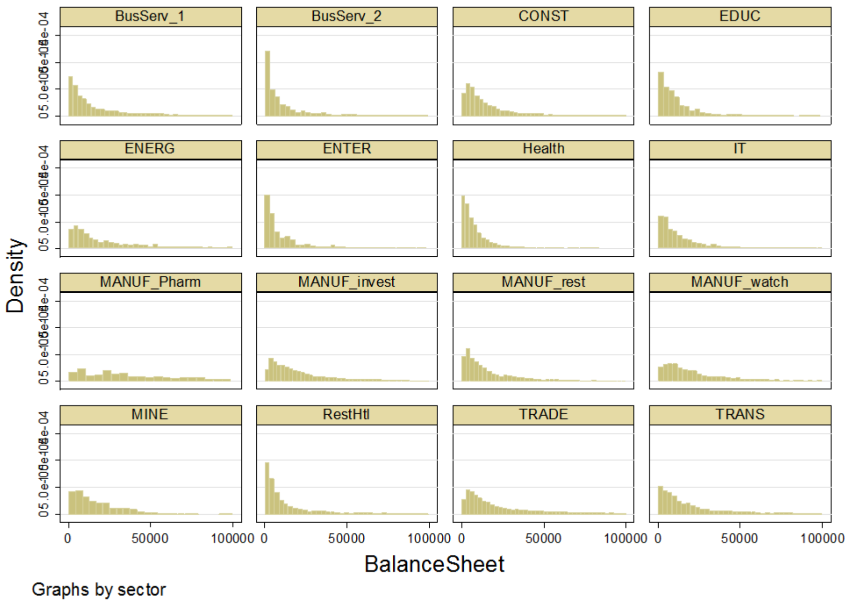


Table 13: Impact of 1% decrease in value added on employment, full regression output

	Coefficient	Std.dev.	t	p
γ_r	0.154	0.154	12.866	0.00
$\gamma_{r,int}$	0.171	0.171	10.682	0.00
$\gamma_{r,ext}$	0.042	0.042	2.841	0.00
γ_{int}	0.010	0.010	1.640	0.10
γ_{ext}	-0.013	-0.013	-1.855	0.06
Δe (lag)	0.027	0.027	4.084	0.00
Δw	-0.609	-0.609	-45.635	0.00
$\Delta capitalstock$	0.014	0.014	8.066	0.00
capital/labour (lag)	0.000	0.000	0.514	0.61
year				
2001	0.013	0.013	3.825	0.00
2002	-0.006	-0.006	-1.715	0.09
2003	-0.013	-0.013	-3.869	0.00
2004	-0.006	-0.006	-1.793	0.07
2005	-0.005	-0.005	-1.400	0.16
2006	-0.004	-0.004	-1.046	0.30
2007	0.004	0.004	1.213	0.22
2008	0.009	0.009	2.720	0.01
2009	-0.023	-0.023	-6.156	0.00
2010	0.002	0.002	0.597	0.55
2011	0.010	0.010	3.329	0.00
2012	0.001	0.001	0.279	0.78
2013	0.000	0.000	0.060	0.95
Industry x ConstrInt				
1	-0.034	-0.034	-3.482	0.00
2	-0.035	-0.035	-2.886	0.00
3	-0.022	-0.022	-2.975	0.00
4	-0.023	-0.023	-1.028	0.30
5	-0.026	-0.026	-2.599	0.01
6	0.002	0.002	0.140	0.89
7	-0.014	-0.014	-1.287	0.20
8	-0.010	-0.010	-0.912	0.36
9	-0.014	-0.014	-0.528	0.60
10	-0.012	-0.012	-1.912	0.06
11	-0.015	-0.015	-2.358	0.02
12	-0.014	-0.014	-1.623	0.10
13	-0.002	-0.002	-0.141	0.89
14	-0.014	-0.014	-1.313	0.19
15	-0.021	-0.021	-2.534	0.01
Industry x ConstrExt				
1	0.008	0.008	0.889	0.37
2	0.008	0.008	0.671	0.50
3	0.005	0.005	0.652	0.51
4	0.022	0.022	1.937	0.05
5	0.016	0.016	1.624	0.10
6	0.011	0.011	1.018	0.31
7	-0.002	-0.002	-0.219	0.83
8	0.002	0.002	0.215	0.83
9	0.055	0.055	4.089	0.00
10	0.007	0.007	0.963	0.34
11	0.012	0.012	1.649	0.10
12	0.017	0.017	1.824	0.07
13	0.020	0.020	0.984	0.33
14	-0.002	-0.002	-0.218	0.83
15	0.012	0.012	1.694	0.09
Industry				
2	-0.008	-0.008	-0.607	0.54
3	-0.019	-0.019	-2.108	0.04
4	0.000	0.000	-0.008	0.99
5	0.002	0.002	0.197	0.84
6	-0.027	-0.027	-2.161	0.03
7	0.007	0.007	0.563	0.57
8	-0.026	-0.026	-2.393	0.02
9	0.012	0.012	1.118	0.26
10	-0.019	-0.019	-2.406	0.02
11	-0.027	-0.027	-3.278	0.00
12	-0.010	-0.010	-1.032	0.30
13	-0.028	-0.028	-2.502	0.01
14	-0.019	-0.019	-1.698	0.09
15	-0.022	-0.022	-2.754	0.01
16	-0.020	-0.020	-2.156	0.03
Constant	0.021	0.021	2.515	0.01

Full regression output for Equation (2), with low liquidity as measure of internal constraint and low collateral ratio as measure of external constraint, in the case of a decrease value added. Full regression outputs for the other specifications are available on request.

Table 14: Costs of temporary work

	Share of temporary work costs to total labour costs, in%
Aggregate	1.5
Industry	
Business Services 1	0.8
Business Services 2	1.7
Construction	6.1
Education	0.3
Energy	1.3
Entertainment	0.6
Health	0.8
IT	1
Manufacturing Pharmaceuticals	1
Manufacturing Investment goods	1.7
Manufacturing Watches and electronics	1.1
Manufacturing Other	1.3
Mining	1.6
Restaurants Hotels	0.5
Trade	0.6
Transport	0.9

Table 15: Impact of 1% increase in value added on employment, sample restricted to observations for which expenditures for temporary work increase

1) Employment elasticity for unconstrained firms and marginal effects of financial constraints				
Specification	(1)	(2)	(3)	(4)
Measure of internal constraint	Liquidity	Profitability	Liquidity	Profitability
Measure of external constraint	Collateral	Collateral	Balance sheet	Balance sheet
γ_y	0.241	0.252	0.235	0.241
	(0.028)***	(0.028)***	(0.022)***	(0.022)***
$\gamma_{y,int}$	0.097	0.073	0.027	0.021
	(0.038)***	(0.035)**	(0.039)	(0.037)
$\gamma_{y,ext}$	0.062	0.055	0.220	0.217
	(0.035)*	(0.035)	(0.035)***	(0.035)***
2) Implied employment elasticity $\tilde{\gamma}_y$ depending on financial constraints				
Unconstrained	0.241	0.252	0.235	0.241
Only internally	0.338	0.325	0.262	0.262
Only externally	0.303	0.307	0.454	0.458
Internally and externally	0.400	0.380	0.481	0.479

Standard deviation in parenthesis, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table 16: Specification tests for GMM estimate

	Collateral Liquidity	Collateral Profitability	Balance sheet Liquidity	Balance sheet Profitability
Arellano-Bond test for 2nd-order autocorrelation	0.80	0.73	0.76	0.856
Hansen test for overidentifying restrictions	0.52	0.41	0.43	0.309

p-values (Hansen test: based on $\chi^2(90)$ distribution).

Recent SNB Working Papers

2017-18 Gregor Bäurle, Sarah M. Lein and Elizabeth Steiner: Employment Adjustment and Financial Constraints – Evidence from Firm-level Data

2017-17 Thomas Lustenberger and Enzo Rossi: The Social Value of Information: A Test of a Beauty and Non-Beauty Contest

2017-16 Aleksander Berentsen and Benjamin Müller: A Tale of Fire-Sales and Liquidity Hoarding

2017-15 Adriel Jost: Is Monetary Policy Too Complex for the Public? Evidence from the UK

2017-14 David R. Haab, Thomas Nitschka: Predicting returns on asset markets of a small, open economy and the influence of global risks

2017-13 Mathieu Grobéty: Government Debt and Growth: The Role of Liquidity

2017-12 Thomas Lustenberger and Enzo Rossi: Does Central Bank Transparency and Communication Affect Financial and Macroeconomic Forecasts?

2017-11 Andreas M. Fischer, Rafael Greminger and Christian Grisse: Portfolio rebalancing in times of stress

2017-10 Christian Grisse and Silvio Schumacher: The response of long-term yields to negative interest rates: evidence from Switzerland

2017-9 Petra Gerlach-Kristen, Richhild Moessner and Rina Rosenblatt-Wisch: Computing long-term market inflation expectations for countries without inflation expectation markets

2017-8 Alain Galli: Which indicators matter? Analyzing the Swiss business cycle using a large-scale mixed-frequency dynamic factor model

2017-7 Gregor Bäurle, Matthias Gubler and Diego R. Känzig: International inflation spillovers - the role of different shocks

2017-6 Lucas Marc Fuhrer: Liquidity in the Repo Market

2017-5 Christian Grisse, Signe Krogstrup and Silvio Schumacher: Lower bound beliefs and long-term interest rates

2017-4 Toni Beutler, Robert Bichsel, Adrian Bruhin and Jayson Danton: The Impact of Interest Rate Risk on Bank Lending

2017-3 Raphael A. Auer, Andrei A. Levchenko and Philip Sauré: International Inflation Spillovers Through Input Linkages

2017-2 Alain Galli, Christian Hepenstrick and Rolf Scheufele: Mixed-frequency models for tracking short-term economic developments in Switzerland

2017-1 Matthias Gubler and Christoph Sax: The Balassa-Samuelson Effect Reversed: New Evidence from OECD Countries

2016-19 Jens H. E. Christensen and Signe Krogstrup: A Portfolio Model of Quantitative Easing

2016-18 Jonas Meuli, Thomas Nellen and Thomas Nitschka: Securitisation, loan growth and bank funding: the Swiss experience since 1932

SCHWEIZERISCHE NATIONALBANK
BANQUE NATIONALE SUISSE
BANCA NAZIONALE SVIZZERA
BANCA NAZIUNALA SVIZRA
SWISS NATIONAL BANK