Bank Equity and Small-Firm Risk Taking: Evidence from Firms Exposed to Climate Change *

Simon Baumgartner
Alex Stomper
Humboldt University
Berlin, Germany

Thomas Schober
Rudolf Winter-Ebmer
Johannes Kepler University
Linz, Austria

October 2019

Abstract

We show that banks' equity capital buffers affect the risk-taking of firms in the banks' vicinity. The analysis is based on a sample of small firms exposed to weather risk as a risk concerning the productivity of the firms' employees. By using highly granular data, we can cleanly identify the baseline effect of the risk on the firms' employment, as well as modulating effects. We find that, if local banks lack equity capital, the firms respond more strongly to the exogenous labor productivity risk by cutting their employment. Our results also highlight that banks' equity capital buffers matter for economic adaptation to climate change and increased weather variability.

*We thank Botond Köszegi, Jan Stuhler, Franz Hartl, Wolfgang Kleemann, Conny Wunsch and seminar participants at the German Bundesbank, the Potsdam Institute for Climate Impact Research as well as in Budapest, Lancaster, Vienna, Norwich, Würzburg and Linz. Thanks to the ÖNB Jubiläumsfonds for support. All errors are our own. Correspondence to Alex Stomper, alex.stomper hu-berlin.de

"making finance flows [...] consistent with climate-resilient development."

from Article 2 of the Paris Agreement, UNFCCC (2016)

1 Introduction

It is widely believed that the depth of the Great Recession was amplified by a combination of risk with financial frictions.[1] This toxic combination has since been the subject of a growing literature. The literature analyzes how the financial system fails firms and their owners when they need it to manage an increase in risk, and how this failure affects the firms' workers and the wider economy. In a recent contribution Arellano et al. [2019] show that they can match the contraction in employment and output observed during the Great Recession using a model in which firms take risk when they hire workers, promising them pay before they generate uncertain revenues. In the model, the contraction is triggered by an increase in the volatility of worker productivity. This occurs against the backdrop of capital market imperfections that keep the firms in the model from sharing risk with outside capital providers. All their outside capital comes from creditors who only take default risk.

In this paper, we provide micro-evidence concerning a sample of small firms like those in the model of Arellano et al. [2019]. The firms are exposed to exogenous shocks to labor productivity due to weather risk. They cannot share this risk with equity investors since their outside capital comes from banks. The sample allows us to analyze effects of exogenous changes in labor productivity risk due to increased weather variability. It turns out that the risk reduces firm-level employment as a quasi-fixed determinant of the firms' risk exposure. This effect is weakened if the banks in the vicinity of a firm have more equity capital. Our analysis thus yields first evidence that bank capitalization affects the risk-taking of firms outside the banking sector.

Given our focus on effects of weather risk, this paper also contributes to the literature on climate change. It suggests that climate-resilient economic development requires a sufficiently well-capitalized banking sector. As a risk of rather verifiable shocks, weather risk should be well-suited for risk-sharing between firms and their banks, e.g., as in the model of Holmström and Tirole [1998]. They show that firms exposed to verifiable liquidity shocks benefit from insurance provided

[1] For example, see Stock and Watson [2012]

by financial intermediaries; agency problems increase the cost of this insurance, reducing firm size. Our results are consistent with this prediction if firm size is measured in terms of employment.[2] In addition, we find that the effects of weather risk on firm size depend on a proxy for banks' capacity to provide firms with liquidity, i.e., their equity capital.[3] The evidence highlights that banks' equity capital buffers matter for economic adaptation to increased weather variability, and that climate change should be considered in the prudential regulation of banks even if prudential rules continue to be only based on risk considerations, rather than on their "climate friendliness".[4]

We now describe our analysis in greater detail. Our results come from panel data about a sample of firms whose assets have a readily identifiable physical location linked to specific climate-related risks.[5] The firms are hotels close to Austrian ski resorts. They hire workers whose productivity depends on the snow conditions in the ski resorts as a determinant of skiers' demand for accommodation. As a consequence, the firms are subject to labor productivity shocks induced by snow risk. In an exploratory analysis, we document that this risk has changed over time. Using high-resolution snow data, we find that, during a period of 25 years, ski resorts at higher levels of altitude experienced pronounced increases in (natural) snow risk.[6] We analyze how this trend affects employment in nearby hotels, and how the effects depend on features of the local banking landscape.

While we focus on a rather special sample of firms, we consider an issue that is generally relevant given a view of firms as institutions insuring workers against temporary labor productivity shocks:[7] To provide this insurance, firms may need the support of banks. We start our analysis

[2]While our data cannot be used to analyze banks' liquidity provision to the firms in our sample, it is rather clear that the firms have no other external sources of liquidity. See Elsas and Krahnen [1998] for evidence that firms in Germany rely on their house-banks for liquidity insurance. We use data about Austrian firms. The banking sectors of Austria and Germany operate in similar ways.

[3]The effect of equity capital can be thought of as an effect of a (shadow) cost of liquidity insurance. For example, consider the simplified version of Holmström and Tirole [1998] model in Section 5.3.1., where financial intermediaries incur no cost when they inject liquidity into a firm. Adding a cost parameter κ to the model reveals that this parameter modulates the effect of liquidity risk on the optimal firm size: $I = A/(1 - \rho_0 + (1 + \kappa)\lambda\rho)$, where A denotes the firm's equity capital, ρ_0 measures the extent to which agency costs limit the pledgeability of the firm's final payoff, and λ is the probability of a liquidity shock, ρI, that must be financed at an intermediate stage. See Berger and Bouwman [2009] for a review of the literature regarding bank liquidity creation.

[4]See Krogstrup and Oman [2019] and Campiglio et al. [2018] for surveys of the emerging literature regarding climate finance and financial regulation. For a discussion of "green" bank capital regulation, see HLEG [2018] , and Thomä and Hilke [2018].

[5]Samples like this are commonly used in microeconometric analyses of effects of climate change. For a survey, see Dell et al. [2014].

[6]At above-median altitudes, snow risk increased by 42%. Unfortunately, the high-resolution snow data is only available to us up to the year 2006. One advantage of our sample period ending in the year 2006 is that it excludes more recent years in which most Austrian ski resorts installed snow cannons in order to produce artificial snow.

[7]This view of the firm was proposed by Knight [1971]. Guiso et al. [2005] show that firms insure their workers against idiosyncratic risk. For evidence regarding systematic risk, see Rettl et al. [2019].

by testing whether the firms in our sample actually insure their workers against weather-induced labor productivity risk, rather than hiring or firing them *after* the risk materializes. This is possible because we can use weekly data about weather realizations to identify unexpected changes in labor productivity. We combine snow data with highly granular employment data and analyze how snow affects firm-level employment while using firm-year fixed effects as controls for longer-term employment variation. We find that the snow conditions do affect the ski hotels' employment during the ending weeks of the skiing season, but not during the starting weeks. These findings are consistent with evidence reported by Guiso et al. [2005], i.e., that firms fully insure their workers against temporary productivity shocks, but not against more permanent shocks. During the ending weeks of the skiing season, the snow-induced labor productivity risk is clearly a risk of permanent shocks. During the starting weeks, it instead is a risk of temporary shocks. With respect to the latter shocks, the ski hotels' employment appears to be quasi-fixed.

Our main analysis exploits variation in snow risk over time. We focus on the starting weeks of the skiing season and analyze how the ski hotels adjust their employment across these weeks in response to changes in risk. The analysis yields first evidence that banks' equity capital buffers affect the risk-taking of firms in their vicinity. The effects concern the ski hotels' risk-taking when they hire seasonal workers prior to the start of the skiing season, anticipating that they will insure these workers against temporary labor productivity shocks. At this time, the firms face the problem modeled by Arellano et al. [2019]: They promising the workers pay before they generate uncertain revenues determined by the - yet unknown - snow conditions. We find that the firms respond to increases in snow risk by reducing their employment and, thus, their risk-taking with respect to exogenous labor productivity risk.[8] This effect is economically significant. An increase in snow risk by one standard deviation reduces firm-level employment by about 3%.

Our main results come from regressions which test whether the effect of snow risk on the firms' employment depends on variables describing the banks in the vicinity of a ski resort.[9] We use these

[8] We find no evidence for a similar effect during the season's ending weeks. This is consistent with the idea that snow risk during the latter weeks is borne by workers who simply get laid off when their productivity drops due to a lack of snow for skiing.

[9] The regressions are based on the assumption that small firms' access to credit is restricted by exogenous geographical constraints since a firm's proximity to a bank affects the banks' access to soft information about the firm's credit-worthiness. This assumption is commonly used in the literature on relationship banking. For examples, see Petersen and Rajan [2002], Degryse and Ongena [2005], and Hauswald and Marquez [2006]. For recent evidence, see Nguyen [2019].

variables in interaction terms with our measures of snow risk. They measure the number of banks with branch offices close to each ski resort, the extent of the banks' geographic diversification, and their equity capital. Our main regressions reveal that bank capitalization modulates the effects of snow risk on firm-level employment. It appears that bank equity acts as a catalyst for firms' risk-taking with respect to labor productivity risk induced by snow risk. This effect is robust to extending our regressions by including other features of the banking landscape close to ski resorts, e.g., bank diversification.

As the final step of our analysis, we present instrumental variables (IV) estimates, addressing the problem that we cannot directly observe the extent to which snow risk induces labor productivity risk. This is a concern because our measures of bank equity may be correlated with cross-sectional variation in the extent to which our sample firms face labor productivity risk due to snow risk. The correlation could be negative (e.g., due to losses incurred by banks with borrowers in high-risk areas), or positive (e.g., due to bank-financed investments reducing hotels' exposure to snow risk). As a consequence, it could be inappropriate to interpret our OLS estimates as results regarding causal effects of bank capitalization on firms' decisions to take labor productivity risk by employing additional workers. Instead, we may be simply observing variation in the effect of snow risk on the labor productivity risk.

The IV estimates are based on an institutional feature of the Austrian banking sector, i.e., that there are many small banks with geographically concentrated branch networks that belong to banking groups with internal capital markets (e.g., the group of savings banks). We use arguably exogenous variation in the groups' aggregate equity capital as a proxy for regional banks' equity capital.[10] Instrumental variables estimates reveal that regional banks' equity capital is indeed endogenous. We, however, again observe a weaker negative effect of snow risk on employment in areas with more bank equity, and we can now rule out that this is due to bank equity proxying for the extent to which snow risk causes exogenous labor productivity risk. Instead, our estimates reveal that the latter risk's negative effect on firm-level employment is weaker in areas with more bank equity. Per basis point of bank equity above its mean, we observe a 1.25% reduction in the semi-elasticity of employment with respect to snow-induced labor productivity risk.[11]

[10] Endogeneity of the aggregate equity capital is of little concern since the banking business in any given ski resort accounts for a negligible share of any banking group's business.

[11] The semi-elasticity equals -13% given the mean value of bank equity.

In summary, our analysis yields evidence for an economically significant causal effect of banks' capital structures on the extent to which small firms take exogenous labor productivity risk. The evidence results from a sample of firms exposed to a particularly quantifiable risk affecting the productivity of their employees, i.e., snow risk. This research strategy may compromise the external validity of our results because the firms in our sample depend only little on firm-specific human capital, thus enjoying an unusual degree of flexibility in adjusting their employment.[12] We address this problem by focusing on a period when the firms' employment does appear to be quasi-fixed, i.e., the starting weeks of the skiing season.[13] It is, however, arguable that we still end up analyzing a labor productivity risk that is relatively benign since it is unusually clear that the risk is one of temporary shocks. This argument suggests that our results should be interpreted as a lower bound regarding an important and as-yet-undocumented real effect of bank capital.

In the concluding section of our paper, we discuss how it adds to the related literature and also speculate about policy implications regarding bank regulation and economic adaptation to increased weather variability. The next section describes our research strategy. Section 3 describes the institutional details of the industries we focus on, Section 4 describes our data sources and descriptive statistics. Section 5 presents our results.

2 Research strategy

Our analysis can be motivated by the idea that firms' expectations about their access to liquidity insurance determine their risk-taking with respect to risks that cause liquidity needs (Holmström and Tirole [1998]). We analyze the risk-taking firms engage in when they hire workers, promising them pay before the workers generate uncertain revenues. This is based on an implicit assumption (which will be tested), i.e., that the firms actually commit to paying their workers, rather than sharing the risk with them. Under this assumption, a firm's wage bill is quasi-fixed, determined by the number of workers of the firm. With e employees, a firm has to finance a liquidity shock of $\max(w - \rho, 0)e$, where we is the firm's wage bill, and ρe is the total revenue generated by the employees, determined by a random variable ρ, realized after the firm has committed to the wage

[12] As discussed in Section 3, the firms' workforce typically includes many temporary workers.

[13] In a placebo analysis, we show that we cannot replicate the results based on employment data with respect to the season's ending weeks. See Table 10.

bill.[14]

We use data about a sample of hotels in ski resorts that are exposed to labor productivity risk due to weather risk. A firm in our sample employs workers that generate a revenue $\rho = f(s, X)$, where s is an exogenous ("snow") shock and X denotes a set of variables that determine the firm's exposure to the shock, i.e., the extent to which the firm is affected by a given shock. Given this specification, we want to measure whether firm-level employment depends on characteristics of nearby banks that should affect firms' access to liquidity insurance. By employing more workers, a firm increases its exposure to liquidity shocks due to snow-induced variation in labor productivity. To measure how this risk-taking depends on bank characteristics, we must address two identification problems. The first problem is that snow risk may be correlated with choice variables included in the set X. We resolve this problem by using highly granular social security data in order to measure effects of variation in snow risk across weeks of the skiing season. Given this focus on short-run variation in risk, we can assume that any choice variables in X are quasi-fixed within firm-years (skiing seasons). This assumption is realistic, e.g., with respect to investments in fixed assets that would reduce the firms' exposure to snow risk.[15]

To set the stage for our main analysis, we will test for risk-sharing between the firms and their workers. In these tests, we distinguish between the starting and ending weeks of the skiing season. We are particularly interested in the season's starting weeks because snow shocks during these weeks are clearly temporary shocks, and because prior evidence suggests that firms insure their workers against such shocks (Guiso et al. [2005]). If the firms in our sample provide this insurance to their workers, their employment should depend on their expectations about the availability of liquidity insurance. We posit that these expectations depend on characteristics of the regional banking sector. This idea motivates the following regression:

$$\ln(ED_{i,t(T)}) = \beta_0 \sigma_{j(i),t(T)} + \beta_1 \sigma_{j(i),t(T)} \times b_{j(i),T} + \gamma Z_{i,t(T)} + \alpha_{i,T} + \alpha_t + \epsilon_{i,t(T)}, \tag{1}$$

[14]More generally, the number of employees may affect the riskiness of the revenue per employee. For example, the firms in our sample can only sell their workers' services to a certain maximum number of customers, given by capacity constraints determined by the firms' fixed assets. As the number of workers in a firm increases, the capacity constraints will at some point limit the firms' exposure to labor productivity risk due to exogenous demand shocks. We will therefore focus on effects of demand shocks at times when the capacity constraints are not binding.

[15]For example, many ski hotels feature wellness areas that their guests use when they are not out skiing. It seems safe to assume that hotels would not add a wellness area during the skiing season since the off-season is a better time for the requisite construction work.

where T indexes years (skiing seasons), t indexes weeks, and i indexes firms in regions (ski resorts) $j(i)$. The coefficient β_0 measures effects of weather risk $\sigma_{j(i),t(T)}$ on firm i's employment $ED_{i,t(T)}$ (in employee-days), and the coefficient β_1 measures how the semi-elasticity of employment with respect to weather risk changes in characteristics of the local banking sector, $b_{j(i),T}$. For details regarding these variables, see Section 3. As discussed above, we focus on effects of short-run variation in weather risk by including firm-year fixed effects $\alpha_{i,T}$ and week fixed effects α_t.

A second identification problem must be addressed to specifically interpret the coefficient β_1 as an effect of bank characteristics $b_{j(i),T}$ on the elasticity of employment with respect to weather-induced labor productivity risk. Lacking suitable measures of labor productivity, we cannot directly measure the extent of labor productivity risk due to weather risk.[16] We must therefore rule out that the variable $b_{j(i),T}$ proxies for the extent to which weather risk causes labor productivity risk. This is a possibility because the variable $b_{j(i),T}$ may be correlated with omitted variables affecting firms' exposure to weather risk, $X_{i,T}$.[17]

We address the second identification problem with respect to regressions in which the variable $b_{j(i),T}$ measures local banks' equity capital buffers. Our approach is based on an institutional feature of the Austrian banking system, i.e., that it is a "three-pillar" banking system composed of three groups of banks, i.e., private banks, savings banks, and cooperative banks. The last two groups contain many small banks with geographically concentrated branch networks. These small banks cooperate in group-specific internal capital markets, including equity capital markets.[18] Variation in the groups' aggregate equity capital can therefore be used as a credibly exogenous proxy for the regional banks' equity. For further details regarding this instrument and our measures of regional banks' equity, see Section 3.2. Validity of the instrument ensures that we can use the ratio β_1/β_0 to measure the effect of bank equity on the semi-elasticity of employment with respect to exogenous labour productivity risk due to snow risk.[19]

[16] The regression (1) will be estimated based on a linked employer-employee dataset that contains no firm-level balance sheet data.

[17] As discussed above, we treat this exposure as a quasi-fixed variable which does not vary across weeks $t(T)$ in which the firms do not share weather-induced labor productivity risk with their workers.

[18] It is clear that the banks obtain their equity capital on group-specific internal capital markets because ownership linkages are much more prevalent within than across groups. During our sample period, all groups had group-specific deposit insurance and access to external equity capital markets through their lead banks.

[19] Suppose that bank equity modulates the effect of labour productivity risk $\xi_{i,t(T)}$ on log employment: $\ln(e_{i,t(T)}) = \theta_0\xi_{i,t(T)} + \theta_1\xi_{i,t(T)}b_{j(i),T} + \ldots$. Moreover, suppose that snow risk causes labour productivity risk: $\xi_{i,t(T)} = x_i\sigma_{j(i),t(T)} + \nu_{i,t(T)}$, where x_i is firm i's exposure to snow risk and $\nu_{i,t(T)}$ is an error. By using a measure of bank equity uncorrelated with this error and x_i, we can assume that the ratio θ_1/θ_0 equals the ratio β_1/β_0 of the coefficients in regression (1).

3 Institutional background

Our analysis is based on a sample of firms exposed to a particularly quantifiable and exogenous risk affecting the productivity of their employees, i.e., weather risk. We now describe the firms' industry, with a focus on its financing and its labour market. Moreover, we briefly describe the Austrian banking sector.

3.1 The Austrian hotel industry

The Austrian hotel industry consists mostly of small family-owned firms: Doerflinger et al. [2013] report that such firms account for 93% of all firms in the industry. While there are some hotel chains in urban areas, these firms are not contained in our sample because we focus on hotel businesses in ski resorts and exclude firms in towns with a population larger than 20,000.[20] On average, the firms in our sample are smaller than the average Austrian hotel, which suggests that the fraction of family-owned firms in our sample should be even higher than 93%.[21]

As family-owned businesses, the firms in our sample depend mostly on local banks when they need outside financing. When they borrow from the banks, they often use real estate as collateral, i.e., their buildings and land. In some cases, the owners are also personally liable for their firms' debt.[22] If the firms receive outside equity, it is typically from relatives.[23]

As businesses in ski resorts, the firms in our sample cater to tourists whose demand depends on the snow conditions in the resorts. Töglhofer et al. [2011] analyze panel data about 185 Austrian ski resorts and find that an unexpected change in snow conditions by one standard deviation changes the number of tourists' overnight stays in nearby hotels by 0.6-1.9%.[24] Not surprisingly, snow risk also affects firm-level employment in our sample. In Figure 1, we plot an average firm's employment

[20]The alpine regions in Austria are only sparsely populated: e.g. the size of 20,000 will in the Tyrol only exlude the capital city Innsbruck.

[21]We have no data about the ownership structure of the firms in our sample. Data about the size of hotels is contained in Statistik Austria [2018]. At the end of our sample period (winter 2006), the average Austrian hotel business had an accommodation capacity of 17.9 beds. This average is higher than the average size of hotels in regions with a strong focus on ski tourism, e.g., Tyrol (15.7 beds) or Vorarlberg (13.3 beds).

[22]A case like this is described in Giroud et al. [2011]. This case concerns a financially distressed hotel.

[23]Loans from relatives are also treated as equity investments under Austrian bankruptcy law.

[24]In unreported regressions with resort and year fixed effects, we find similar effects on tourists' overnight stays in the resorts included in our sample. Töglhofer et al. [2011] measure snow conditions in terms of the number of days in which the snow depth at a resort's mean altitude exceeds either 1 centimetre or 30 centimetres. As discussed in Section 4.1, we use a cut-off of 15 centimetres, following Giroud et al. [2011]. Like Töglhofer et al. [2011], we use data about natural snow levels. During our sample period, there were hardly any snow cannons in Austrian ski resorts. As a consequence, data about natural snow levels can be used to measure the snow conditions relevant for skiing.

over the weeks of the skiing season. We measure employment in terms of person-days, as discussed in Section 4.1. The plot shows the average total employment and the dashed line the average employment of temporary employees.[25] We plot the variation in these averages over the weeks of the skiing season, i.e., between week 47 and week 15 of the subsequent year.[26] The plot reveals that the hotels' employment exhibits strong seasonal variation, driven by their hiring and firing of temporary employees.

Figure 2 contrasts the plot in Figure 1 with plots depicting variation in ski resorts' snow conditions across the weeks of the skiing season. As discussed in Section 4.1, we focus on the risk that the snow conditions may be too bad for skiing since there is not enough snow. We measure this risk based on a dummy variable indicating "ski weeks", i.e., weeks in which the average snow level in a ski resort exceeded 15 centimeters for a majority of days. The solid line plots the probability with which, across all ski resorts and years in our sample, a given week (e.g., the second week of December) is classified as a ski week. The dashed line plots the standard deviation of this ski week indicator during the sample period. It appears that the variation in the snow conditions coincides not only with tourists' demand for accommodation (Töglhofer et al. [2011]), but also with the employment variation depicted in Figure 1.

In our analysis, we will focus on the variation in employment during the periods marked by the two corridors of red lines in Figure 1, i.e., the starting and ending weeks of the skiing season. We will test whether, during these periods, the hotels' employment responds to snow realizations as a potential determinant of labor productivity. By focusing on the off-season weeks at the start and at the end of the skiing season, we exclude weeks during which the hotels' employment is limited by their physical accommodation capacities, i.e., the number of beds. We instead focus on weeks during which labor productivity should respond to snow-induced variation in tourists' demand for accommodation since the hotels are not booked out.[27]

We end this section by discussing various ways in which the firms in our sample could potentially manage weather-induced demand- and labor productivity risk. With respect to demand risk, the

[25] As discussed in Section 4.1, we focus on temporary workers employed by the firms in our sample during the winter season. We therefore define temporary employees as workers with employment spells starting after October 19 and ending before May 21 of the following calendar year.

[26] These start and end dates are based on information about ski lifts' opening and closing dates. See the discussion in Section 4.1.

[27] Figure 1 shows that, during the high season, employment is indeed rather constant.

main risk-management tools are the hotels' cancellation and pricing policies. During our sample period, the hotels were, however, hardly able to communicate short-notice price changes to tourists since online booking platforms were not yet used.[28] Rather than conditioning their prices on the snow levels in nearby ski resorts, they typically set their prices in advance of the skiing season by specifying two prices per room, i.e., a high-season price and an off-season price. Given these prices, tourists would typically book their rooms several months in advance.[29] In the event of a lack of snow, tourists would cancel their bookings subject to cancellation policies specified in industry-wide terms of trade.[30] The cancellation fee was/is typically a fraction of the total price of a booking, and it increases in the lateness of the cancellation. The standard fee schedule specifies a fee of 70% for cancellations with a notice period of less than 1 month, but the fee is 90% for cancellations less than one week before the first night booked.[31] This fee schedule suggests that tourists' demand for accommodation during a given week of the skiing season should depend not only on the current snow conditions, but also on those lagged by one week because tourists can avoid a substantial rise in cancellation fees by canceling one week before arrival.

We next turn to the issue of labor productivity risk. Figure 1 shows that the firms in our sample manage this risk by employing temporary workers. Under Austrian labor law, these workers ("Saisoniers") will sign a fixed-term contract with the firm. Such a contract is only valid, if it contains a start and end date stated as an exact calendar day; i.e. a contract "starting when the snow arrives and ending when the snow is gone" is not valid and will be considered as a permanent contract [Steuerberatung, 2018]. It is not legal for a firm to unilaterally fire a temporary worker before the worker's contract ends. It is, however, relatively easy for firms and workers to bilaterally extend employment relationships after the end of employment contracts. As a consequence, many of the employment contracts specify ending dates before the likely end of the skiing season. The contracts' starting dates are instead chosen so that the workers have sufficient time to move to the ski resort villages before they have to start working; hiring workers on the spot is almost impossible

[28] For example, consider the most popular platform, i.e., www.booking.com. While this platform was founded in the Netherlands in 1996, it only started to operate in Austria in week 27 of 2006, i.e., at the very end of our sample period. Data from Google trends show zero traffic in Austria before that date. The overall share of total online travel sales in Europe was only 5.5% in the year 2003 [Eurostat, 2006].

[29] Even in 2015, 66% of Austrian hotels' bookings are made more than one month in advance WKO [2016]. In ski resorts, this percentage should be higher because of the missing short-run bookings by business travelers.

[30] The terms of trade are drafted by lawyers of the Austrian Hotel Association. By using these terms of trade, the hotels avoid costs of legal expertise.

[31] This fee schedule has remained unchanged for decades. The 2006 fee schedule is depicted in the Online Appendix.

because of labor market tightness (since the villages are typically rather small).

Are there other forms of risk-sharing with workers, e.g. in terms of hours worked or wage changes? Workers in ongoing temporary contracts have a fixed wage which cannot be changed downwards – in particular not at the beginning of the contract. Changes in hours would be possible, in principle. To assess the extent to which snow risk affects workers' hours, we can compare the variance of wages that workers received during the two parts of a skiing season before/after the turn of the year.[32] Given that the season's starting weeks are in the first part, snow risk should increase the wage variance during this part of the season if the risk affects workers' hours. We however see no evidence for this effect.

In our empirical analysis, we will analyze the extent to which the firms in our sample take exogenous labour productivity risk associated with snow risk. This risk-taking is not directly related to hotels' ability to obtain insurance against weather-induced demand shocks since the productivity of their workers depends on the number of tourists actually staying at the hotels. Instead, the hotels' options to obtain insurance will indirectly affect their employment policies as a determinant of their access to liquidity in case they have to pay their workers even though a lack of snow reduces their revenue. In our empirical analysis, we will focus on the supply of liquidity insurance by the banks in the hotels' vicinity. If the hotels used other types of liquidity insurance, their capacity to take labour productivity risk should not depend on features of the regional banking sector.[33] As a consequence, our analysis can be seen as a test of a joint hypothesis, i.e., that the firms depend on liquidity insurance provided by banks, and that the extent of this insurance provision is affected by observable features of local banking markets.

3.2 The Austrian banking industry

Like Germany, Austria has a "three-pillar" banking sector, consisting of private banks (stock corporations), savings banks, and cooperative banks. Savings banks and cooperative banks form groups that operate under group-specific institutional frameworks, featuring joint supervisory institutions and deposit insurance, as well as lead banks that provide the groups with access to the

[32] This is possible because we have data about workers' total annual income (but no more granular data).

[33] While Austrian insurance companies offer farmers insurance against hail risk, bad-weather-insurance for hotels is very rare in Austria and exists only for large outdoor events typically held in summer, but not for a generally bad snow season.

wider financial markets. Within-group competition between banks is quite limited, but there is a healthy level of between-group competition. In terms of population size per bank branch, Austria remains among the most competitive countries in the European Union.[34] In terms of total assets, the savings banks have a market share of about 20% while the cooperative banks have a share of about 30% (Bülbül et al. [2014]).

In terms of ownership links, the groups of savings and cooperative banks are separate parts of the Austrian banking sector, but there are complex cross-ownership structures within the groups. The groups feature internal equity capital markets. For example, the savings banks' lead bank, Erste Bank, is partly owned by other savings banks. The internal equity markets are also key to resolving cases of financial distress. Distressed banks are typically saved through equity infusions provided by other banks in the same group.

As in Germany, the banks within a group also assist each other in their lending, e.g., by making joint loans.[35] This practice complements the groups' joint equity markets. To avoid that a lack of equity capital constrains an individual bank's lending, the bank can either obtain equity capital from other banks in the same group or make a joint loan together with the other banks. In the latter case, the banks' joint equity capital must be sufficient in order to meet regulatory equity capital requirements. Throughout our sample period, the Austrian banks were subject to equity capital requirements according to Basel I.

4 Data and descriptive statistics

4.1 Data

We construct a dataset in which one observation corresponds to a firm-week. The focus is on calendar weeks of the skiing season. In each season T, the first week included in the data concerns the 47th week of year $T-1$ and the last week concerns the 15th week of year T. The starting weeks of a season are weeks 47-51 of year $T-1$, and the ending weeks are weeks 11-15 of year T.

Employment data The employment data come from the Austrian Social Security System (ASSD). Our complete dataset contains the universe of employment relations (spells) in the Austrian tourism

[34] See Table 9.2 in ECB [2017].

[35] For further discussion with respect to German savings banks, see DSGV [2012].

sector between 1977 and 2011. In total, we observe 7,254,517 employment spells between 1,182,011 distinct employees and 129,371 hotels. Of these spells, 18.2% concern temporary employees working in accommodation and food service activities during the skiing seasons. Within this group, most of the workers are in the hotel industry (69.5%), while the rest work in other accommodation, or in food and beverage services. We define temporary employees as workers with employment spells starting after October 19 and ending before May 21 of the following calendar year. Thus we only consider temporary workers who are employed for the winter season.

Given that we have no data about hours-worked, we focus on the days during which a temporary employee was employed by a firm. To measure the number of employment days, we first define a dummy variable, denoted as $E_{w,i,d}$, which indicates whether worker w was employed at firm i on calendar day d. We use this dummy to measure "employment days" at the firm-week level, defined as follows:

$$\text{Employment days}_{i,t(T)} = \sum_{d \in t(T)} \sum_{w} E_{w,i,d}, \tag{2}$$

where $t(T)$ denotes week t of season T. We construct two versions of the above-stated variable, measuring total employment days and employment days of temporary employees. Figure 1 plots averages of these two variables across all firms and skiing seasons.

Snow data We use weather data for the years 1973 to 2006. The data come from the Austrian Meteorological Office (AMO). The AMO provides 1×1 km grid data containing daily information on snow depth, based on a snow cover model using air temperature and precipitation data (Beck et al. [2009]).

In order to measure the snow conditions in ski resorts, we use the coordinates of all ski lifts in Austria from OpenStreetMap, and calculate the average snow depth of all lifts within a radius of 10 km for each municipality. We use the center of the ski lift to determine the snow conditions. Next, we define a dummy variable which measures whether it was possible to ski in the area of a ski lift during a given week. This "snow week" dummy equals one if the lift's average snow level exceeded 15 centimetres on most days of a week.[36]

[36]The same cut-off was used in Giroud et al. [2011]. They use two different cut-offs, i.e., 1 centimetre and 30 centimetres. The two specifications yield similar estimates regarding the effects of snow conditions on tourists'

In our empirical analysis, we will distinguish between two types of information about the snow conditions in ski resorts, i.e., information available before the start of the skiing season, and "news" that arrive during the season. The first type of information includes the expected snow conditions in ski resorts, and a measure of snow risk. As discussed above, we focus on whether the snow conditions allowed for skiing, using our snow dummy to indicate a sufficient level of snow. We therefore measure expected snow during a skiing week $t(T)$ as the average of the snow dummy during the same week of the previous five years. Snow risk is defined in a similar way, based on the standard deviation of the snow dummy. The formal definitions are as follows:

$$\text{Exp. snow}_{j,t(T)} = \frac{1}{5} \sum_{n=-5}^{-1} \text{Snow week}_{j,t(T+n)}, \tag{3}$$

$$\text{Snow risk}_{j,t(T)} = \sqrt{\frac{1}{5} \sum_{n=-5}^{-1} (\text{Snow week}_{j,t(T+n)} - \text{Exp. snow}_{j,t(T)})^2}, \tag{4}$$

where j indexes ski resorts.

Snow "news" are defined as the difference between the snow dummy and expected snow:

$$\text{Snow news}_{j,t(T)} = Snow_{j,t(T)} - \text{Exp. snow}_{j,t(T)}. \tag{5}$$

Banking data Balance sheet data about Austrian banks is available from the Austrian Central Bank (OeNB). The data starts in the year 1998 and contains unconsolidated balance sheets of all banks operating in Austria. To map the data to the firms in our sample, we use data about the branch networks of Austrian banks. This second type of data also comes from the OeNB.

The mapping is based on postal codes. We first assign to each hotel in our sample the coordinates of the center of the area associated with the hotel's postal code. Then, we identify all bank branches within a radius of 20 kilometres of these coordinates. Given this information, we can define a number of variables measuring features of the local banking landscape in the area of a hotel i. The first variable is the average equity ratio of the banks in the vicinity of the hotel:

$$\text{Bank Equity}_{i,T} = \sum_{b} \frac{m_{i,b,T}}{M_{i,T}} \times \frac{\text{Total equity}_{b,T}}{\text{Total assets}_{b,T}}, \tag{6}$$

overnight stays in the ski resorts.

where the fraction is the equity ratio of bank b in year T, and we compute a weighted average of the equity ratios of all banks. For bank b, the weight is the number of its branches in the area of hotel i divided by the total number of bank branches in this area, $m_{i,b,T}/M_{i,T}$.

As discussed in Section 2, we use specific measures of the equity capital of the groups of savings and cooperative banks. We refer to these banks as "regional banks" and denote the set of regional banks by $\mathcal{R}$. Similar to the definition of Bank Equity$_{i,T}$, we define the average equity ratio of the regional banks as follows:

$$\text{Bank Equity}_{i,T}^{reg} = \sum_{b \in \mathcal{R}} \frac{m_{i,b,T}}{M_{i,T}^{reg}} \times \frac{\text{Total equity}_{b,T}}{\text{Total assets}_{b,T}} \tag{7}$$

where $M_{i,T}^{reg}$ denotes the number of regional banks in the area of hotel i. In addition, we measure the equity capital of the banking groups in the area. To do so, we construct the following variable based on the group-level consolidated equity ratio for each of the regional banks:

$$\text{Bank Equity}_{i,T}^{grp,reg} = \sum_{b \in \mathcal{R}} \frac{m_{i,b,T}}{M_{i,T}^{reg}} \times \frac{\text{Total equity}_{b,T}^{grp}}{\text{Total assets}_{b,T}^{grp}} \tag{8}$$

where Total equity$_{b,T}^{grp}$ denotes the aggregate equity capital of the group of banks associated with bank b, i.e., the sum of the equity capital of all member banks of this group.

While the last two measures of bank equity are only available for the regional banks, we also define a variable which combines the group-level consolidated equity ratios with the equity ratios of banks that are not part of a group. This variable is denoted as Bank Equity$_{i,T}^{grp}$. It is defined in a similar way as the variable in expression (6), but we replace the equity ratios of all regional banks in hotel i's area by the group-level equity ratios of these banks' groups.

In section 5, we use two alternative variables describing the local banking landscape: The number of banks in the vicinity of the firm and a measure which captures whether banks operate on a local or nationwide scale, *Branch diversification.* Number of banks is simply defined as the number of distinct banking groups which operate in the 20 kilometer radius around the firm in year T. A bank's branch level diversification is defined as the euclidean distance of all branches to a hypothetical mid-branch. More specifically, it is defined as follows:

$$\text{Branch diversification}_{i,T} = \sum_{b} \frac{m_{i,b,T}}{M_{i,T}} \sum_{n \in b} \sqrt{(lat_{n,b,T} - \overline{lat_{b,T}})^2 + (lon_{n,b,T} - \overline{lon_{b,T}})^2} \tag{9}$$

where n indexes the branches of bank b. The hypothetical mid-branch is given by $\overline{lat_{b,T}}$ and $\overline{lon_{b,T}}$ which are defined as the average latitude and longitude of all of bank b's branches in year T. Branch diversification, therefore, measures the expansion of the branch network of the "average bank" in the 20 kilometer radius around the firm.[37]

4.2 Descriptive statistics

We next discuss the descriptive statistics of our main variables. Table 1 concerns our snow variables, i.e., our dummy variables indicating snow days and snow weeks, as well as the variables measuring expected snow and snow risk, as defined in expressions (4). While the dummy variables are based on the entire period for which we have snow data (1978-2006), the latter variables are measured over the period 1983-2007 (because each data point of these variables is based on the past 5 years of snow data). For each variable, we report the extent of its variation between and within ski resort-years. The within-variation in snow risk is key to our research strategy for measuring effects of exogenous labour productivity risk on firm-level employment. The descriptive statistics show that the within-variation accounts for a substantial part of the overall variation in snow risk and expected snow.

Table 3 reports descriptive statistics regarding our measures of firm-level employment, i.e., the number of employees (overall and temporary employees), as well as employment days, defined in expression (2). These statistics complement Figure 1 which shows the variation in employment days over the weeks of the skiing season. Both in terms of number of employees and employment days, temporary employment accounts for roughly 50% of the total employment of the firms in our sample. Of course, temporary employment varies relatively more than total employment throughout the weeks of the winter season, i.e., the within component accounts for a larger fraction of the overall variation. In our analysis, we do analyse the extensive margin of running the firm in certain weeks,

[37] Similar to the definition of 6, we use the number of branches in the 20 kilometer radius as weights to compute the weighted average.

which explains the existence of zero employees in certain weeks of the season.[38]

Table 4 reports descriptive statistics about variables which do not vary within the winter season, i.e. variables which characterize the local banking landscape and altitude. The average firm is located at around 1000 meters above sea level. Concerning the local banking landscape, on average there are about 6 distinct banks located in the vicinity of our firms. The mean of equity ratio of these banks is roughly the same at 8% for (i) the universe of banks and the subset of regional banks, and (ii) bank-level balance sheet data and group-level consolidated balance sheet data. Not surprisingly, the standard deviation of group-level consolidated equity ratios is relatively lower when compared to unconsolidated equity ratios. On average, the banks around our firms span a branch network of 2000 kilometers, with some banks being very local while other banks operating nationwide.

5 Results

5.1 Exploratory analysis

As discussed above, our research question concerns firms' risk-taking when they employ workers whose productivity depends on the weather. Given this focus, we start our analysis by testing whether the firms in our sample share risk with their workers by adjusting their employment in response to weather realizations. As hotels in ski resorts, they could respond to changes in the resorts' snow conditions that affect tourists' demand for accommodation during a skiing season. In addition, their employment could depend on information about snow conditions that the firms obtained before the start of the season. The latter information may change the firms' pre-season expectations about the expected snow conditions as well as snow risk. For example, the firms could use this information in order to update their expectations with respect to effects of climate change.

We start by documenting that there indeed are significant long-term trends affecting the snow conditions in Austrian ski resorts. Table 2 presents regressions in which we report trends in our snow variables (defined in expression (4)) while controlling for ski resort-week fixed effects. The fixed effects rule out that the estimates are driven by time-invariant cross-sectional variation. In

[38] However, the firm must be open, i.e. employ workers, for at least a week during the winter season in order to be included in our sample.

addition, we do allow for differences in trends across ski resorts and different parts of the skiing season. The trends are linear time trends measured by regressing the dependent variables on the calendar year. Given our interest in long-term trends, we use all available snow data, including years for which we have no employment or bank data. The data covers the period 1983-2007.[39]

We find that the expected snow levels in the ski resorts decreased over time, and snow risk increased. While the strength of the former trend decreases in the altitude of ski resorts, that of the latter trend increases in altitude. We measure altitude both in terms of standard deviations (across ski resorts) and in terms of a dummy indicating ski resorts at above-median altitude. In addition, we distinguish between the starting and ending weeks of the skiing season, as well as the rest of the season (as an omitted category). With respect to the starting (ending) weeks, we see weaker (stronger) negative time trends in expected snow. Snow risk increased particularly strongly during both the starting and ending weeks, and even more so at higher levels of altitude.

All in all, the estimates suggest the existence of long-term trends worsening the snow conditions in Austrian ski resorts. Ski resorts at higher levels of altitude were subject to particularly strong increases in snow risk. At above-median altitudes, snow risk increased on average (across all weeks) by 8.6% over the 25 years 1983-2007. This number implies an increase in snow risk of more than 40% relative to its 1982 mean in the higher 50% of ski resorts, which was 20.7% (across all weeks).

We next analyze how the changing snow conditions in Austrian ski resorts affect firm-level employment in nearby hotels. As discussed above, the hotels face exogenous labor productivity risk since the snow conditions affect tourists' demand for accommodation. We test whether the hotels manage this risk by adjusting their employment when the snow conditions change during the season. If/once there is ample snow for skiing, the firms can safely assume that skiing will remain possible for some time. During the starting weeks of the skiing season, it is, however, typically hard to predict the snow conditions more than a few days ahead since reliable weather forecasts are only available over short horizons. In this situation, many hotels take labor productivity risk when they commit to employing temporary workers, promising them pay before they generate uncertain revenues.[40]

[39] While our snow data starts in 1978, we need the first five years of data to compute the value of the dependent variables of our regressions in the year 1983. We cluster the standard errors at the level of ski resorts to address the problem that consecutive years' observations of our dependent variables are based on overlapping snow data.

[40] As discussed in Section 3, the hotels need to allow many of their workers some time to move before they can start working. As a consequence, they have to hire the workers well before the start of the skiing season. This is

Table 5 reports regressions explaining firm-level employment using our measures of expected snow, snow risk, and snow "news", i.e., the difference between the actual snow conditions in a given week and expected snow. The regressions include firm-year fixed effects as well as week fixed effects. The firm-year fixed effects control for determinants of firm-level employment that remain constant across the weeks of a skiing season, and the week fixed effects control for trends affecting all ski resorts, e.g., general demand fluctuations due to official holidays in Austria and neighboring countries. In the presence of these fixed effects, our estimates result from resort-specific variation in our snow variables across weeks of the skiing season. This is important because hotels may have other risk-alleviating strategies, like building spas and other resort-like amenities, which can entertain tourists in times of little snow. All these measures cannot be taken within a season, only prior to a winter season. Standard errors are clustered at the ski-resort level.

With respect to the starting weeks, we find that firms' employment responds to the expected snow conditions and snow risk. Snow risk has a negative effect on employment. To assess the economic significance of this effect, we use the standard deviation of snow risk within ski resort-years, reported in Table 1. Given this standard deviation of 20%, the coefficient of snow risk in Table 5 implies that a one-standard deviation increase in the risk reduces employment by about 3%. While variation in expected snow also affects employment, we find no effects of snow news, defined as in expression (5). These results show that, during the starting weeks of the skiing season, employment is, in fact, quasi-fixed. This is not surprising because a lack of snow during these weeks will only cause a temporary reduction in tourists' demand for accommodation and in hotels' labor productivity. Our estimates in fact confirm prior evidence in Guiso et al. [2005] that firms insure their workers against temporary shocks to labor productivity.

The estimates regarding the starting weeks of the skiing season differ markedly from the estimates regarding the ending weeks. During the ending weeks, the firms seem to be able to manage ex-ante snow risk by exercising real options – firing workers – in order to adjust their employment in response to changing snow conditions: We find that employment responds to snow news, but not to ex-ante snow risk. In fact, ex-ante snow risk should not matter if this risk can be managed by firing workers when their productivity drops due to a lack of snow. At the end of the skiing

possible because the hotels can trust that a potential late start of the skiing season is a temporary negative shock to labor productivity, rather than a persistent shock. See Guiso et al. [2005] for evidence that firms insure their workers against temporary productivity shocks.

season, a lack of snow is likely to cause a persistent drop in tourists' demand for accommodation. Our estimates show that the hotels do not insure their employees against persistent drops in labor productivity. This is again consistent with prior evidence in Guiso et al. [2005].

Overall, the results in this section suggest that, while we consider a specific sample of firms exposed to a particularly quantifiable type of exogenous labor productivity risk, we actually focus on firms that behave like many other firms in terms of risk-sharing with their workers. The firms take the risk of temporary labor productivity shocks, but not that of persistent shocks. While the incidence of these different types of shocks is hardly observable in other industries, we focus on an industry in which we can clearly distinguish between periods in which the industry is subject to temporary shocks and periods in which it is hit by persistent shocks. We can therefore zoom in on determinants of firms' ability to take risk by insuring their workers against temporary labor productivity shocks. In the next section, we test whether this risk-taking depends on features of the local banking landscape in the firms' vicinity.

5.2 OLS estimates

We next present estimates regarding our main regressions, i.e., the regressions stated in expression (1). We start by presenting OLS estimates. Table 6 reports first tests of the hypothesis that bank equity affects the risk-taking of the firms in our sample with respect to the risk of temporary labor productivity shocks due to snow risk. We focus on the starting weeks of the skiing season, i.e., the weeks during which the firms' employment appears to be quasi-fixed with respect to snow news. The regressions extend those in Table 5 which showed that employment decreases in snow risk. They include not only our snow variables, but also their interactions with measures of the equity ratios of banks in the vicinity of the firms in our sample. We measure these equity ratios in terms of basis points because they are generally quite small, typically taking values between 5 and 10%.

The main coefficient of interest is that of the interaction of bank equity and snow risk. Our OLS estimates of this coefficient are first evidence regarding the effect of bank equity as a variable modulating the negative effect of snow risk on employment.[41] All estimates suggest that firms

[41] Alternatively, bank equity may simply proxy for the extent to which snow risk causes labor productivity risk. We address this issue by means of instrumental variables estimates. See Section 5.3.

in areas with more bank equity take more risk by employing more workers. While employment decreases in snow risk, the coefficient of the interaction of snow risk and bank equity is significantly positive. We also find - somewhat puzzling - negative coefficients of the interaction of bank equity and expected snow. While employment is generally positively correlated with expected snow, this correlation appears to be weaker in areas where banks have more equity capital. It is possible that, in its interaction with bank equity, our measure of expected snow simply serves as an inverse measure of snow risk. Below, we however find that, in our instrumental variables regressions, only the coefficient of the interaction of bank equity and snow risk remains statistically significant. These regressions will allow us to more specifically interpret our estimates as causal evidence that bank equity affects firms' risk-taking with respect to exogenous labor productivity risk.

The evidence in Table 6 is robust with respect to changing our measures of bank equity in a number of ways. In the second column, we measure bank equity at the bank-level based on data about all banks, i.e., we use the variable defined in expression (6). In the third column, we only consider regional banks, using the measure of bank equity in expression (7). Both specifications result in rather similar estimates.

We next check the effect of measuring bank equity at the level of banking groups, rather than individual banks. As discussed in Section 3.2, many regional Austrian banks are part of banking groups, cooperating in their lending activities and sharing internal equity capital markets. We test whether the groups' aggregate equity capital affects the risk-taking of firms in the vicinity of member banks as a variable that is arguably more exogenous than the equity capital of the individual member banks.[42] The regressions in Table 6's last column of estimates are based on the measure of bank equity defined in expression (8) while those in the next-to-last column result from our combined measure – using all banks, but consolidating bank equity for all banks that belong to the groups. Both measures yield somewhat larger estimates regarding the effect of bank equity as a catalyst for the risk-taking of the firms in our sample. Moreover, the puzzling negative coefficient of bank equity and expected snow looses some statistical significance when we measure bank equity at the group level.

Tables 7 and 8 report regressions in which we check whether our results regarding effects of bank

[42] In Section 5.3, we will explicitly use aggregate bank equity as an instrumental variable for the equity of individual banks.

equity are robust in horse-race specifications in which we include other characteristics of the local banking landscape around the firms in our sample. Table 7 contrasts bank equity and a measure of banks' geographical diversification. As defined in expression (9), this measure increases in the extent of geographical diversification of the branch networks of banks in the vicinity of a ski resort. The regressions show that our results regarding bank equity are not driven by bank equity proxying for the extent of bank diversification. The last column of Table 7 also reports a regression in which we allow for the effect of bank equity to depend on bank diversification. This regression shows that the equity of more diversified banks actually has a bigger effect as a catalyst for the risk-taking of the firms in our sample. Similar results appear in Table 8, where we replace our measure of bank diversification by the number of banks in the vicinity of a ski resort.

The results in Tables 6 - 8 suggest that bank equity alleviates the extent to which snow risk reduces the employment of the firms in our sample as a cause of exogenous labor productivity risk. Given our prior evidence that employment is quasi-fixed with respect to snow shocks, it appears that bank equity acts as a catalyst for small-firm risk taking. If we interpret the estimates of our OLS regressions in a causal way, they suggest that an additional basis point of bank equity reduces the negative effect of snow risk on employment by about 1%, i.e., the ratio of the coefficient of the interaction of snow risk and bank equity and the baseline coefficient of snow risk.[43] In the Online Appendix, we also report regressions checking whether bank equity changes the way firms respond to snow news, but we find no evidence for this.

With respect to our estimates so far, there remains a key identification problem that keeps us from interpreting the estimates as measuring a causal effects of bank equity on the extent to which the firms in our sample take labor productivity risk. This problem exists because we have no way to directly observe labor productivity risk. In the next Section, we address this problem in two ways, thus checking whether our OLS estimates can indeed be interpreted in a causal way.

5.3 Causal Evidence

We next address the issue that we cannot directly observe the extent to which snow risk causes labor productivity risk in our sample of firms. In interpreting our previous estimates as evidence that bank equity affects firms' risk-taking with respect to labor productivity risk, we implicitly

[43] In expression (1), this ratio is denoted as β_1/β_0. Estimates of this ratio appear in the bottom of Table 6.

assume that it does not affect the extent to which this risk is caused by snow risk. This assumption cannot be tested without direct data about labor productivity. We can, however, check whether our previous results are robust across subsamples that should differ in terms of firms' exposure to snow risk as a cause of labor productivity risk. Moreover, we can rule out that we use variation in bank equity which may be correlated with variation across firms or ski resorts in the extent to which snow risk causes labor productivity risk. To do this, we compute instrumental variables estimates, using the aggregate equity capital of Austria's various banking groups as an instrument for the equity of their member banks in the vicinity of a ski resort.

The subsample analysis appears in Table 11. It shows that our results are robust to splitting our sample based on firm size, altitude, the aggregate size of the firms in a ski resort measured in terms of bed counts.[44] Moreover, we report results obtained by using employment data to split the firms in our sample into two size groups. These sample splits are motivated by the idea that certain hotels may be better able to offer tourists alternatives to skiing, thus reducing the extent to which their demand depends on the snow conditions in nearby ski resorts. For example, bigger hotels should be better able to break even on fixed investments into spa areas that should reduce demand- and labor productivity risk induced by snow risk. Investments of this sort could explain our previous estimates if their extent is correlated with the equity capital buffers of local banks. We, however, find similar effects of bank equity within the various subsamples. Bank equity is not simply measuring differences between the subsamples in terms of firms' exposure to labor productivity risk induced by snow risk.

We next turn to the instrumental variables (IV) estimates. As discussed in Section 2, these estimates are based on institutional features of the Austrian banking sector, i.e. that many regional Austrian banks are part of banking groups, cooperating in their lending activities and sharing internal equity capital markets. We instrument the equity capital ratios of individual regional member banks of the various banking groups using the aggregate equity capital ratio of a bank's group. The instrument is defined in expression (8). It measures the equity capital ratios of a large number of banks that operate all across Austria, and it depends only to a negligible extent on the equity ratios of the banks close to any particular ski resort. To use this instrument, we must, however, focus on effects of the equity capital buffers of banks that are actually part of a banking

[44] The requisite data comes from the Austrian Statistical Office.

group.[45] These equity capital buffers are measured by the variable defined in expression (7).

We present the IV results in Table 9, and also report the corresponding OLS estimates. The IV estimates appear in the right-most column. The two preceding columns present two first stage regressions, regarding the interactions of bank equity with expected snow and snow risk. The fixed effects control for the effect of bank equity per se. We again use a large number of fixed effects (at the firm-year and week levels) and report clustered standard errors (at the village level).

In the first-stage regressions, we obtain satisfactory results of the F-tests for the excluded instrument. Comparing the OLS and IV estimates shows that the puzzling negative coefficient of the interaction of expected snow and bank equity becomes statistically insignificant when we instrument this interaction term. The coefficient's point estimate is closer to zero, with a wider confidence interval relative to the corresponding OLS estimates. We also obtain a substantially wider confidence interval for the coefficient of the interaction of snow risk and bank equity, but the IV point estimate of this coefficient is more negative than the OLS point estimate. As a consequence, this coefficient remains statistically significant. To assess the economic significance of the effect of bank equity, we again compare the coefficient of its interaction with snow risk to the coefficient of snow risk per se. The ratio of the two coefficients is denoted as β_1/β_0 in expression (1). In terms of this ratio, reported in the bottom of Table 9, the IV results are rather similar to the OLS results.

All in all, our estimates reveal that banks' equity capital buffers affect the risk-taking of firms in the banks' vicinity. The IV estimates allow for a more specific interpretation of the results as evidence concerning firms' risk-taking with respect to labor productivity risk induced by weather risk. They show that bank equity does not just proxy for variation across firms in the extent to which snow risk causes labor productivity risk. While this may be true, the IV estimates identify the causal effect of bank equity on firms' risk-taking. It is reassuring that, with respect to the size of this effect, the IV estimates are similar to the OLS estimates. This suggests that the OLS estimates are also driven by a variation in banks' equity ratios that occurs at the level of Austrias' banking groups, rather than within-group variation in bank equity. It appears that the latter variation is relatively negligible in terms of its effects on the risk-taking of the firms in our sample. This is indirect evidence that the internal capital markets of the banking groups function quite efficiently.

[45] The remaining banks are savings banks (Sparkassen) or cooperative banks (Volksbanken, and Raiffeisenbanken).

6 Conclusion

We analyze the effect of risk on small-firm employment. The analysis is based on highly granular data about a sample of small firms exposed to weather risk as a particularly quantifiable risk affecting the productivity of the firms' employees. We analyze the risk-sharing between the firms, their workers, and their banks by testing for effects of weather realizations on the firms' employment. We find that, when employment does not respond to weather realizations, it is affected by weather risk. This risk reduces employment as a quasi-fixed determinant of firms' exposure to weather shocks. The strength of this effect decreases in the average equity capital of the banks in the firms' vicinity.

Our analysis adds micro-evidence to the literature on the effects of labor productivity risk on employment. These effects appear in models of macroeconomic effects of fluctuations in uncertainty in the presence of financial market imperfections, e.g., Arellano et al. [2019].[46] Our results suggest that banks' equity capital buffers affect firms' ability to insure workers against productivity shocks. This "insurance within the firm" is analyzed in Guiso et al. [2005] and follow-up papers. Caggese and Cuñat [2008]analyze effects of financial constraints on employment contracts and workers' risk exposure. We instead document effects of risk on employment when firms do not share the risk with their workers. It appears that bank capitalization affects employment as a quasi-fixed determinant of firms' exposure of labor productivity risk.

A second strand of related literature are papers about relationship banking as the predominant form of financing for small and medium sized enterprises (SMEs) such as the firms in our sample. Contributions to this literature highlight that banks extend credit to firms in bad times, hoping to profit from their business relationships to the firms once they recover.[47] Our results add to the literature as evidence concerning firms' capacity to expose themselves to a risk of bad times in the first place by hiring workers and promising them pay before they generate uncertain revenues. Related evidence appears in papers analyzing employment effects of credit supply and effects of changes in the banking landscape, e.g.,Chodorow-Reich [2014], Banerjee et al. [2017], Bentolila

[46] Other analyses of the interaction of uncertainty with financial market frictions appear in Christiano et al. [2014], Gilchrist et al. [2014], Alessandri and Mumtaz [2017], Lhuissier et al. [2016], Alfaro et al. [2018].

[47] A surveys of this large literature appear inDegryse et al. [2009]. A recent wave of contributions establishes that relationship lending alleviates effects of credit cycles/crunches on firms' access to credit. For examples, see Bolton et al. [2016] and Beck et al. [2018].

et al. [2018] and Nguyen [2019]. To the best of our knowledge, none of these papers focus on the important issue of labor productivity risk.

We document an important real effect of bank capital on the risk-management of non-financial firms with respect to weather-induced labor productivity risk. The paper thus provides evidence relevant for "making finance flows [...] consistent with climate-resilient development" UNFCCC [2015]. It adds to an emerging literature considering climate change from a risk-management perspective,[48] but we focus on economic adaptation to increased weather variability, rather than climate change mitigation. Future research could more broadly analyze weather-induced liquidity risks, including other types of weather-induced labor productivity risk.[49]

References

Piergiorgio Alessandri and Haroon Mumtaz. Financial conditions and density forecasts for us output and inflation. *Review of Economic Dynamics*, 24:66–78, 2017.

Ivan Alfaro, Nicholas Bloom, and Xiaoji Lin. The finance uncertainty multiplier. Technical report, National Bureau of Economic Research, 2018.

Cristina Arellano, Yan Bai, and Patrick Kehoe. Financial frictions and fluctuations in volatility. *Journal of Political Economy*, forthcoming, 2019.

Ryan Banerjee, Leonardo Gambacorta, and Enrico Sette. The real effects of relationship lending. *Bank of Italy Temi di Discussione (Working Paper) No*, 1133, 2017.

A Beck, J Hiebl, E Koch, R Potzmann, and W Schöner. Institutionelle und regulatorische Fragestellungen der Bereitstellung von Wetterdaten. *Graz: Economics of Weather and Climate Risks Working Paper Series*, (10), 2009.

Thorsten Beck, Hans Degryse, Ralph De Haas, and Neeltje Van Horen. When arm's length is too far: Relationship banking over the credit cycle. *Journal of Financial Economics*, 127(1):174–196, 2018.

Samuel Bentolila, Marcel Jansen, and Gabriel Jiménez. Erratum: When credit dries up: Job losses in the great recession. *Journal of the European Economic Association*, 2018.

Allen N Berger and Christa HS Bouwman. Bank liquidity creation. *The Review of Financial Studies*, 22(9):3779–3837, 2009.

[48] For example, see Lemoine [2017].

[49] See Dell et al. [2014] for a review of the literature regarding the impact of the weather on labor productivity.

Patrick Bolton, Xavier Freixas, Leonardo Gambacorta, and Paolo Emilio Mistrulli. Relationship and transaction lending in a crisis. *The Review of Financial Studies*, 29(10):2643–2676, 2016.

Dilek Bülbül, Reinhard H. Schmidt, and Ulrich Schüwer. Savings banks and cooperative banks in europe. *Bezpieczny Bank*, 2(55):38–49, 2014.

Andrea Caggese and Vicente Cuñat. Financing constraints and fixed-term employment contracts. *The Economic Journal*, 118(533):2013–2046, 2008.

Emanuele Campiglio, Yannis Dafermos, Pierre Monnin, Josh Ryan-Collins, Guido Schotten, and Misa Tanaka. Climate change challenges for central banks and financial regulators. *Nature Climate Change*, 8(6):462, 2018.

Gabriel Chodorow-Reich. Effects of unconventional monetary policy on financial institutions. Technical report, National Bureau of Economic Research, 2014.

Lawrence J Christiano, Roberto Motto, and Massimo Rostagno. Risk shocks. *American Economic Review*, 104(1):27–65, 2014.

Hans Degryse and Steven Ongena. Distance, lending relationships, and competition. *The Journal of Finance*, 60(1):231–266, 2005.

Hans Degryse, Moshe Kim, and Steven Ongena. *Microeconometrics of banking: methods, applications, and results.* Oxford University Press, USA, 2009.

Melissa Dell, Benjamin F Jones, and Benjamin A Olken. What do we learn from the weather? the new climate-economy literature. *Journal of Economic Literature*, 52(3):740–98, 2014.

Celine Doerflinger, Aliette Doerflinger, Karin Gavac, and Brigitte Vogl. *Familienunternehmen in Oesterreich.* KMU Forschung Austria, 2013.

DSGV. Inside the savings banks finance group. 2012.

ECB. Report on financial structures. 2017.

Ralf Elsas and Jan Pieter Krahnen. Is relationship lending special? evidence from credit-file data in germany. *Journal of Banking & Finance*, 22(10-11):1283–1316, 1998.

Eurostat. Panorama on tourism. 2006.

Simon Gilchrist, Jae W Sim, and Egon Zakrajšek. Uncertainty, financial frictions, and investment dynamics. Technical report, National Bureau of Economic Research, 2014.

Xavier Giroud, Holger M Mueller, Alex Stomper, and Arne Westerkamp. Snow and Leverage. *The Review of Financial Studies*, 25(3):680–710, 2011.

Luigi Guiso, Luigi Pistaferri, and Fabiano Schivardi. Insurance within the firm. *Journal of Political Economy*, 113(5):1054–1087, 2005.

Robert Hauswald and Robert Marquez. Competition and strategic information acquisition in credit markets. *The Review of Financial Studies*, 19(3):967–1000, 2006.

EU HLEG. Final report 2018 by the high-level expert group on sustainable finance. *Retrieved from European Commission website: https://ec. europa. eu/info/publications/180131-sustainable-finance-report_en*, 2018.

Bengt Holmström and Jean Tirole. Private and public supply of liquidity. *Journal of Political Economy*, 106(1):1–40, 1998.

Frank H Knight. Risk, uncertainty and profit, 1921. *Library of Economics and Liberty*, 1971.

Signe Krogstrup and William Oman. Macroeconomic and financial policies for climate change mitigation: A review of the literature. 2019.

Derek Lemoine. The climate risk premium: How uncertainty affects the social cost of carbon. University of Arizona, Working Paper 15-01, 2017.

Stephane Lhuissier, Fabien Tripier, et al. Do uncertainty shocks always matter for business cycles? *Centre d Etudes Prospectives et d Informations Internationales research center*, 2016.

Hoai-Luu Q Nguyen. Are credit markets still local? evidence from bank branch closings. *American Economic Journal: Applied Economics*, 11(1):1–32, 2019.

Mitchell A. Petersen and Raghuram G. Rajan. Does distance still matter? the information revolution in small business lending. *The Journal of Finance*, 57(6):2533–2570, 2002.

Daniel Rettl, Alex Stomper, and Josef Zechner. The stability of dividends and wages: Effects of competitor flexibility. CFS Frankfurt Working Paper 549, 2019.

Statistik Austria. Bestandsstatistik Tourismus. STATcube - Statistische Datenbank von STATISTIK AUSTRIA, 2018. [accessed 2018-Sep-4].

Prodinger Steuerberatung. Was muss bei Hotellerie Saisonarbeit beachtet werden. online, 2018. URL `https://tourismusberatung.prodinger.at/2018/03/14/saisonarbeit/`. last assessed Nov 10, 2019.

James H Stock and Mark W Watson. Generalized shrinkage methods for forecasting using many predictors. *Journal of Business & Economic Statistics*, 30(4):481–493, 2012.

J Thomä and A Hilke. The green supporting factor-quantifying the impact on european banks and green finance. 2018.

Christoph Töglhofer, Franz Eigner, and Franz Prettenthaler. Impacts of snow conditions on tourism demand in Austrian ski areas. *Climate Research*, 46(1):1–14, 2011.

UNFCCC. Paris Agreement, 2015.

WKO. *Tourismus und Freizeitwirtschaft in Zahlen - Österreichische und internationale Tourismus- und Wirtschaftsdaten*. Wirtschaftskammer Österreich, 2016. Österreich, Wirtschaftskammer and und Freizeitwirtschaft, Bundessparte Tourismus.

7 Figures and tables

Figure 1

We plot an average firm's total (solid line) and temporary employment (dashed line) over the weeks of the skiing season. We measure employment in terms of person-days. We plot the variation in these averages over the weeks of the skiing season, i.e., between week 47 and week 15 of the subsequent year. The vertical red lines indicate the starting weeks and the ending weeks of the skiing season.

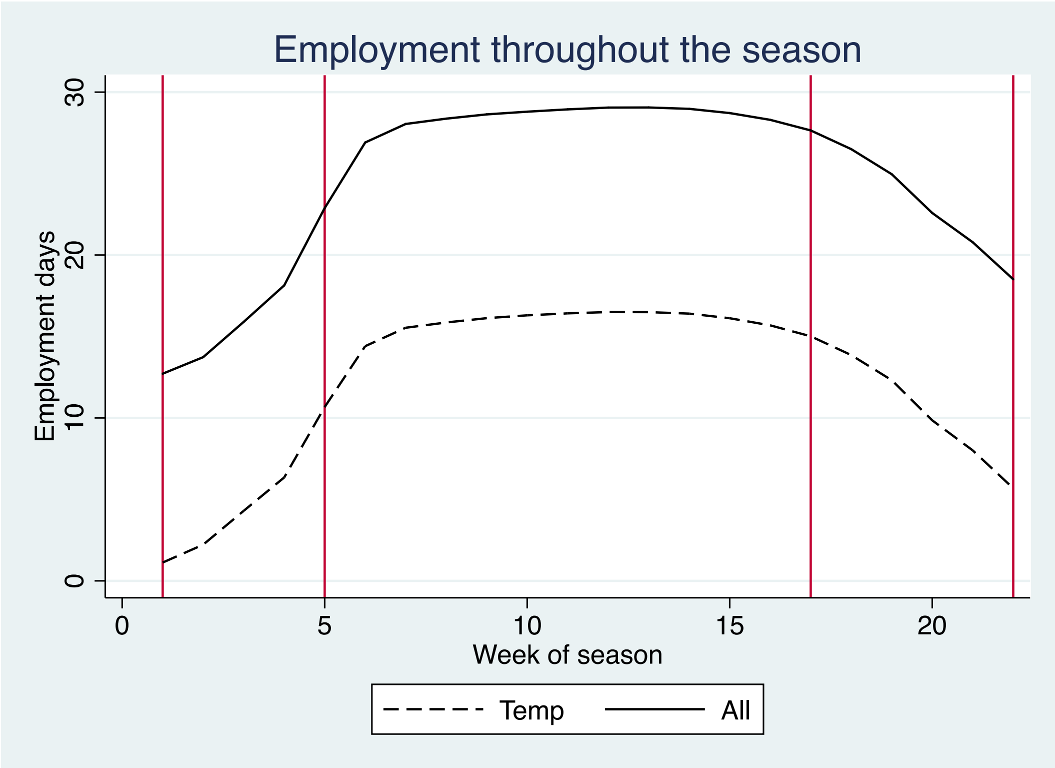

Figure 2

We plot the average snow conditions over the weeks of the skiing season. The solid line depicts the average of the snow week dummy over all ski resorts and all years. The dashed line plots the standard deviation of this ski week indicator during the sample period. The vertical red lines indicate the starting weeks and the ending weeks of the skiing season.

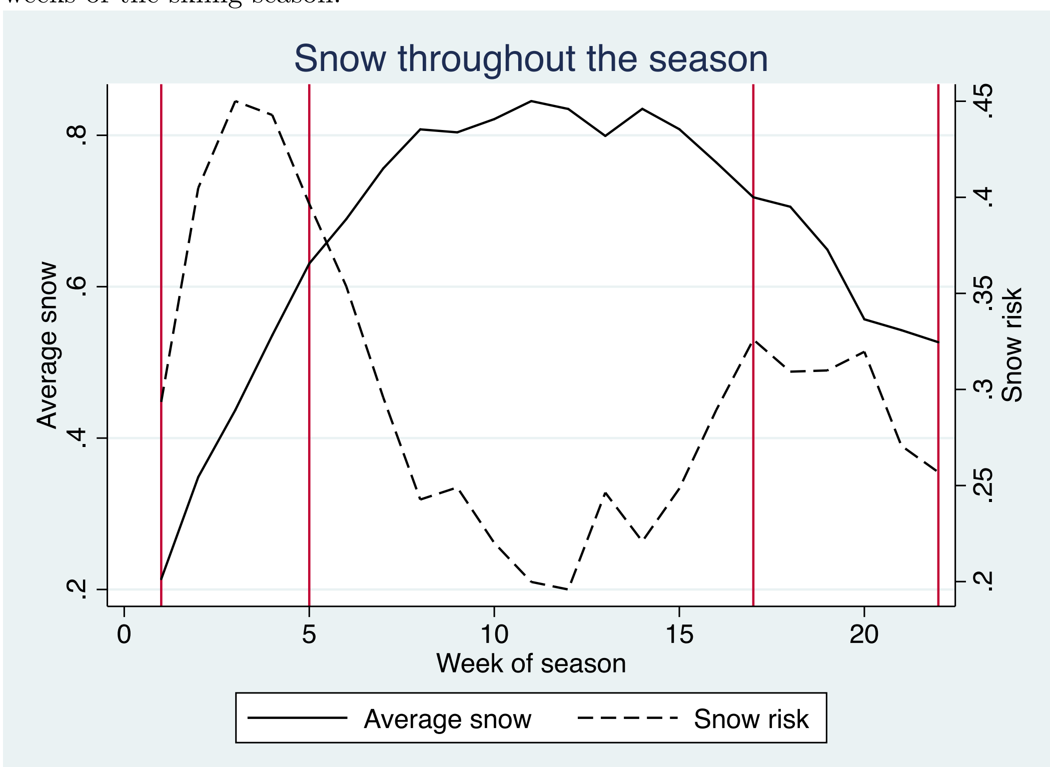

Table 1: **Summary statistics: Snow conditions**

This table reports summary statistics regarding the snow conditions in Austrian ski resorts during the years 1998-2006. We split the variation in the snow variables into variation between and within resort-years. The within component measures variation across the weeks of a winter season in a given ski resort. Snow days are defined as the number of days in a week for which the ski resort's average snow coverage exceeds 15 centimeters. Weeks in which the majority of days are snow days are considered snow weeks. Expected snow (Snow risk) is defined as the backward-looking 5 year average (standard deviation) of snow week in a given resort and week.

Variable	Category	Mean	SD	Min	Max	Obs
Snow days	overall	4.001	3.294	0	7	84870
	between		2.165			3690
	within		2.482			23
Snow week	overall	.567	.495	0	1	84870
	between		.313			3690
	within		.384			23
Average snow	overall	.534	.346	0	1	84870
	between		.251			3690
	within		.239			23
Snow risk	overall	.319	.244	0	.548	84870
	between		.13			3690
	within		.206			23

Table 2: **Long run trends in snow conditions**

This table reports regressions measuring long-run trends in our measures of expected snow and snow risk in Austrian ski resorts during the weeks of the skiing seasons 1983-2007. The dependent variables are defined in expression (4). We measure linear time trends and allow for the trends to differ across a number of variables. *Altitude* is a ski resort's altitude, and *High* is a dummy variable indicating ski resorts at above-median altitude. *Start* (*End*) are dummy variables indicating the starting (ending) weeks of the skiing season. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively.

	Expected Snow				**Snow Risk**			
$Year$	-0.00538***	-0.00591***	-0.00543***	-0.00605***	0.00271***	0.00209***	0.00402***	0.00390***
	(0.000172)	(0.000236)	(0.000184)	(0.000259)	(0.000175)	(0.000247)	(0.000216)	(0.000302)
$Year \times Altitude$	0.000938***		0.000962***		0.000332*		-0.000278	
	(0.000161)		(0.000173)		(0.000172)		(0.000197)	
$Year \times High$		0.00147***		0.00166***		0.00137***		0.000107
		(0.000335)		(0.000355)		(0.000336)		(0.000408)
$Year \times Start$			0.00640***	0.00599***			-0.00415***	-0.00494***
			(0.000241)	(0.000332)			(0.000277)	(0.000382)
$Year \times End$			-0.00491***	-0.00420***			-0.00219***	-0.00364***
			(0.000239)	(0.000308)			(0.000278)	(0.000382)
$Year \times Altitude \times Start$			0.000323				0.000866***	
			(0.000247)				(0.000266)	
$Year \times Altitude \times End$			-0.000361				0.00187***	
			(0.000245)				(0.000224)	
$Year \times High \times Start$				0.000960**				0.00197***
				(0.000474)				(0.000534)
$Year \times High \times End$				-0.00157***				0.00373***
				(0.000482)				(0.000530)
N	473550	473550	473550	473550	473550	473550	473550	473550
R^2	0.051	0.051	0.077	0.077	0.012	0.013	0.017	0.017
Resort-Week FE	YES	YES	YES	YES	YES	YES	YES	YES
Clustered SEs	Resort	Resort	Resort	Resort	Resort	Resort	Resort	Resort

Table 3: **Summary statistics: Employment**

This table reports summary statistics regarding the employment of hotels in Austrian ski resorts during the years 1998-2006. We split the variation in our measures of employment into variation between and within firm-years. The within component measures variation across the weeks of a winter season in a given firm. The number of employees is defined as the sum of distinct employees of a hotel in a given week. Employment days is defined as the total number of days these workers are employed during a hotel-week. We report summary statistics for these variables based on all employees and based on firms' temporary employees during the skiing season.

Variable	Category	Mean	SD	min	max	Obs
Employment days (temporary)	overall	11.67927	34.05602	0	1062	1857089
	between		30.96413			80743
	within		14.17907			23
# of Employees (temporary)	overall	1.747436	4.988109	0	152	1857089
	between		4.603321			80743
	within		1.921176			23
Employment days	overall	24.10459	56.63102	0	2254	1857089
	between		54.28888			80743
	within		16.11908			23
# of Employees	overall	3.668062	8.475501	0	322	1857089
	between		8.170183			80743
	within		2.254557			23

Table 4: **Summary statistics: Bank characteristics**

This table reports summary statistics regarding variables describing the local banks in Austrian ski resort villages. We report the average equity ratio of banks operating in a 20 kilometer radius around the ski resorts, both for all banks (*all*) and for the subset of regional banks (*reg*). In each case, we report separate statistics based on bank-level balance sheet data and on balance sheet data aggregated at the level of Austria's banking groups (*grp*), e.g., the group of savings banks. The number of banks is defined as the number of distinct banking groups in a 20 kilometer radius around a ski resort. Branch diversification measures the degree of geographic expansion of the branch network of the "average bank" in a 20 kilometer radius around a ski resort. For formal definitions of the variables, see Section 4.1.

Variable	Mean	SD	Min	Max	Obs
Bank Equity^{all}	.082	.013	.054	.135	3654
Bank Equity^{grp,all}	.079	.008	.067	.1	3654
Bank Equity^{reg}	.08	.012	.054	.134	3654
Bank Equity^{grp,reg}	.08	.008	.067	.1	3654
Distinct banks^{grp}	5.753	2.193	2	11	3654
Branch Diversification	2008.702	1701.47	34.903	15408.6	3654

Table 5: **Snow conditions and employment**

This table reports results for regressions explaining the weekly employment days of temporary workers of hotels in Austrian ski resorts during the years 1998-2006. The dependent variable is defined in expression (2). We use explanatory variables based on information about snow conditions known before the start of a season, and variables describing within-season variation in the snow conditions. The former variables are based on data about the last five skiing seasons and measure the expected snow conditions and snow risk in a ski resort-week. See expression (4) for formal definitions. $Snow_t$ denotes a dummy variable indicating whether there was enough snow for skiing during a resort-week. We report separate estimates based on data about the starting and ending weeks of the skiing season. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively.

	Log(Employment days)							
	Starting weeks				Ending weeks			
Ex-ante								
Exp. snow_t	0.263***	0.264***	0.264***	0.264***	0.348***	0.350***	0.351***	0.351***
	(0.0528)	(0.0528)	(0.0530)	(0.0531)	(0.0443)	(0.0447)	(0.0446)	(0.0445)
Snow risk_t	-0.139***	-0.143***	-0.144***	-0.154***	-0.0256	-0.0236	-0.0226	-0.0239
	(0.0312)	(0.0315)	(0.0315)	(0.0311)	(0.0300)	(0.0301)	(0.0301)	(0.0299)
Within-season								
$\text{Snow}_t - \text{Exp. snow}_t$	0.0285	0.0249	0.0254	0.0305	0.0637***	0.0583***	0.0621***	0.0571***
	(0.0197)	(0.0199)	(0.0190)	(0.0193)	(0.0211)	(0.0199)	(0.0192)	(0.0192)
$\text{Snow}_{t-1} - \text{Exp. snow}_{t-1}$		0.0167	0.0160	0.0217		0.0239	0.0191	0.0156
		(0.0186)	(0.0160)	(0.0151)		(0.0154)	(0.0130)	(0.0136)
$\text{Snow}_{t-2} - \text{Exp. snow}_{t-2}$			0.00281	-0.00213			0.0138	0.0204*
			(0.0211)	(0.0203)			(0.0148)	(0.0117)
$\text{Snow}_{t-3\ \&\ t-4} - \text{Exp. snow}_{t-3\ \&\ t-4}$				0.0346				-0.0150
				(0.0234)				(0.0122)
N	322976	322976	322976	322976	403720	403720	403720	403720
R^2	0.173	0.173	0.173	0.173	0.203	0.203	0.203	0.203
Firm-Season FE	YES	YES	YES	YES	YES	YES	YES	YES
Week FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 6: **Snow conditions and employment: Effects of banks' equity ratios**

This table reports results for regressions explaining the weekly employment days of temporary workers of hotels in Austrian ski resorts during the years 1998-2006. We focus on the starting weeks of the skiing season. The dependent variable is defined in expression (2). We use explanatory variables measuring the expected snow and snow risk in a resort-week, based on data about the last five skiing seasons. See expression (4) for formal definitions. Bank Equity^{all} (Bank Equity^{reg}) is defined as the average equity ratio of all (regional) banks located in a 20 kilometer radius around a ski resort. In the first three columns, we measure banks' equity ratios about individual banks' balance sheets. In the last three columns, we use equity ratios aggregated at the level of banking groups, e.g., the group of savings banks. All equity ratio variables are de-meaned and defined in terms of basis points. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively. The ratio β_1/β_0 equals the coefficient of the interaction of snow risk and bank equity divided by the baseline coefficient of snow risk. Below our estimates regarding this ratio, we report the p-value of tests that it equals zero.

	Log(Employment days)					
	Bank level			Group level		
Exp. snow$_t$	0.236***	0.209***	0.223***	0.236***	0.207***	0.226***
	(0.0489)	(0.0482)	(0.0483)	(0.0489)	(0.0461)	(0.0472)
Snow risk$_t$	-0.138***	-0.145***	-0.150***	-0.138***	-0.131***	-0.129***
	(0.0311)	(0.0320)	(0.0312)	(0.0311)	(0.0302)	(0.0305)
All banks						
Bank Equity^{all} $\times$ Exp. snow$_t$		-0.00148***			-0.00149**	
		(0.000323)			(0.000640)	
Bank Equity^{all} $\times$ Snow risk$_t$		0.000773***			0.00109***	
		(0.000251)			(0.000356)	
Regional banks						
Bank Equity^{reg} $\times$ Exp. snow$_t$			-0.00134***			-0.000608
			(0.000331)			(0.000648)
Bank Equity^{reg} $\times$ Snow risk$_t$			0.000754***			0.000908**
			(0.000248)			(0.000357)
N	322976	322976	322976	322976	322976	322976
R^2	0.173	0.174	0.174	0.173	0.173	0.173
Firm-Season FE	YES	YES	YES	YES	YES	YES
Week FE	YES	YES	YES	YES	YES	YES
β_1/β_0		-0.01	-0.01		-0.01	-0.01
P-Value		0.02	0.02		0.01	0.03

Table 7: **Horse race: Bank equity vs. bank branch network diversification**

This table reports results for regressions explaining the weekly employment days of temporary workers of hotels in Austrian ski resorts during the years 1998-2006. We focus on the starting weeks of the skiing season. The dependent variable is defined in expression (2). We use explanatory variables measuring the expected snow and snow risk in a resort-week, based on data about the last five skiing seasons. See expression (4) for formal definitions. Bank equity is defined as the average equity ratio of all banks located in a 20 kilometer radius around a ski resort, measured at the level of the banking groups to which the banks belong, e.g., the group of savings banks. It is de-meaned and defined in terms of basis points. Branch diversification measures the degree of geographic expansion of the branch network of the "average bank" in a 20 kilometer radius around a ski resort. For a formal definition, see 4.1. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively.

	Log(Employment days)			
Exp. snow_t	0.207^{***}	0.230^{***}	0.208^{***}	0.217^{***}
	(0.0461)	(0.0497)	(0.0461)	(0.0483)
Snow risk_t	-0.131^{***}	-0.134^{***}	-0.130^{***}	-0.149^{***}
	(0.0302)	(0.0314)	(0.0302)	(0.0313)
Bank $\text{Equity}^{grp,all}$ $\times$ Exp. snow_t	-0.00149^{**}		-0.00115^{*}	-0.00126^{*}
	(0.000640)		(0.000675)	(0.000673)
Bank $\text{Equity}^{grp,all}$ $\times$ Snow risk_t	0.00109^{***}		0.000779^{**}	0.000853^{**}
	(0.000356)		(0.000338)	(0.000332)
Branch Diversification $\times$ Exp. snow_t		-0.102^{**}	-0.0766^{*}	-0.0602
		(0.0429)	(0.0456)	(0.0473)
Branch Diversification $\times$ Snow risk_t		0.105^{***}	0.0893^{***}	0.0676^{**}
		(0.0266)	(0.0267)	(0.0296)
Bank $\text{Equity}^{grp,all}$ $\times$ Branch Diversification $\times$ Exp. snow_t				-0.000602
				(0.000604)
Bank $\text{Equity}^{grp,all}$ $\times$ Branch Diversification $\times$ Snow risk_t				0.00111^{***}
				(0.000333)
N	322976	322976	322976	322976
R^2	0.173	0.174	0.174	0.175
Firm-Season FE	YES	YES	YES	YES
Week FE	YES	YES	YES	YES

Table 8: **Horse race: Bank equity vs. number of banks**

This table reports results for regressions explaining the weekly employment days of temporary workers of hotels in Austrian ski resorts during the years 1998-2006. We focus on the starting weeks of the skiing season. The dependent variable is defined in expression (2). We use explanatory variables measuring the expected snow and snow risk in a resort-week, based on data about the last five skiing seasons. See expression (4) for formal definitions. Bank equity is defined as the average equity ratio of all banks located in a 20 kilometer radius around a ski resort, measured at the level of the banking groups to which the banks belong, e.g., the group of savings banks. It is de-meaned and defined in terms of basis points. The number of banks is defined as the number of distinct banking groups in a 20 kilometer radius around a ski resort. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively.

	Log(Employment days)			
Exp. snow_t	0.207^{***}	0.223^{***}	0.198^{***}	0.195^{***}
	(0.0461)	(0.0502)	(0.0471)	(0.0470)
Snow risk_t	-0.131^{***}	-0.125^{***}	-0.119^{***}	-0.116^{***}
	(0.0302)	(0.0321)	(0.0308)	(0.0305)
Bank $\text{Equity}^{grp,all}$ $\times$ Exp. snow_t	-0.00149^{**}		-0.00140^{**}	-0.00165^{***}
	(0.000640)		(0.000627)	(0.000629)
Bank $\text{Equity}^{grp,all}$ $\times$ Snow risk_t	0.00109^{***}		0.00106^{***}	0.00127^{***}
	(0.000356)		(0.000338)	(0.000329)
# of Banks $\times$ Exp. snow_t		-0.0729^{*}	-0.0611	-0.0608
		(0.0430)	(0.0420)	(0.0413)
# of Banks $\times$ Snow risk_t		0.0617^{**}	0.0593^{**}	0.0665^{**}
		(0.0273)	(0.0269)	(0.0261)
Bank $\text{Equity}^{grp,all}$ $\times$ # of Banks $\times$ Exp. snow_t				-0.000509
				(0.000595)
Bank $\text{Equity}^{grp,all}$ $\times$ # of Banks $\times$ Snow risk_t				0.00116^{***}
				(0.000266)
N	322976	322976	322976	322976
R^2	0.173	0.173	0.174	0.174
Firm-Season FE	YES	YES	YES	YES
Week FE	YES	YES	YES	YES

Table 9: **Snow conditions and employment: Effects of banks' equity ratios - IV Estimates**

This table reports results for instrumental variables (IV) regressions explaining the weekly employment days (ED) of temporary workers of hotels in Austrian ski resorts during the years 1998-2006. We focus on the starting weeks of the skiing season. The dependent variable is defined in expression (2). We use explanatory variables measuring the expected snow and snow risk in a resort-week, based on data about the last five skiing seasons. See expression (4) for formal definitions. Bank Equity^{reg} is defined as the average equity ratio of all regionally active banks located in a 20 kilometer radius around a ski resort, e.g., the savings banks. These banks belong to banking groups. We use the aggregate equity ratio of a bank's group as an instrument, denoted as Bank Equity^{grp,reg}. All equity ratio variables are de-meaned and defined in terms of basis points. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively. The ratio β_1/β_0 equals the coefficient of the interaction of snow risk and bank equity divided by the baseline coefficient of snow risk. Below our estimates regarding this ratio, we report the p-value of tests that it equals zero.

	OLS	1st stage results		2nd stage
	Log(ED)	Bank Equity^{reg} × Exp. snow$_t$	Bank Equity^{reg} × Snow risk$_t$	Log(ED)
Exp. snow$_t$	0.223***	-2.508	-11.80***	0.243***
	(0.0483)	(4.234)	(3.410)	(0.0476)
Snow risk$_t$	-0.150***	-18.66***	-10.39**	-0.130***
	(0.0312)	(2.989)	(4.214)	(0.0355)
Bank Equity^{reg} × Exp. snow$_t$	-0.00134***			-0.000941
	(0.000331)			(0.00102)
Bank Equity^{reg} × Snow risk$_t$	0.000754***			0.00163**
	(0.000248)			(0.000633)
Bank Equity^{grp,reg} × Exp. snow$_t$		0.621***	-0.0147	
		(0.0576)	(0.0632)	
Bank Equity^{grp,reg} × Snow risk$_t$		-0.0111	0.552***	
		(0.0487)	(0.0725)	
N	322976	322976	322976	322976
R^2	0.174			0.173
Firm-Season FE	YES	YES	YES	YES
Week FE	YES	YES	YES	YES
β_1/β_0	-0.01			-0.01
P-Value	0.02			0.03
F-Test of excluded instruments		122.89	73.62	
Angrist-Pieschke F-Test		129.80	61.71	
Endogeneity test (p-value)				0.06

Table 10: **Placebo test based on data about the ending weeks of the skiing season**

This table reports results for regressions explaining the weekly employment days of temporary workers of hotels in Austrian ski resorts during the years 1998-2006. We focus on the ending weeks of the skiing season. The dependent variable is defined in expression (2). We use explanatory variables measuring the expected snow and snow risk in a resort-week, based on data about the last five skiing seasons. See expression (4) for formal definitions. Bank Equity^{all} (Bank Equity^{reg}) is defined as the average equity ratio of all (regional) banks located in a 20 kilometer radius around a ski resort. In the first three columns, we measure banks' equity ratios about individual banks' balance sheets. In the last three columns, we use equity ratios aggregated at the level of banking groups, e.g., the group of savings banks. All equity ratio variables are de-meaned and defined in terms of basis points. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively. The ratio β_1/β_0 equals the coefficient of the interaction of snow risk and bank equity divided by the baseline coefficient of snow risk. Below our estimates regarding this ratio, we report the p-value of tests that it equals zero.

	Log(Employment days)					
	Bank level			Group level		
Exp. snow$_t$	0.292***	0.270***	0.287***	0.292***	0.277***	0.270***
	(0.0398)	(0.0367)	(0.0388)	(0.0398)	(0.0376)	(0.0369)
Snow risk$_t$	-0.0148	-0.0377	-0.0142	-0.0148	-0.0197	-0.0282
	(0.0293)	(0.0265)	(0.0286)	(0.0293)	(0.0266)	(0.0261)
All banks						
Bank Equity^{all} × Exp. snow$_t$		0.000906***			0.000795*	
		(0.000259)			(0.000425)	
Bank Equity^{all} × Snow risk$_t$		0.000456**			-0.0000530	
		(0.000205)			(0.000310)	
Regional banks						
Bank Equity^{reg} × Exp. snow$_t$			0.000696***			0.000960**
			(0.000253)			(0.000411)
Bank Equity^{reg} × Snow risk$_t$			-0.000142			0.000119
			(0.000214)			(0.000304)
N	403720	403720	403720	403720	403720	403720
R^2	0.202	0.203	0.202	0.202	0.202	0.202
Firm-Season FE	YES	YES	YES	YES	YES	YES
Week FE	YES	YES	YES	YES	YES	YES
β_1/β_0		-0.01	0.01		0.00	-0.00
P-Value		0.24	0.69		0.87	0.70

Table 11: **Snow conditions and employment: Effects of banks' equity ratios - Subsample analysis**

This table reports results for regressions explaining the weekly employment days of temporary workers of hotels in Austrian ski resorts during the years 1998-2006. We focus on the starting weeks of the skiing season. The dependent variable is defined in expression (2). We use explanatory variables measuring the expected snow and snow risk in a resort-week, based on data about the last five skiing seasons. See expression (4) for formal definitions. Bank equity is defined as the average equity ratio of all banks located in a 20 kilometer radius around a ski resort, measured at the level of the banking groups to which the banks belong, e.g., the group of savings banks. It is de-meaned and defined in terms of basis points. We split our sample at the median according to firm size (measured in terms of total employees), ski resort size (measured in terms of the aggregate number of beds of all hotels in a ski resort) and ski resort altitude. In parentheses, we report standard errors clustered at the ski-resort level. *,**,*** indicate statistical significance at the 10%, 5% and 1% levels respectively.

	Log(Employment days)					
	Firm size		Resort size		Altitude	
	S	L	S	L	Low	High
Exp. snow_t	0.0407^{*}	0.307^{***}	0.0516	0.147^{***}	0.0750^{**}	0.127^{**}
	(0.0216)	(0.0611)	(0.0328)	(0.0569)	(0.0345)	(0.0595)
Snow risk_t	-0.0693^{***}	-0.172^{***}	-0.0689^{***}	-0.0693^{*}	-0.104^{***}	-0.0791^{**}
	(0.0161)	(0.0396)	(0.0247)	(0.0384)	(0.0240)	(0.0395)
Bank $\text{Equity}^{grp,all}$ $\times$ Exp. snow_t	-0.000746^{**}	-0.00174^{**}	-0.00127^{***}	-0.00124^{*}	-0.000790^{*}	-0.00132^{*}
	(0.000319)	(0.000832)	(0.000431)	(0.000733)	(0.000459)	(0.000763)
Bank $\text{Equity}^{grp,all}$ $\times$ Snow risk_t	0.000372^{**}	0.00124^{***}	0.00131^{***}	0.000902^{*}	0.000605^{**}	0.00109^{**}
	(0.000180)	(0.000471)	(0.000331)	(0.000468)	(0.000303)	(0.000491)
N	122104	200872	60872	234880	102316	213036
R^2	0.081	0.233	0.083	0.206	0.085	0.217
Firm-Season FE	YES	YES	YES	YES	YES	YES
Week FE	YES	YES	YES	YES	YES	YES