

RESEARCH UPDATE

CONTENTS: [Features](#) / [Publications](#) / [News and Events](#) / [People](#) / [Announcements](#)

Welcome to the Banco de España RESEARCH UPDATE

The Banco de España is pleased to announce the release of the Spring 2018 issue of its *Research Update*. The *Update* aims to inform both academic and policy-oriented economists and financial specialists about publications, conferences, and other research activities at the Banco de España.

As usual, this issue includes several feature articles summarizing policy-relevant findings from recent Banco de España projects in diverse areas of research. First, I. Argimón compares the results of international diversification across different Spanish banking groups, concluding that groups with a more decentralized business model have proved less risky. Second, G. Ganics presents a methodology for optimally combining several competing economic forecasts. Next, O. Bover, L. Hospido, and E. Villanueva evaluate the impact of a financial literacy course administered by the Banco de España in a sample of Spanish high schools, showing that the course persistently improved financial knowledge and increased measures of patience. Fourth, A. Abbate and D. Thaler discuss a macroeconomic model of the risk-taking channel of monetary policy, arguing that interest rate smoothing may improve welfare in an economy where low interest rates encourage excessively risky investment. Finally, L. Alfaro, M. García-Santana, and E. Moral-Benito link microdata on bank loans to Spanish input-output data to document both the direct effects of credit supply shocks on firms' employment, output, and investment, and the indirect effects of these shocks on firms' customers and suppliers.

Moreover, this *Update* reports on other Banco de España research news, such as recent publications, current conferences and our latest visiting scholars. This issue also includes an interview with S. Mayordomo and M. Rodríguez-Moreno discussing how microeconomic studies can shed light on financial stability and macroprudential policy today.

We highlight these and other research developments at the Banco de España in hopes that they will interest the broader research community, in Spain and internationally, and thereby contribute to an improved understanding of economic policy.

Óscar Arce
Ángel Estrada
Juan Francisco Jimeno
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FEATURES

DECENTRALIZED MULTINATIONAL BANKS AND RISK TAKING: THE SPANISH EXPERIENCE IN THE CRISIS

SUMMARY OF BANCO DE ESPAÑA WORKING PAPER N° 1749

ISABEL ARGIMÓN

Using banking supervisory data, this study finds that international diversification helps lower the riskiness of Spanish banking groups. In theory, international activity could be a source of risk diversification, especially in stressful times, but alternatively, it could also lead banks to assume greater risk, either by diversifying into high-risk activities or, among other hypotheses, because of the difficulty of monitoring distant affiliates abroad. Our estimates identify three channels by which international diversification lowers banks' default risk: greater geographic diversification, less output growth synchronization across markets, and an international business model characterized especially by subsidiaries with substantial funding autonomy and a high weight of local claims which are mostly financed with local liabilities.

Introduction

The literature has failed to provide clear evidence on the direction of the effect of banks' geographic diversification on their risk. In accordance with portfolio theory, banks see diversification, *ceteris paribus*, as an opportunity to improve their risk-return trade-off, so that risk-adjusted returns should be higher at more diversified banks. However, if this lowers the variability of their net income to assets, banks may react by decreasing their capital-to-assets ratio or their expected net income to assets. Moreover, diversification might extend into higher risk activities. Thus, the question of whether diversified financial institutions outperform their more concentrated peers has been widely studied, with mixed results.¹

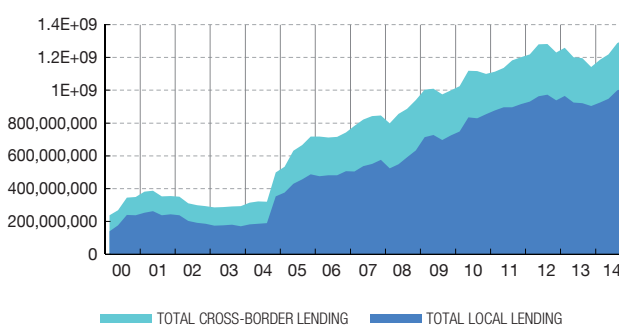
International banking has increased with economic globalization, following different patterns in different economies. In general, direct cross-border lending (lending from headquarters to residents in other

jurisdictions) as a share of total banking assets has declined since the crisis, while the share of local lending by bank affiliates that operate abroad has remained steady (IMF, 2015).²

The Spanish banking system stands out as the one with the largest share of local activity among the major banking systems (McCauley *et al.*, 2010). Since the crisis, it has been characterised by an increasing weight of foreign activity in the consolidated results of banking groups. At the bank level, the mode of entry into foreign markets varies substantially. While the vast majority of Spanish banks carry out their international lending activity by establishing branches or even without setting up affiliates abroad, the largest banks tend to establish subsidiaries abroad with a lot of financial autonomy and very little intragroup funding.

TOTAL FOREIGN LENDING THROUGH CROSS-BORDER EXPOSURES AND LOCAL AFFILIATES OF SPANISH CREDIT INSTITUTIONS (1000€)

FIGURE 1



SOURCE: Author's calculations, based on Banco de España supervisory data.

This article addresses the relevance of banks' international business model, and the effects of geographic diversification and business cycle synchronization on banks' riskiness, using confidential Spanish supervisory data. It also provides empirical

¹ See, for example, Saunders and Walters (1994), DeYoung and Roland (2001), Stiroh (2004), and Lepetit *et al.*, (2007).

² Here, "local lending" means lending to the residents in a given country by either branches or subsidiaries of the consolidated group in that country.

evidence on whether the impact on risk during the recent crisis depended on the international business model.

Empirical approach

We analyse the relevance of these factors linked to geographic diversification on bank's resilience by means of an OLS regression. We proxy resilience by the *Z-score*, which can be interpreted as a distance-to-default measure. The *Z-score* of bank *i* at time *t* is calculated as:

$$Z\text{-score}_{i,t} = (ROA_{i,t-k+1,t} + (E/A)_{i,t-k+1,t}) / \delta ROA_{i,t-k+1,t},$$

where *ROA* is the average return on assets, *E/A* is the average equity to assets ratio and δROA is the standard deviation of return on assets, which are all computed over the *k* periods from *t-k+1* to *t* (12 quarters). A high *Z-score* indicates that returns and capital are high relative to the volatility of returns, implying a safer bank. Although this indicator has limitations as a risk measure, it has the advantage that it can be defined for non-listed institutions, which constitute the majority of our sample.

Formally, we estimate equations which include some combination of the following terms:

$$\begin{aligned} \log Z\text{-score}_{i,t} = & \alpha_{1i} + \alpha_{2t} + \beta_1 HH_{i,t-k} + \beta_2 \text{synchro}_{i,t-k} \\ & + \lambda_2 \text{multidiv}_{i,t-k} + \lambda_3 HH_{i,t-k} * \text{multidiv}_{i,t-k} \\ & + \lambda_4 \text{synchro}_{i,t-k} * \text{multidiv}_{i,t-k} + \gamma X_{i,t-k} + \varepsilon_{i,t}, \end{aligned} \quad (1)$$

where the right-hand-side variables are measured at period *t-k* to ensure that they are predetermined in relation to the dependent variable.

Here $HH_{i,t}$ is an indicator of international geographic diversification, which is obtained as a Hirsch-Herfindhal index:

$$HH_{i,t} = 1 - \sum_{j=1}^{R_{i,t}} \left(\frac{\text{Lending of bank } i \text{ to residents in country } j}{\text{total lending of bank } i} \right)^2,$$

where $R_{i,t}$ is the total number of jurisdictions *j* where bank *i* operates, including the home country. The *HH* index lies between zero and one; the lower bound corresponds to a purely domestic bank, and the upper bound corresponds to the most internationally diversified bank. If international geographic diversification is associated to higher resilience, we can expect a positive coefficient in regression (1).

The variable $\text{synchro}_{i,t}$ is a weighted index of synchronization or correlation between the business cycle of Spain and the country of residence of those

receiving the lending at time *t*. The weights are the lagged share of the counterparty country's assets in the total assets of bank *i*. Synchronization is measured as the negative absolute difference between the two countries' real GDP growth rates, so higher values of the index (closer to zero) indicate a higher degree of bilateral synchronization between Spain and country *j* in year *t*.

The variables $\text{multidiv}_{i,t-k}$ are several indicators capturing different modes of entry into foreign markets (McCauley *et al.*, 2010, and Gambacorta and van Rixtel, 2013).³ On the claims side, we distinguish "multinational" banks, characterized by the predominance of local business (either through branches or subsidiaries), from "international" banks which operate out of the home country and conduct mostly cross-border business. We proxy this dimension by the ratio of local claims over total foreign claims (*multi*). The higher the value of the variable *multi*, the closer the bank is to following a multinational model.

On the liabilities side, we distinguish between a "centralized" bank, which raises funds at the country where its headquarters is and redistributes them around the group, and a "decentralized" bank, which has affiliates abroad that raise funds locally to finance local activity. Decentralization is linked to where the bank raises funds, so we proxy it by the ratio of total local liabilities over total foreign claims (*decentral*). The larger the value of the ratio, the more decentralized the bank is. Besides *multi* and *decentral*, we also include their product, *multi*decentral*, in the business model indicator *multidiv*.

We estimate coefficients λ_3 and λ_4 which will provide a test for the differential impact that these modes of international expansion have on the determinants of bank risk in an international environment. If the estimated coefficient λ_3 is positive it implies that the more multinational or decentralized a bank is, the larger the positive impact of geographic diversification on that bank's resilience. If λ_4 is positive, this implies that a more multinational or decentralized business model attenuates the negative impact of synchronization on the bank's resilience, which would reinforce the idea that international geographic diversification is associated with higher resilience.

³ McCauley *et al.* (2010) do not center the distinction in the two sides of the balance sheet. They also use the share of foreign liabilities booked outside the home country to distinguish between international and multinational banks. They distinguish centralized banks from decentralized multinational banks by the extent to which local assets are locally funded.

| Dependent variable: | Logarithm of z-score (1) | | | | | | |
|--------------------------------------|--------------------------|--------------------------------|----------------------|-----------------------|--------------------------|-------------------------|--------------------------|
| | All banks | Only banks with foreign claims | | | | | |
| Regressors | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $HH_{i,t-12}$ | 0.852*** (0.00244) | 0.441 (0.114) | 0.474* (0.0907) | 0.499* (0.0758) | -0.0590 (0.839) | 0.101 (0.732) | 0.136 (0.643) |
| $synchro_{i,t-12}$ | -0.132 (0.126) | -0.271*** (0.00412) | -0.241** (0.0120) | -0.200** (0.0369) | -0.574*** (0.00670) | -0.620*** (0.00452) | -0.572*** (0.00597) |
| $multi_{i,t-12}$ | | -0.00369 (0.207) | | | | | |
| $decentral_{i,t-12}$ | | | 0.00216 | | | | |
| $(multi*decentral)_{i,t-12}$ | | | | 0.000132** -0.0161 | | | |
| $(multi*HH)_{i,t-12}$ | | | | | 0.0756*** (0) | | |
| $(multi*synchro)_{i,t-12}$ | | | | | 0.00958*** (0.000518) | | |
| $(decentral*HH)_{i,t-12}$ | | | | | | 0.0289*** (1.02e-05) | |
| $(decentral*synchro)_{i,t-12}$ | | | | | | 0.00712** -0.0169 | |
| $(multi*decentral*HH)_{i,t-12}$ | | | | | | | 0.000579*** -1.03E-09 |
| $(multi*decentral*synchro)_{i,t-12}$ | | | | | | | 0.000109*** -0.0035 |
| Observations | 2,155 | 1,941 | 1,928 | 1,928 | 1,941 | 1,928 | 1,928 |
| Adjusted R ² | 0.656 | 0.602 | 0.6 | 0.6 | 0.61 | 0.603 | 0.604 |

NOTES: (*) All specifications include bank and time dummies. See Working Paper 1749 for a complete list of regressors.

(1) z-score is computed as the sum of the mean return on assets (net income over total assets) and the mean capitalization ratio (equity over total assets) divided by the standard deviation of the return on assets, over a 12 quarter period. Robust p-values in brackets; ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

We also include control variables, $X_{i,t}$, both at the bank and the time dimension, which include an index of the bank's income diversity, a measure of overhead costs and the bank's size. Finally, we also include time and bank fixed effects in all specifications.

Data

We use quarterly balance sheet data and income statements submitted by Spanish banks to the Banco de España. We consider as international activity both cross-border activity, and all the activity developed by the affiliates operating abroad that are classified as credit institutions or financial institutions.

The sample is an unbalanced panel of banks spanning from 1999Q4 to 2014Q4, although the lag structure of the definition of our risk variable limits the starting

period to 2002Q4. We use consolidated financial statements that include the activity corresponding to subsidiaries and other affiliates abroad, and we merge them with the statements provided for each country where the group has affiliates or to which it provides loans. Our final database consists of 66 banks. Five of them engaged in international activity through subsidiaries at all times during the period of analysis. Twelve banks never had any international activity. We distinguish among 34 different jurisdictions for which we have information on macrovariables.

Results

The findings in Table 1 provide support for the hypothesis that internationalization helps reduce risk. Under all the specifications, either the HH index has a positive coefficient, as under the baseline specification in column 1,

and/or the synchronization index has a negative coefficient, as in the remaining columns. These results indicate that greater geographical diversification, and lower business cycle synchronization of the countries represented in a bank's portfolio, both reduce a bank's risk.

We do not find evidence that more decentralized or more multinational banks show lower risk on average, as the coefficients on *multi* and *decentral* are not statistically significant (cols. 2 and 3). However, we find that the product of the two variables (the multiplicative variable *multi*decentral*) has a positive effect on resilience (col. 4), so being more decentralized and multinational at the same time reduces risk.

Moreover, the results also show that the more multinational (col. 5) or the more decentralised the bank is (col. 6), the greater is the positive impact of geographic diversification on resilience, as captured by the statistically significant coefficients for the cross terms of the bank's international business model with the *HH* index. The results in columns 5 and 6 show that if it were not for these types of banks, the effect of geographic diversification would be nil. We also find that the negative effect of business synchronization on resilience is reduced by a decentralized or multinational structure. The same qualitative results hold for the multiplicative multinational and decentralized banks indicator (col. 7). Therefore, we find that decentralized multinational banks have lower risk through more effective geographic diversification and a mitigating effect on synchronization.

Table 2 reports the results obtained when we examine how internationalization affects risk during the financial crisis. We first split the sample in two, with observations up to the third quarter of 2008 and observations from then onwards and run separate regressions of equation (1) for the two periods. We then define the dummy variable *crisis* that takes value zero up to the third term of 2008 and one thereafter, and include the interaction terms *decentralized*crisis* and *multinational*crisis* using the whole sample to test whether these types of banks were more resilient in the crisis than their peers.

The estimates reported in column 1 and 2 show that banks which are both decentralized and multinational had lower risk than their competitors both before and after the crisis. The direct comparison of the two periods using the whole sample (col. 3) shows that during the crisis, these banks had higher resilience. Therefore, the evidence shows that during the crisis, banks that were more decentralized and more multinational were more resilient than their peers, and therefore further away from default.

MULTINATIONAL AND DECENTRALIZED BANKS BEFORE AND AFTER 2008Q3. (1999Q4-2014Q4) (*) TABLE 2

| Regressors | Logarithm of z-score (1) | | |
|-------------------------------------|--------------------------|---------------------------|------------------------|
| | Before crisis | After crisis | Overall |
| $HH_{i,t-12}$ | 0.760** (0.0260) | 0.814* (0.0586) | 0.191 (0.492) |
| $synchro_{i,t-12}$ | -0.214* (0.0834) | -0.117 (0.214) | -0.255*** (0.00442) |
| $(multi*decentral)_{i,t-12}$ | 0.000226*** (0.00836) | 0.000249*** (0.000200) | 1.60e-06 (0.976) |
| $(crisis*multi*decentral)_{i,t-12}$ | | | 0.000143*** (0) |
| Observations | 1,199 | 729 | 1,931 |
| Adjusted R ² | 0.602 | 0.733 | 0.610 |

NOTES: (*) All specifications include bank and time dummies. See Working Paper 1749 for a complete list of regressors. (1) z-score is computed as the sum of the mean return on assets (net income over total assets) and the mean capitalization ratio (equity over total assets) divided by the standard deviation of the return on assets, over a 12 quarter period. Robust p-values in brackets; ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Conclusions

Internationally active banking groups have been increasing in size and complexity, and since the crisis they have been subject to tighter regulatory requirements, aiming at better aligning regulatory capital to actual risk.

The evidence presented in this study suggests that while geographic diversification affects banks' *ex post* risk, their international business model and the cyclical synchronization of the countries where they do business matters too. These findings, like those of Gotz *et al.* (2016) and Griffith-Jones *et al.* (2002), provide supporting evidence for proposals to incorporate the benefits of international diversification into the regulatory framework. Proper alignment of capital requirements with risk would suggest rewarding geographic diversification with lower capital. The findings also suggest that regulators should take account of banks' international business models. The evidence on the higher resilience of multinational-decentralized banks, especially during the crisis, suggests considering these characteristics when assessing global banks and their capital requirements, and when treating the Multiple Point of Entry models for resolution. This evidence also calls for a reconsideration of the level of detail used in stress tests, which have become a key tool of supervisory policy since 2008. Detailed scenarios for different geographical regions, taking into account their expected cyclical synchronization, could consider the joint probabilities of different local stress scenarios.

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OPTIMAL DENSITY FORECAST COMBINATIONS

SUMMARY OF BANCO DE ESPAÑA WORKING PAPER N° 1751

GERGELY GANICS

How should researchers combine several predictive densities to improve their forecasts? This paper proposes consistent estimators of weights which deliver density forecast combinations approximating the true predictive density, and confirms that the proposed methods work well through Monte Carlo simulations. In an empirical example of forecasting monthly US industrial production, the method delivers density forecasts which are superior to well-known benchmarks, such as an equal weights scheme. Specifically, housing permits had valuable predictive power before and after the Great Recession, and stock returns and corporate bond spreads proved to be useful predictors during the recent crisis.

Introduction

Researchers and policy makers seeking to predict future economic conditions often need to go beyond simple point forecasts of an economic time series. As Alan Greenspan stated, “a central bank needs to consider not only the most likely future path for the economy, but also the distribution of possible outcomes about that path” (Greenspan, 2004, p. 37). For this reason, *density forecasts* (also called *distribution forecasts*) – which describe the conditional probability distribution of a time series, instead of just describing its conditional mean – have become increasingly popular both in the academic literature and among professional forecasters. Well-known examples of forecasts produced in this spirit include the fan charts of the Bank of England, and the Surveys of Professional Forecasters (SPF) of the Federal Reserve Bank of Philadelphia and the European Central Bank.

Moreover, forecasters often have several competing predictions available for the same time series. Just as combinations of individual point forecasts have been found to be superior against a single point forecast in many settings, *density combinations* have been shown to outperform the density forecasts of individual models (Elliott and Timmermann, 2016; Timmermann, 2006). The reasons for both are largely the same: model misspecification, structural breaks and parameter estimation uncertainty complicate the task of producing reliable forecasts. Practitioners often rely on simple rules or expert judgment to combine point forecasts. But convex combinations of densities can take shapes that are dissimilar to their individual components,

resulting in considerably different predictions. This makes density forecast combination a more challenging task than the combination of point forecasts. While assigning equal weights to predictive densities often results in improvements (see e.g. Rossi and Sekhposyan, 2014), this does not offer insights into the individual models' performance. In contrast, the data-driven weighting scheme proposed in this study can help researchers understand and improve their forecasting methods.

The present paper studies how to optimally choose the weights used to combine several predictive densities. The method focuses on estimators of density combination weights based on the Probability Integral Transform or PIT (Rosenblatt, 1952; Diebold, Gunther, and Tay, 1998), which is defined as the researcher's predictive cumulative distribution function (CDF) evaluated at the actual realization of the time series. The PIT has a remarkably simple yet powerful property: it is uniformly distributed if and only if the predictive density used by the researcher coincides with the true predictive density conditional on the researcher's information set, which is the notion of optimality in this paper. Discrepancies between the true, unknown predictive distribution and the researcher's density forecast show up in the distribution of the PIT. This property can be used to design tests, but the present paper instead inverts the problem, proposing to estimate the optimal weights for combining densities by minimizing the distance between the uniform distribution and the empirical distribution of the combined PIT.

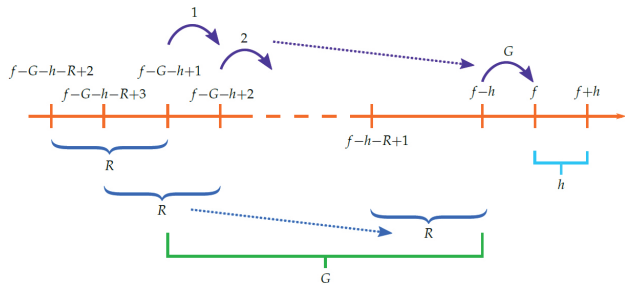
The paper shows that this method leads to consistent weight estimators which have an optimality property. In an empirical application, I demonstrate that the novel PIT-based forecast combination method delivers one-month-ahead forecasts of US industrial production growth which are superior to the widely used equal-weights benchmark. The weight estimates show that housing permits were a useful predictor in the years preceding and following the Great Recession. Furthermore, financial variables, especially corporate bond spreads, received considerable weight during and after the recent financial crisis.

Econometric framework

Let y_t denote the variable of interest to the forecaster. The available sample of size $T+h$ is utilized as follows.

PROPOSED ESTIMATION SCHEME

FIGURE 1



At forecasting time f , the researcher has M models available, which are indexed by $m=1, \dots, M$.¹ These models are estimated in rolling windows of size R , where each estimation is based on information between $t-R+1$ and t . The time index t runs from $t=f-G-h+1$ to $t=f-h$, where G is the total number of rolling windows (see Figure 1). At each t , each model implies an h -step-ahead density forecast of y_{t+h} . We use the notation $\phi_{t+h}^m(y|I_{t-R+1}^t)$ to represent the density of the variable y_{t+h} , according to model m , based on the information set I_{t-R+1}^t that looks R periods back from time t . I propose to construct forecasts using a convex combination ϕ_{t+h}^C of the M density models, as follows:

$$\phi_{t+h}^C(y|I_{t-R+1}^t) \equiv \sum_{m=1}^M w_m \phi_{t+h}^m(y|I_{t-R+1}^t),$$

where the m superscript indexes the models. The weights are collected in a vector $w \equiv (w_1, \dots, w_M)'$. Requiring that the weights w_m satisfy $w_m \geq 0$ for all m , and $\sum_{m=1}^M w_m = 1$, guarantees that the density combination is itself also a density. The densities can also be converted into cumulative distribution functions (CDFs) by integrating:

$$\begin{aligned} \Phi_{t+h}^C(\bar{y}|I_{t-R+1}^t) &= \int_{-\infty}^{\bar{y}} \sum_{m=1}^M w_m \phi_{t+h}^m(y|I_{t-R+1}^t) dy \\ &= \sum_{m=1}^M w_m \Phi_{t+h}^m(\bar{y}|I_{t-R+1}^t). \end{aligned}$$

The estimation procedure is repeated in a similar way at all forecasting times f from $G+h+R-1$ to T . This scheme yields a total number of $P=T-G-h-R$ out-of-sample density forecasts with the corresponding realizations, which could be used to assess the performance of the forecast combinations. This rolling window scheme potentially alleviates problems related to structural instabilities. Furthermore, the paper shows that a consistent estimator is guaranteed by keeping the density estimation window size R relatively small, so that the number G of windows used to estimate the weights is relatively large.

Let $\Phi_{t+h}^*(y|I_{t-R+1}^t)$ denote the true distribution of y_{t+h} , conditional on information I_{t-R+1}^t . If a set of weights w is

¹ “Model” is understood in a wide sense, and may include judgmental or survey forecasts as well.

found so that the combination $\sum_{m=1}^M w_m \Phi_{t+h}^m(y|I_{t-R+1}^t)$ coincides with the true distribution $\Phi_{t+h}^*(y|I_{t-R+1}^t)$, then the combined forecast is said to be probabilistically calibrated. It is important to note that this notion of calibration does not require that the true predictive distribution belong to the set of M distributions. In practice, researchers typically do not know the true predictive density of y_{t+h} , so the most they can aspire to is producing the best forecast conditional on the specific information set – that is, producing a probabilistically calibrated forecast.

The Probability Integral Transform (PIT) is defined as $PIT_{t+h} \equiv \Phi_{t+h}^C(y_{t+h}|I_{t-R+1}^t)$, which is the combined CDF evaluated at the realization of the variable y_{t+h} . It can be shown that PIT_{t+h} follows the standard uniform distribution if and only if the forecast is probabilistically calibrated (see e.g. Corradi and Swanson, 2006). This key result forms the basis of the weight estimator proposed here.

Given this result, predictive performance can be assessed by observing how much the empirical distribution of the PIT deviates from uniformity. Therefore, for any quantile $r \in [0,1]$, let us define the function $\Psi(r;w) \equiv Pr(PIT_{t+h} \leq r) - r$ and its sample counterpart

$$\Psi_G(r;w) \equiv G^{-1} \sum_{t=f-G-h+1}^{f-h} 1 [PIT_{t+h} \leq r] - r;$$

where $1[\cdot]$ is the indicator function. The function Ψ_G measures the vertical distance between the empirical CDF of the PIT and the CDF of the uniform distribution (the 45 degree line) at quantile r , given the G observations used to evaluate the PITs up to and including the forecast origin f . Recall that over the full sample, the forecast origin f ranges from $G+R+h-1$ to T .

A particularly useful measure of discrepancy between distributions is the Anderson – Darling statistic² (Anderson and Darling, 1952), which is defined as

$$A_G(w) \equiv \int_0^1 \frac{\Psi_G^2(r;w)}{r(1-r)} dr.$$

Intuitively, this statistic measures the squared vertical difference between the empirical CDF of the PIT and the uniform distribution, giving larger weight to deviations in the tails. Hence this paper proposes estimating the weights on a set of available density models to minimize the Anderson-Darling statistic:

$$\hat{w} \equiv \underset{w}{\operatorname{argmin}} A_G(w).$$

² The working paper also reports results based on the Kolmogorov – Smirnov and Cramer – von Mises statistics and the Kullback – Leibler Information Criterion (KLIC).

This estimator can be proved consistent, as G becomes large, under several technical conditions, including weak dependence,³ and continuity of the predictive distributions.

The working paper reports numerous Monte Carlo simulations demonstrating the favorable properties of the proposed estimator, featuring different data generating processes and sample sizes ($G=80, 200, 500, 1000, 2000$), to guide researchers in macroeconomics and finance.

Empirical application

The paper studies the empirical performance of the PIT-based density combination method by comparing it against several alternative ways of combining density forecasts for US Industrial Production (IP). Based on their empirical success, as documented by Stock and Watson (2003), Granger and Jeon (2004), and Rossi and Sekhposyan (2014), I consider linear Autoregressive Distributed Lag (ARDL) models of the following form:

$$y_{\tau+1} = c + \sum_{j=0}^1 \beta_j y_{\tau-j} + \sum_{j=0}^1 \gamma_j x_{\tau-j} + \sigma \epsilon_{\tau+1}, \quad \epsilon_{\tau+1} \sim iid.N(0,1),$$

where y_{τ} is annualized US IP growth in month τ , that is $y_{\tau} \equiv 1200 \Delta \log IP_{\tau}$, where Δ is the first difference operator, c is a constant term, β_j and γ_j are coefficients on autoregressive terms and on additional explanatory variables, and σ scales the independently and identically normally distributed error term $\epsilon_{\tau+1}$. The lag length was specified following Granger and Jeon (2004), who demonstrated that two lags typically provide output forecasts with low root mean squared error.

All the data were obtained from the March 2016 vintage of the FRED-MD database (McCracken and Ng, 2016). The chosen output measure is the INDPRO series (ID: 3), which measures total industrial production. The possible elements of x_{τ} are the following variables (database identifiers in parentheses) - New Private Housing Permits SAAR (ID: 55); ISM: New Orders Index (ID: 61); S&P Common Stock Price Index: Composite (ID: 80); and Moody's Seasoned Baa Corporate Bond Yield minus FEDFUNDS (ID: 100). I included these variables one at a time, obtaining four different specifications. Finally, I also estimated the pure AR(2) model, without additional regressors x_{τ} . Hence, in total, the model set M contains five models. To obtain stationary series, I took the log difference of the S&P index and the log of the housing permits series, leaving other variables

³ This assumption limits the temporal dependence of the time series, and rules out unit root processes, for example. It is required to invoke a law of large numbers.

untransformed, following McCracken and Ng (2016) and Carriero *et al.* (2015).⁴ All models were estimated using Maximum Likelihood in rolling windows of $R=120$ months, with forecast origins f and target dates $f+h$ ranging from February 1985 to January 2016 and March 1985 to February 2016, respectively, resulting in a sequence of PITs for each model. The weights were themselves estimated in rolling windows of $G=180$ monthly observations on the PITs, using the Anderson-Darling objective function.

I compared the PIT-based estimator with (i) the KLIC-based weight estimator (Hall and Mitchell, 2007), (ii) equal weights, (iii) the pure AR(2), (iv) a single model selected by the Bayesian Information Criterion (BIC), and (v) Bayesian Model Averaging (BMA). All of these benchmarks have been demonstrated to perform well in empirical exercises.⁵

To formally evaluate whether each density forecasting scheme delivers probabilistically calibrated forecasts, I test the uniformity of the PITs using the test developed by Rossi and Sekhposyan (2017). Under the null hypothesis of uniformity, their test allows for dynamic misspecification and maintains parameter estimation uncertainty, in line with this paper's framework, as the proposed optimal weighting scheme allows for both as well. Table 1 shows the results of the test of correct specification of each density combination method. As we can see, the Anderson-Darling weights, the BIC, and BMA deliver probabilistically calibrated forecasts of industrial production according to the Kolmogorov – Smirnov and the Cramer – von Mises-type test statistics, not rejecting the null even at the 10% level. Furthermore, the KLIC and the AR(2)-N also generate calibrated forecasts at the 5% level. It is reassuring that the proposed optimal weighting scheme is able to produce probabilistically calibrated forecasts in a setting where equal weighting surprisingly fails. Therefore we can conclude that the Anderson-Darling-based estimator, and to a lesser extent, the KLIC-based estimator are capable of delivering well-calibrated density forecasts.

Furthermore, it is also interesting to see how the combination weights of the PIT-based estimator evolved over the out-of-sample period (March 1985 to February 2016), which is shown in Figure 2.

⁵ Kascha and Ravazzolo (2010) and Rossi and Sekhposyan (2014) found that the equal weights combination scheme performs well when forecasting inflation with a large number of simple models. The AR(2) model with normal error terms, denoted by AR(2)-N, was shown to be a tough benchmark in point forecasting exercises, see for example Del Negro and Schorfheide (2013).

ROSSI AND SEKHPOSYAN'S (2017) TEST ON CORRECT SPECIFICATION OF CONDITIONAL PREDICTIVE DENSITIES

TABLE 1

| Models | Kolmogorov – Smirnov | Cramer – von Mises |
|---------------|----------------------|--------------------|
| AD weights | 0.90 (0.38) | 0.24 (0.22) |
| KLIC weights | 1.28 (0.08) | 0.42 (0.06) |
| Equal weights | 1.39 (0.05) | 0.50 (0.04) |
| AR(2)-N | 1.31 (0.08) | 0.40 (0.09) |
| BIC | 1.16 (0.17) | 0.32 (0.16) |
| BMA | 1.28 (0.10) | 0.38 (0.11) |

NOTE: The table displays the test statistics and the corresponding p-values (in parentheses) testing the null hypothesis of uniformity of the PITs, based on P=372 out-of-sample forecasts.

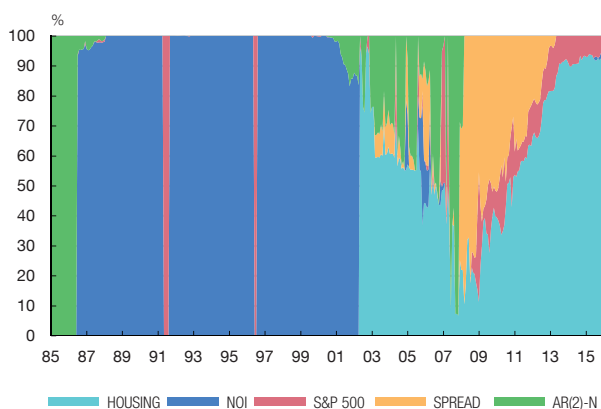
knowledge, the present paper is the first to show in an out-of-sample forecasting exercise that during and after the Great Recession, density forecasts of models that feature a spread variable also perform better in predicting industrial production. Interestingly, since around 2009, housing permits have again emerged as a powerful predictor.

Conclusion

This paper has proposed consistent estimators of weights that can be used to combine several density models to approximate the true predictive density for an economic time series. Most of the existing literature discusses *testing* whether density forecasts are correctly calibrated, but *estimating* the combination weights has received considerably less attention, which is the topic of the present paper. Monte Carlo experiments confirm that the proposed asymptotic theory performs well for sample sizes which are relevant in macroeconometrics and finance. The empirical exercise reported here demonstrates that this paper's methodology improves on individual models' density forecasts of US industrial production and delivers probabilistically calibrated forecast densities. The estimated weights highlight the importance of non-Gaussian predictive densities, and they are also intuitively interpretable, demonstrating that the housing market was one of the drivers of output growth before and after the recent financial crisis. Moreover, corporate bond yield spreads have considerable predictive content, especially during the Great Recession.

TIME-VARIATION OF ANDERSON - DARLING WEIGHT ESTIMATES

FIGURE 2



NOTE: the figure shows the weight estimates corresponding to each model. The forecast target dates range from March 1985 to February 2016.

In Figure 2, we see that the model with the New Orders Index (NOI) dominated the model pool until the early 2000s, apart from the beginning of the sample. From the early 2000s, new housing permits proved to be by far the best predictor of industrial production, highlighting the importance of the housing sector as one of the drivers of the bubble leading to the financial crisis. During and after the Great Recession, the models featuring the corporate bond yield spread and the S&P 500 received large weight. It is noteworthy that the optimal combination scheme using Anderson-Darling weights was able to capture the predictive power of the spread variable at the beginning of the financial crisis. These findings are similar to the conclusions of Ng and Wright (2013), who suggest that the predictive content of individual variables displays rather large variations over time and that financial data were useful predictors of output in the wake of the Great Recession. As they explain, in a more leveraged economy, interest rate spreads have a stronger effect on output through channels affecting firms' finances. However, to my

The present paper offers several avenues for further research. The empirical exercise suggests that weight estimates display persistence, so incorporating the information contained in past weights might improve the estimators. Another possibility is the inclusion of a penalty term to shrink the weights towards zero, focusing on the most relevant models. Practitioners in finance and risk management could also take advantage of the estimators proposed here to construct more precise Value at Risk estimates using combinations of density forecasts, and focusing on a specific part of the predictive distribution.

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THE IMPACT OF HIGH SCHOOL FINANCIAL EDUCATION ON KNOWLEDGE AND CHOICES: EVIDENCE FROM A RANDOMIZED TRIAL

SUMMARY OF BANCO DE ESPAÑA WORKING PAPER N° 1801

OLYMPIA BOVER, LAURA HOSPIDO AND ERNESTO VILLANUEVA

Introduction

Surveys conducted in several countries around the world confirm that many individuals are not familiar with basic notions about inflation, interest rate compounding and diversification. Furthermore, several studies have documented that households with higher financial knowledge tend to have higher net wealth levels and lower indebtedness. These findings have given rise to a number of initiatives aimed at increasing the financial knowledge of the population.¹ However, a correlation between financial knowledge and financial outcomes may not be informative about the effectiveness of financial education in avoiding some bad outcomes such as excess indebtedness. The reason is that a correlation between financial knowledge and higher levels of net wealth may merely reflect the fact that individuals with high wealth levels also have a higher incentive to devote time to acquiring financial skills.

To understand the implications of providing financial education in high school, this article summarizes the results of an intervention in the academic year 2014-2015 that delivered 10 hours of instruction on personal finance to some 3,000 students aged 14-15 years in 77 high schools all over Spain. In 12 out of the 17 Autonomous Communities, teachers from each high school involved in the study delivered lessons on banking products, means of payments, elaborating a budget or responsible consumption. Relative to previous interventions, this study makes three main contributions.² Firstly, personal finance programs differ in the target population group. We focus on the knowledge acquired and on the behaviour of adolescents, a group of the population at the verge of making important lifetime decisions, like leaving school after completing compulsory education. Secondly, financial education programs also differ in their contents –some emphasizing

the elaboration of budgets, others emphasizing saving vehicles. By combining surveys of teachers and the results of standardized financial knowledge tests, we examine which specific contents students lack and in which ones they improve. Finally, the impact of financial education programs on knowledge and choices may vary across students according to their opportunities to acquire that knowledge in the family or elsewhere. The design of the experiment allows us to estimate different impacts for public and non-public schools, strong correlates of parental background.

Contents of the course

The intervention we analyze gives teachers access to ten lessons of Web-based material. The material can be grouped into four main areas:

- **Saving towards a goal:** This topic addresses how saving increases future consumption possibilities and, in addition, introduces the notion of interest rates.
- A second set of modules includes examples of **how to elaborate a budget** to be able to save and meet future needs. For example, students learn about the allocation of regular and irregular expenses in a monthly budget.
- A third set of modules deals with **responsible consumption**, aimed at characterizing conspicuous or environmentally unfriendly expenditure.
- A fourth set of modules introduces the different types of **bank accounts and credit cards**. Students are introduced to the concepts of commissions and fees, as well as the trade-off between liquidity and return. This part also covers basic security rules in checking and saving accounts.

There are two final modules on specific investment vehicles, such as pension funds and insurance vehicles. However, survey evidence suggests that very few teachers had enough time to deliver that material.

¹ Lusardi and Mitchell (2014) and OECD (2017) review international evidence on financial literacy. Bernheim *et al.* (2001) provided evidence about the link between financial education and outcomes in adulthood. There have been several reassessments of that evidence, see for example Brown *et al.* (2016).

² See, for example, Bruhn *et al.* (2013), Alan and Ertac (2017) and Lührmann *et al.* (2017).

| | December 2014 | | March 2015 | | June 2015 |
|--------------------------------|------------------------------|-----------|-------------------------------|-----------|-----------------------------------------|
| 9th graders (15 years of age) | | | | | |
| 1 Treated schools | Baseline survey and pre-test | FL course | Post-test, survey to students | No course | Third test and incentivized saving task |
| 2 Control schools | | No course | | FL course | |
| 10th graders (16 years of age) | | | | | |
| 1 Treated schools | Baseline survey and pre-test | No course | Post-test, survey to students | No course | Incentivized saving task** |
| 2 Control schools | | No course | | No course | |

NOTES: (*) November 2014: All teachers invited to Banco de España for a session on the purpose of the evaluation, timetable of the course and going over one of the lessons. (**) 10th grade incentivized saving task conducted in Madrid schools only.

Methodology

The population of interest are 9th grade students in high schools applying to participate in the program for the first time during the 2014-2015 academic year. Ninth grade is called 3° ESO in the Spanish educational system and, assuming normal academic progress, it is meant to be directed to 14-15 year-olds. Tenth grade (4° ESO) is the last year of compulsory education.

We used a phased-in design, randomized across schools, within the 2014-2015 academic year. We randomized the quarter when the material was delivered, the options being either January-March 2015 (the treated schools) or April-June 2015 (the control schools). Given the heterogeneity in applicants, randomization was done within strata defined by the type of school (public, private or chartered), whether the school was in Madrid or not, and the date of application to the program.

Table 1 shows the design of the evaluation. In December 2014 students took a baseline test as well as a short survey on demographics. In March 2015 students took a second financial literacy (FL) test and an additional survey. At the time of the March 2015 measurement, neither 9th graders in the control schools nor any 10th graders had received any material on financial literacy, thus providing a natural control group. Finally, in June 2015, 9th graders took a third financial literacy test as well as an incentivized task where students could choose between receiving actual payments in two moments in time at different interest rates. Due to budgetary considerations, the only 10th graders who did the incentivized saving task were those in Madrid.

Participation was conditional on schools' acceptance of the following conditions. The course should be delivered to 9th graders in the assigned quarter. In addition, a group in 10th grade (4 ESO) had to be

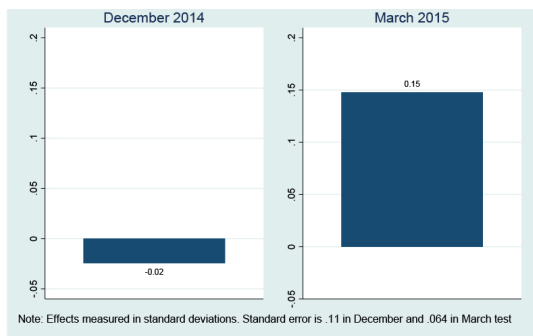
tested and surveyed, but not taught the material. 46% of all high schools contacted fully accepted the conditions. The final sample of 9th graders we use contains 3,055 students in the baseline measurement. Most of the analysis uses a balanced sample of 2,734 9th graders.

Given the evaluation calendar, we can test various hypotheses.

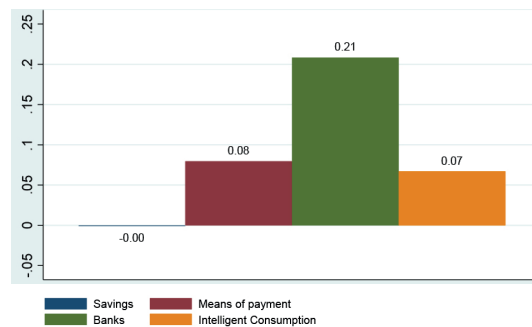
- Firstly, did the course increase financial knowledge and change attitudes and choices immediately after the course? We do this by comparing 9th graders in treated and control schools in March 2015.
- Regarding longer-run outcomes – a three-month period after the course was delivered – we can test two hypotheses. Firstly, we can test if financial knowledge is forgotten by comparing the results in June 2015 test of 9th graders in early and late treated schools. Secondly, we examine the impact of financial literacy courses on the preferences for current versus future income in an incentivized saving task conducted in June 2015. This is done by comparing choices of 9th and 10th graders – as the latter have not gone through the course.

We test all hypotheses by means of OLS regressions, controlling for the corresponding outcome observed in the baseline measurement in 2014. When the outcome of interest is the score in standardized tests of financial knowledge, we hold constant the score in the baseline test, and when the outcome is preferences for earlier payments, we hold constant preferences for current income elicited through hypothetical survey questions in December 2014.

1 DIFFERENCES IN FINANCIAL LITERACY TEST
Standardized scores, 3° ESO



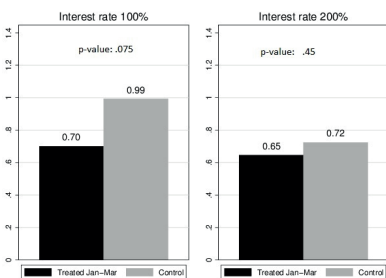
2 DIFFERENCES IN FINANCIAL LITERACY TEST BY TOPIC
Standardized scores, 3° ESO



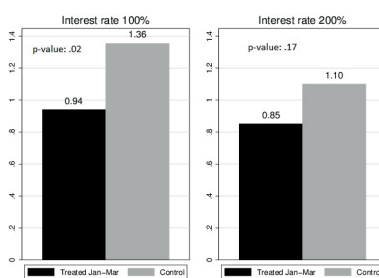
The Panel on the left side shows the difference in normalized scores in financial knowledge tests between treated and control 9th graders in December 2014 (baseline) and in March 2015 (after students treated in January-March 2015 had received the course). The Panel on the right side splits the gain in financial knowledge in the March 2015 test by topic. The sample size is 2734 students from 77 high schools.

EUROS ALLOCATED TO EARLIER PAYMENT BY TREATED AND CONTROL GROUPS IN INCENTIVIZED SAVING TASK. June 2015

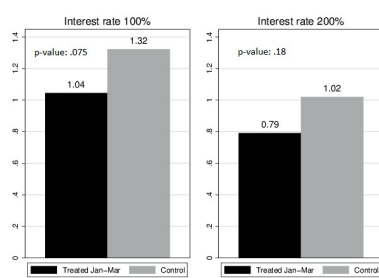
1 TODAY VS. ONE WEEK



2 TODAY VS. TWO WEEKS



3 ONE WEEK VS. TWO WEEKS



Treated students are 9th graders in Madrid receiving the course between January and March 2015. Controls are all 10th graders in Madrid. Estimates are means, unadjusted by covariates or strata. Choices inconsistent with the law of demand are included.

Results

4.1 Financial knowledge

Figure 1 summarizes the impact of the course on the score on a financial literacy test. The score is the fraction of correct answers in a test containing 30 items developed and tested by educational experts. As shown in the left-hand panel of Figure 1, baseline differences across treated and control schools were negligible in December 2014. By March 2015 9th graders in treated schools increased their performance in the financial knowledge test by 15 percent of one standard deviation. It is convenient to compare the magnitude of the estimate with the impact of parental background on financial knowledge, measured by the 2012 financial PISA assessment. In Spain, the differences in performance in the financial PISA assessment between students whose parents had skilled

occupations (say, a lawyer) and with a mid-skill occupation (say, an accountant) were 30% of one standard deviation. The impact of the course on financial knowledge is half as large as that difference. Finally, as of June 2015, there were no noticeable differences between two groups, once the second group had also received the material. That finding is consistent with the notion that the material is not forgotten quickly.

Turning to the specific knowledge acquired through the course, we find that the program mostly affected knowledge of banking relationships—i.e, bank accounts, interest rate compounding and bank fees. The improvement in budgeting ability (for example, allocating expenses and incomes into fixed or variable) was very limited, possibly because knowledge on the topic was already high at baseline. In contrast, banking relationships (bank accounts, interest rate compounding, bank fees) were the topic where students performed worst on in the baseline.

4.2. Behavior in incentivized saving tasks (Convex Time Budget Task)

Students may forget financial knowledge if it is not put into practice. However, the course may have a lasting impact to the extent that the intervention also changes students' attitudes. We tested formally for changes in attitudes by having students allocate 6 euros between two different moments in time at varying interest rates – a Convex Time Budget Task.³ Each student was asked to make three different choices. The first decision allocated resources between the day of the test or one week later. The second allocated between the day of the test and two weeks later, and the third between one and two weeks from the day of the test. Students could allocate to the earlier payment either all the resources (6 euros), 2/3 of the resources (4 euros), 1/3 (2 euros) or nothing at all. For each decision, and depending on the specific treatment, the amount not allocated to the earlier payment accumulated at two interest rates: 100% and 200%.

Payments were made in terms of USBs with different storage capacities, roughly corresponding to market values. One student randomly chosen in each class would receive one of his/her own choices.

The results in Figure 2 show that students having gone over the course between January and March 2015 allocated less euros to the earlier payment at each possible maturity. For example, when given the possibility to allocate 6 euros between the present day or one week later at a 100% interest rate, 9th graders going through the course in January-March 2015 allocated 70 cents to the day of the test (out of the 6 euros) while controls allocated thirty cents more (the standard error is 17 cents). Not surprisingly, the reduction in present payments is more salient for the 100% interest rate choice than for the 200% one. Interestingly, that result is consistent with answers in hypothetical choices between current and future income stated in the March 2015 survey.

Results by type of school

The impact of financial education is likely to be heterogeneous across different groups of the population. Firstly, as financial literacy correlates with parental income and education, students of better-off parents may be more likely to acquire that financial knowledge at home. Therefore, one could expect that financial courses in school would be most effective for disadvantaged students. On the other hand, interest in

certain financial matters may only pay off for students who have a minimum level of wealth. In that case, the intervention would primarily benefit better-off students.

The design of the evaluation permits us to identify differential impacts by parental background. School type is a strong predictor of parental background, as students in public schools are more likely to have repeated a grade than students in non-public ones (28% vs 16%), and expect to abandon their studies earlier (71% vs 82% expect to finish college). The fact that randomization was conducted within groups of schools (public or non-public) guarantees that, within those strata, students have comparable observed and unobserved characteristics.

We focus here on two main outcomes of those shown in Table 2. The first is financial knowledge, measured right after the course was taken. The average impact on knowledge is remarkably similar across both sets of schools, and amounts to 17 percent of one standard deviation. However, the distribution of the effect is very different across schools. In public schools, receiving financial literacy material diminishes the fraction of students who perform poorly. Namely, the fraction of treated students who get less than 25% of the questions right falls by 4 percentage points. Conversely, in non-public schools the fraction of low achievers does not change. The working paper summarized here argues that this impact may be associated to grade repeaters.

Turning to attitudes, students in public schools treated between January and March allocated 37 cents less to the earlier payment than controls, while the corresponding difference among students in non-public schools is 6 cents. While we cannot reject the null of equal coefficients, the results suggest that when we measure preferences for time using an incentivized saving task, exposure to financial education changed financial decision-making of students in strata with a relatively poorer background.

Discussion

Recent studies have documented that introducing financial education in high school is effective in increasing financial knowledge, although little is known about whether all sorts of students benefit from that training and what contents reach students better. Our results show that financial education increases standardized test scores by 15% of one standard deviation. In terms of knowledge, students learnt most about the functioning of savings and borrowing products – *i.e.*, about the opportunity cost of

³ See Andreoni and Sprenger (2012).

| | Public | Non-Public | |
|--------------------------------------------------------------------------------|-------------------|------------------|--------------------------------------------------|
| Panel A: Sample characteristics, by stratum | | | |
| Foreign born | 0.14 | 0.07 | |
| Older than normal progression | 0.28 | 0.16 | |
| Father is self-employed | 0.24 | 0.32 | |
| Father works as an employee | 0.57 | 0.55 | |
| Father does not work | 0.14 | 0.09 | |
| Expects to leave at 16 | 0.05 | 0.02 | |
| Expects to finish at most HS academic track | 0.12 | 0.07 | |
| Expects to finish at most HS vocational training | 0.11 | 0.08 | |
| Expects to finish college | 0.71 | 0.82 | |
| Number of students (schools) | 1,646 (42) | 671 (24) | |
| Panel B: Impacts of financial education on knowledge and attitudes, by stratum | | | |
| B.1 Score in financial knowledge tests | | | H ₀ : Equal coefficients [p-value] |
| 1 Standardized test score | .170 (.096)* | .173 (.075)** | [.971] |
| 2 Fraction with less than 25% questions correct | -.040 (.018)** | .003 (.009) | [.043] |
| 3 Fraction with less than 35% questions correct | -.058 (.030)** | .020 (.027) | [.059] |
| 4 Fraction with less than 50% questions correct | -.052 | -.070 | |
| B.2 Attitudes | | | |
| 5 Talks to parents | .079 (.077) | .152 (.072)** | [.356] |
| 6 Prefers delayed hypothetical income | .021 (.016) | .038 (.016)** | [.441] |
| B.2 Sources of income | | | |
| 7 Money for chores at home/family business | .026 (.031) | .086 (.032)** | [.069] |
| 8 Money for occasional jobs outside home | -.009 | .037 | |
| 9 Other source of income | (.016) | (.027) | [.505] |
| B.5 Incentivized saving task (Madrid) | | | |
| 10 Euros allocated to the earlier date | -.37 (.20)* | -.065 (.14) | [.271] |

NOTES: In panel B, each cell shows the estimate and standard error (S.E) of the variable "Treated" in a regression where the dependent variable is shown in the row and covariates include the lagged dependent variable and strata dummies. All coefficients estimated by OLS but the one in row 6, which is the latent coefficient of an ordered Probit, and standard errors are clustered at the school level. *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1.

transferring resources over time. When given the option to transfer resources between two moments in time at a given interest rate, students exposed to financial education assigned lower amounts to earlier payments than those that did not. Both findings are consistent with the notion that financial education changes the awareness of students about the future consequences of current choices. However, our results do not indicate that financial literacy courses change students' behavior by teaching them how to

elaborate a budget or how to avoid conspicuous consumption.

Secondly, comparing results across school types we find that the average impact of financial literacy on financial knowledge is similar in public and non-public schools, while in public schools only we find decreased inequality in financial literacy scores after the course. Separate analyses suggest that impacts on financial test scores are largest among grade

repeaters or among students who expect to drop out earlier. When it comes to incentivized saving tasks, the impact of financial literacy on measures of patience is higher in public- than in non-public schools, although the difference is not statistically significant. At any rate, we find that exposure to financial literacy increases incentivized measures of patience in public schools.

The time span of the intervention does not allow us to answer the question posed at the beginning of this summary: “Does financial education delivered in high school help in achieving better financial outcomes in adulthood?” We note however that we find changes in attitudes –in particular, patience- within a group that is at the verge of taking important lifetime decisions. Our current efforts are directed to following participant students and addressing whether financial education changes outcomes later in life.

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Introduction

The recent financial crisis has sparked a debate about the influence of monetary policy on the risk-taking behavior of the banking sector. A number of recent studies such as Jimenez *et al.* (2014), Buch *et al.* (2014) and Ioannidou *et al.* (2014) show that low interest rates increase the risk appetite of banks, creating an additional channel of monetary policy transmission, known as the risk-taking channel. Though there has been much discussion of this channel amongst policy makers in recent years, its general equilibrium and optimal monetary policy implications remain unclear. Answering these questions requires a quantitative model that is consistent with both the evidence on the risk-taking channel and with conventional views about monetary policy. Our contribution is to build and estimate a medium-scale New Keynesian DSGE model where monetary policy influences bank risk taking, which in turn affects the real economy.¹ Furthermore, we provide analytical results which show how the inefficiency of risk taking depends on the volatility of the real interest rate, implying a motive for the policy maker to stabilize the real interest rate, at the cost of greater inflation volatility. This constitutes a new trade-off that influences optimal monetary policy in a quantitatively significant way.

Model

We propose a New Keynesian general-equilibrium model with banks. The real economy follows the well-known workhorse model of Smets and Wouters (2007). For brevity it suffices to say that it features both wage and price rigidities as well as consumption habits and investment adjustment costs. The novel building block is the banking sector, which builds on Dell’Ariccia *et al.* (2014) and which we represent here in a simplified way.

Each period t , a continuum of banks raise funds from the household through deposit and equity contracts; then they use these funds to invest in risky capital projects. These projects turn into capital next period, which is then rented to the firms. Hence, banks face a

two-stage problem, which can conveniently be solved backwards, starting with the second-stage investment choice. At this stage banks have already raised equity and deposits and now choose from a continuum of investment projects with different risk-return characteristics. Each bank can invest in only one project. Each project has its own success probability, q_t . If successful, it yields $(\omega_1 - \frac{\omega_2}{2} q_t)$ units of capital in the next period; otherwise it fails and yields nothing. Thus, the expected return on one unit of investment is $f(q_t) \equiv q_t (\omega_1 - \frac{\omega_2}{2} q_t)$. This implies the return to a project *in the event of success* increases in its riskiness, but the *expected* return is concave function, as shown by the solid line in Figure 1. The bank chooses the risk level of its investment in order to maximize the expected return of the investment minus the cost of deposits.

Two distinct frictions are relevant at this stage. First, we assume that depositors cannot observe the bank’s risk choice, and hence cannot condition the deposit rate on it. Second, bank equity holders, who manage the bank, are protected by limited liability. Hence, they default on the deposit liabilities in case the investment fails. Now, denote the deposit rate by $r_{d,t}$, the equity ratio by k_t , and the expected value of one unit of capital tomorrow² by $r_{l,t}$. Suppressing aggregate uncertainty and the stochastic discount factor in order to simplify the exposition,³ the bank’s second stage problem is

$$\max_q q (\omega_1 - \frac{\omega_2}{2} q) r_{l,t} - q r_{d,t} (1 - k_t). \tag{1}$$

Figure 1 represents this problem graphically. While the solid line traces out the expected return of the investment, the dashed line depicts the bank’s objective function, *i.e.* the expected return to the leveraged bank’s investment under limited liability and unobservability of the risk choice.

As the figure shows, these two frictions together constitute an agency problem, which leads to an incentive for *risk shifting*: the bank chooses a level of

¹ Risk taking on the liabilities side of banks in the context of DSGE models is analyzed in papers such as Angeloni and Faia (2013), Angeloni *et al.* (2015). Asset risk taking is typically analyzed from a primarily regulatory perspective such as in Christensen *et al.* (2011) and Collard *et al.* (2012).

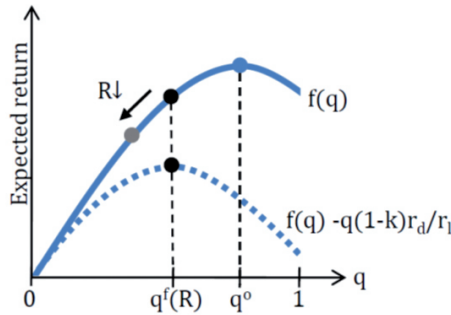
² $r_{l,t}$ is given by sum of the expected rental rate obtained when renting capital to the firms plus the resale value of the depreciated stock of capital.

³ See Working Paper 1805 for the complete exposition.

risk that is higher than the one which maximizes the expected return $f(q_t)$. This is because, on the one hand, limited liability implies that the bank benefits fully from the upside risk of the investment but suffers only partially from its downside risk. On the other hand, due to unobservability, depositors can't discipline the bank's incentives by conditioning the deposit rate on risk.

THE BANK'S RISK CHOICE

FIGURE 1



NOTES: The solid line is the expected return of the investment as a function of the level of safety q chosen. The dashed curve describes the return on equity, which is maximized at the second stage for given r_d , r_i and k . Its maximum is marked by the black dot. A reduction in the real rate R implies higher leverage (a lower equity ratio k), shifting the dashed curve down and left, which leads to a lower choice of q (gray dot).

At stage 1 banks raise their funds. They choose both deposits and equity, but in equilibrium they will be indifferent about their size, so it suffices to analyze the banks' choice in terms of the equity ratio k_t (equity over deposits). Households supply deposits and equity according to the following supply schedules (again, suppressing the stochastic discount factor):

$$r_{d,t} q_t = R_t \quad \text{and} \quad r_{e,t} q_t = R_t + \zeta.$$

Here q_t denotes the solution to the second stage problem, R_t is the gross nominal return on safe government bonds divided by expected inflation, and ζ is an exogenous equity premium. $r_{d,t}$ denotes the *ex ante* fixed gross nominal deposit rate divided by expected inflation, and $r_{e,t}$ the expected uncertain real return on equity. Two details are important: first, equity is assumed to be ζ units more expensive than deposits. One interpretation of this excess equity premium ζ is a management cost.⁴ Second, both depositors and equity providers anticipate the risk choice in stage 2 correctly. The bank's equity provider, who manages the bank, chooses the equity ratio so as to maximize his profits net of his opportunity cost:

⁴ Notice that ζ is an excess premium. It makes equity more expensive over and above the compensation for aggregate risk. (Recall that aggregate risk is suppressed in the notation here.)

$$\max_k q(k) \left(\omega_1 - \frac{\omega_2}{2} q(k) \right) r_{i,t} - q(k) r_{d,t} (1-k) - q(k) r_{e,t} k \quad (2)$$

subject to the above supply schedules.

Furthermore, we shall assume that banks can enter the market each period freely, such that the excess return on equity, *i.e.* the return net of opportunity costs given by (2), has to be zero in equilibrium. Given these assumptions, and assuming interior solutions, the banks' equilibrium choices for their equity ratio and the riskiness of their investments are

$$k_t^* = \frac{R_t}{(R_t + 2\zeta)} \quad (3)$$

$$q_t^* = \frac{\omega_1 (\zeta + R_t)}{\omega_2 (2\zeta + R_t)} \quad (4)$$

These solutions have three noteworthy features. First, as mentioned before and shown in Figure 1, banks' risk choices are excessive: they choose a success probability q_t^* lower than the probability $q^o \equiv \omega_1 / \omega_2$ that maximizes the expected return. Second, notice that these choices depend on R_t , the expected safe real rate of the economy. In particular, both the equity ratio k_t^* and the success probability q_t^* increase with R_t . That is, lower interest rates are associated with higher risk taking, just as the empirical literature suggests. Why? A lower risk-free rate increases the relative cost advantage of deposits, since the equity premium becomes more important in relative terms. Banks respond by leveraging up and choose riskier investment projects. Third, notice that the efficiency of the bank's investment choice, measured by the expected return $q_t(R_t)$ of its investment, is an increasing and concave function of the interest rate R_t . That is, lower interest rates lead to higher risk taking, which in turn implies a lower expected return of investment. Furthermore, concavity implies that this effect is stronger, the lower the interest rate, as seen in Figure 1.

In the paper we extend this simple model to allow for a recovery rate for failed investment projects, partial deposit insurance, and a generic relationship between the safeness q_t of an investment and its expected return $q_t(R_t)$, and show that the above results still go through.

Implications for monetary policy

Introducing the risk-taking channel into a macro model has two implications for monetary policy.

First, lower real interest rates, by increasing the risk choice of banks, *ceteris paribus*, *i.e.* holding constant investment, lead to a decline in the capital stock in

general equilibrium. Hence, our model generates a new transmission channel through which monetary policy affects the real economy, which offsets the positive effects of expansionary monetary policy, as reductions in the interest rate exacerbate the financial market distortions and their implied inefficiency. We validate the quantitative implications of the model by estimating it on US data with Bayesian methods. We use the same 7 time series⁵ as Smets and Wouters (2007) and focus on the Great Moderation period, 1984Q1 to 2007Q3. Posterior odds show that the inclusion of the risk-taking channel improves the in-sample fit for non-financial variables. At the same time our model predicts a path of risk taking that matches survey evidence on the riskiness of newly issued loans from the Fed Survey of Terms of Business Lending.

But more importantly, the risk-taking channel has normative implications. Since the efficiency of investment is linked to the real rate through banks' risk choice, monetary policy affects allocative efficiency in this economy not only through the conventional channels related to price rigidities, but also through the risk-taking channel. In particular, higher rates imply higher efficiency of the banks' risk choice. Hence, the policy maker may want to raise the average level of real interest rates. However, under long-run neutrality of monetary policy this is not possible; monetary policy can only affect real interest rates in the short run.

But that does not mean that the risk-taking channel is irrelevant for the policy maker. As we just argued, the expected return on investment $f(q_t^*(R_t))$ is a concave function of the real rate. That means that even if monetary policy can not affect the average level of R_t , it can affect the average level of $f(q_t^*(R_t))$ through the volatility of R_t . In particular, the more stable the real rate, the higher the expected return of investment. Mathematically, this is a result of Jensen's inequality. Intuitively, this is because movements of the rate downwards have a negative effect on the expected return that is stronger than the positive effect of upward movements of the same size.

Hence, the risk-taking channel generates a motive to stabilize the real interest rate, because this ameliorates the average inefficiency in the financial sector. This however requires more muted responses of the interest rate to inflation deviations. Thus, stabilizing the real rate comes at the expense of greater inflation volatility, which, is undesirable in a framework with nominal rigidities. Therefore, the risk-taking channel generates

⁵ Hours worked, inflation, the fed funds rate, and the growth rates of real hourly wage, real GDP per capita, real consumption per capita and investment per capita.

a new trade-off between the conventional objective of inflation stabilization and the new objective of interest rate stabilization. Still, one may also wonder whether this finding is of any quantitative significance. Is this new channel strong, affecting optimal monetary policy in a quantitatively significant manner? After all, previous studies have found that inflation stabilization is a rather robust policy objective.

Our estimated model allows us to answer this quantitative question. To do so, we determine optimal simple monetary policy rules both in our model of the risk-taking channel and in the benchmark Smets and Wouters (2007) model.⁶ That is, we consider a Taylor-type interest rate setting rule and optimize its parameters for each of the two models. For example, consider the rule

$$\hat{R}_t^n = \phi_\pi \hat{\pi}_t + \phi_y \hat{y}_t \quad (5)$$

This is a standard Taylor rule, in which the central bank sets its nominal interest rate in response to deviations of inflation $\hat{\pi}_t$ and output \hat{y}_t from steady state (deviations are denoted by the hat). For comparability, the parameters we use are the same in both models and are those which we estimated for our model with the risk-taking channel.⁷ The table shows the resulting policy parameters. We observe that in the presence of the risk-taking channel the central bank responds much less strongly to inflation (the inflation coefficient is cut by more than half), its primary concern in the model without risk taking.

OPTIMAL SIMPLE RULES TABLE 1

| Smets and Wouters (2007) model (S) | | Model with risk taking (O) | | Welfare difference in % of cons. equ. |
|------------------------------------|----------|----------------------------|----------|---------------------------------------|
| ϕ_π | ϕ_y | ϕ_π | ϕ_y | |
| 7.1 | 0.12 | 3.08 | 0.13 | 0.48 |

NOTES: The first four columns show the optimal Taylor rule coefficients. The last column reports the difference in welfare between the two rules in the model with risk taking.

Next, we compare the performance of the two rules in the model with risk taking. We shall refer to them as rules S (optimal in the Smets and Wouters model) and O (optimal with risk taking). This comparison has an interesting interpretation. Suppose that the actual economy features the risk-taking channel, but the

⁶ Note that our model collapses to this benchmark model if any of the three frictions (incomplete contracts, limited liability, equity premium) is removed.

⁷ In the paper we show that our results are robust to estimating each model separately. We also consider a wider set of policy rules.

central bank is unaware of this channel and believes that risk cannot be influenced by the interest rate. The central bank would then implement rule S, *i.e.* optimal policy based on a wrong model. Our comparison then answers the question of how important it is to understand the risk-taking channel.

We find that applying the truly optimal rule O instead of rule S leads to a marked decline in the volatility of the real interest rate (−48%) and the banks' risk choice q , (−42%) and an equally important increase of inflation volatility (+52%).⁸ While the direction of this change was foreseeable based on the previous discussion, the magnitude of the effect appears significant. This strong reduction in the second moment of the real rate has a sizable effect on the first moment (the average) of the expected return on investment, which increases by about 0.5%. This higher investment efficiency in turn increases welfare. Indeed, we find that expected welfare (expressed in terms of lifetime consumption equivalent) is roughly 0.5% higher if the central bank applies rule O instead of rule S. Thus, the risk-taking channel appears quantitatively important.

In the paper we also show that a policy rule with persistence can do even better and that in our model there is no strong reason for the central bank to respond to leverage. This is because leverage itself is a function of the interest rate, so including leverage explicitly in the policy rule is not necessary.

Conclusion

Summing up, the paper discussed here integrates a micro-founded model of the bank risk-taking channel into an otherwise standard New Keynesian framework. This channel is driven by three frictions in the financial sector: unobservability of risk taking, limited liability, and a cost advantage of deposits over equity. Due to

these frictions, real interest rate stabilization arises as a new objective for monetary policy. Estimating the model for US data, we conclude that this channel indeed affects the optimal conduct of monetary policy in a significant way.

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⁸ These numbers are reported under the ergodic distribution, calculated using a second order approximation of the model.

ON THE DIRECT AND INDIRECT REAL EFFECTS OF CREDIT SUPPLY SHOCKS

SUMMARY OF BANCO DE ESPAÑA WORKING PAPER N° 1809

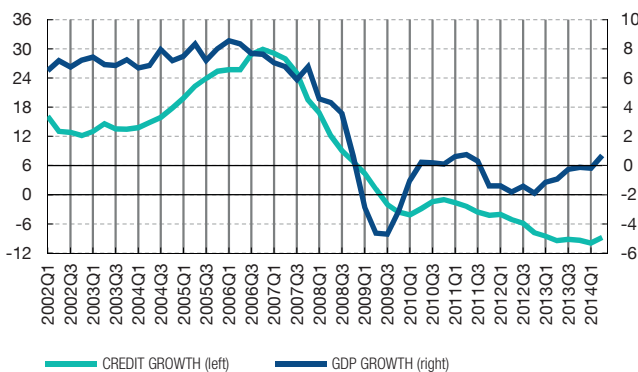
LAURA ALFARO, MANUEL GARCÍA-SANTANA AND ENRIQUE MORAL-BENITO

The Spanish economy witnessed an unprecedented boom-bust cycle over the 2002-2013 period, both in terms of real activity and credit. Indeed, the high correlation between the growth rate of credit to non-financial corporations and GDP points to strong feedback effects between both variables, as evidenced in Figure 1. The investigation of the link between credit shocks and real variables, however, poses several challenges. In terms of identification, one needs to disentangle the bank lending-channel (banks' ability or willingness to lend) from the firm borrowing-channel (firms' ability or willingness to borrow). Even after identifying the two channels separately, the intricate real consequences may depend on a firm's position in the value chain, involving direct and indirect effects via buyer-supplier (input-output) relations. So far, little empirical work has analyzed this channel. In this paper, we take crucial steps to address these challenges.

increase in firms' credit supply generates increases of 0.28 pp., 0.10 pp., and 0.79 pp. in the annual growth of employment, output, and investment, respectively. Similarly, a one standard deviation increase in our measure of how much firms buy inputs from industries in which credit supply expands (downstream effects) generates increases of 0.30 pp., 0.35 pp., and 0.69 pp. in the growth rates of employment, output, and investment.

Interestingly, the direct and indirect effects of bank credit supply shocks vary over time, being much stronger during the 2008-2009 credit collapse, when firms faced more difficulties in undoing bank-specific credit shocks. We find no significant effects of credit supply shocks on employment before the financial crisis, while investment displays similar reactions throughout the entire period.

NOMINAL GDP AND CREDIT GROWTH IN SPAIN FIGURE 1



Disentangling credit supply and demand

Consider a firm that has credit exposure with two different banks in year $t-1$. If this firm's credit grows more between $t-1$ and t with the first bank, we assume that the credit supply of the first bank has grown more than that of the second bank. The justification for this assumption is that demand factors are held constant by comparing the same firm in the same year with two different banks, so differences between the two credit growth rates can be attributed to the (bank) supply side. More formally, we consider the following regression:

$$\Delta \ln c_{ijt} = \delta_{it} + \lambda_{jt} + \epsilon_{ijt} \quad (1)$$

where $\Delta \ln c_{ijt}$ refers to the yearly average of outstanding credit of firm j with bank i in year t . δ_{it} and λ_{jt} can be interpreted as time-varying supply and demand shocks, respectively. To be more concrete, δ_{it} captures bank-specific effects identified through differences in credit growth between banks lending to the same firm.¹ This identification strategy resembles that of the bank lending channel by Khwaja and Mian (2008) but instead of considering observed bank supply shocks (e.g., liquidity shocks), we consider unobserved shocks

We combine administrative data for all firms in Spain with a matched bank-firm-loan dataset that incorporates information on the universe of corporate loans for 2003-2013 (Spanish Credit Registry, CIR). Using methods from the matched employer-employee literature for handling large data sets, we identify and estimate bank- and firm-specific shocks for each year in our sample. Using the Spanish input-output structure to construct firm-specific measures of upstream and downstream exposure, we estimate the direct and indirect effects of firm-specific exogenous credit supply shocks on real activity.

According to our estimates, both the direct and indirect propagation effects on real variables are sizable. We calculate that a one standard deviation

¹ Note that this identification scheme implies reliance on multi-bank firms, which represent approximately 75% of the bank-firm-year relationships in our sample.



estimated by means of bank-specific fixed effects, as in Amiti and Weinstein (forthcoming). Crucially, our strategy allows us to identify time-varying credit supply shocks, which will be a key ingredient for identifying real effects of credit shocks that differ between expansions and recessions.

In order to assess the plausibility of the bank-year credit supply shocks ($\hat{\delta}_{it}$), we divide our sample into healthy and weak banks, as in Bentolila *et al.* (forthcoming). Weak banks are those bailed out by the Spanish government in the aftermath of the global financial crisis, which were mainly savings banks (*cajas de ahorros*). The left panel of Figure 2 shows the year-by-year evolution of the average difference in credit supply shocks between healthy and weak banks as identified by the bank-year dummies ($\hat{\delta}_{it}$). Weak banks had higher supply shocks until 2006 and lower afterwards, which coincides with the narrative in Bentolila *et al.* (forthcoming). We interpret this evolution as clear evidence in favor of the plausibility of our estimated bank supply shocks.

We also validate our estimates using loan applications from the Spanish CIR. If our identified bank-year-specific credit shocks capture supply factors, a bank with a larger fixed effect should grant more loans. Loan application data enable us to test this hypothesis. We regress a loan granting dummy on the estimated bank-year shocks and a set of firm-year fixed effects to account for time-varying demand factors. Crucially, the bank-firm pairs used in this validation exercise are not used to estimate the bank-year shocks because they are not included in the loan application data, which only report information on loan applications to non-current banks. The right panel of Figure 2 plots the estimated coefficient associated to the estimated bank-year fixed effects (credit supply shocks) for each year. The effect of the bank-specific shocks is always positive, significantly so over most of the sample, which we interpret as

further evidence in favor of the validity of our identified bank supply shocks.

Direct real effects of credit shocks over the cycle

To estimate the effects of the bank lending channel on real outcomes, we match the credit registry information with annual, firm-level administrative data on different firm characteristics. We consider the effects of credit supply on firms' annual employment and output growth as well as investment as follows:

$$Y_{jt} = \theta \bar{\delta}_{jt} + \pi X_{jt} + v_{jt} \tag{2}$$

where Y_{jt} refers to employment growth (in terms of log-differences of number of employees), output growth (in terms of log-differences of euros), or investment (capital stock in t minus capital stock in $t-1$ as a share of total capital stock in t) of firm j in year t . $\bar{\delta}_{jt}$ represents a firm-specific credit supply shock constructed as a weighted average of the supply shocks estimated for all banks in a relationship with firm j , with weights given by each bank's share of credit with firm j in the previous period. X_{jt} represents a vector of firm characteristics, including the firm-specific credit demand shocks (λ_{jt}), as well as size dummies, the lagged loan-to-assets ratio, and lagged productivity. Finally, we also include a set of sector-year dummies.

Table 1 presents our estimates of the coefficient θ for employment growth, output growth, and investment over different subsamples. We find that aggregate economic conditions alter the effects of credit supply shocks on employment. For example, the estimated effect is not significant in the regression run for the expansion period of 2003-2007, but is positive and significant in the regressions run for the financial crisis of 2008-2009. In particular, our estimates suggest that in 2008-2009, an increase of one standard deviation in the credit supply shock is associated

| | Employment | | | Output | | | Investment | | |
|--------------|------------|-----------|-----------|-----------|-----------|-----------|------------|-----------|-----------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | 2003-2007 | 2008-2009 | 2010-2013 | 2003-2007 | 2008-2009 | 2010-2013 | 2003-2007 | 2008-2009 | 2010-2013 |
| Credit shock | 0.251 | 0.503*** | 0.243** | 0.060** | 0.152*** | 0.109*** | 0.821*** | 0.625*** | 0.711*** |
| (s.e.) | (0.153) | (0.149) | (0.111) | (0.028) | (0.032) | (0.024) | (0.173) | (0.087) | (0.080) |
| # obs | 1,823.859 | 810.335 | 1,430.182 | 1,765.665 | 764.699 | 1,342.639 | 1,763.184 | 783.316 | 1,391.738 |
| R2 | 0.042 | 0.055 | 0.035 | 0.040 | 0.075 | 0.042 | 0.034 | 0.016 | 0.011 |

NOTES: This table reports the effect of credit supply on employment, output and investment for the 2003-2007, 2008-2009, and 2010-2013 periods. Dependent variable is employment growth in % in columns (1)-(3); output growth in columns (4)-(6); and investment in columns (7)-(9). Credit Shock refers to the firm-specific credit supply shock of equation (2), normalized to have zero mean and unit variance. All regressions include industry-year fixed effects as well as the following controls: firm-specific credit demand shocks, size dummies, lagged loan-to-assets ratio, and lagged productivity. We denote significance at 10%, 5%, and 1% with *, **, and ***, respectively. Standard errors clustered at the main bank level are reported in parentheses.

with a 0.5 pp. increase in the employment growth rate (column 2). The average annual change in firm-level employment for the 2008-2009 period was -2.17% , which implies that the estimated effect represents 18% of the mean change in absolute value.

The effects of credit supply shocks on output are always significant. However, the effect is particularly strong during the financial crisis of 2008-2009: an increase of one standard deviation in the shock implies an increase in output growth of 0.15 pp. (column 5), approximately 9% of the absolute value of the actual change in output over the period (-1.75%). Turning to investment, we find that the estimated coefficients are significant at 1% across all specifications. In terms of magnitude, we find that a one standard deviation increase in the credit supply shock generates an increase in investment rates that varies from 0.6 pp. to 0.8 pp. The magnitude of the effect varies across the different periods. For the expansion period (2003-2007), the estimated effect represents approximately 6% of the actual average investment rate of 12.89% over the period. The estimated effect represents around 12% of the average investment rate of 5.11% during the financial crisis. During the recession period (2010-2013), the effect more than doubled the average investment rate of 0.59% observed in the data over those years.

Propagation of credit shocks through input-output linkages

Firms not directly hit by a credit supply shock may be affected through buyer-supplier relations. For instance, if a supplier of firm j is hit by a negative credit supply shock, the reaction of this supplier may also affect production of firm j . The indirect effects of credit supply shocks can operate through various channels,

from purchases or sales of intermediate inputs by the directly hit firms to changes in factor and goods prices in general equilibrium (see Acemoglu *et al.* 2012).

We exploit our firm-level information, combined with data on input-output linkages, to study the propagation of our identified bank-credit supply shocks. Specifically, following Di Giovanni *et al.* (2018), we combine firm-specific measures of usage intensity of material inputs and domestic sales with the sector-level input-output (IO) matrix, as in Alfaro *et al.* (forthcoming). We use IO relations for Spain for both downstream propagation (shocks from suppliers) and upstream propagation (shocks from customers). In practice, we do this by augmenting our previous empirical specification with two additional firm-level regressors. DOWN measures the indirect shock received by a given firm j from its suppliers (downstream propagation) and UP proxies for the indirect shock received by a given firm j from its customers (upstream propagation).² We thus consider the following empirical model:

$$Y_{jt} = \theta \bar{\delta}_{jt} + \pi X_{jt} + \theta_D \text{DOWN}_{jt} + \theta_U \text{UP}_{jt} + v_{jt} \quad (3)$$

If a negative credit supply shock hits firms operating in a given industry, the production in this industry will decrease, which is likely, in equilibrium, to make its output more expensive. Customer firms will then be forced to decrease production. DOWN is a proxy for this effect. In addition, when a negative credit supply shock hits firms operating in a given industry, their revenue and, hence, their demand for intermediate goods, is

² DOWN and UP can be understood as weighted averages of credit supply shocks hitting suppliers and customers, respectively. Weights are given by the intensity of the relationship of each firm with its suppliers and customers based on the Spanish IO structure (see the working paper for details).

| | Employment | | Output | | Investment | |
|--------------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | (1) 2003-2013 | (2) 2008-2009 | (3) 2010-2013 | (4) 2008-2009 | (5) 2003-2013 | (6) 2008-2009 |
| Mean annual growth (%) | 0.312 | -2.764 | 0.508 | -1.755 | 7.572 | 5.111 |
| Credit shock coefficient | 0.284*** | 0.482*** | 0.107*** | 0.155*** | 0.798*** | 0.576*** |
| Coef /mean annual growth | 0.91 | 0.17 | 0.21 | 0.09 | 0.10 | 0.11 |
| DOWN coefficient | 0.301*** | 0.697*** | 0.354*** | 0.646*** | 0.690*** | 1.263*** |
| Coef /mean annual growth | 0.96 | 0.28 | 0.70 | 0.37 | 0.09 | 0.25 |
| UP coefficient | 0.061 | -0.187 | 0.209*** | 0.459*** | 0.174 | 0.085 |
| Coef /mean annual growth | 0.19 | 0.60 | 0.41 | 0.26 | 0.02 | 0.02 |

NOTES: This table presents a summary of the estimated indirect effects from equation (3). We focus on the effects estimated for the entire period (2003-2013) and the financial crisis (2008-2009) period. Mean annual growth (%) refers to the simple average annual growth rate of the variable as measured in our final sample of firms for a particular period. Credit Shock coefficient, DOWN coefficient, and UP coefficient refer to the estimated coefficients. We denote significance at 10%, 5%, and 1% with *, **, and ***, respectively. Coef /mean annual growth is simply the absolute value of the estimated coefficient divided by the mean annual growth (%).

likely to go down. This will affect their supplier industries, which will be forced to scale down production. UP proxies for this indirect shock.

Table 2 summarizes our main findings. Over the entire sample period 2003-2013, indirect credit shocks through IO propagation have a significant effect on the evolution of firm-level employment, output and investment. This effect is driven by the financial crisis period (2008-2009), where the downstream propagation effect systematically dominates in magnitude the direct effect of credit shocks. Note also that for employment and value added, the coefficients estimated for the boom period (2003-2007) and the financial crisis (2008-2009) differ significantly, with p-values below 0.1 for the null of equality, for both the direct and the downstream indirect effects. For the case of investment, coefficients are different only for the downstream indirect effect. However, the differences in the estimated effects for the financial crisis (2008-2009) and the recession (2010-2013) are not statistically significant in the case of investment. Finally, evidence of the importance of the upstream propagation shock is mixed. Greater credit to a firm's customers significantly stimulates that firm's output, but does not have a significant impact on its employment or investment.

We perform several robustness tests of our findings. To ensure results are not driven by few observations, we restrict our sample of multi-bank firms to those with at least 5 banks per year. In order to account for bank-firm idiosyncratic factors, we include lagged exposure between bank i and firm j . We also consider two different subsamples for shock identification and real effects estimation.

Finally, the paper investigates the aggregate effects of financial shocks by using a general equilibrium model

with buyer-supplier relations subject to financial frictions, as in Bigio and La'o (2017). In particular, we aggregate our estimated credit supply shocks from the firm level to the industry level, in a way that makes them comparable over time. We then plug these shocks into the model and examine how they permeate the economy. We find that IO linkages significantly amplify the effects of credit supply shocks. The model predicts, for instance, that during the financial crisis, -0.60 pp. of annual employment growth between 2009 and 2010 was due to a negative credit supply shock (actual growth was -3.28%), with -0.29 pp. due to direct effects, and -0.31 pp. to propagation effects. We also use the model to investigate the relative importance of each sector in accounting for the aggregate effects. In particular, we focus on the financial crisis period and compute counterfactual economies in which we only shock one industry at a time. Perhaps not surprisingly, the sector that generates the largest output drop is the real estate sector. Our model predicts that shocking just the real state sector would generate an aggregate output loss of 0.24%. While it was hit particularly strongly by the credit supply shock at the time of the crisis, real estate is also intensively used by other sectors. In fact, our model predicts that around 50% of the 0.24% loss is explained by propagation of the shock to other sectors. We also find that shocking other central sectors like electricity services or wholesale would also generate large output losses.

Conclusion

Using the quasi-census of firms' loans and economic activity for Spain and data on input-output linkages, we analyze the real effects of bank-lending shocks during the period 2003-2013. This period allows us to study

firms' responses to different shocks during times of boom (expansion) and bust (financial crisis and recession).

Our results show that credit supply shocks affect the real economy through sizable direct and indirect effects on investment and output. Direct and indirect effects are quantitatively important during the financial crisis, but the impact cannot be generalized to other episodes. Overall, our results corroborate the importance of network effects in quantifying the real effects of credit shocks. More generally, our estimates show that the real effects of bank-lending shocks vary substantially between booms and busts.

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PUBLICATIONS

RECENT WORKING PAPERS

[LINK TO WORKING PAPERS PAGE](#)

[NORMS IN BARGAINING: EVIDENCE FROM GOVERNMENT FORMATION IN SPAIN](#)

THOMAS FUJIWARA AND CARLOS SANZ

WORKING PAPER N° 1741

Theories of multilateral bargaining and coalition formation applied to legislatures predict that parties' seat shares determine their bargaining power. We present findings that are difficult to reconcile with this prediction. We use data from 2,898 municipal Spanish elections in which two parties tie in the number of seats. The party with slightly more general election votes is substantially more likely to appoint the mayor (form the government). Since tied parties should, on average, have equal bargaining power, this identifies the effect of being the most voted due to a norm prescribing that "the most voted should form government." The effect of being most voted is comparable in size to the effect of obtaining an additional seat. This norm binds behavior even when the second and third most voted parties can form a winning coalition that prefers the most voted not to appoint the mayor. Voters punish, in future elections, second most voted parties that appoint mayors, suggesting that they enforce the norm. We document a similar second-versus-third most voted effect and provide suggestive evidence of similar norms from 28 national European parliaments. A model where elections play a dual role (aggregating information and disciplining incumbents) and different equilibria (norms) can occur is consistent with our results and yields additional predictions.

[GLOBAL IMBALANCES FROM A STOCK PERSPECTIVE](#)

ENRIQUE ALBEROLA, ÁNGEL ESTRADA AND FRANCESCA VIANI

WORKING PAPER N° 1742

After the recent crisis, a reduction was observed in global current account ("flow") imbalances. Even so, global disequilibria as measured in terms of countries' net foreign assets ("stock imbalances") kept increasing. This paper discusses whether stock imbalances have a stabilising or destabilising impact on countries'

accumulation of external wealth. That is, do creditor economies, by virtue of their positive stock of net foreign assets, keep accumulating – everything else equal – external wealth? Do debtor countries, due to their negative net foreign assets position, keep accumulating external debt? Our results show that in debtor economies the existing stock of net debt helps to limit current account deficits, thus halting future debt accumulation. In creditor countries, however, the positive stock of net foreign assets contributes – everything else equal – to increase future current account surpluses, potentially leading to destabilising dynamics in wealth accumulation. This asymmetry between creditors and debtors holds in spite of the stabilising impact that net foreign assets have on the trade balance of creditor countries through real exchange rate fluctuations, and might have major implications for global trade and growth.

[MAKING ROOM FOR THE NEEDY: THE CREDIT-REALLOCATION EFFECTS OF THE ECB'S CORPORATE QE](#)

ÓSCAR ARCE, RICARDO GIMENO AND SERGIO MAYORDOMO

WORKING PAPER N° 1743

We analyse how the European Central Bank's purchases of corporate bonds under its Corporate Sector Purchase Programme (CSPP) affected the financing of Spanish non-financial firms. Our results show that the announcement of the CSPP in March 2016 significantly raised firms' propensity to issue CSPP-eligible bonds. The flipside was a drop in the demand for bank loans by these firms. This drop in the demand for credit by bond-issuers, which are usually large corporations, unchained a positive and significant side effect on the flow of new loans extended to – typically smaller – firms that do not issue bonds. Specifically, we find that around 78% of the drop in loans previously given to bond issuers was redirected to other companies, which led them to raise investment. This reallocation of credit was amplified by the ECB's Targeted Longer Term Refinancing Operations (TLTRO).

CLUSTERING REGIONAL BUSINESS CYCLES

M. D. GADEA-RIVAS, ANA GÓMEZ-LOSCOS AND EDUARDO BANDRÉS
WORKING PAPER N° 1744

The aim of this paper is to show the usefulness of Finite Mixture Markov Models (FMMMs) for regional analysis. FMMMs combine clustering techniques and Markov Switching models, providing a powerful methodological framework to jointly obtain business cycle datings and clusters of regions that share similar business cycle characteristics. An illustration with European regional data shows the sound performance of the proposed method.

MARRIAGE AND HEALTH: SELECTION, PROTECTION, AND ASSORTATIVE MATING

NEZIH GUNER, YULIYA KULIKOVA AND JOAN LLULL
WORKING PAPER N° 1745

Using data from the Panel Study of Income Dynamics (PSID) and the Medical Expenditure Panel Survey (MEPS), we analyze the health gap between married and unmarried individuals of working-age. Controlling for observables, we find a gap that peaks at 10 percentage points at ages 55-59 years. The marriage health gap is similar for men and women. If we allow for unobserved heterogeneity in innate health (permanent and age-dependent), potentially correlated with timing and likelihood of marriage, we find that the effect of marriage on health disappears below age 40 years, while about 5 percentage points difference between married and unmarried individuals remains at older ages (55-59 years). This indicates that the observed gap is mainly driven by selection into marriage at younger ages, but there might be a protective effect of marriage at older ages. Exploring the mechanisms behind this result, we find that better innate health is associated with a higher probability of marriage and a lower probability of divorce, and there is strong assortative mating among couples by innate health. We also find that married individuals are more likely to have a healthier behavior compared to unmarried ones. Finally, we find that health insurance is critical for the beneficial effect of marriage.

DID THE BANK CAPITAL RELIEF INDUCED BY THE SUPPORTING FACTOR ENHANCE SME LENDING?

SERGIO MAYORDOMO AND MARÍA RODRÍGUEZ-MORENO
WORKING PAPER N° 1746

The introduction of the SME Supporting Factor (SF) allows banks to reduce capital requirements for credit risk on exposures to SME. This means that banks can

free up capital resources that can be redeployed in the form of new loans. Our study documents that the SF alleviates credit rationing for medium-sized firms that are eligible for the application of the SF but not for micro/small firms. These results suggest that European banks were aware of this policy measure and optimized both their regulatory capital and their credit exposures by granting loans to the medium-sized firms, which are safer than micro/small firms.

CREDIT SHOCKS AND THE EUROPEAN LABOUR MARKET

KATALIN BODNÁR, LUDMILA FADEJEVA, MARCO HOEBERICHTS,
MARIO IZQUIERDO PEINADO, CHRISTOPHE JADEAU AND ELIANA VIVIANO
WORKING PAPER N° 1747

More than five years after the start of the Sovereign debt crisis in Europe, its impact on labour market outcomes is not clear. This paper aims to fill this gap. We use qualitative firm-level data for 24 European countries, collected within the Wage Dynamics Network (WDN) of the ESCB. We first derive a set of indices measuring difficulties in accessing the credit market for the period 2010-13. Second, we provide a description of the relationship between credit difficulties and changes in labour input both along the extensive and the intensive margins as well as on wages. We find strong and significant correlation between credit difficulties and adjustments along both the extensive and the intensive margin. In the presence of credit market difficulties, firms cut wages by reducing the variable part of wages. This evidence suggests that credit shocks can affect not only the real economy, but also nominal variables.

MARKOV-SWITCHING THREE-PASS REGRESSION FILTER

PIERRE GUÉRIN, DANILO LEIVA-LEON AND MASSIMILIANO MARCELLINO
WORKING PAPER N° 1748

We introduce a new approach for the estimation of high-dimensional factor models with regime-switching factor loadings by extending the linear three-pass regression filter to settings where parameters can vary according to Markov processes. The new method, denoted as Markov-switching three-pass regression filter (MS-3PRF), is suitable for data sets with large cross-sectional dimensions, since estimation and inference are straightforward, as opposed to existing regime-switching factor models where computational complexity limits applicability to few variables. In a Monte Carlo experiment, we study the finite sample properties of the MS-3PRF and find that it performs favourably compared with alternative modelling approaches whenever there is structural instability in factor loadings. For empirical applications, we consider forecasting economic activity

and bilateral exchange rates, finding that the MS-3PRF approach is competitive in both cases.

DECENTRALIZED MULTINATIONAL BANKS AND RISK TAKING: THE SPANISH EXPERIENCE IN THE CRISIS

ISABEL ARGIMÓN

WORKING PAPER N° 1749

See Features section.

PERMISSIBLE COLLATERAL AND ACCESS TO FINANCE: EVIDENCE FROM A QUASI-NATURAL EXPERIMENT

BING XU

WORKING PAPER N° 1750

By allowing large classes of movable assets to be used as collateral, the Property Law reform transformed the secured transactions in China. Difference-in-differences test show firms operating with ex-ante more movable assets expand access to bank credit and prolong debt maturity. However, the reform does not seem to improve the efficiency of credit allocation, as debt capacity of ex-ante low quality firms expands the most following the reform. Credit expansion also does not lead to better firm performance. These findings are not driven by confounding factors such as improvements in creditor and property rights protection. Our results also cannot be explained by other important reforms which were introduced around the same time as the introduction of the Property Law. These include anti-tunneling and split-share reforms and amendments to the corporate tax structure in China. We conduct explicit robustness tests for these other reforms and hence contribute to the empirical literature on the reform process in China with new findings.

OPTIMAL DENSITY FORECAST COMBINATIONS

GERGELY AKOS GANICS

WORKING PAPER N° 1751

See Features section.

THE IMPACT OF HIGH SCHOOL FINANCIAL EDUCATION ON FINANCIAL KNOWLEDGE AND CHOICES: EVIDENCE FROM A RANDOMIZED TRIAL IN SPAIN

OLYMPIA BOVER, LAURA HOSPIDO AND ERNESTO VILLANUEVA

WORKING PAPER N° 1801

See Features section.

PRIVATE SAVING. NEW CROSS-COUNTRY EVIDENCE BASED ON BAYESIAN TECHNIQUES

IGNACIO HERNANDO, IRENE PABLOS, DANIEL SANTABÁRBARA AND JAVIER VALLÉS

WORKING PAPER N° 1802

The existing literature exhibits high uncertainty over the theoretical and empirical determinants of private world saving. This paper reports new evidence on the drivers of private saving by applying Bayesian techniques, using data from the world's 35 largest economies in the period 1980-2012. After reviewing the main theories of consumption and saving decisions, and discussing the potential effects of different determinants, we specify a general model that incorporates the most commonly used factors in the literature, considering the potential endogeneity of some of the regressors. The Bayesian Model Averaging (BMA) approach summarises the information embedded in all combinations of the explanatory variables considered by averaging each specification according to its likelihood. We find that in the medium term private credit to GDP ratio, the government surplus to GDP ratio, the terms of trade, life expectancy and the old-age dependency ratio are key determinants of cross-country private saving behaviour. Lastly, we assess the long-term effect of expected demographic changes in private saving globally.

TERM STRUCTURE AND REAL-TIME LEARNING

PABLO AGUILAR AND JESÚS VÁZQUEZ

WORKING PAPER N° 1803

This paper introduces the term structure of interest rates into a medium-scale DSGE model. This extension results in a multi-period forecasting model that is estimated under both adaptive learning and rational expectations. Term structure information enables us to characterize agents' expectations in real time, which addresses an imperfect information issue mostly neglected in the adaptive learning literature. Relative to the rational expectations version, our estimated DSGE model under adaptive learning largely improves the model fit to the data, which include not just macroeconomic data but also the yield curve and the consumption growth and inflation forecasts reported in the Survey of Professional Forecasters. Moreover, the estimation results show that most endogenous sources of aggregate persistence are dramatically undercut when adaptive learning based on multi-period forecasting is incorporated through the term structure of interest rates.

INTERNATIONAL CO-MOVEMENTS IN RECESSIONS

MORITZ A. ROTH

WORKING PAPER N° 1804

Business cycle correlations are state-dependent and higher in recessions than in expansions. In this paper, I suggest a mechanism to explain why this is the case. For this purpose, I build an international real business cycle model with occasionally binding constraints on capacity utilization which can account for state-dependent cross-country correlations in GDP growth rates. The intuition is that firms can only use their machines up to a capacity ceiling. Therefore, in booms the growth of an individual economy can be dampened when the economy hits its capacity constraint. This creates an asymmetry that can spill-over to other economies, thereby creating state-dependent cross-country correlations in GDP growth rates. Empirically, I successfully test for the presence of capacity constraints using data from the G7 advanced economies in a Bayesian threshold autoregressive (T-VAR) model. This finding supports capacity constraints as a prominent transmission channel of cross-country GDP asymmetries in recessions compared to expansions.

MONETARY POLICY AND THE ASSET RISK-TAKING CHANNEL

ANGELA ABBATE AND DOMINIK THALER

WORKING PAPER N° 1805

See Features section.

MONEY IN SPAIN. NEW HISTORICAL STATISTICS. 1830-1998

PABLO MARTÍN-ACEÑA

WORKING PAPER N° 1806

The purpose of this Working Paper is to present a reconstruction of the main monetary aggregates for the period 1830, when the first modern banknotes were issued, to 1998, the last year before the substitution of the peseta by the euro. It offers series for currency in circulation and its components, bank deposits and its components, high-powered money and the money supply. With regard to previous monetary historical statistics, this Working Paper improves the quality and the time-span of the series, covering a period of more than 150 years. The Working Paper offers also a short approach to the long-term evolution of the quantity of money in Spain and the changes in its composition. The sources and methodology employed are explained in detail.

FISCAL TRANSFERS IN A MONETARY UNION WITH SOVEREIGN RISK

GUILHERME BANDEIRA

WORKING PAPER N° 1807

This paper investigates the welfare and economic stabilization properties of a fiscal transfers scheme between members of a monetary union subject to sovereign spread shocks. The scheme, which consists of cross-country transfer rules triggered when sovereign spreads widen, is incorporated in a two-country model with financial frictions. In particular, banks hold government bonds in their portfolios, being exposed to sovereign risk. When this increases, a drop in a bank's equity value forces them to contract credit and to raise lending rates at the same time as they retain funds to build up their net worth. I show that, when domestic fiscal policy is not distortionary, fiscal transfers improve welfare and macroeconomic stability. This is because fiscal transfers can reduce banks' exposure to government debt, freeing credit supply to the private sector. On the contrary, when domestic fiscal policy is distortionary, fiscal transfers cause welfare losses, despite stabilizing the economy. This result arises because the distortions caused by funding the scheme outweigh the positive effects of fiscal transfers in smoothing the adjustment of the economy hit by the shock.

CREDIT CONSTRAINTS, FIRM INVESTMENT AND GROWTH: EVIDENCE FROM SURVEY DATA

MIGUEL GARCÍA-POSADA GÓMEZ

WORKING PAPER N° 1808

We assess the impact of credit constraints on investment, inventories and other working capital and firm growth with a large panel of small and medium-sized enterprises from 12 European countries for the period 2014-2016. The data come from the Survey on the access to finance of enterprises (SAFE), a survey that is especially designed to analyse the problems in the access to external finance of European SMEs. The key identification challenge is a potential reverse-causality bias, as firms with poor investment and growth opportunities may have a higher probability of being credit constrained. We implement several strategies to overcome this obstacle: proxies for investment opportunities, lagged regressors, random effects and instrumental variables. Our findings suggest that credit constraints, both in bank financing and other financing (e.g. trade credit), have strong negative effects on investment in fixed assets, while the impact on firm growth and working capital is less robust.

[ON THE DIRECT AND INDIRECT REAL EFFECTS OF CREDIT SUPPLY SHOCKS](#)

LAURA ALFARO, MANUEL GARCÍA-SANTANA AND ENRIQUE MORAL-BENITO
WORKING PAPER N° 1809

See Features section.

[BACKING THE INCUMBENT IN DIFFICULT TIMES: THE ELECTORAL IMPACT OF WILDFIRES](#)

ROBERTO RAMOS AND CARLOS SANZ
WORKING PAPER N° 1810

How do voters react to large shocks that are (mostly) outside the control of politicians? We address this question by studying the electoral effects of wildfires in Spain during 1983-2011. Using a difference-in-difference strategy, we find that a large accidental fire up to nine months ahead of a local election increases the incumbent party's vote share by almost 8 percentage points. We find that a rally-behind-the-leader effect best explains the results. A simple formalization of this mechanism yields an implication – that the effect should be larger for stronger (more voted) incumbents – that is supported by the data.

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[A SHORT-TERM FORECASTING MODEL FOR THE SPANISH ECONOMY: GDP AND ITS DEMAND COMPONENTS](#)

ANA ARENCIBIA PAREJA, ANA GÓMEZ LOSCOS, MERCEDES DE LUIS LÓPEZ AND GABRIEL PÉREZ QUIRÓS
OCCASIONAL PAPER N° 1801

This document describes the key aspects of the extended and revised version of Spain-STING (Spain, Short-Term INdicator of Growth), which is a tool used by the Banco de España for the short-term forecasting of the Spanish economy's GDP and its demand components. Drawing on a broad set of indicators, several dynamic factor models are estimated. These models allow the forecasting of GDP, private consumption, public expenditure, investment in capital goods, construction investment, exports and imports in a consistent way. We assess the predictive power of the GDP and its demand components for the period 2005-2017. With regard to the GDP forecast, we find a slight improvement on the previous version of Spain-STING. As for the demand components, we show that our proposal is better than other possible time series models.

[EVALUATING THE MACRO-REPRESENTATIVENESS OF A FIRM-LEVEL DATABASE: AN APPLICATION FOR THE SPANISH ECONOMY](#)

MIGUEL ALMUNIA, DAVID LÓPEZ-RODRÍGUEZ AND ENRIQUE MORAL-BENITO
OCCASIONAL PAPER N° 1802

The availability of a firm-level database that represents the productive sector of an economy at the aggregate level is a necessary condition to undertake both reliable policy analysis and economic research in multiple areas. In this paper, we document the construction of a new representative firm-level dataset for Spain using detailed micro-level information provided by firms to the Spanish Commercial Registry and the Bank of Spain. A comparison with National Accounts figures serves to illustrate that the new micro-dataset is able to replicate the growth rates of output, employment and wage bill of the private sector. Using official statistics from the National Institute of Statistics (INE), we show that the resulting dataset covers more than 80% of firms registered in the census over the years 2000-2013 and, more importantly, the resulting dataset replicates the firm size distribution of the Spanish non-financial market economy. The same representativeness analysis is done for the manufacturing sector indicating that this sector is particularly well-represented in the dataset.

[THE CHALLENGES OF PUBLIC DELEVERAGING](#)

PABLO HERNÁNDEZ DE COS, DAVID LÓPEZ RODRÍGUEZ AND JAVIER J. PÉREZ
OCCASIONAL PAPER N° 1803

The government debt-to-GDP ratios in the majority of euro area economies, including Spain, are at very high levels according to the available historical records. Economic research is conclusive in pointing out that bearing high levels of public debt ratios for an extended period of time can be damaging for economic growth. The economic literature also concludes that sustained high debt ratios create a source of vulnerability for the economy, in addition to lessening the stabilisation capacity of the public budget. Against this background, the reform of both the European Stability Pact and the Spanish budgetary stability law during the recent crisis strengthened the role of public debt in the budgetary framework. The simulations performed in this paper show that, under plausible macroeconomic assumptions, the public deleveraging process required by the Sustainability Pact for Spain will still imply a significant fiscal consolidation effort that has to be sustained over time.

FINANCIAL STABILITY JOURNAL

The Financial Stability Journal (Revista de Estabilidad Financiera) is a half-yearly journal published by the Banco de España that aims to act as a platform for communication and dialogue regarding issues related to financial stability, with a particular focus on prudential regulation and supervision. Its board of editors comprises internal and external professionals. All articles appearing in the journal, which may be authored by Banco de España staff or researchers from other institutions, are refereed by at least one member of the board of editors.

PRECISIONES DE LA EBA EN RELACIÓN CON DETERMINADOS ASPECTOS DEL GOBIERNO CORPORATIVO DE LAS ENTIDADES DE CRÉDITO

CARMEN ALONSO LEDESMA

ESTABILIDAD FINANCIERA 33, NOVEMBER 2017, 9-34

This paper provides a legal assessment of recently published EBA guidelines on corporate governance of credit institutions (GL/2017/12 and GL/2017/11). These guidelines were issued by the EBA in September 2017 in order to operationalize the requirements of Capital Requirements Directive IV (CRD IV), which adopted the Basel III bank regulation framework into European legislation. The author first discusses the broad objectives for corporate governance that motivate the extensive list of recommendations in the EBA guidelines. Furthermore, she considers the extra burden institutions face in accommodating these recommendations.

LA EVOLUCIÓN DE LA FRAGILIDAD FINANCIERA DE LAS EMPRESAS NO FINANCIERAS ESPAÑOLAS ENTRE 2007 Y 2015

ÁLVARO MENÉNDEZ AND MARISTELA MULINO

ESTABILIDAD FINANCIERA 33, NOVEMBER 2017, 35-54

The authors analyse the evolution of the degree of financial fragility of the Spanish non-financial corporate sector between 2007 and 2015 (the latest available year) on the basis of firms' risk exposures. The study presents statistics on potentially vulnerable firms and measures of fragility, differentiating on the basis of firm size and sector, and assesses the relative significance of vulnerable companies, both in terms of their employment and their debt. The results show that the number of firms classified as potentially vulnerable, according to the criteria used, grew significantly during the crisis and fell in the years of economic recovery,

although in 2015 fragility was still above pre-crisis levels. Moreover, greater vulnerability is observed to be concentrated among SMEs and, especially, in the construction sector. Given the continuation of the recovery over the two years following the cut-off date for the data used, the decline in fragility will foreseeably have continued into this more recent period.

Articles related to the First Financial Stability Conference of the Banco de España

The last four articles of Issue 33 of *Financial Stability Journal* are drawn from the First Financial Stability Conference which the Banco de España organized jointly with the Centro de Estudios Monetarios y Financieros (CEMFI) in May 2017 in Madrid in order to promote research and debate on matters related to financial stability. Participants at the conference included Mario Draghi, the President of the European Central Bank, and Luis M. Linde, the Governor of the Banco de España. The Conference was structured around six sessions in which twelve papers were presented and discussed, tackling subjects such as the role of macroprudential tools, the instruments available to address systemic risk, the trade-offs between different policy options and the efficiency of prudential policies in boosting credit growth in periods of economic weakness. A prominent event at the Conference was a panel discussion, chaired by Javier Suárez, of the book "*The countercyclical provisions of the Banco de España, 2000-2016*", which was published by the Banco de España and authored by Jesús Saurina and Carlos Trucharte.

PRESENTATION OF THE FIRST CONFERENCE ON FINANCIAL STABILITY AND OF THE PANEL *THE COUNTERCYCLICAL PROVISIONS OF THE BANCO DE ESPAÑA, 2000-2016*

RAFAEL REPULLO AND JESÚS SAURINA

ESTABILIDAD FINANCIERA 33, NOVEMBER 2017, 55-58

This article summarises the general aim and content of the First Financial Stability Conference.

PRESENTATION OF THE BOOK *THE COUNTERCYCLICAL PROVISIONS OF THE BANCO DE ESPAÑA, 2000-2016*

JESÚS SAURINA AND CARLOS TRUCHARTE

ESTABILIDAD FINANCIERA 33, NOVEMBER 2017, 59-68

This article discusses the history of countercyclical provisioning at the Banco de España, which pioneered the practice long before the macroprudential regulation of credit institutions became widespread. It highlights how provisions linked to credit growth can moderate

both expansions and contractions of credit. It also underscores the impact of the Spanish provisions as an inspiration for the countercyclical capital buffer established by the Basel Committee in 2010 and as a forerunner of the expected-loss concept in the IFRS 9 framework.

[THE COUNTERCYCLICAL PROVISIONS OF THE BANCO DE ESPAÑA, 2000-2016](#)

PEDRO DUARTE NEVES

ESTABILIDAD FINANCIERA 33, NOVEMBER 2017, 69-76

The author compares the Spanish countercyclical provisions with other, subsequent macroprudential instruments, such as the countercyclical capital buffer and the new provisioning framework introduced by IFRS 9.

[COUNTERCYCLICAL PROVISIONS, A PARTIAL ANSWER TO DISASTER MYOPIA](#)

RICHARD HERRING

ESTABILIDAD FINANCIERA 33, NOVEMBER 2017, 77-89

The author discusses countercyclical provisioning as an antidote to managers' myopia about rare but catastrophic events.

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SERIES, JOURNAL OF THE SPANISH ECONOMIC ASSOCIATION, 8 (4), NOVEMBER 2017, 417-473

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ECONOMICS LETTERS,

161, DECEMBER 2017, 82-85

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[DISENTANGLING THE EFFECTS OF HOUSEHOLD FINANCIAL CONSTRAINTS AND RISK PROFILE ON MORTGAGE RATES](#)

S. MAYORDOMO, S. CARBÓ-VALVERDE AND F. RODRÍGUEZ-FERNÁNDEZ

JOURNAL OF REAL ESTATE FINANCE AND ECONOMICS,

56 (1), JANUARY 2018, 76-100

[UNCOVERING THE HETEROGENEOUS EFFECTS OF ECB UNCONVENTIONAL MONETARY POLICIES ACROSS EURO AREA COUNTRIES](#)

P. BURRIEL AND A. GALESÌ

EUROPEAN ECONOMIC REVIEW,

101, JANUARY 2018, 210-229

[CROSS-BORDER BANKING ON THE TWO SIDES OF THE ATLANTIC: DOES IT HAVE AN IMPACT ON BANK CRISIS MANAGEMENT?](#)

MARÍA J. NIETO AND LARRY WALL

JOURNAL OF BANK REGULATION,

19 (1), JANUARY 2018, 4-17

CLUSTERING REGIONAL BUSINESS CYCLES

A. GÓMEZ-LOSCOS, E. BANDRÉS AND M. D. GADEA
ECONOMIC LETTERS,
162, JANUARY 2018, 171-176

DISCUSSION OF THE PAPER “DECIDING BETWEEN ALTERNATIVE APPROACHES IN MACROECONOMICS”

G. PÉREZ QUIRÓS
INTERNATIONAL JOURNAL OF FORECASTING,
34 (1) JANUARY-MARCH 2018, 139-141

EVALUACIÓN MACROECONÓMICA DE LAS REFORMAS IMPOSITIVAS: ASPECTOS METODOLÓGICOS Y ALGUNAS APLICACIONES

P. BURRIEL, D. LÓPEZ AND J. J. PÉREZ
PAPELES DE ECONOMÍA ESPAÑOLA,
154, FEBRUARY 2018, 265-288

UNDER THE RADAR: THE EFFECTS OF MONITORING FIRMS ON TAX COMPLIANCE

M. ALMUNIA AND D. LÓPEZ-RODRÍGUEZ
AMERICAN ECONOMIC JOURNAL: ECONOMIC POLICY,
10 (1), FEBRUARY 2018, 1-38

GROWING BY LEARNING: FIRM-LEVEL EVIDENCE ON THE SIZE-PRODUCTIVITY NEXUS

E. MORAL-BENITO
SERIES, JOURNAL OF THE SPANISH ECONOMIC ASSOCIATION
9 (1), MARCH 2018, 65-90

DOES EXPORT CONCENTRATION MATTER IN ECONOMIC ADJUSTMENT PROGRAMS? EVIDENCE FROM THE EURO AREA

P. SOARES AND E. PRADES
JOURNAL OF POLICY MODELLING

SOCIAL OPTIMA IN ECONOMIES WITH HETEROGENEOUS AGENTS

G. NUÑO AND B. MOLL
REVIEW OF ECONOMIC DYNAMICS,
28, APRIL 2018, 150-180
40 (2), MARCH-APRIL 2018, 225-241

FISCAL CONSOLIDATION AFTER THE GREAT RECESSION: THE ROLE OF COMPOSITION

I. KATARYNIUK AND J. VALLÉS
OXFORD ECONOMIC PAPERS,
70 (2), APRIL 2018, 563-585

LAS IMPLICACIONES MACROECONÓMICAS Y SOBRE EL SECTOR BANCARIO DE LA POLÍTICA MONETARIA DEL BCE

O. ARCE AND A. DEL RÍO
PAPELES DE ECONOMÍA ESPAÑOLA,
155, APRIL 2018, 10-18

INFLATION AND OPTIMAL MONETARY POLICY IN A MODEL WITH FIRM HETEROGENEITY AND BERTRAND COMPETITION

J. ANDRÉS AND P. BURRIEL
EUROPEAN ECONOMIC REVIEW,
103, APRIL 2018, 18-38

AGGLOMERATION BY EXPORT DESTINATION: EVIDENCE FROM SPAIN

R. RAMOS AND E. MORAL-BENITO
JOURNAL OF ECONOMIC GEOGRAPHY
18 (3), MAY 2018, 599-625

FORTHCOMING ARTICLES IN REFEREED JOURNALS

VOLATILITY-RELATED EXCHANGE TRADED ASSETS: AN ECONOMETRIC INVESTIGATION

J. MENCÍA AND E. SENTANA
JOURNAL OF BUSINESS AND ECONOMIC STATISTICS

A QUARTERLY FISCAL DATABASE FIT FOR MACROECONOMIC ANALYSIS

F. DE CASTRO, F. MARTÍ, A. MONTESINOS, J. J. PÉREZ
AND A. J. SÁNCHEZ
HACIENDA PÚBLICA ESPAÑOLA - REVIEW OF PUBLIC ECONOMICS

PORTFOLIO REBALANCING AND ASSET PRICING WITH HETEROGENEOUS INATTENTION

O. RACHEDI
INTERNATIONAL ECONOMIC REVIEW

THE PROPAGATION OF INDUSTRIAL BUSINESS CYCLES

D. LEIVA-LEÓN AND M. CAMACHO
MACROECONOMIC DYNAMICS

PRUDENTIAL FILTERS, PORTFOLIO COMPOSITION AT FAIR VALUE AND CAPITAL RATIOS IN EUROPEAN BANKS

I. ARGIMÓN, M. DIETSCH AND A. ESTRADA
JOURNAL OF FINANCIAL STABILITY

GREAT MODERATION AND GREAT RECESSION. FROM PLAIN SAILING TO STORMY SEAS?

A. GÓMEZ-LOSCOS, M. D. GADEA AND G. PÉREZ-QUIRÓS
INTERNATIONAL ECONOMIC REVIEW

FISCAL CONSOLIDATION IN A LOW INFLATION ENVIRONMENT: PAY CUTS VERSUS LOST JOBS

G. BANDEIRA, E. PAPPA, R. SAJEDI AND E. VELLA
INTERNATIONAL JOURNAL OF CENTRAL BANKING

THE IMPACT OF THE IRB APPROACH ON THE RISK WEIGHTS OF EUROPEAN BANKS

C. PÉREZ, C. TRUCHARTE, M. E. CRISTÓFOLI AND N. LAVÍN
JOURNAL OF FINANCIAL STABILITY

FINANCIAL INSTITUTIONS' BUSINESS MODELS AND THE GLOBAL TRANSMISSION OF MONETARY POLICY

I. ARGIMÓN, C. BONNER, R. CORREA, P. DUIJM, J. FROST, J. DE HAAN, L. DE HAAN AND V. STEBUNOV
JOURNAL OF INTERNATIONAL MONEY AND FINANCE

CURRENCY UNIONS AND HETEROGENEOUS TRADE EFFECTS: THE CASE OF THE LATIN MONETARY UNION

J. TIMINI
EUROPEAN REVIEW OF ECONOMIC HISTORY

THE ROLE OF COGNITIVE LIMITATIONS AND HETEROGENEOUS EXPECTATIONS FOR AGGREGATE PRODUCTION AND CREDIT CYCLES

P. DE GRAUWE AND E. GERBA
JOURNAL OF ECONOMIC DYNAMICS AND CONTROL

THE OUTPUT EFFECTS OF TAX CHANGES: NARRATIVE EVIDENCE FOR SPAIN

P. GIL, F. MARTÍ, R. MORRIS, J. J. PÉREZ AND R. RAMOS
SERIES-JOURNAL OF THE SPANISH ECONOMIC ASSOCIATION

WHEN CREDIT DRIES UP: JOB LOSSES IN THE GREAT RECESSION

S. BENTOLILA, M. JANSEN AND G. JIMÉNEZ
JOURNAL OF THE EUROPEAN ECONOMIC ASSOCIATION

A MENU ON OUTPUT GAP ESTIMATION METHODS

L. J. ÁLVAREZ AND A. GÓMEZ-LOSCOS
JOURNAL OF POLICY MODELLING

DEMOGRAPHIC STRUCTURE AND MACROECONOMIC TRENDS

Y. AKSOY, H. S. BASSO, R. SMITH AND T. GRASL
AMERICAN ECONOMIC JOURNAL: MACROECONOMICS

SERVICES DEEPENING AND THE TRANSMISSION OF MONETARY POLICY

A. GALESÌ AND O. RACHEDI
JOURNAL OF THE EUROPEAN ECONOMIC ASSOCIATION

A SPECTRAL EM ALGORITHM FOR DYNAMIC FACTOR MODELS

G. FIORENTINI, A. GALESÌ, AND E. SENTANA
JOURNAL OF ECONOMETRICS

LINKING BANK CRISES AND SOVEREIGN DEFAULTS: EVIDENCE FROM EMERGING MARKETS

I. BALTEANU AND A. ERCE
IMF ECONOMIC REVIEW

XTDPDML: LINEAR DYNAMIC PANEL-DATA ESTIMATION USING MAXIMUM LIKELIHOOD AND STRUCTURAL EQUATION MODELING

P. ALLISON, E. MORAL-BENITO AND R. WILLIAMS
STATA JOURNAL

DEALING WITH DEALERS: SOVEREIGN CDS COMOVEMENTS

M. ANTÓN, S. MAYORDOMO AND M. RODRÍGUEZ
JOURNAL OF BANKING AND FINANCE

WHAT IS THE FISCAL STRESS IN THE EURO AREA? EVIDENCE FROM A JOINT MONETARY-FISCAL STRUCTURAL MODEL

E. GERBA
ENSAYOS SOBRE POLÍTICA ECONÓMICA

NEWS AND EVENTS

NEWS

FEDERICO PRADES PRIZE AWARDED TO MARÍA RODRÍGUEZ AND SERGIO MAYORDOMO

Banco de España economists María Rodríguez Moreno (DG Financial Stability) and Sergio Mayordomo of the ADG Economics and Research were the first winners of the Federico Prades Prize for Young Economists (Premio Federico Prades a Jóvenes Economistas), established by the Spanish Banking Association (Asociación Española de Banca, AEB). They were recognized for their study on the effects of bank capital regulations on lending to small and medium firms, entitled “Did the bank capital relief induced by the supporting factor enhance SME lending?”, which has been conditionally accepted for publication in the *Journal of Financial Intermediation*. Their paper was selected from among thirty-two submissions by academic and professional economists from all over the world.

[Prize announcement of Spanish Banking Association \(AEB\) >](#)
[Download Banco de España Working Paper 1746 >](#)

RECENT CONFERENCES

[LINK TO CONFERENCES PAGE](#)

SPAIN: FROM RECOVERY TO RESILIENCE

MADRID, 3 APRIL 2018

The Banco de España and the International Monetary Fund (IMF) organized this conference, which examined Spain’s crisis responses and discussed policy options to ensure a sustained and inclusive economic path forward.

Sessions:

- 1 Lowering fiscal vulnerabilities
- 2 Reducing high structural unemployment and labor market duality
- 3 Raising Medium-term growth prospects
- 4 Panel discussion: Completing the Banking Union

Keynote speaker: David Lipton (IMF)

[Link to conference website >](#)

FOURTH JOINT RESEARCH WORKSHOP

MADRID, 10 APRIL 2017

The Banco de España and the Centro de Estudios Monetarios y Financieros (CEMFI) held their fourth Joint Research Workshop on April 10, featuring recent work by economists of both institutions.

Speakers:

- Laura Hospido (Banco de España)
- Javier Suárez (CEMFI)
- Clodomiro Ferreiro (Banco de España)
- Enrique Sentana (CEMFI)

FOURTH NABE INTERNATIONAL SYMPOSIUM

MADRID, 16-17 APRIL 2018

The Banco de España hosted the 2018 edition of the International Symposium of the National Association of Business Economics (NABE), which was entitled “Global Recovery: the Good, the Bad, and the Ugly”. The Symposium addressed challenges faced by US and European businesses in today’s economy.

Topics addressed included the future of banking and finance, inflation targets, automation and supply chains, tax reforms, and the future of trade.

Keynote speakers included Peter Praet (European Central Bank) and John Williams (Federal Reserve Bank of San Francisco), and the conference was opened by Banco de España Governor Luis M. Linde.

Further information about the NABE conference is available at the following website: <https://nabe.com/is2018>

RECENT ECONOMIC RESEARCH SEMINARS

[LINK TO SEMINARS PAGE](#)

LOWERING WELFARE BENEFITS: INTENDED AND UNINTENDED CONSEQUENCES FOR MIGRANTS AND THEIR FAMILIES

CHRISTIAN DUSTMAN

UNIVERSITY COLLEGE LONDON,

4 OCTOBER 2017

WHAT DO PEOPLE WANT?

MILES KIMBALL

UNIVERSITY OF COLORADO BOULDER,
6 OCTOBER 2017

COMMODITY SHOCKS, FIRM-LEVEL RESPONSES AND LABOR MARKET DYNAMICS

SERGIO URZUA

UNIVERSITY OF MARYLAND,
6 OCTOBER 2017

QUANTILE FACTOR MODELS

JESÚS GONZALO

UNIVERSIDAD CARLOS III DE MADRID,
27 OCTOBER 2017

THE FISCAL-MONETARY POLICY MIX IN THE EURO-AREA: CHALLENGES AT THE ZERO LOWER BOUND

ATHANASIOS ORPHANIDES

MIT SLOAN SCHOOL OF MANAGEMENT,
30 OCTOBER 2017

APPROXIMATING EQUILIBRIA WITH EX-POST HETEROGENEITY AND AGGREGATE RISK

ELISABETH PROEHL

UNIVERSITY OF GENEVA,
15 NOVEMBER 2017

VENTING OUT: EXPORTS DURING A DOMESTIC SLUMP

POL ANTRAS

HARVARD UNIVERSITY,
16 NOVEMBER 2017

FISCAL CONSOLIDATION PROGRAMS AND INCOME INEQUALITY

PEDRO BRINCA

NOVA SBE,
22 NOVEMBER 2017

AGGREGATING ELASTICITIES: INTENSIVE AND EXTENSIVE MARGINS OF FEMALE LABOUR SUPPLY

VIRGINIA SANCHEZ MARCOS

UNIVERSIDAD DE CANTABRIA,
29 NOVEMBER 2017

POTENTIAL OUTPUT, OUTPUT GAP AND INFLATION: EVIDENCE FROM ARGENTINA (2007-2015)

LUCIANO CAMPOS

COLEGIO UNIVERSITARIO DE ESTUDIOS FINANCIEROS (CUNEF),
5 DECEMBER 2017

PEGGING THE INTEREST RATE ON BANK RESERVES: A RESOLUTION OF NEW KEYNESIAN PUZZLES AND PARADOXES

OLIVIER LOISEL

ÉCOLE NATIONALE DE LA STATISTIQUE ET DE L'ADMINISTRATION (ENSAE),
13 DECEMBER 2017

CONTRACT CYCLES

EFFROSYNI ADAMPOULOU

BANCA D'ITALIA,
18 DECEMBER 2017

WHATEVER IT TAKES: CROSS-BORDER SPILLOVERS OF A MAJOR CENTRAL BANK INTERVENTION

DAVID MARQUES

EUROPEAN CENTRAL BANK,
21 FEBRUARY 2018

FROM WEBER TO KAFKA: POLITICAL INSTABILITY AND THE RISE OF AN INEFFICIENT BUREAUCRACY

MASSIMO MORELLI

BOCCONI UNIVERSITY,
14 MARCH 2018

HOUSING BOOMS AND LOCAL SPENDING

ALBERT SOLÉ-OLLÉ

UNIVERSITAT DE BARCELONA,
4 APRIL 2018

THE GLOBAL RISE OF ASSET PRICES AND THE DECLINE OF THE LABOR SHARE

PEDRO TRIVIN

UNIVERSITAT DE GIRONA,
11 APRIL 2018

RELATIVE PRICES AND SECTORAL PRODUCTIVITY

MARGARIDA DUARTE

UNIVERSITY OF TORONTO,
18 APRIL 2018

STOCK RETURN COMOVEMENT WHEN INVESTORS ARE DISTRACTED: MORE, AND MORE HOMOGENEOUS

MICHAEL EHRMANN

EUROPEAN CENTRAL BANK,
25 APRIL 2018

PEOPLE

PROFILES

SERGIO MAYORDOMO

Financial Analysis Division
ADG Economics and Research

MARÍA RODRÍGUEZ-MORENO

Macroprudential Policy Division
Financial Stability Department



RU: You are both quite young, but before joining the Banco de España in 2016 you already had substantial research experience, having spent time as academics at the Univ. de Navarra, and also at the CNMV (the Spanish securities regulation authority) and at the European Central Bank. Please tell us about your professional background before you came to the Banco de España.

Our previous work experience has given us insight into policy questions related to the regulation and functioning of financial markets (during the stage at the CNMV) and the banking sector (both at the ECB and now here at the Banco de España). Likewise, ever since our Ph.D. studies at Univ. Carlos III, our academic career has been devoted to understanding financial policy issues, such as the implementation of the Supporting Factor. And teaching was an excellent opportunity to learn how to communicate about these issues with a wider audience.

RU: Your work on empirical finance was recently recognized by the Spanish Banking Association (AEB), which awarded you the “Federico Prades” prize for your study of policies to promote lending to small and medium enterprises within the context of European bank capital regulation. Please tell us what the “SME supporting factor” is, what empirical strategy you pursued to analyze it, and what you discovered about its effects on bank lending.

The SME supporting factor (SF) is a multiplicative factor that reduces capital requirements for loans to small and medium enterprises (SMEs). It was introduced by the Capital Requirements Regulation (CRR) for all European Union countries in January 2014, except for Spain, which had already introduced

the SF through national legislation in September 2013. After the introduction of the SME SF, capital requirements for qualified credit risk exposures to SMEs (i.e., exposures of less than €1.5 million to firms with a turnover below €50 million) are multiplied by 0.7619. So banks need roughly 24% less capital for loans to smaller firms than they would need to make the same loans to larger firms.

The paper aims to provide evidence on the effectiveness of the SF. To this end, we employ the Survey on the Access to Finance of Enterprises (SAFE), which contains microdata on financial conditions for firms located in the European Union. We first compare the success of loan applications by SMEs and larger firms before and after the introduction of the SF, in order to evaluate how lending constraints changed under the SF. The results indicate an easing in credit constraints for medium-sized SMEs after the introduction of the SF, but not for micro/small firms.

As a complementary experiment, we conduct an analysis based on Spanish bank-firm matched microdata which enables us to: i) discard the effect of potential confounding events; ii) study how the effect of the SF depends on the bank’s capital ratios; and iii) perform a regression discontinuity analysis for a better estimation of the causal impact of the SF. All these analyses provide further evidence for the effectiveness of the SF.

All in all, our results suggest that banks do not treat SMEs as a homogeneous group — there are important fundamental differences across firms.

So perhaps regulation should accommodate these specificities, trying to loosen credit constraints not only to medium-sized but also to micro and small firms.

RU: Your paper on SMEs is a great example of how better data and improved computer technologies are making it possible to study the effects of economic policies in more precise ways. Could you discuss briefly how data have improved in recent years?

The key difference is that, nowadays, data are truly “granular”. In other words, instead of looking at aggregated data, it is often possible to look at specific transactions. That’s essential for better understanding the impact of policies because it allows researchers to isolate potential confounding effects. For example, in the paper on the SME SF, the use of the credit registry enables us to determine whether a given SME is effectively eligible for the application of the SF depending on the bank-firm credit exposure (i.e., only when the exposure is below €1.5 million).

During the last ten years we have seen an amazing evolution in terms of data availability. This is partly due to the better regulation and transparency of financial markets but also to the fact that many institutions with proprietary datasets have opened this data to the researchers. Likewise for data related to firms or credit institutions.

The other big innovation recently is that researchers are often able to merge very detailed datasets from different sources to contribute to a wider understanding of the whole picture. For example, for the SME paper we merged the credit registry data with balance sheet information, so we could control for other characteristics of the banks and the firms which are not recorded in the credit registry.

RU: Another question that can be better understood with contemporary datasets is how monetary policy affects the economy. Could you describe some results from your work on monetary policy transmission?

Sergio has recently worked with Óscar Arce and Ricardo Gimeno to analyze the credit reallocation channel associated with the ECB’s corporate bond purchases programme (CSPP), which was one component of its quantitative easing (QE) policies. More specifically, the paper first documents the fact that eligible firms issued more bonds and likewise

reduced their demand for bank loans when the CSPP was announced in March 2016. But beyond that direct effect, they were able to trace the credit reallocation effects through the economy. They observed that banks facing lower loan demand from bond issuers reallocated most of that available credit to other borrowers that were ineligible for the CSPP, including smaller firms, which then invested more. Again, measuring effects like these would be impossible without rich microdata on the actions of specific banks and firms.

Also, María has worked with Stefano Corradin to study the effect of ECB’s non-conventional monetary policies from an asset pricing perspective. They showed that these policies affect the pricing of sovereign bonds in a way that violates the Law of One Price. Concretely, they find a monetary funding liquidity premium on those bonds that can be used as ECB collateral. This premium is especially valued in times of increasing sovereign credit spreads and increasing haircuts by central counterparties (CCPs).

RU: Another focus of your research has been systemic risk, in financial markets generally, and in the Eurozone context more specifically. Please tell us about some of your findings.

The Lehman Brothers collapse in 2008 and the subsequent financial crisis made clear that systemic risk is a genuine threat, with potentially huge costs for the real economy. However, at that time, there was a lot of debate about how to measure systemic risk. Thus, Rodríguez-Moreno and Peña (2013) compared the performance of several models used to measure systemic risk and found that the simpler ones tend to outperform complex models.

Another paper we wrote on systemic risk (Mayordomo, Rodríguez-Moreno and Peña, 2014) was motivated by the bad reputation of derivative instruments at that time. In fact, derivatives were described as “financial weapons of mass destruction” and a “potential time bomb” by Warren Buffett. Our results, based on banks’ holdings of five different classes of derivatives, document that their contribution to systemic risk played second fiddle in comparison with traditional banking activities.

RU: Last but not least, you are a professional couple with small children. You are also both researchers, and frequent co-authors. Would you mind talking for a moment about how you manage work/life balance?

It is not so difficult to find the right balance between work and life with small children. We would say that children discipline you to manage your time, and to avoid losing sight of the line between work and life.

Finding a good co-author is a difficult task, maybe almost as hard as finding a spouse. Writing a paper is a medium-term project and so, apart from needing a person with complementary skills to yours, you need to feel comfortable and to trust the other person.

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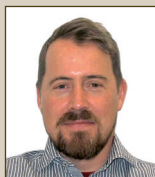
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VISITING FELLOWS



ELIAS BENGTSSON

Associate Professor
Halmstad University

ELIAS BENGTSSON is an Associate Professor at Halmstad University in Sweden. He received his PhD in Finance from Stockholm University. In terms of research, his publication record includes a large number of articles on financial regulation, policy and stability in a variety of internationally recognized academic journals. Elias has also held various positions outside academia, including Principal Economist at the ESRB Secretariat at the European Central Bank, Advisor at the central bank of Sweden and Senior Economist at the European Fund and Asset Management Association. In these roles, he has been involved in a variety of tasks relating to financial regulation, including the development

of Basel III and the European framework for macroprudential policy.

During his stay at DG Estabilidad Financiera at the Banco de España, Elias is working on a project on the political economy of macroprudential policy. The project seeks to understand the effects of industry and political capture, as well as authorities' institutional arrangements and resources, on macroprudential policy stances.

Research page: <https://scholar.google.com/citations?user=vTdmXQ8AAAAJ&hl=sv&oi=ao>



EMANUELE TARANTINO

Assistant Professor
University of Mannheim

EMANUELE TARANTINO is an Assistant Professor in Economics at the University of Mannheim, Germany, a research affiliate of the CEPR, and a member of the Economic Advisory Group on Competition Policy of the European Commission Chief Economist. He holds a PhD in Economics from the European University Institute (Florence) and, before joining the University of Mannheim, he was a “Franco Modigliani” Research Fellow at the University of Bologna. His research papers emphasize financial contracting, innovation and competition economics, and have been published in leading journals

in economics and finance, like the *Rand Journal of Economics*, the *Review of Financial Studies*, and the *Journal of Financial Economics*.

At the Banco de España, he will do further research in the area of financial economics, and in particular work on the link between lending standards and the composition of firms in the real economy over the cycle, and the relationship between trade credit and market structure.

Research page: <https://sites.google.com/site/etarantino/>



JONATHAN HALKET

Lecturer
University of Essex

JONATHAN HALKET is a Lecturer in Economics at the University of Essex in the United Kingdom and a Research Fellow for the Institute for Fiscal Studies and the Centre for Microdata Methods and Practice. His research addresses the fields of real estate finance, urban economics and macroeconomics. He earned a Ph.D. in Economics from New York University and a B.A. in Economics and Physics from Amherst College.

His research while at the Banco de España focuses on local public finance and on household finance. His project on public finance uses an optimal taxation approach with private information and

spatial geometry to understand the non-trivial tradeoffs between land taxes, income taxes and in-kind transfers of housing (e.g. public housing).

His work on household finance includes building a structural model of life-cycle consumption, savings and location profiles in an urban setting to examine how households jointly choose where to live and how much to save and how trends in homeownership and mortgage finance interact with trends in household labor supply and demographics.

Research page: <http://halket.com/>

ANNOUNCEMENTS

UPCOMING CONFERENCES

[LINK TO CONFERENCES PAGE](#)

FIFTH WORLD BANK – BANCO DE ESPAÑA RESEARCH CONFERENCE

MADRID, 4-5 JUNE 2018

On June 4-5, the fifth joint Research Conference of the World Bank and the Banco de España will take place in Madrid. The conference, entitled “Macroeconomic Policies, Output Fluctuations, and Long-Term Growth”, will examine the effects of monetary and fiscal policies on the business cycle and on long-run labor productivity and growth. The geographical scope of the conference is global, but special consideration will be given to papers with applications to Europe, to emerging markets in general, or to Latin America in particular.

[Conference webpage >](#)

SECOND BANCO DE ESPAÑA ANNUAL RESEARCH CONFERENCE: TAXES AND TRANSFERS

MADRID, 3-4 SEPTEMBER 2018

On September 3-4, the Banco de España will host its second Annual Research Conference, which will be jointly organized with the Institute for Fiscal Studies (UK). At the conference, entitled “Taxes and Transfers”, leading academics will address a wide range of fiscal policy questions. The organizers are Olympia Bover (Banco de España), Richard Blundell (UCL), and Nezih Guner (CEMFI).

[Conference webpage >](#)

FINANCIAL DISINTERMEDIATION AND THE FUTURE OF THE BANKING SECTOR

MADRID, 30 OCTOBER 2018

On October 30, the Banco de España will host a conference on “Financial Disintermediation and the Future of the Banking Sector”. The conference will be jointly organized with SUERF, the European Money and

Finance Forum. This event will bring together academics, market practitioners and policy makers, and will combine more academically oriented sessions with a policy panel on the Capital Markets Union. It will cover various topics related to financial disintermediation, including: bank-based versus market-based financial systems, the interactions with monetary policy, the role of regulation, FinTech and the Capital Markets Union.

<https://www.suerf.org/>

CALLS FOR PAPERS

IV SEMINAR IN ECONOMIC HISTORY

MADRID, 11 OCTOBER 2018

The Banco de España cordially invites submissions for its Fourth Seminar in Economic History, which will be held on October 11, 2018, at its central headquarters in Madrid.

The Seminar aims to bring together scholars from all over the world to discuss current academic work on Spanish or international economic history. Scholars are invited to submit their proposals before June 15, 2018.

[Call for papers \(deadline 15 June 2018\) >](#)

RISK, VOLATILITY AND CENTRAL BANKS' POLICIES

MADRID, 29-30 NOVEMBER 2018

The Banco de España will organize a joint conference with the [Central Bank Research Association \(CEBRA\)](#) on “Risk, volatility and central banks’ policies”, on 29-30 November 2018 in Madrid. The conference aims to cover a broad range of topics related to risk and volatility. The Banco de España and CEBRA chose this topic considering the growing awareness of the importance of risk and market volatility for both monetary policy and financial stability.

[Call for papers \(deadline 15 May 2018\) >](#)

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