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JEL classification: F3, R3, E3

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Capital Flows, Real Estate, and Local Cycles: Evidence from German Cities, Banks, and Firms*

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Abstract

Capital flows and real estate are pro-cyclical, and real estate has a substantial weight in economies' income and wealth. In this paper, we study the role of real estate markets in the transmission of bank flow shocks to output growth across German cities. The empirical analysis relies on a new and unique matched data set at the city level and the bank-firm level. To measure bank flow shocks, we show that changes in sovereign spreads of Southern European countries (the so-called GIPS spread) can predict German cross-border bank flows. To achieve identification by geographic variation, in addition to a traditional supply-side variable, we use a novel instrument that exploits a policy assigning refugee immigrants to municipalities on an exogenous basis. We find that output growth responds more to bank flow shocks in cities that are more exposed to tightness in local real estate markets. We estimate that, during the 2009-2014 period, for every 100-basis point increase in the GIPS spread, the most exposed cities grow 15-25 basis points more than the least exposed ones. Moreover, the differential response of commercial property prices can explain most of this growth differential. When we unpack the transmission mechanism by using matched bank-firm-level data on credit, employment, capital expenditure and TFP, we find that firm real estate collateral as measured by tangible fixed assets plays a critical role. In particular, bank flow shocks increase the credit supply to firms and sectors with more real estate collateral. Higher credit supply then leads firms to hire and invest more, without evidence of capital misallocation.

Keywords: BIS Cross-border flows, Capital Flows, Collateral, City Business Cycles, Credit, Germany, Misallocation, GIPS Spread, Real Estate, Tangible Assets
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1 Introduction

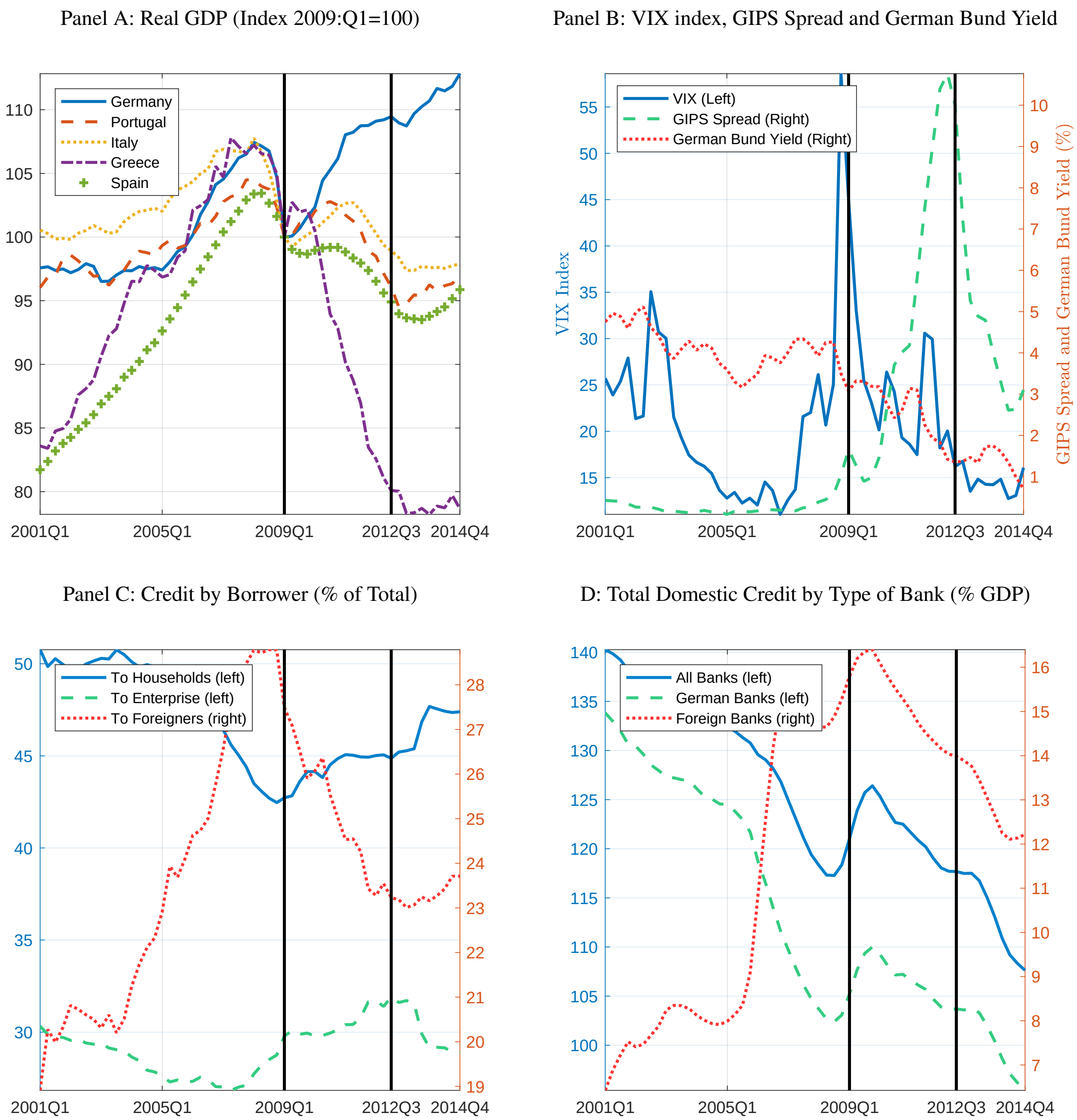
Capital flows are procyclical at business cycle frequency and can affect output through multiple channels (e.g., Uribe and Schmitt-Grohé (2017)). As an asset class, real estate is also procyclical and has a large weight in economies' income and wealth (Davis and Van Nieuwerburgh (2015)).[1] Do real estate markets play a role in the transmission of capital flow shocks to output over the business cycle? What are the mechanisms? This paper addresses these questions by studying the role of real estate markets in the transmission of capital flow shocks to output growth across German cities during the post-global financial crisis (GFC) episode of bank repatriation of foreign assets from Southern Europe.

Germany during the post-GFC period is an ideal laboratory to investigate the questions above. Before the GFC, German and other Northern European banks built up claims on the periphery that were far in excess of their respective countries' bilateral surpluses (Hale and Obstfeld (2016)). After the crisis, they reduced cross-border holdings of sovereign debt and increased their holdings of locally issued debt (Brutti and Sauré (2016)). As Figure 1 shows, post-GFC, Germany strongly outperformed Southern Europe in terms of real GDP growth (Panel A), as Portugal, Italy, Spain and Greece were engulfed in a deep and persistent sovereign debt and banking crisis (Panel B). Banks rebalanced the composition of their loan portfolios toward domestic households and firms (Panel C). Interest rates fell dramatically (Panel B), the stock market soared (not reported), and Germany experienced the first property price boom in 20 years, with a cumulative increase during the 2009-2014 period exceeding 20 percent in both the residential and the commercial sector (Figure 2).

We find that the impact of a bank flow shock, as captured by the sovereign bond spread of Southern European countries over Germany (the so-called GIPS spread plotted in Figure 1 Panel B), is more significant in cities that are more exposed to tightness in local real estate markets. We estimate that, during the 2009-2014 period, for every 100-basis point increase in the GIPS spread, the most exposed German cities grow 15-25 basis points more than the least exposed ones. Moreover, the differential response of commercial property prices across cities to the bank flow shock can explain most of this growth differential. When we unpack the transmission mechanism, we find that firms with more real estate collateral, as measured by tangible fixed assets, receive more credit when banks repatriate foreign assets and retrench from Southern Europe. Firms with more collateral also invest and hire more, thereby contributing to higher output growth. During the episode that we study, however, we find no evidence that better credit access and higher investment by firms with more real estate collateral leads to capital misallocation.

[1] See the Data Appendix for selected stylized facts from the literature and our data set.

Figure 1 MACROECONOMIC BACKGROUND

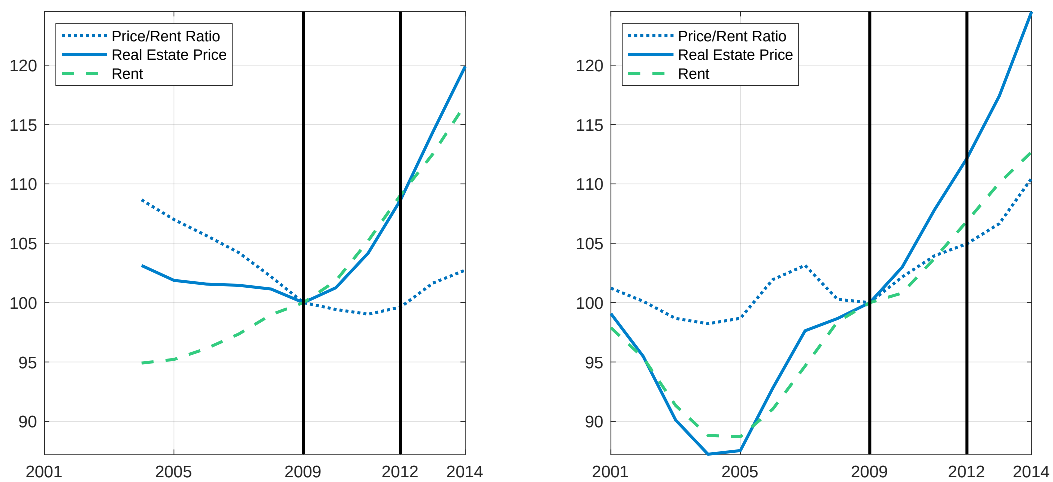


NOTE. Panel A plots real GDP for Germany, Portugal, Italy, Greece and Spain. Panel B plots the US VIX index of implied stock market volatility together with the GIPS Spread (the simple average of the 10-year sovereign bond yield spread over the German Bund for Portugal, Italy, Greece, and Spain), and 10-year German Bund yield. Panel C plots the share of total lending by German banks to different borrowers. Panel D plots total credit as a share of GDP extended by different type of banks. The vertical lines mark the beginning of the German recovery in 2009:Q1 and the "Whatever It Takes" speech by ECB Governor Draghi in 2012:Q3, respectively. See the Data Appendix for variable definitions and data sources.

Figure 2 THE GERMAN REAL ESTATE BOOM

Panel A: Residential Real Estate (Indexes, 2009=100)

Panel B: Commercial Real Estate (Indexes, 2009=100)



NOTE. Panel A plots national residential real estate prices, rent and price-to-rent indexes. Residential data are not available from 2001-2003. Panel B plots national commercial real estate prices, rent, and price-to-rent indexes. The vertical lines mark the beginning of the recovery in 2009:Q1 and the "Whatever It Takes" speech by ECB Governor Draghi in 2012:Q3, respectively. See the Data Appendix for variable definitions and data sources.

To investigate the importance of real estate markets in the transmission of capital flows shocks to city output growth, we assemble a new database that includes aggregate, city-level and bank-firm-level data. At the aggregate level, we focus on bank flow data, based on BIS Locational Statistics, which is an important component of total capital flows (Bruno and Shin (2014)). Next, we construct a new matched city-level data set that, in addition to publicly available variables, includes a proprietary database on residential and commercial property price indexes from Bulwiengesa AG (a reputable German real estate data provider). Finally, to unpack the transmission mechanism, we construct a second novel bank-firm relationship level data set based on the German credit register, the Bundesbank supervisory database, and Bureau van Dijk's Amadeus.

To identify the importance of real estate markets in the transmission of bank flow shocks, we rely on identification by geographic variation, as for instance in Chaney, Sraer and Thesmar (2012), Favara and Imbs (2015), Mian, Sufi and Verner (2017), Hoffmann and Stewen (forthcoming), and Jordà et al. (2015) among others. We first establish that, during our sample period, the GIPS spread is closely associated with alternative measures of bank flows from the rest of the euro area, and particularly with banks' repatriation of gross foreign assets.[2] We show that this link is

[2]Many studies use on the VIX index of stock market volatility, plotted in Panel B of Figure 1, as a driver of global bank flows, following the seminal work of Rey (2013) on the importance of the global financial cycle. In a similar vein, we use the GIPS spread as a way to characterize regional bank flows.

tight both at the national level and the individual-bank level. We also show that the GIPS Spread is associated with lower domestic lending-deposit spreads at the national level and lower firm borrowing costs at the firm level, consistent with the notion that, when banks repatriate foreign assets, they can expand the domestic credit supply, as the macroeconomic evidence in Panel C of Figure 1 shows. We then interact the GIPS spread, as a proxy for bank inflows from Southern Europe, with a measure of real estate market tightness (or exposure for brevity) that varies across cities quasi-randomly.

This exposure measure is the product of two variables: one affecting the city supply of real estate and the other the demand side of the market. The supply-side indicator is the gross share of land that cannot be developed for real estate purposes (henceforth the "share of non-developable area") in the spirit of Saiz (2010). The share of non-developable area is a good candidate instrument for real estate prices as land-use regulations and geography determine it. Unlike in the United States, however, variation across German cities in the gross share of non-developable area comes mostly from variation in land designated as forestland or for agricultural uses, rather than differences in the incidence of steep-slope terrains and water bodies. Moreover, land-use regulations are distributed rather uniformly in Germany. For relevance purposes, therefore, we will show that it is useful to complement this indicator with information on a source of random demand variation across cities. Indeed, in the paper, we will argue that both components of our exposure measure are plausibly distributed quasi-randomly across cities, but neither of them predicts property prices as well as the interaction of the two, especially in the commercial sector.

The demand-side indicator that we propose to complement the share of non-developable area is the share of refugees in total refugees (henceforth the "share of refugees"), which is a novel instrument in the real estate literature. The share of refugees is a good candidate instrument because it exploits a policy framework in Germany that assigns refugee immigrants to cities (or municipalities) on a quasi-random basis. As we document in the paper, in Germany, the city share of refugees is determined by government rules and regulations at the state and city level, which are well known to be applied strictly. We also argue that refugees have limited or no ability to impact the labor market in the short-term in Germany.

Yet, refugee immigrants can have a strong impact on local real estate markets.[3] As in other countries, in Germany, refugees are entitled to housing benefits, but are allocated across municipalities without taking pre-exiting levels of congestion into account. Moreover, the correlation between commercial and residential real estate prices is sizable in our data. This correlation, which is almost 0.4 in our panel data set, is similar to the one in the United States (see, for instance, Gyourko (2009) and Chaney et al. (2012)), and is typically seen as driven by land prices and spatial linkages (Ahlfeldt, Redding, Sturm and Wolf (2015), Mills (1967), and Roback (1982)). The share

[3]For example, econometric evidence on the impact of Syrian refugees in the case of Turkey shows that the impact on local housing markets is large and statistically significant (Tumen (2016)).

of refugees, therefore, can be a relevant instrument also for commercial property prices. In fact, in the paper we will show that in the commercial sector, the share of refugees is an even stronger predictor than in the residential one.

The main result of the paper is that bank flow shocks, as captured by changes in the GIPS spread, have a larger impact on output growth in cities with tighter real estate markets, as proxied by our exposure measure. We estimate that, during the 2009-2014 period, for every 100-basis point increase in the GIPS spread, cities at the 90th percentile of the exposure distribution grow 15-25 basis points more than cities at the 10th percentile. Moreover, we find that most of this growth differential across cities can be accounted for by the differential response of commercial property prices across cities triggered by the GIPS spread change. We interpret this result as consistent with the working of a collateral channel on the firm side (e.g., Liu, Wang and Zha (2013), Chaney et al. (2012)), Gan (2007), Schmalz et al. (2017), Adelino et al. (2015) among others), and thus highlight the importance of commercial real estate in the transmission of capital flow shocks.

In the second part of the paper, we open the black box of the transmission mechanism of bank flow shocks through commercial real estate, focusing on the role of collateral. As a proxy for real estate collateral, we use tangible fixed assets as a share of total assets, which are a sizable fraction of property, plants, and equipment assets (PPEs) in both Germany and the United States.[4] We study the role of collateral in bank credit allocation to firms, in firm employment and investment decisions, and in capital misallocation in response to the same bank flow shock that we considered in the first part of the paper. To address endogeneity concerns, in this second part of the empirical analysis, we rely on the granular nature of our bank-firm-level data, adding a comprehensive set of control variables and on the implementation of a large set of robustness exercises.

Consistent with a large body of existing literature, we find that collateral plays a critical role in differential impact of the bank flow shocks across cities. Repatriation of foreign assets from Southern Europe leads German banks to increase domestic credit supply to firms and sectors with a relatively higher share of tangible fixed assets. We also show that firms with more tangible assets invest and hire more, thus contributing to the local economic expansion. Interestingly, however, this transmission is not associated with evidence of capital misallocation. We attribute the latter finding to the fact that the German post-GFC real estate boom is not associated with a credit boom (Panel D of Figure 1).

[4]See Rochdi (2015) and Chaney et al. (2012), respectively. Unfortunately, the German credit register does not contain information on collateral. Moreover, buildings, land and improvements, and construction in progress are not identified separately from PPE in Amadeus. However, one important advantage of Amadeus relative to the filings of public companies that would permit disentangling real estate holdings from other fixed tangible assets ore precisely, is that it covers not only publicly listed companies but also smaller and private firms. This is crucial has holding of real estate assets is heterogeneous across firm size and industry (again see Rochdi (2015) and Chaney et al. (2012) for details.

Literature Review

Our paper relates to the literature along multiple dimensions. First, our paper contributes to the literature on the relationships between capital flows, the business cycle and house prices. Two large bodies of empirical and theoretical work focus on capital flows and the business cycle on the one hand, and capital flows and house prices on the other.[5] Our main contribution is to identify the causal role of real estate markets in the transmission of capital flow shocks to short-term output growth.[6] As far as we are aware, this is the first paper that documents empirically with disaggregated data the mediating role of property prices in the transmission of capital flow shocks.

More specifically, several empirical papers document a positive correlation between the current account and house prices. For example, Aizenman and Jinjarak (2009) document a strong positive association between the current account and house prices, holding constant a number of country characteristics in a large panel of countries. We document a similarly close association between bank flows and commercial property prices. Cesa-Bianchi, Ferrero and Rebucci (2018) show that residential house prices co-move strongly with consumption growth conditional on an bank flow shock identified in the time series dimension and relate countries' consumption sensitivity to different characteristics. We exploit the quasi-random variation of our real estate market exposure measure to assess the differential impact of a bank flow shocks across cities causally. Favilukis, Ludvigson and Van Nieuwerburgh (2017) study theoretically the impact of capital flows in the United States and show that lower bond yields cannot explain the US residential house price boom. We focus on commercial real estate prices and provide disaggregated evidence that firm real estate collateral introduces additional channels of transmission of capital flow shocks. Caballero and Simsek (forthcoming) develop a model of transmission of a capital flow shock originating from repatriation of domestic assets as in our empirical analysis. We provide direct evidence speaking to these dynamics.

Second, our paper relates to the literature on the impact of capital flows on credit supply, the real economy and house prices. Cetorelli and Goldberg (2011, 2012) show that global banks contracted their direct and indirect (interbank) cross-border lending during the GFC, leading to a reduction in credit supply in regions from which capital was pulled. We study the case of a country whose banks repatriated foreign assets during the GFC and establish that bank retrenchment led to an increase in domestic credit supply benefiting especially firms richer in real estate collateral. Employing bank-firm level from the Turkish credit registry, Baskaya, Di Giovanni, Kalemli-Özcan, Peydro and Ulu (2017) and Baskaya, Giovanni, Kalemli-Ozcan and Ulu (2018) show that

[5]The first block is longstanding and voluminous. The second block is more recent and focused. For instance, Favilukis, Kohn, Ludvigson and Van Nieuwerburgh (2013) review both theory and evidence.

[6]Note that the paper is silent on the puzzling behavior of capital flows and their relationship with growth in the long run (e.g., Gourinchas and Jeanne (2013)).

capital inflows increase the volume and reduce the price of domestic credit. We provide complementary and consistent evidence using credit register data for a major advanced economy and we also evaluate the transmission mechanism to firm outcomes, including misallocation. Mian, Sufi and Verner (2017) show that an aggregate credit supply expansion boosts local demand and amplifies the expansion phase of the business cycle, with higher GDP, employment, residential investment, and house prices. We document comparable dynamics for Germany following a similar identification strategy and we document the transmission mechanism at the bank-firm level.

Third, our paper relates to the literature on the collateral channel and real estate prices. The underlying mechanism is that firms use pledgeable assets as collateral, typically land and buildings, to finance productive projects, residential housing and durable consumption. Fluctuations in real estate prices, therefore, can have sizable effects on aggregate investment, consumption and output. For instance, Iacoviello (2005) and Liu et al. (2013) develop quantitative general equilibrium models in the spirit of Kiyotaki and Moore (1997) of the collateral channel on the household and the firm side, respectively. Liu, Wang and Zha (2013), in particular, introduce land in firms' credit constraints and show that the model can explain the co-movement between land prices and business investments that the collateral channel from the household side cannot match. In this paper, we show that commercial property price changes triggered by bank flow shocks can account for most of the differential impact of these shocks on city output growth, thus providing diaggregated evidence consistent with the working of a collateral channel on the firm side. Chaney, Sraer and Thesmar (2012) use firm-level data to show that an exogenous variation in property prices triggered by aggregate mortgage rate changes can have a sizable impact on corporate investment. Using comparable data and methodology, we find that these effects are quantitatively sizable in the transmission of bank flow shocks. Other studies with micro data showed that fluctuations in property prices can also have an impact on firm employment, exit and entry decisions, and capital structure (e.g., Schmalz et al. (2017), Cvijanović (2014)) and Davis and Haltiwanger (2019), respectively). We provide micro evidence on the the transmission mechanism of bank flow shocks through similar effects on firm hiring and investment decision.

Fourth, this paper contributes to the literature on capital misallocation in response to capital flow shocks or housing booms. Gopinath, Kalemli-Özcan, Karabarbounis and Villegas-Sanchez (2017) show that, during the boom years before the GFC, cross-border bank flows led to misallocation and reduced total factor productivity in Southern Europe, but not in Northern Europe, including Germany. We investigate capital misallocation in Germany during the post-GFC cross-border bank retrenching episode. Chakraborty, Goldstein and MacKinlay (2018) find that banks that are active in buoyant housing markets substitute mortgages for corporate loans. As a result, the credit supply to firms tied to these banks shrinks and their investment contracts. Doerr (2018) shows that, when property and land prices increase, firms with larger real estate holdings hire, invest, and produce more, but are less productive than firms with smaller real estate holdings in a sample of US public companies. Both Chakraborty, Goldstein and MacKinlay (2018) and Doerr (2018) study housing booms with credit booms. We focus on a real estate boom without a credit boom. Similarly, Martin, Moral-Benito and Schmitz (2018) find that Spanish banks more exposed to a real estate bubble initially lend relatively more to housing firms than non-housing firms. However, as the bubble persists, the composition effect disappears because housing credit repayments raise banks' net worth, supporting the credit access of all firms. We show that a capital flow shock leads to a larger expansion in cities more exposed to real estate markets. In the absence of a credit boom, however, the bank flow shock does not appear to be associated with lower TFP growth and capital misallocation.

Fifth, the paper speaks to the new literature on the role of foreign purchases of real estate in global cities like London, New York and Vancouver. Favilukis and Van Nieuwerburgh (2017) develop a heterogeneous spatial model of cities and show that an increase in out-of-town home buyers can drive up local real estate prices significantly. Consistent with their findings, we show that influxes of refugee immigrants predict property prices in both the residential and the commercial sector. Badarinza and Ramadorai (2018) use a "preferred habitat" framework to document that foreign risk can affect real estate valuations in global cities. We show that instability in Southern Europe was associated with bank retrenchment and impacted real estate valuations in Germany's main cities.

Finally, other papers have used the government allocation of refugees for identification purposes. Dustmann, Vasiljeva and Piil Damm (forthcoming) and Eckert, Walsh and Hejlesen (2018) exploit the quasi-random nature of the refugee allocation in Denmark to study the impact of immigration on voting outcomes and the urban wage premium, respectively. We exploit the quasi-random distribution refugees to estimate the differential impact of bank flow shocks on city business cycles. As far as we are aware, this is the first paper that uses the spatial distribution of refugees as an instrument for property prices.

The rest of the paper is organized as follows. Section 2 describes our data. Section 3 outlines the empirical strategy and the research design, including a discussion of the proxy for bank flows and the instrumental variables that we use in the paper. Section 4 reports the main result of the paper on the role of real estate in the transmission of capital flow shocks. The rest of the paper unpacks the transmission mechanism in two separate steps. Section 5 explores the role of real estate collateral in the allocation of credit to individual firms and industries. Section 6 provides evidence on the differential impact of the capital flow shock on firm employment and investment decisions and investigates whether or not the transmission documented is associated with misallocation. Section 7 concludes. Details on the data we use and selected robustness checks are reported in an appendix at the end of the paper.

2 Data

To conduct the empirical analysis, we assembled a new and unique data set at the annual and quarterly frequency, from 2009:Q1 to 2014:Q4.[7] As a source of aggregate capital flow shocks, we focus on *cross-border bank flows* from the BIS Locational Statistics, or "bank flows" for brevity, which is an important share of total flows (Bruno and Shin (2014)). In particular, as we motivate in detail in Section 3.1 below, we will focus on the component of bank flows predicted by the GIPS spread. In addition to official city-level statistics, the data set for the main results of the paper includes an annual proprietary panel data set on residential and commercial property price indexes at the city level from Bulwiengesa AG. To study the details of the transmission mechanism, we then merge information on bank and firm characteristics from Bundesbank supervisory data and Bureau van Dijk's Amadeus with individual bank-firm relationship data from the German credit register.

2.1 City-Level Data

Data on residential and commercial nominal property price indexes at the city level are proprietary from the research consultancy Bulwiengesa AG, accessed through the Bundesbank.[8] To construct nominal property price indexes by city and type of property, Bulwiengesa AG uses both valuation and transaction data from building and loan associations, research institutions, realtor associations, as well as the chambers of industry and commerce. As city-level CPI indexes are not available, we construct *real* property price indexes by using *state-level* official consumer price indexes. Germany is a diversified large economy and inflation was low and stable during the period we consider. Hence, using state-level CPI deflator is unlikely to influence our estimation results.

Both residential and commercial indexes are at the annual frequency. Residential indexes include the price of town houses, owner-occupied apartments and single-family detached homes. Commercial indexes include information on two segments of the market, retail and office buildings. The indexes are calculated at the city level as simple averages of the individual unit prices. Thus, they can be seen as common factors for city-level property prices—see, for instance, Pesaran (2015). We focus on the 79 urban areas or cities listed in Appendix Table A.3. Bulwiengesa provides commercial real estate price data for 127 urban areas. In the German national accounts, however, some contiguous urban areas are aggregated under a single administrative district identifier. For instance, the city of Hanover and its hinterland were merged into one larger administrative district in 2001, which includes the city of Hanover itself and 20 other smaller municipalities. In

[7]Appendix Table A.1 defines all city and bank-firm-level variables that we use and describes their sources. Appendix Table A.2 reports summary statistics for all variables. The Data Appendix also describes all the macroeconomic variables that we use.

[8]The Bundesbank relies on this provider for the publication of national indexes, also shared with the European Central Bank.

our analysis, we focus on the 79 cities or areas whose geographical definition is the same as in the national accounts, so as to match data from the two sources exactly.

The dependent variable in the econometric specification of our main regressions is city real per capita GDP growth. As city-level GDP deflators are not available, we construct real GDP by using the same state-level official consumer price indexes used to deflate property prices indexes. We match real GDP and real estate price data with a number of other city-level variables. In particular, to construct our instrumental variable, we will use the gross share of land that cannot be developed relative to total area, calling this variable the "share of non-developable area" for brevity, and the share of refugees allocated by the government to a given city relative to the total number of refugees that entered the country, which we will call the "share of refugees" for brevity. Note here that, "asylum seekers" usually refers to individuals applying for asylum, and "refugees" refers to individuals whose asylum status has been approved and are entitled to the associated benefits, including housing benefits. In the German statistics, the total number of refugees includes (i) admitted refugees on a permanent basis, (ii) admitted refugees on a temporary basis, (iii) rejected asylum seekers that cannot be relocated, and (iv) a small fraction of asylum seekers not processed within the year. The matching of all city-level data is straightforward because based on a common city identifier across all variables.

The data are winsorized. Output growth is censored on the left hand side of the distribution at -10%, with very few city-year observations below this large negative value. We also winsorize the share of refugees by setting the value for Berlin and Hamburg, which have the highest average value in the sample, to the largest value in the third highest city, which is Munich. Note here that Berlin and Hamburg are two of the three German city states (Bremen being the third one), and are the two largest cities.[9] We note here that winsorizing output growth and the share of refugees at the 1% level in the panel would be insufficient, since our results would still be driven by some extreme city-year observations. Our empirical results, therefore, are not driven by outliers. On the contrary, as we shall see, our main result is stronger when we drop from the city sample the three city states.

2.2 Bank-Firm-Level Data

To explore the relationship among capital flows, bank lending behavior, firm decisions and commercial real estate prices, we match data from the German credit register over the period 2009:Q1-2014:Q4 with Bundesbank supervisory bank balance sheet data and firm-level data from Bureau van Dijk's Amadeus.

The German credit register contains information on bank exposure, including loans, bonds,

[9]The sample average of the share of refugees and our exposure measure for all 79 cities is reported in Appendix Table A.3.

off-balance sheet, and derivative positions (excluding trading book positions).[10] Financial institutions in Germany are required to report to the credit register if their exposure to an individual borrower, or the sum of the exposures to borrowers belonging to one legal entity, exceeds a threshold of 1 million euro. A legal borrowing entity comprises independent borrowers that are legally or economically connected to each other due to majority ownership (more than 50%), or due to profit transfer agreements. Consequently, the effective reporting threshold is usually lower than 1 million euro.[11] A borrowing entity in the credit register, however, can have multiple bank relationships.[12] The German credit register captures about two-thirds of bank credit outstanding. That is, if we sum all loans reported in the credit register in a given quarter, this amounts to about two thirds of total credit outstanding as reported by German official bank balance sheet statistics.

We match credit register data with information on bank balance sheets from Bundesbank supervisory data.[13] Balance sheet data include total assets, liquid assets, the interbank-to-deposit funding ratio, the regulatory-capital ratio, non-performing loans, the return on assets and net and gross bank foreign asset. We also match firm-level accounting variables from the Bureau van Dijk's Amadeus with credit register data. In our analysis, we use firms' total assets (defined as the sum of current assets and non-current assets), tangible fixed assets (i.e., property, plant and equipment–PPE), total fixed assets, the equity-to-asset ratio, the return on assets, the number of employees and capital expenditure.

Our proxy for real estate collateral at the firm level, or collateral for brevity, which plays a critical role in the second part of our empirical analysis, is the share of tangible fixed assets in total assets. Unfortunately, the German credit registry does not include information on collateral. In addition, Amadeus data do not provide separate information on buildings, land and improvements, and construction in progress, the three categories of tangible fixed assets that are usually considered in the accounting definition of corporate real estate assets. However, for the United States, real estate is estimated to be a sizable fraction of total fixed assets, total assets, or firms' market values for publicly listed companies—see for instance Chaney et al. (2012) and Nelson, Potter and Wilde (2000)). This ratio is usually assumed to be higher for private firms. Moreover, Laposa and Charlton (2002) estimate that European corporate holdings of real estate assets of publicly listed companies are even higher as a share of total assets than in the US due to the underdevelopment of the property management industry. Recent estimates of the share of real estate assets in total assets for German public companies, up to 2013, show substantial variation across sectors and, unlike

[10] For a more detailed definition of bank exposure, see Section 14 of the German Banking Act: https://www.bundesbank.de/Redaktion/EN/Downloads/Tasks/Banking_supervision/Acts_Regulations_Guidelines/banking_act.pdf?__blob=publicationFile.

[11] The official reporting threshold was lowered from 1.5 million to 1 million euro in 2014. Due to the relatively low effective reporting threshold, however, this reduction does not affect our results.

[12] Indeed, 92% of the firms in the German credit register borrow from more than one bank.

[13] We match the end-quarter values of these variables to the credit register data.

the United States, limited decline over time during the sample period we study (Rochdi (2015)). While the proxy variable we use is an imperfect measure of firm-level real estate collateral, one clear advantage of using total fixed tangible assets from Amadeus is that this variable is available not only for publicly listed companies, but also for smaller and private firms.

The data matching at the bank-firm level is challenging because the German credit register and the Amadeus database do not share a common identifier. We proceed as follows. First, we match by the unique commercial register number, when it is available. Second, for observations without this identifier, we rely on Stata's *reclink* command.[14] At this step, we match firms either by their name and zip code or by their name and city, with a minimum matching reliability of 0.99. We then match the remaining firms manually.[15] Overall, we can track the records of more than 44% of German firms included in the credit register during the sample period, slightly more than in previous studies using these data (see for instance Behn, Haselmann and Wachtel (2016)).

After the merge, we make two adjustments. First, we focus on commercial banks, excluding non-commercial entities, such as investment funds and special purpose vehicles, that are less likely to be involved in traditional lending, capturing the large majority of the credit institutions in this category. Second, we correct for outliers with respect to loan growth rates by trimming the top 1% of the distribution and values below -100% quarterly growth. The resulting sample after these adjustments comprises approximately 700,000 bank-firm-quarter observations, including multiple firm-bank relationships. Appendix Table A.2 reports summary statistics for all variables used in the analysis.

3 Empirical Strategy

Capital flows can affect the economy through multiple channels. Capital flow shocks can loosen domestic financial conditions and increase credit supply. Increased credit supply can stimulate real estate markets and property prices. Higher property prices can amplify the initial credit impulse through collateral channels on the household or the firm side, driving investment, employment, and other firm outcomes.[16]

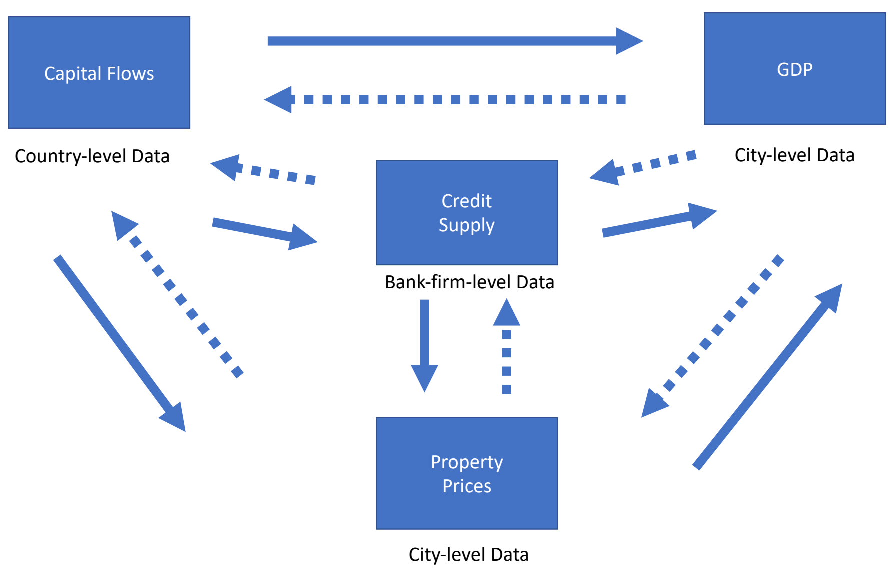
Figure 3 represents the multiplicity of channels through which capital flows can affect a city's

[14] See Blasnik et al. (2010), RECLINK: Stata module to probabilistically match records: `http://EconPapers.repec.org/RePEc:boc:bocode:s456876`.

[15] We matched 4,143 firms in the first step, 23,010 firms in the second step, and 1,038 firms by hand and hence more than 28,000 in total.

[16] Among others, see Mian, Sufi and Verner (2017)), Hoffmann and Stewen (forthcoming), Baskaya et al. (2018) and Baskaya et al. (2017) on capital flows and credit supply; see Favara and Imbs (2015), Di Maggio and Kermani (2017), Jordà et al. (2015) on credit and property prices; see Iacoviello (2005) and Liu et al. (2013) for general equilibrium models of amplification via real estate collateral and prices on the household or the firm side, respectively; see Chaney et al. (2012), Gan (2007), Ahlfeldt, Redding, Sturm and Wolf (2015), Cvijanović (2014) and Adelino et al. (2015) on property price, collateral, and firm outcomes.

Figure 3 TRANSMISSION MECHANISM: ROAD-MAP



economic activity at the business cycle frequency. The solid arrows represent causal linkages and the dashed arrows reverse causal effects. The top arrows represent the traditional push-pull view of the short-run association between between capital flows and cyclical indicators of economic activity (e.g., Fratzscher (2012)). The inner loop emphasizes the role of credit in this transmission, which has been extensively studied in the literature. The outer loop, and its connection with the credit market, represents the possible role of real estate markets that we want to explore in this paper.

The central hypothesis in our empirical analysis is that the tighter a city's real estate markets are, or the more exposed a city is to demand and supply shocks in these markets, the more significant the impact of bank flow shocks on the city's output growth. In a given local real estate market, all else equal, an exogenously higher demand or lower supply of real estate, or a combination of both, translates into a higher sensitivity of property prices to housing demand and supply shocks. Cities with tighter real estate markets, therefore, should be more sensitive to capital flow shocks than other cities, assuming that the transmission mechanism sketched above is at work. Moreover, consistent with macroeconomic models with borrowing constraints as in Kiyotaki and Moore (1997) in which real estate serves as collateral (Iacoviello (2005) and Liu et al. (2013)), our prior is that property prices should play an important role in the transmission.

The econometric challenge, therefore, is to establish a causal effect of capital flows on output via property prices. Equipped with a valid instrument to estimate the impact of capital flow shocks on property prices, we can then use the predicted component of property price changes triggered by a capital flow shock to estimate the impact on city output growth. Taken together, these two steps can provide an estimate of the causal effects of capital flows shocks on city output growth *through* property price changes. The identification strategy in the first part of the analysis, based on city-level data, is one of identification by geographic variation as, for instance, in Mian et al. (2017), Chaney et al. (2012), and Hoffmann and Stewen (forthcoming). The research design, therefore, is grounded on (i) the availability of a well-defined aggregate or nation-wide measure of capital flows and (ii) the construction of an indicator of real estate market tightness (or exposure) that varies randomly across cities, which we discuss in more details below.

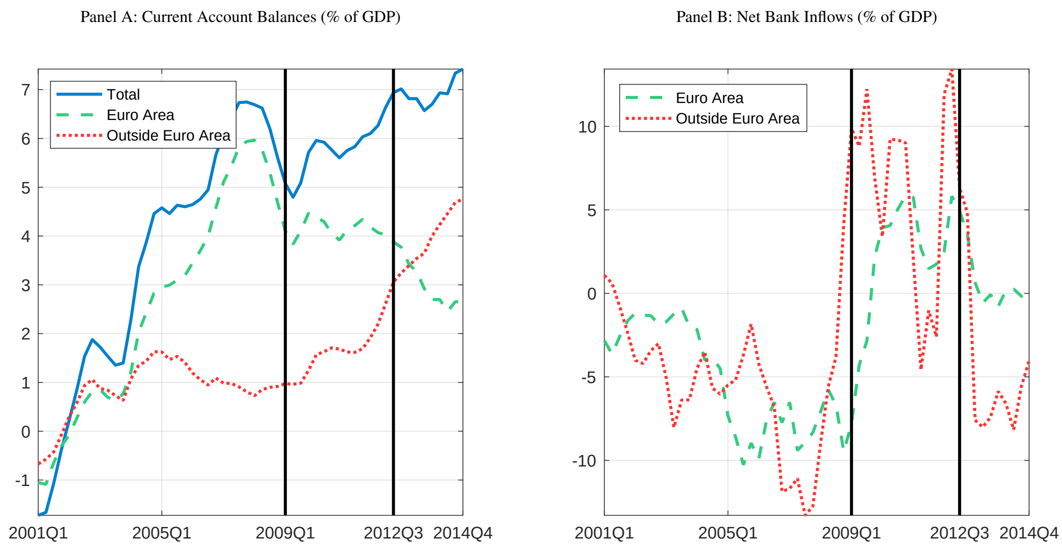
In the second part of the paper, we want to open up the black box of the transmission mechanism. In particular, we study the role of real estate collateral in the allocation of the increased credit supply triggered by the capital flow shock. We also focus on firm employment and investment decisions, total factor productivity at the firm and industry level, and capital misallocation. The empirical strategy to address endogenity concerns, here, relies on the availability of matched bank-firm level data combined with suitable regression designs typically used in the empirical banking literature and the literature on firm behavior.

3.1 Measuring Capital Flows: Cross-border Bank Flows and the GIPS Spread

As measured by the current account surplus of the balance of payments, Germany experienced sizable net capital *outflows* rather than *inflows* throughout the period we consider (Figure 4, Panel A). The current account balance, therefore, is not a suitable measure for our empirical analysis. From this figure, however, we can also see that the current account surplus vis-a-vis the *rest of the euro area* started to decline during the GFC, and continued in that direction throughout the period we consider. In contrast, the current account surplus vis-a-vis the *rest of the world outside the euro area* became even larger after 2009:Q1. Moreover, Panel B of Figure 4 shows that the net foreign asset position of German BIS reporting banks changed dramatically during and after the GFC. In the rest of the paper, therefore, we will focus on *cross-border bank flows*, labelled "bank flows" for brevity, which are an important component of total flows.

Aggregate cross-border bank flow data pose their own challenges because subject to measurement errors and contaminated by foreign currency valuation effects difficult to account for. Moreover, our sample period is rather short from a time series perspective. An alternative measurement approach, often employed in the extant literature, is to use price-based indicators that co-move closely with quantity-based measures of bank flows. For instance, one indicator often employed to capture bank flows driven by global risk or risk aversion is the US VIX index of implied equity market volatility (e.g., Baskaya et al. (2018), Baskaya et al. (2017), Forbes and Warnock (2012)). Following this approach, and consistent with theoretical models of retrench-

Figure 4 CURRENT ACCOUNT BALANCE AND NET BANK FLOWS



NOTE. Panel A plots the current account balance as a share of GDP, together with its breakdown vs. the rest of the euro area and outside the euro area. Panel B plots net bank vs. the rest of the euro area and vs. outside the euro based on BIS Locational Statistics. The vertical bars mark the beginning of the post-GFC recovery in 2009:Q1 and the "Whatever It Takes" speech by ECB Governor Draghi in 2012:Q3, respectively. See the Data Appendix for variable definitions and data sources.

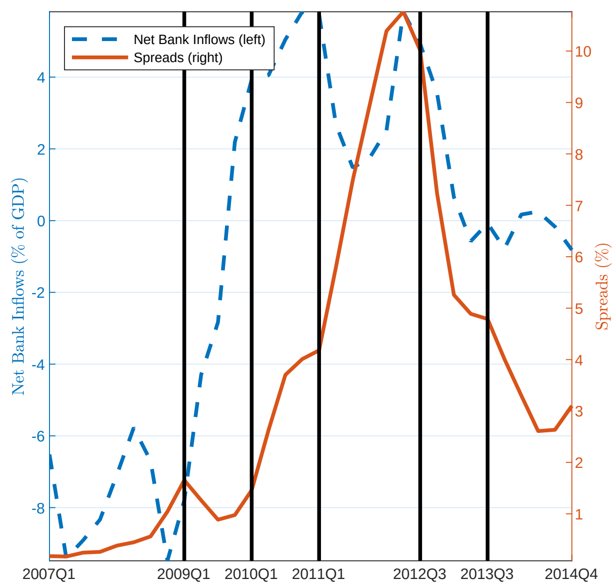
ment transmission (Caballero and Simsek (forthcoming)), as a proxy for bank flows, we use an indicator of financial instability and risk in Southern Europe, namely the average sovereign bond spread of Portugal, Italy, Greece, and Spain vs. Germany, henceforth called the GIPS spread. The GIPS spread is plotted in Figure 5, together with German bank flows vs. the rest of the euro area from Panel B of Figure 4. From this figure, we can see that the turning points in the GIPS spread correlate closely with net bank flows vs. the rest of the euro area and are also closely associated with the milestones of the sovereign debt and banking crisis in Southern Europe.

To quantify more precisely the relevance of the GIPS spread as predictor of bank flows, as the first step in our empirical analysis, we run a battery of regressions for alternative bank flow measures on the GIPS spread. The frequency is quarterly and the sample period is 2000:Q1-2014:Q4 to make sure that the spread can capture both phases of the boom-bust cycle. The estimated equation is specified as follows:

$$\mathrm{BF}_t = \gamma \cdot \mathrm{Spread}_t + \varepsilon_t, \tag{1}$$

where BF_t represents alternative measures of bank flows, and "Spread_t" denotes the GIPS spread.

Figure 5 GIPS SPREAD, NET BANK FLOWS, AND THE EUROPEAN CRISIS



NOTE. The figure plots the GIPS spreads and Net Bank Inflows (% of GDP). The five vertical lines mark the following events: (1) the beginning of the German recovery in 2009:Q1; (2) Greek bonds downgraded to junk status and the Troika's launch of the 2010 110-billion euro bail-out; (3) 2011 downgrade and euro area leaders' disagreement on the rescue package for Greece; (4) "Whatever It Takes" speech by ECB Governor Draghi; and (5) interest rate cuts by the ECB. See the Data Appendix for variable definitions and data sources.

We distinguish between *net* flows from *outside* and *inside* the euro area. We then break down net flows from the rest of the euro area into *gross* inflows and outflows. Following Larrain and Stumpner (2017), we also examine the impact of the GIPS spread on the domestic lending-deposit interest rate spread. If the bank flows increase the domestic credit supply, we should observe a negative effect on the domestic lending-deposit spread. Finally, we use our *bank-level* data to evaluate the predictive ability of the GIPS spread for *individual* banks' gross foreign assets as a share of total assets, controlling for bank fixed effects. The last regression is important as concerns regarding reverse causation from bank flows to the GIPS spread are mitigated by the use of bank-level data.

Table 1 reports the results. Columns (1) and (2) show that a higher GIPS spread is positively associated with net bank flows into Germany from both outside and inside the euro area. The relation, however, is statistically significant only for net bank flows originating from the rest of the euro area. The strength of the association is similar to what was found by Baskaya et al. (2018).

Table 1 THE GIPS SPREAD AND BANK FLOWS

	Country-Level	Country-Level	Country-Level	Country-Level	Country-Level	Bank-Level
	(1) Net Bank Inflows Outside Eurozone	(2) Net Bank Inflows Inside Eurozone	(3) Gross Bank Inflows Inside Eurozone	(4) Gross Bank Outflows Inside Eurozone	(5) Lending-Deposit Spread	(6) Bank Share of Gross Foreign Assets
GIPS Spread$_t$	0.790	0.991***	-0.160	-1.151***	-0.115***	-0.246***
	(0.855)	(0.223)	(0.209)	(0.261)	(0.026)	(0.030)
Bank FE	-	-	-	-	-	Yes
Obs	60	60	60	60	48	89,651
R^2	0.033	0.216	0.009	0.238	0.247	0.844

NOTE. All regressions are based on quarterly data over the period 2000:Q1-2014:Q4, except for the regression in Column (5) for which the data are not available before 2003. The dependent variable in columns (1) and (2) is *net* bank flows into the German banking system from the rest of the world outside the euro area and from the rest of the euro area, respectively. In columns (3) and (4), the dependent variable is *gross* inflows and outflows from the rest of the euro area, respectively. In column (5), the dependent variable is the difference between the domestic lending and deposit interest rate. In column (6), the dependent variable is the share of individual banks' gross foreign assets over total assets. The regression in column (6) includes individual bank fixed effects. See the Data Appendixes for variable definitions and data sources. Heteroskedasticity-robust standard errors are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

The results in column (3) and (4) also illustrate that net bank flows are driven by lower gross bank outflows, rather than higher gross bank inflows. These regressions, therefore, taken together, suggest that a GIPS spread increase is associated with a repatriation of bank foreign assets from the rest of the euro area, which Forbes and Warnock (2012) call "retrenchment" of capital.

The evidence of retrenchment is further corroborated by column (6), which shows that a higher GIPS spread is associated with a smaller share of gross foreign assets in total bank assets at the level of individual banks. This last regression suggests that, in economic terms, a 100-basis points increase in the GIPS spread reduces banks' share of foreign assets in total assets by almost 25 basis points. Put it differently, this estimate implies that, during the peak of the European crisis, the German banking system shifted lending from foreign to domestic borrowers amounting to about 1.6% of its aggregate balance sheet, or 1.9% of GDP.[17]

As shown in column (5), a higher GIPS spread is also associated with a lower domestic lending-deposit spread, suggesting that the German bank retrenchment episode we consider is associated with looser domestic financial conditions. Moreover, as we will report and discuss in Section 6, a higher GIPS spread leads to lower debt service costs at the firm level. This transmission, therefore, is in line with the hypothesis that a bank flow shock can loosen domestic financial conditions and increase the domestic credit supply.

Appendix Table B.1 shows that these results are similar if we restrict the sample to the 2007-2014. The same table shows that the important result in column (6) of Table 1 is robust to adding a

[17] The GIPS spread averaged 6.5% during the acute phase of the European crisis, from 2010:Q1 to 2012:Q3, compared to a value close to zero right before the GFC. Hence, the impact of the crisis is quantified as 6.5%*0.246=1.60%. According to FRED data, total assets held by deposit money banks compared to GDP were approximately 120% in 2009. As a result, the estimated shift in banking assets is 1.60%*1.2=1.92% of GDP.

comprehensive set of macroeconomic and bank-level control variables. In unreported regressions, we also obtain essentially the same results as in column (6) above by using net, rather than gross, individual bank foreign assets.[18] Finally, the results are also unchanged if we include in the construction of the GIPS spread Ireland, or exclude Greece, as the sovereign bond spreads are highly correlated in crisis times.

In summary, this evidence documents that German banks experienced a sizable net inflow of capital from the rest of the Euro Area since the GFC, driven by German banks' repatriation of foreign assets, consistent with available evidence on the behavior of Northern European banks before and after the GFC discussed in Section 1. The evidence also shows that the GIPS spread is a good predictor of bank flows. Based on these preliminary findings, in the rest of the paper, we will use the GIPS spread as a our proxy for bank flows.

3.2 Identification: Non-Developable Area, Refugees, and Cities' Exposure to Real Estate Market Tightness

As we mentioned earlier, our aim is to identify the output growth impact of property price variation across cities triggered by an aggregate change in bank flows. For this purpose, we construct a measure of city exposure to real estate market tightness that varies quasi-randomly across cities. To construct this measure of tightness in the local real estate markets, our exposure measure, we propose to complement information on the supply side with an indicator capturing pressure on the demand side of the market. Specifically, our local real estate market tightness measure is the product of two variables: the gross share of land that cannot be developed relative to total land available, which we call the share of non-developable area, and the share of refugees allocated by government policy to a given city relative to the total number of refugees in the country, which we call the share of refugees. The first variable captures supply constraints due to geography and land-use regulations in the spirit of Saiz (2010). The second variable is an exogenous source of pressure on the demand side of the local real estate markets because refugees cannot chose where they locate in the short term. It is a potentially relevant instrument because asylum seekers need shelter and, if they reach refugee status, are encouraged and supported financially to find non-segregated housing solutions. So, we now discuss each of these two measures in more detail.

3.2.1 Supply Side: the Share of Non-developable Area

Consistent with the notion of housing supply elasticity of Saiz (2010), in cities in which the share of (gross) developable area is lower, supply constraints due to land-use regulations and geography should bind more tightly. As a result, this variable should be associated with real estate price

[18] All results not reported in the paper are available from the authors on request.

growth at the city level, but should be unrelated to short-term changes in the level of local economic activity because its distribution across cities is fixed in the short term and determined by geography and land-use regulations. Unlike the United States, however, variation across German cities in the gross share of non-developable area comes mostly from variation in land designated as forestland or for agricultural uses rather than differences in the incidence of steep-slope terrains and water bodies. Moreover, land-use regulations are distributed rather uniformly in Germany. For relevance purposes, therefore, it is useful to complement this indicator with information on sources of exogenous demand variation across cities.

3.2.2 Demand Side: the Share of Refugees

The share of refugees allocated to a given city relative to the total number of refugees is a good candidate instrument because, as we show below, it has an impact on real estate valuations across German municipalities. Note here, however, that we do not claim that refugees are one of the most important drivers of the German housing boom, but that, from a statistical point of view, they are both a good and exogenous predictor of real estate price increases. Specifically, in Germany, the *city* allocation of refugees is quasi-random with respect to local business cycle conditions. This is because refugees are allocated across states and cities according to federal laws and regulations governing asylum seeking and the granting of refugee status, and other state and local laws and regulations that determine their location and their benefit entitlements, including housing. Unlike other categories of migrants, therefore, refugees cannot settle freely across cities in Germany. Our identification strategy thus broadly follows Dustmann, Vasiljeva and Piil Damm (forthcoming) and Eckert, Walsh and Hejlesen (2018), who exploit the quasi-random nature of the refugee allocation in Denmark to study the impact of immigration on voting outcomes and the urban wage premium, respectively.

The well-known federal *Koenigsteiner Schluessel* rule determines annually quotas for the distribution of refugees across German *states* based on state *population* (1/3) and *tax revenue* (2/3) of the previous two years.[19] This rule was established in 1949 and is used to allocate also other contributions or resources across states, such as the share of federal funding to universities and research institutions. Because of the dependency of this rule on past tax revenue, the *state* allocation of refugees could be endogenous to state business cycle conditions or to highly synchronized local economic conditions. As we can see from Table 2, however, the *state* rules governing the allocation of refugees across *cities* within state borders do not depend on tax revenue. Individual states have similar, but not identical allocation systems. Even though there is some heterogeneity, most determine the city-allocation of refugees based only on *population*, while some also use

[19]The main sources of information on the institutional details of German refugee policy on which we relied upon are Müller (2013), Baier and Siegert (2018) and Nam and Steinhoff (2018).

total area, and neither criteria depend on outcomes at business cycle frequency. In particular, no state uses lagged tax revenue although Brandenburg uses the number of employees as secondary criterion. Berlin, Bremen and Hamburg are city states and, therefore, do not have independent within-state allocation criteria. Berlin and Hamburg are also among the largest cities and have the highest share of refugees (Appendix Table A.3). However, they also have the highest share of refugees housed in large public facilities. In the empirical analysis, we will control for the special characteristics of these cities by conducting robustness to their exclusion from the sample. Moreover, cities or municipalities have no influence on the characteristics of the allocated refugees, such as the country of origin, skills and education, or other background. Finally, the predictability and efficiency of this system is well-known with small deviations from the assigned quota norms.

Table 2 WITHIN-STATE REFUGEE ALLOCATION CRITERIA AND HOUSING SOLUTION

State	Allocation Criteria	Refugees in Independent Accommodations
Baden-Württemberg	Population	35.0
Bavaria	Population	32.0
Berlin	NA	17.0
Brandenburg	Population, number of employees	30.0
Bremen	NA	60.0
Hamburg	NA	25.0
Hesse	Population	50.0
Lower Saxony	Population	67.0
Mecklenburg-Vorpommern	Population	71.0
North Rhine-Westphalia	Population, total area	63.0
Rhineland-Palatinate	Population	78.0
Saarland	Population	79.0
Saxony	Population	53.0
Saxony-Anhalt	Population	72.0
Schleswig-Holstein	Population	62.0
Thuringia	Population level in 1998	57.0

NOTE. This table reports the refugee allocation criteria across cites within *all* 16 German states, based on Müller (2013). The table also shows the share of refugees housed in independent accommodations, such as apartments and single-family homes, as opposed to large public facilities, based on data provided by Baier and Siegert (2018). Note that Berlin, Bremen and Hamburg are city states and, therefore, do not have independent within-state allocation criteria.

The allocation of refugees to a particular municipality is persistent over time, as refugees cannot easily relocate. Upon arrival, asylum seekers must apply for status at the assigned federal office for immigration and refugees (BAMF). A first-round decision on status is supposed to be taken in one-to-six months. While an application is pending, asylum seekers are required to stay at the initial reception center and cannot leave the area without permission. Only if and when BAMF grants status, refugees can relocate. However, even after asylum is granted, if a refugee is not financially self-sufficient, the government continues to determine where subsidized shelter is provided. As many applications are initially rejected, and most asylum seekers appeal in the courts, which typically takes a year or more, refugees usually remain confined to their initial city assignment for much longer than the minimum time necessary to obtain status.

In Germany, during our sample period, refugees are unlikely to have had any impact on the labor market, even after they received status. The main reason is a legal requirement of working knowledge of the German language for formal employment in most jobs that was in place until changes were introduced with new legislation in 2015 and 2016. The law also entailed preferences toward applicants from Germany and the rest of the European Union, as well as other restrictions on residence permits for refugees who did not complete vocational training.[20] During the period of time considered in this study, the rate of employment of refugees was only 10-20% in the first year after arrival, and still well below 50% after five years. Most of these jobs, however, are temporary and low-skill.

There are several reasons why the city share of refugees can be a relevant instrument for property prices in both the residential and the commercial sector. First, municipalities must provide both short-term housing for asylum seekers and long-term affordable options for refugees who cannot self-sustain financially, ultimately putting demand pressure on the fixed supply of land available for all uses. Once asylum seekers reach status, refugees who cannot self-sustain are housed in collective living facilities or they are granted the right to independent accommodation depending on the public interest and individual circumstances (Table 2). The decision is at the discretion of the local government. As we can see from Table 2, a minimum of 30 percent of the refugees are housed in independent accommodations, with peaks at 75-80 percent if we exclude the city states of Berlin and Hamburg, which house only 17 and 25 percent of their refugees in independent accommodations, respectively.

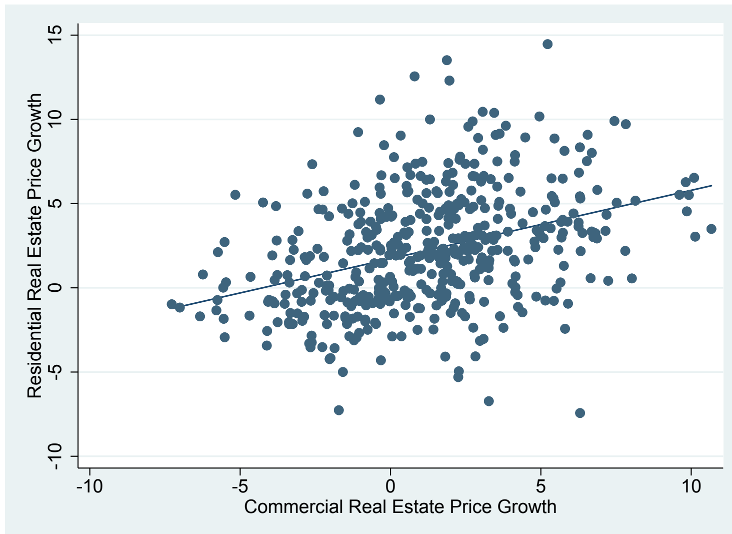
Second, as the existing rules for the allocation of refugees across cities do not take into account population density, or other characteristics of the receiving cities linked to housing scarcity and land scarcity, the allocation rules may put disproportionate pressure on cities already facing excess demand for social housing, commercial spaces, or other real estate supply shortages. Not surprisingly, as we shall see, when we use population density instead of our share of refugees, we find similar results.

Third, the residential and commercial markets are highly correlated, competing for land and city space that is in fixed supply in the short-term. The share of refugees, therefore, can be a relevant instrument also for the commercial sector. Figure 6 shows that commercial and residential property price changes are highly correlated in Germany over our sample period, as in the United States.[21] Land value, which is a large component of both residential and commercial valu-

[20] Refugees are not allowed to work during the first 3 months after arrival. Between month 4 and 15, they are only allowed to work if the Federal Employment Agency agrees that no other German is equally suitable for the job and that the wage offered is comparable to the market rate. Between month 16 and the end of the third year, they are allowed to work only if their wage is deemed market comparable. Starting with the 4th year, they can work without restrictions.

[21] For evidence on this correlation in the United States see, for instance, Gyourko (2009) and Chaney et al. (2012).

Figure 6 COMMERCIAL AND RESIDENTIAL REAL ESTATE PRICES CHANGES: CITY-LEVEL COMOVEMENT



NOTE. The figure is a scatter plot of commercial and residential real estate price changes over the 2009-2014 period (corr=37%, p value=0). One observation is a city-year. See the Data Appendix for variable definitions and sources.

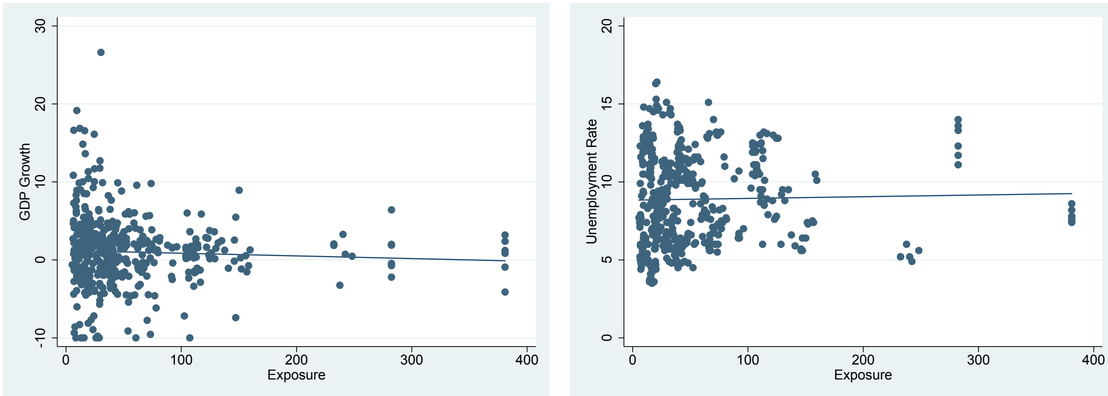
ations (Davis and Van Nieuwerburgh (2015)), urban transportation costs and spatial dynamics are possible drivers of this correlation (see Ahlfeldt et al. (2015), Mills (1967) and Roback (1982)).

3.2.3 Relevance and Orthogonality Conditions of the Exposure Measure

The relevance condition for our exposure measure, will be tested formally with the first-stage regression of the econometric specification that we use in the next section. The exclusion restriction for our exposure measure cannot be tested formally. Nonetheless, Figure 7 illustrates clearly that there is no correlation between our measure of real estate market tightness and city GDP growth or the city unemployment rate, in line with the assumptions made and the details of the institutional background discussed above. Additional not-reported scatter plots show that the two separate components of the exposure measure are also uncorrelated with GDP growth and the unemployment rate. In the case of the refugee component of the exposure measure, in particular, neither the state nor the city distribution of refugees is correlated with the distribution of output growth rates. We also find no association between the share of refugees and the rate of growth of employment calculated by aggregating firm-level data at the city level.

Overall, the evidence reported and the details of the institutional background to the Germany policy framework for the allocation of refugees across cities suggest that our exposure measure is a good candidate instrumental variable for property price changes since it can only affect city

Figure 7 EXPOSURE, GDP GROWTH, AND THE UNEMPLOYMENT RATE



NOTE. The figure plots the association between city-level real estate exposure and GDP growth (corr=-5%, p value=31%), and the unemployment rate (corr=2%, p value=61%), respectively, over the 2009-2014 period. One observation is a city-year. See the Data Appendix for variable definitions and sources.

output growth through its impact on the real estate prices. In the next section, therefore, we will use this instrumental variable interacted with the GIPS spread to investigate the role of real estate markets, and property price changes more specifically, in the transmission of bank flow shocks to city output growth.

4 Bank Flows, Real Estate Markets, and City Business Cycles

The hypothesis in the paper is that higher property prices, *triggered* by aggregate capital flow shocks, may have stronger impact on output growth in cities with tighter real estate markets. In this section, we investigate this hypothesis empirically, for both the residential and the commercial sector, exploiting the quasi-random city variation of our measure of real estate market tightness to achieve identification. Our "instrument" is the interaction of the aggregate bank flow change, as captured by the GIPS spread, with the city-level measure of exposure. While the GIPS spread could be endogenous to economic conditions in individual German cities, its interaction with the exposure measure, whose city distribution is assumed to be unrelated to local economic conditions, provides an exogenous source of variation in the bank flow shock intensity that can be related to city differences in economic performance.

4.1 Reduced-Form Estimates

Equipped with a proxy measure for bank flows and a measure of city exposure to real estate market tightness, following Mian, Sufi and Verner (2017), we start by investigating the role of real estate markets in the transmission of bank flow shocks to city output growth by estimating the following city-level reduced-form regression:

$$\Delta GDP_{c,t} = \alpha_c + \alpha_t + \beta \cdot (\text{Spread}_{t-1} \times \text{Exposure}_{c,t-1}) + \gamma \cdot \text{Exposure}_{c,t-1} + \varepsilon_{c,t} \quad (2)$$

where GDP_{ct} is log real GDP per capita in city c at time t, Spread_{t-1} is our proxy for bank inflows at time $t-1$, and $\text{Exposure}_{c,t-1}$ is our proxy for local real estate market tightness. The latter is assumed to be distributed quasi-randomly across cities. Even though bank inflows, and hence the GIPS spread, might be endogenous to business conditions in some German cities, once interacted with our exposure measure, the differential impact of the GIPS spread across cities, as measured by the β regression coefficient in equation (2), is well identified. Hence, this regression examines the extent to which a city's sensitivity to the aggregate state of the GIPS spread differs based on the extent of the real estate market tightness.

Table 3 BANK FLOWS, REAL ESTATE EXPOSURE, AND CITY CYCLES: REDUCED FORM ESTIMATES WITH CITY STATES

	(1) ΔGDP	(2) ΔGDP	(3) ΔGDP	(4) ΔGDP
Spread_{t-1}	-0.043	-0.101*	-0.102	-
	(0.043)	(0.058)	(0.064)	
$\text{Spread}_{t-1} \times \text{Exposure}_{t-1}$		0.001*	0.001*	0.001*
		(0.001)	(0.001)	(0.001)
Exposure_{t-1}		-0.008**	0.059	0.036**
		(0.004)	(0.036)	(0.017)
Time FE	No	No	No	Yes
City FE	No	No	Yes	Yes
Obs	466	466	466	466
R^2	0.001	0.005	0.127	0.461

NOTE. The regressions are based on annual city-level data over the period 2009-2014. The dependent variable is real GDP per capita growth. The regressors are the lagged values of the GIPS spread, the city-level exposure measure, and the interaction between the two. The regression in column (3) also includes city fixed effects, while the regression in column (4) includes both city and time fixed effects. Heteroskedasticity-robust standard errors clustered at the city level are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4 BANK FLOWS, REAL ESTATE EXPOSURE, AND CITY CYCLES: REDUCED FORM ESTIMATES WITHOUT CITY STATES

	(1) ΔGDP	(2) ΔGDP	(3) ΔGDP	(4) ΔGDP
Spread_{t-1}	-0.049	-0.139**	-0.148**	-
	(0.044)	(0.064)	(0.071)	
$\text{Spread}_{t-1} \times \text{Exposure}_{t-1}$		0.002**	0.002***	0.002***
		(0.001)	(0.001)	(0.001)
Exposure_{t-1}		-0.014***	0.058*	0.035**
		(0.005)	(0.034)	(0.017)
Time FE	No	No	No	Yes
City FE	No	No	Yes	Yes
Obs	448	448	448	448
R^2	0.001	0.007	0.131	0.459

NOTE. The regressions are the same as in Table 3, but the sample excludes the city states of Berlin, Bremen and Hamburg. Heteroskedasticity-robust standard errors clustered at the city level are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3 displays the results based on the full sample. As a benchmark, Column (1) reports an estimates of the linear association between bank flows, as captured by the GIPS spread level, and city output growth. Columns (2)-(4) report the estimated β coefficient that can be interpreted as a causal effect under our identification assumptions. These regressions include the interaction term between the spread and the exposure measure, as well as the level of the spread and the exposure. In Columns (3) and (4), the regression is saturated with fixed and time effects to control for city-specific factors and common shocks, such as city size and common factors across cites in the German business cycle. City size is particularly important because larger cities tend to grow disproportionately more due to agglomeration forces.

The estimated coefficient on the GIPS spread in Column (1) is negative, but not significant statistically. The estimated β coefficient on the interaction term is positive and has the same magnitude in Columns (2), (3) and (4). This suggests that a bank flow shock has a positive causal effect on output growth, with an impact that is larger in more exposed cities. Clearly, the magnitude of the β estimate is robust to the inclusion of city and time fixed effects.

The estimated β coefficient on the interaction term is not estimated precisely in the full sample of Table 3, even though the statistical significance does not decrease once we saturate the regression with fixed and time effects. However, Table 4 shows that, if we drop from the sample the three city states (i.e., Berlin, Bremen, and Hamburg), the estimated β coefficient on the interaction term becomes highly significant statistically and doubles in size across the three specifications in Columns (2), (3), and (4). This result is important not only because it addresses possible endogeneity concerns raised by the dependency of the allocation rule for the city states on lagged tax revenue (see Table 2 and the discussion in Section 3), but also because Berlin and Hamburg have the highest share of refugees in the sample (see Appendix Table A.3).[22]

The estimated coefficients in Columns (2)-(4) of Tables 3 and 4 point to an economically sizable role of real estate markets in the transmission of capital flow shocks. Our estimates imply that, for every 100-basis points increase in the GIPS spread, output growth in cities at the 90th percentile of the exposure distribution is between 12.4 and 24.8 basis points higher than in cities at the 10th percentile, depending whether we evaluate this impact with or without city states. Cities at the 90th percentile of the distribution have an exposure value of 138, compared for instance with 380, 280 and about 240 in Hamburg, Berlin, and Munich, respectively. Thus, the output growth effect of a 100-basis points GIPS spread change is 13.8=(100*138*0.001) or 27.6=(100*138*0.002) basis points, depending on whether we use the estimated value of the β coefficient in Table 3 or 4. In contrast, cities at the 10th percentile have an exposure value of 14. Hence, in this case, the impact is a mere 1.4=(100*14*0.001) or 2.8=(100*14*0.002) basis points, respectively. This roughly means a tenth to a quarter percentage point more growth in cities in which real estate

[22] In unreported regressions, we obtain an estimated β coefficient of the same size, statistically significant at the 5% level when we drop Berlin, Hamburg and Munich, leaving low-exposure Bremen in the sample.

markets are tighter for every 100 basis points of GIPS spread increase. Considering the 300-basis points average GIPS spread increase during the acute phase of the European crisis, as observed on average between 2009 and 2012, these estimates imply that cities most exposed to real estate markets might have grown almost a full percentage point more per year than least exposed cities during that period.

The results in Table 3 are robust to a number of other changes, most of which are reported in Appendix Table B.2. The results are consistent with the baseline above, with an even lager estimated β coefficient, if we replace the share of refugees with population density in the construction of the exposure measure (Column 1). We obtain similar results when we use a time-invariant city-level share of refugees, evaluated at the beginning of the sample in 2009, to rule out the possibility that the results are driven by within-city rather than between-city variation (Column 2). The findings are further similar if we replace the share of non-developable area with an alternative indicator of supply tightness across cities, the change in building permits from the pre-boom period of 2000-2008 to the post-boom period of 2009-2014 (Column 3). In this case, the impact is estimated more precisely, but is quantitatively smaller.

The exposure measure could be seen as a triple interaction. In additional unreported regressions, in addition to the interaction term between the GIPS spread and the exposure measure, we include, separately, the interaction of the spread with the share of refugees and with the gross share of non-developable area. In these regressions, the only variable that is significant is the interaction between the GIPS spread and the exposure measure. This is clear evidence on the merits of interacting a supply-side and demand-side indicator of tightness in local real estate markets.

4.2 Two-Stage Least Square Estimates

The reduced form estimate of equation (2) yields evidence on the generic importance of real estate market tightness for output growth, but is silent on the specific role that property prices may play. So, we now turn to the mediating role of property price changes in the transmission of bank flow shocks more specifically. To this end, following Chaney et al. (2012), we regress city output growth on property prices instrumenting the latter with the interaction of the GIPS spread with our exposure measure.[23] The specification is:

$$\Delta GDP_{c,t} = \alpha_c + \alpha_t + \beta \cdot \text{REP}_{c,t-1} + \varepsilon_{c,t} \quad (3)$$

$$\text{REP}_{c,t-1} = \alpha_c + \alpha_{t-1} + \gamma \cdot (\text{Spread}_{t-1} \times \text{Exposure}_{c,t-1}) + \eta_{c,t-1} \quad (4)$$

[23] Chaney et al. (2012) interact Saiz (2010) housing supply elasticity (our exposure) with the aggregate mortgage interest rate (our spread) and then use the predicted component of local real estate prices to estimate their mediating effect on firm investments.

where $\text{REP}_{c,t-1}$ is either the residential real estate price index ($RREP$) or the commercial index ($CREP$), and $\text{Spread}_{t-1} \times \text{Exposure}_{c,t-1}$ is the instrument. For robustness, we run the model also in terms property price changes, denoted with $\Delta RREP$ and $\Delta CREP$, respectively. In this specification, bank flows, as captured by the GIPS spread, can affect city output growth *via* city property price variations predicted by the bank flows, with a strength that depends on the tightness of the local real estate market.

4.2.1 First Stage

Table 5 and 6 report the first-stage results for equation (4) specified in levels and changes, respectively. The estimates in Columns (1) and (2) are based on the full sample of cities for residential and commercial prices indexes, respectively. Columns (3) and (4) drop the 3 city states. All regressions are saturated with time and fixed effects.

The results with property price levels show that our exposure measure is a good predictor of property prices in both the residential and commercial sectors, with F-statistics well above the norm even after controlling for time and fixed effects. For commercial prices (Column 4), the results are even stronger both quantitatively and statistically when we drop the city states. For residential prices (Column 3), however, the F-statistics deteriorates below acceptable levels when we drop the city states. This is problematic, as it suggests that the relevance of our instrument for residential prices depends on the extreme values of the share of refugees of Berlin and Hamburg.

For robustness and consistency, we also run the regression (4) in terms of property price changes rather than levels. Table 6 shows that the estimates are quite robust for the commercial sector (Columns 2 and 4), with even higher F-statistics when we drop city states, and only a slightly lower value when we run the regression on the full sample. The F-statistics, however, confirms that the instrument is weak in the case of the residential sector (Columns 1 and 3). The instrument performs better, and the estimated coefficient becomes significant at the 5 percent level, when we drop the city states (Column 3), but remains weak by conventional standards. The relevance of our instrument for the residential sector weakens further when we drop Berlin, Hamburg, and Munich from the sample, while it is essentially unchanged for the commercial sector in this case (results not reported).

Table 5 PROPERTY PRICE LEVELS AND EXPOSURE:
FIRST-STAGE RESULTS

	Full sample	Full Sample	Without City States	Without City States
	(1)	(2)	(3)	(4)
	RREP	*CREP*	*RREP*	*CREP*
$\text{Spread}_{t-1} \times \text{Exposure}_{t-1}$	0.005^{***}	0.008^{***}	0.005^{*}	0.011^{***}
	(0.001)	(0.001)	(0.003)	(0.002)
Time FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
F-Statistic	17.9	27.7	2.9	21.8
Obs	466	466	448	448
R^2	0.703	0.730	0.683	0.738

NOTE. The table reports the estimation results for the first-stage estimation of equation 4. They are based on annual city-level data from 2009 to 2014. The dependent variables are the residential and commercial real estate price indexes. The regressor is the lagged value of the GIPS spread interacted with the lagged value of the exposure measure. All regressions include city and time fixed effects. Columns (1) and (2) are based on the full sample of cities for residential and commercial prices indexes, respectively. Columns (3) and (4) drop the 3 city states. The hetroskedasticity-robust standard errors clustered at the city level are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6 PROPERTY PRICE CHANGES AND EXPOSURE:
FIRST-STAGE RESULTS

	Full sample	Full Sample	Without City States	Without City States
	(1)	(2)	(3)	(4)
	$\Delta RREP$	$\Delta CREP$	$\Delta RREP$	$\Delta CREP$
$\text{Spread}_{t-1} \times \text{Exposure}_{t-1}$	0.001^{*}	0.004^{***}	0.002^{**}	0.006^{***}
	(0.001)	(0.001)	(0.001)	(0.001)
Time FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
F-Statistic	2.9	21.4	4.6	39.5
Obs	466	466	448	448
R^2	0.558	0.517	0.557	0.528

NOTE. This table reports the same estimates as in Table 5 but in terms of property price changes. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

4.2.2 Second Stage

Tables 7 and 8 report the second-stage estimation results for the regression model in equation (3)-(4) specified in terms of property price levels and changes, respectively. In Columns (1) and (2), the city sample is complete. In Columns (3) and (4), the sample excludes the city states. All regressions are saturated with time and fixed effects.

The results in Table 7 suggest that both commercial and residential property prices variations predicted by changes in the GIPS spread affect city output growth, although the magnitude of the impact is seemingly larger in the residential sector (Columns 1 and 2). When we drop the city states (Columns 3 and 4), however, the impact in the commercial sector becomes strongly significant statistically, while it looses significance in the residential sector, despite more than doubling in size. In light of the statistical evidence on the first stage in Table 5, we interpret these results as suggesting solid robustness to outliers for the commercial sector, but a weak instrument problem for the residential sector.

The second-stage results are similar when we estimate equation (3) in terms of property price changes (Table 8). In particular, the effects on the residential sector (Columns 1 and 3) become even larger, but remain statistical insignificant. In contrast, in the commercial sector, the estimated coefficients become not only larger and also more precisely estimated in the sample without city states (Columns 2 and 4), confirming their robustness.

Table 7 CITY OUTPUT GROWTH AND PROPERTY PRICE LEVELS: 2SLS

	Full sample	Full Sample	No City States	No City States
	(1)	(2)	(3)	(4)
	ΔGDP	ΔGDP	ΔGDP	ΔGDP
$RREP_{t-1}$	0.235^{**}		0.517	
	(0.11)		(0.326)	
$CREP_{t-1}$		0.165^{**}		0.221^{***}
		(0.082)		(0.077)
Time FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Obs	466	466	448	448
R^2	0.404	0.453	0.216	0.439

NOTE. This table reports 2SLS estimates for equation (3). The regressions are based on annual city-level data from 2009 to 2014. The dependent variable is real percapita GDP growth. The main regressors are the commercial and residential real estate price indexes, instrumented by the interaction term between GIPS spread and the exposure measure. All regressions include city and time fixed effects. The heteroskedasticity-robust standard errors clustered at the city level are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8 City Output Growth and Property Price Changes: 2SLS

	Full sample	Full Sample	No City States	No City States
	(1)	(2)	(3)	(4)
	ΔGDP	ΔGDP	ΔGDP	ΔGDP
ΔRREP_{t-1}	1.122		1.295	
	(0.839)		(0.781)	
ΔCREP_{t-1}		0.287^{*}		0.443^{***}
		(0.169)		(0.166)
Time FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Obs	466	466	448	448
R^2	0.147	0.437	0.034	0.414

Note. This table reports the same estimates as in Table 7, but in terms of property price changes. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

We saw earlier that, based on the reduced-form estimate of our model, a 100 basis points GIPS spread increase leads to a higher real GDP growth in cities most exposed to real estate market tightness ranging from a tenth to a quarter of a percentage point relative to cities least exposed. The second stage estimates reported in Table 7 and 8 suggest that commercial property price increases triggered by GIPS spread changes can account for *all* of this difference. To see this, multiply the first stage coefficient in Column (2) of Table 5 by the second-stage estimate in Column (2) of Table 7. The resulting product is very close to the point estimate in Column (4) of Table 3. The latter is indicative of the fact that commercial property price are at the heart of the transmission mechanism of the bank flow shock in cities more exposed to real estate market tightness, consistent with the working of a collateral channel on the firm side (e.g., Liu et al. (2013)).

In sum, the evidence reported in this section establishes that (i) tighter real estate markets as captured by our exposure measure are associated with a stronger impact of bank inflows on local economic activity, and (ii) commercial property price differences across cities triggered by bank flow shocks can explain the most part of this differential impact. We find similar effects working through the residential sector when we estimate the regression model with the full city sample, but the results are sensitive to the exclusion of the city states, whose allocation rules depend on lagged revenue, or the exclusion of the three cities with the highest share of refugees. In fact, when we estimate the model without the city states, our instrument lose its relevance for residential property prices. In light of this, when we open up the black box of the transmission mechanism underlying the estimated differential impact of bank flow shocks across cities, in the rest of the paper, we will focus on the commercial sector, exploring the collateral channel on the firm side.

5 Bank Flows, Real Estate Collateral, and Credit Supply

In this section, we study the role of real estate collateral for credit supply to firms triggered by a bank flow shock. Figure 8 plots average credit growth during the 2009-2014 period by 2-digit NAICS classification against the average share of tangible assets in the same sector (TS). The figure shows that, on average during this period, all sectors experienced a sharp credit contraction, consistent the aggregate picture in Panel D of Figure 1. However, it also suggests a positive and tight association between faster (slower) credit growth (decline) and the availability of real estate collateral, with sectors typically using land and structures more intensively, such as Agriculture, Real Estate itself, Transport and Warehousing, Accommodation and Recreation, experiencing higher (lower) credit growth (decline).

Consistent with micro evidence on the role of collateral in financial contracting (e.g., Benmelech et al. (2005) and Benmelech and Bergman (2008)), we conjecture that an increase in the domestic credit supply associated with repatriation of foreign assets should benefit more firms and sectors with more real estate collateral, as this form of lending is safer and easier to screen, price and monitor. This hypothesis also accords with more directly related evidence on the impact of capital flow shocks on the domestic credit supply reviewed in Section 1.

We saw earlier that a higher GIPS spread is associated with a reduction in German bank holdings of foreign assets in the rest of the euro area and a lower aggregate domestic lending-deposit spreads. Here, we focus on the allocation of domestic credit at the bank-firm level associated with changes in the GIPS spread. As we discussed in Section 2, our bank-firm level proxy for real estate collateral is the share of tangible fixed assets in total assets, or "share of tangible assets" for brevity. To address endogeneity concerns, in this step of the empirical analysis, we rely on the microeconomic nature of our bank-firm-relationship data, assuming that no such individual relationship can affect the GIPS spread, and that the *quantity* of real estate collateral at the bank-firm-relationship level is predetermined with respect to lending decisions, controlling for loan demand with fixed effects as we explain in more details below.

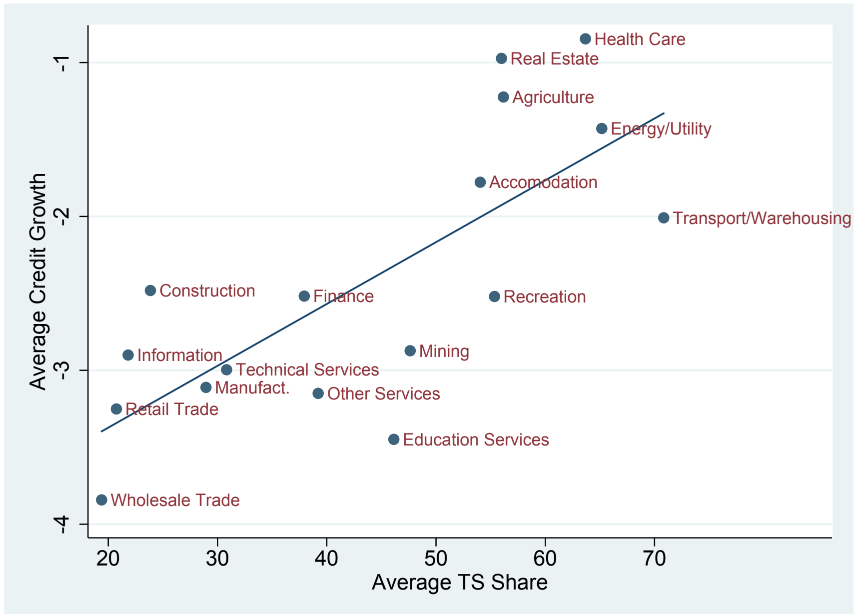
5.1 Firm-level Credit Allocation

In order to assess the role of real estate collateral in the credit allocation to firms, following Behn, Haselmann and Wachtel (2016), who use German credit register data to study the impact of capital regulation on credit supply, we estimate the following reduced-form regression:

$$\Delta \mathrm{L}_{i,j,t} \quad = \quad \alpha_{i,t} + \alpha_{j,year} + \beta \cdot (\mathrm{SPREAD}_{t-1} \times \mathrm{TS}_{j,t-4}) + \varepsilon_{i,j,t}, \tag{5}$$

where $\Delta L_{i,j,t}$ is the log-change in loan volume of bank i to firm j in quarter-year t, and $(\mathrm{SPREAD}_{t-1} \times \mathrm{TS}_{j,t-4})$ is a lagged interaction term between the GIPS spread and firm j's share of tangible as-

Figure 8 CREDIT GROWTH AND REAL ESTATE COLLATERAL BY SECTOR



NOTE. The figure plots average credit growth against average tangible fixed assets over total assets (TS), by industry. The industry classification corresponds to the 2-digit NAICS code, with the following adjustments listed in Appendix Table A.4 together with the corresponding average sector shares of tangible assets: Manufacturing equals codes 31-33; Retail Trade equals codes 44-45; Transport and Warehousing equal codes 48-49; and Technical Services equal codes 54-56. The correlation between the two variables is 75% with a p-value of 0. The sample period is 2009-2014.

sets, $TS_{j,t-4}$.[24] In order to control for unobserved time-varying heterogeneity at the bank level, we include bank-year-quarter fixed effects ($\alpha_{i,t}$). To control for year-on-year changes in firm loan demand, and also for the location of firm headquarters that might influence firm credit access, we include firm-year fixed effects ($\alpha_{j,year}$). Finally, by clustering the standard errors at the bank-firm level, we allow the observations to be correlated across bank-firm relationships. The main coefficient of interest is β that captures the differential strength of credit access across firms in response to the bank flow shock.

Table 9 summarizes the baseline results, as in equation (5), and a number of robustness checks. The positive and highly statistically significant estimate of β in Column (1) suggests that a higher GIPS spread leads to more bank lending to firms with more real estate collateral, controlling for loan demand with firm-year fixed effects. The magnitude of this effect is economically significant: a 100-basis points GIPS spread increase raises (slows) the quarterly rate of credit growth (decline) of high-TS firms (at the 75th percentile of the distribution) by 74 basis points more than the corresponding growth rate of low-TS firms (at the 25th percentile).[25]

[24] The tangible asset ratio is lagged by four quarters because firm-level data are at the annual frequency.

[25] We calculate these magnitudes as follows. The 25th percentile of the distribution of TS is 8.74%. The corre-

Table 9 BANK FLOWS, REAL ESTATE COLLATERAL, FIRM CREDIT ACCESS

	(1)	(2)	(3)	(4)	(5)
	ΔL	ΔL	ΔL	ΔL	ΔL
$\text{Spread}_{t-1} \times \text{TS}_{t-4}$	0.013^{***}				
	(0.003)				
$\text{Spread}_{t-1} \times \text{TS}_{\text{Industry},t-4}$		0.014^{***}			
		(0.003)			
$\text{Spread}_{t-1} \times (\text{TS}_{2008} * \text{CREP}_{t-4})$			0.011^{**}		
			(0.005)		
$\text{Spread}_{t-1} \times \text{TS}_{t-4} \times \text{Interbank}_{t-1}$				0.467^{**}	
				(0.231)	
$\text{TS}_{t-4} \times \text{Interbank}_{t-1}$				-3.832^{**}	
				(1.813)	
$\text{Spread}_{t-1} \times \text{TS}_{t-4} \times \text{Net Foreign Assets}_{t-1}$					0.030^{*}
					(0.017)
$\text{TS}_{t-4} \times \text{Net Foreign Assets}_{t-1}$					-0.370^{***}
					(0.122)
Firm-Year FE	Yes	Yes	Yes	No	No
Firm-Year-Quarter FE	No	No	No	Yes	Yes
Bank-Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
Obs	573,985	707,742	188,965	387,734	514,985
R^2	0.141	0.145	0.147	0.456	0.430

NOTE. The regressions are based on quarterly bank-firm-relationship level data over the period 2009:Q1-2014:Q4. The dependent variable is the log-difference in loan value of bank i to firm j in quarter-year pair t. The independent variable is the GIPS spread interacted with firms' share of tangible assets. The latter is replaced by its industry mean in Column (2). In Column (3), we inflate the pre-determined 2008 share of firm-level tangible assets with the city-level real commercial real estate price index. Column (1)-(3) include bank-time and firm-year fixed effects. Columns (4) interacts the GIPS spread with firm-level tangible assets and the interbank funding over retail deposits ratio. Column (5) interacts the spread with tangible assets and banks' net foreign assets vs. euro area countries over total assets, respectively. In Column (4) and (5), we replace firm-year with firm-year-quarter fixed effects. The standard errors are clustered at the bank-firm level and shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Column (2) of Table 9 interacts the GIPS spread with average share of tangible assets across industries.[26] The motivation behind this specification is that industry-specific characteristics can affect the level and nature of firms' real estate asset holdings (see, for instance, Rochdi (2015)). In addition, the average industry share of tangible assets is less likely to be endogenous with respect to other firm characteristics or lending at the bank-firm level—see, for instance, Campello and Giambona (2011) and the literature cited therein. Column (2) indicates that our results are robust to using the industry average of tangible assets. In particular, we find that banks shift credit towards firms in industries with higher shares of tangible assets.

The specification in Column (3) holds the firm share of tangible assets fixed at its 2008 level and inflates it with the city-level commercial real property price index, assuming that firms own most of their real estate assets in the city where their headquarters are located, in a manner similar to Chaney et al. (2012) and Doerr (2018). Again, we find that banks shift their credit supply towards firms with more real estate collateral, even though the β coefficient is now estimated slightly less precisely. This is likely to be the case due to the lower number of observations in this experiment, as the variable CREP is not available for all cities and rural areas covered by the German credit registry, leading to a sample size that is roughly half the one used in the baseline.

The role of two important bank characteristics is explored in Columns (4)-(5). Specifically, following Baskaya et al. (2018), first we examine whether the role of collateral is stronger for banks with higher interbank-to-deposit ratios. As this type of funding is more likely to be exposed to international capital market fluctuations, banks with a high share of non-deposit funding should be most affected by changes in the GIPS spread, which captures also changes in global financial conditions. Second, we also examine the role of individual-bank pre-GFC exposure to the rest of the euro area as captured by the net foreign assets position vs the rest of the euro area as a share of total assets in 2006. If the GIPS spread is capturing bank retrenchment from Southern Europe, we should find that banks with a higher pre-GFC exposure to the rest of the euro area should respond more to the spread change. To this end, we include two triple interaction terms. The first is the interaction between the GIPS spread, the share of tangible assets and the lagged interbank-to-deposit funding ratio (Column 4). The second term interacts the spread with the share of tangible assets and the lagged value of the share of net foreign assets (Column 5).

In these two additional regressions, the granularity of the credit register data permits us to restrict the sample to firms with multiple bank relationships, and hence allowing us to include firm-year-quarter fixed effects ($\alpha_{j,t}$), as opposed to firm-year fixed effects as before. As shown by Khwaja and Mian (2008), this strategy fully absorbs firm-specific loan demand shocks.[27] The

sponding value for the 75th percentile is 65.52%. Thus, the credit growth difference between both types of firms is: (65.52-8.74)*0.013=0.74.

[26]The results are virtually unchanged if we use the median industry value instead.

[27]Recall that we can employ this identification strategy because 92% of the firms in the German credit register borrow from more than one bank. Note here that, in these two specifications, firm-time fixed effects absorb the double

estimation results in Column (4) indicate that the sensitivity of the credit supply to real estate collateral is stronger for banks with a higher non-core funding ratio, as can be gauged from the positive and statistically significant coefficient on the triple interaction term. The results in Column (5) suggest that lending might also be affected by the initial euro area exposure, even though this effect is statistically significant only at the 10 % level.

Appendix Table B.3 reports additional robustness checks. The results in Table 9 are robust to augmenting the baseline regression with the interaction between the GIPS spread with other firm-level controls that are likely to be correlated with the firm share of tangible assets (Columns (1)-(3)). This additional experiment ensures that the baseline results are not driven by a correlation between the share of tangible assets and other firm-level characteristics. The results show that, if anything, adding more firm-level controls interacted with the GIPS spread increases the economic magnitude of the estimated coefficient on the key interaction term between the GIPS spread and tangible assets. In Column (4) of Table B.3, we drop observations during the 2009-2010 period. This might be important because the German government, after the GFC, provided guarantees to certain firms and sectors. To the extent to which these guarantees are correlated with the tangible asset ratio of firms, our baseline results could be biased. The results in Column (4) show that, even excluding 2009-2010, a higher GIPS spread leads to a shift in credit supply towards high-tangible asset firms. Finally, in Column (5), we document that our results are also robust to employing a time-invariant level of TS, measured in 2008, without inflating the initial level with commercial property price changes.

To sum up, Table 9 documents an important role of real estate collateral in firm access to credit in response to bank flow shocks. The results suggest that banks allocate more credit to firms with more real estate collateral as measured by a higher share of tangible assets, even after controlling for loan demand. This effect is stronger for riskier banks with higher interbank funding ratios or greater net foreign assets. The estimation results are robust to using the industry, rather than the individual, share of tangible assets, to employing the initial level of tangible assets, or to excluding from the sample the period of government stimulus via credit guarantees.

5.2 Industry-level Credit Allocation

Next, we study the credit allocation by industry showing that credit increases (declines) the fastest (the slowest) in the industries with the highest shares of tangible assets. As we saw earlier, these sectors are those in which land and buildings are used more intensively in the production of their output (Figure 8 and Table A.4).

interaction term between the GIPS spread and the tangible asset ratio, which therefore cannot be included separately.

Table 10 BANK FLOWS AND BANK LENDING BEHAVIOR: BETWEEN-SECTOR DIFFERENCES

Dependent variable: ΔL	
$\text{Spread}_{t-1} \times \text{I}_{\text{Agriculture}}$	2.980***
	(0.97)
$\text{Spread}_{t-1} \times \text{I}_{\text{Energy/Utility}}$	1.053***
	(0.27)
$\text{Spread}_{t-1} \times \text{I}_{\text{Transport/Warehousing}}$	0.628**
	(0.24)
$\text{Spread}_{t-1} \times \text{I}_{\text{Information}}$	-1.635**
	(0.80)
$\text{Spread}_{t-1} \times \text{I}_{\text{Real Estate}}$	0.960***
	(0.33)
Bank-Year-Quarter FE	Yes
Firm-Year FE	Yes
Obs	708,714
R^2	0.133

NOTE. This regression is based on matched quarterly German bank-firm-level data over the period 2009:Q1-2014:Q4. The dependent variable is the log difference in loan value of bank i to firm j in quarter-year pair t. The main regressor is the GIPS spread interacted with a sector dummy that corresponds to the 2-digit NAICS classification as in Figure 8. The table reports only sectors behaving in a statistically significant different manner. The regression also includes bank-time and firm-year fixed effects. The standard errors are clustered at the bank-firm level and are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

In order to identify between-industry differences, we estimate the following regression:

$$\Delta \text{L}_{i,j,t} = \alpha_{i,t} + \alpha_{j,year} + \beta \cdot (\text{SPREAD}_{t-1} \times \text{SECTOR}_s) + \varepsilon_{i,j,t}, \tag{6}$$

where SECTOR_s is a dummy variable for sector s constructed based on the 2-digit NAICS industry classification used in Figure 8. In particular, for all sectors except manufacturing, we interact the GIPS spread with a set of industry dummies that are equal to one for industry s and zero otherwise. We use manufacturing as the reference group because this is the industry in which real estate is least likely to dominate total tangible fixed assets.[28] Manufacturing is also the largest industry in the data set by number of firms. Thus, this specification evaluates the difference in credit growth in response to the bank flow shock relative to the allocation of credit in manufacturing. To control for time-varying bank heterogeneity and loan demand, we also control for bank-year-quarter and firm-year fixed effects as discussed above.

Table 10 reports the estimation results. For ease of presentation, the table displays only sectors whose credit allocation is statistically different than manufacturing. It is evident that a higher GIPS spread has a stronger effect on the credit growth of industries with a higher share of tangible assets, and hence more likely to be exposed to commercial real estate. Specifically, credit growth is highest in Agriculture, Energy and Utility, Transport and Warehousing and Real Estate itself—

[28]Manufacturing is right at the 25th percentile of the tangible asset share distribution with an average value slightly below 30% in Table 8 and Table A.4. See also Rochdi (2015).

the industries with the highest average shares of tangible assets in total assets, as can be seen from Figure 8 and Table A.4. In contrast, the results show that the information sector, which has one of the lowest shares of tangible fixed assets and whose production function is intensive in *intangible* assets, receives a significantly lower share of credit in response to bank inflows. For robustness, we also regress credit growth of bank i to firm j on the triple interaction between the GIPS spread, the industry dummies and the different bank characteristics introduced in Table 9. The results are not reported to conserve space, but are in line with those reported in Table 10.

In summary, the evidence at the sector level confirms the findings at the bank-firm level and suggests that firms with more real estate collateral have easier access to credit in response to bank flow shocks. Or, in other words, banks allocate disproportionately more credit to firms and sectors with more real estate collateral. This evidence is in strong accord with a transmission mechanism of bank flow shocks to output in which real estate collateral plays a critical role, as established in Section 4.

6 Firm and Industry Outcomes

Having established that retrenching banks supplied more credit to firms with more real estate collateral, in this section, we want to evaluate the role of collateral in determining the differential impact a bank flow shock on firm and industry-level outcomes. We focus on employment, investment, total factor productivity (TFP), and borrowing costs. We then also evaluate whether bank flow shocks are associated with capital misallocation.

We measure borrowing cost changes ($\Delta INTEXP$) with the log difference of firm interest expenses as a share of total debt, following Bernile et al. (2017) and Gambacorta and Shin (2018). Employment growth ($\Delta EMPL$) is the rate of growth in the total number of firm employees. Investment (ΔK) is the change in firm *total* fixed assets as a share of total assets, so as to make sure that the results are not driven by firm size. TFP growth (ΔTFP) is constructed by estimating a production function based on our firm-level data aggregated at the industry level at the second digit of the NAICS code, following Wooldridge (2009). Specifically, TFP is the residual of a regression of firm-level log real value added on log labor input (the log of the real wage bill) and log capital input (the log of the real book value of total fixed assets), where firm value added and the wage bill are deflated with the two-digit industry price deflators from the OECD STAN database. The capital stock is deflated by the price of investment goods. For this TFP regression, all variables are winsorized at the 1% level before taking logs.

To evaluate the role of real estate collateral in the transmission of bank flow shocks to firms, we specify the following firm-level reduced-form regression:

$$\Delta \mathrm{Y}_{j,t} \quad = \quad \alpha_j + \alpha_t + \gamma \cdot \Delta \mathrm{Y}_{j,t-1} + \upsilon \cdot (\mathrm{SPREAD}_{t-1} \times \mathrm{TS}_{j,t-1}) + \varepsilon_{j,t}, \tag{7}$$

where Y denotes alternative firm outcomes. As in the credit regression of the previous section, the main independent variable in all specifications is the GIPS spread interacted with the firm-level share of tangible assets. To mitigate endogenity concerns, we continue to rely on the microeconomic nature of the data, including firm and time fixed effects. In order to address concerns that firms may be on different trend paths, all regressions include the lagged dependent variable (LDV).

We expect bank flow shocks to reduce the borrowing costs of firms with a higher share of real estate collateral since these firms can obtain more credit on possibly better terms (Benmelech et al. (2005) and Benmelech and Bergman (2008)).[29] Second, for consistency with the results in Section 4, one should also find a positive coefficient on employment growth and investment in the transmission of a bank flow shock to output through the commercial real estate sector. In contrast, we do not have a definite prior on the impact of the bank flow shock on TFP.

Table 11 reports the results. Column (1) shows that bank flow shocks not only increase the credit supply to high-tangible asset firms, as shown before, but also reduce their costs of borrowing. Moreover, Columns (2)-(3) show that bank flow shocks increase employment and investment of high-tangible asset firms, with a statistically significance at the 1% and 10% level, respectively. Column (4) suggests that a higher firm share of tangible assets has a strong positive linear effect on TFP growth, with no differential impact on high-tangible asset firms during the episode of bank retrenchment that we consider. This is evident from the estimated coefficient on the level of lagged firm TS, which is positive and highly significant, and the insignificant coefficient on the interaction term. In other words, Column (4) says that bank flow shocks are not associated with a disproportionate increase or reduction in TFP growth of high-tangible asset firms. This result suggests that we should not expect strong evidence of capital misallocation during the bank repatriation episode that we study.

To assess this hypothesis more formally, we first aggregate our firm-level data at the NAICS2 code industry level as in Doerr (2018). We then regress average industry TFP *growth* rates on the interaction between the GIPS spread and average industry-level shares of tangible assets, controlling for lagged TFP growth in addition to time and industry fixed effects. Column (5) shows that, as in the firm regression, there is no significant association between the bank flow shock and a disproportionate change in TFP of high-tangible asset industries.

Second, we also regress the industry-level TFP *dispersion* on the interaction between the GIPS spread and the industry-level average share of tangible assets. Following Hsieh and Klenow (2009), the idea here is that, if credit growth leads to capital misallocation, TFP dispersion across firms in the same industry should increase with the bank flow shock, especially in industries with more real estate collateral that obtained a more than proportional share of the declining credit

[29] See also the aggregate evidence we reported in Table 1 and Baskaya et al. (2018), who explore the effect of capital flows on both the volume and price of credit. Unfortunately, the German credit registry does not include information on the price of credit contracted.

Table 11 FIRM AND INDUSTRY OUTCOMES

	Firm-Level	Firm-Level	Firm-Level	Firm-Level	Industry-Level	Industry-Level
	(1)	(2)	(3)	(4)	(5)	(6)
	ΔINTEXP	ΔEMPL	ΔK	ΔTFP	ΔTFP	SD(TFP)
$\text{Spread}_{t-1} \times \text{TS}_{t-1}$	-0.031***	0.009***	0.144*	-0.002	-	-
	(0.01)	(0.00)	(0.08)	(0.01)		
$\text{Spread}_{t-1} \times \text{TS}_{\text{Industry},t-1}$	-	-	-	-	-0.016	0.005
					(0.02)	(0.03)
TS_{t-1}	1.279***	-0.042	1.225***	0.386***	-	-
	(0.16)	(0.07)	(0.34)	(0.08)		
$\text{TS}_{\text{Industry},t-1}$	-	-	-	-	1.308	0.335
					(0.86)	(1.14)
LDV_{t-1}	-0.369***	-0.484***	0.031	-0.425***	-0.358**	-0.024
	(0.01)	(0.03)	(0.03)	(0.03)	(0.12)	(0.21)
Firm FE	Yes	Yes	Yes	Yes	-	-
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	-	-	-	-	Yes	Yes
Obs	22419	41827	50774	15143	64	64
R^2	0.311	0.364	0.031	0.389	0.340	0.735

NOTE. The regressions in columns (1)-(4) are based on annual firm-level data over the period 2009-2014. The dependent variables are: changes in firm borrowing costs ($\Delta INTEXP$) measured as the log difference of firm interest expenses as a share of total debt in Column (1); employment growth ($\Delta EMPL$) measured as the rate of growth in the total number of firm employees in Column (2); investment (ΔK) measured as the change in firm *total* fixed assets as a share of total assets in Column (3); TFP growth (ΔTFP) constructed by estimating a production function based on our firm-level data aggregated at the industry level at the second digit of the NAICS code, following Wooldridge (2009). The independent variable is the GIPS spread interacted with the firm share of tangible assets. All specifications (1)-(4) include the respective lagged dependent variable (LDV), in addition to firm and time fixed effects. The standard errors are clustered at the industry-year level and are shown in parentheses. Columns (5)-(6) are industry level regressions in which the dependent variables are industry-level average total factor productivity growth, and the industry-level dispersion in total factor productivity. The main regressor here is the GIPS spread interacted with the industry average share of tangible assets. Both specifications include the lagged dependent variable, as well as time and industry fixed effects. Standard errors are clustered at the industry level. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

volumes during the 2009-2014 period. Column (6) shows that the estimated coefficient on this interaction term is positive, but statistically insignificant. Even though this regression is run with very few observation, the finding is consistent with the results of Gopinath et al. (2017), who do not uncover evidence of misallocation in Germany. The result is unchanged if we replace TFP dispersion with the dispersion of the marginal product of capital.[30] In an unreported regression, we also regressed TFP dispersion on the GIPS spread, without interacting the latter with industry-level average tangible asset ratios, finding no association between the GIPS spread and industry-level TFP dispersion.

These results are interesting as they stand in contrast to some other findings in the misalloca-

[30] This is not surprising because, with the constant factor shares and a Cobb-Douglas production function, TFP dispersion and the dispersion of the marginal product of capital are proportional to each other (see Gopinath et al. (2017)).

tion literature specifically focused on housing booms. For example, Doerr (2018) and Chakraborty et al. (2018) document that real estate booms tend to distort credit and capital allocation, leading to sizable aggregate TFP losses. In contrast, we show that bank retrenchment, while causing higher property prices with varying intensities across cities, is not associated with lower productivity growth at the firm or industry-level, or increased TFP dispersion. One way to reconcile these seemingly conflicting results is to note that the German residential and commercial real estate price booms did not take place in the context of a credit boom. On the contrary, as noted above, aggregate credit declined in real terms during the period considered (see, for instance, Panel D in Figure 1).

To summarize, the results in this section also accord well with our main results in Section 4 based on city-level data. The estimated differential impact of a bank flow shock on firm and industry-level outcomes provide additional evidence that real estate collateral plays a significant role. Real estate collateral seems critical not only for the differential access of firms and sectors to the increased credit supply triggered by bank inflows, but is also associated with increased hiring and investment, thus contributing to higher levels of local economic activity, without evidence of capital misallocation.

7 Conclusions

This paper studies the role of real estate markets in the transmission of bank flow shocks to city business cycles in Germany by using a new and unique matched city-level and bank-firm-level data set. Germany is an interesting laboratory because it experienced sizable bank inflows with a real estate boom, but without a domestic credit boom, during and after the global financial crisis (GFC).

To identify the differential impact of bank flow shocks on output growth across German cities, we exploit the quasi-random geographic variation in a city-level measure of real estate market tightness or exposure. This measure is the product of the gross share of land that cannot be developed, which is determined by geography and land use regulations, and the city-level share of refugees in total refugees, which is determined by longstanding government rules and regulations.

We find that the output growth impact of a bank flow shock, as measured by the sovereign bond spread of Southern European countries (the so-called GIPS spread), is more significant in cities that are more exposed to tightness in local real estate markets. We estimate that, during the 2009-2014 period, for every 100-basis point increase in the GIPS spread, the most exposed German cities grow 15-25 basis points more than the least exposed ones. The differential response of commercial property prices across cities to the bank flow shock accounts for all of this growth differential.

The transmission mechanism that we uncover works through a collateral channel on the firm side in which commercial real estate plays a central role. We document the importance of real estate collateral for firm credit access and bank behavior by showing that German banks repatriated gross foreign assets from the rest of Europe after the GFC and lent disproportionately more to domestic firms and sectors with more tangible fixed assets. We also show that firms with more tangible assets hire and invest more in response to the bank flow shock. Consistent with the extant literature on Germany, but differently from studies of housing booms with credit booms, we do not find evidence of capital misallocation associated with the transmission of bank flow shock across German cities.

Our paper is ultimately silent on the role of the residential real estate sector in the transmission of the bank flow shock that we consider. Macroeconomic data show that the leverage of German households, already low by international standards before the GFC, declined further during the post-GFC period. Exploring drivers on residential house prices in the context of a portfolio re-balancing framework, like in Flavin and Yamashita (2002), and exploring its impact on consumption is an interesting area of future research.

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A Data Appendix For Online Publication

Table A.1 DEFINITIONS AND SOURCES OF ALL VARIABLES USED IN THE EMPIRICAL ANALYSIS

Variable	Definition	Unit	Source
$\Delta RREP$	City c's residential real estate price index, log-change and deflated by state-level CPI	%	Bulwiengesa
$\Delta CREP$	City c's commercial real estate price index, log-change and deflated by state-level CPI	%	Bulwiengesa
RREP	City c's residential real estate price index, deflated by state-level CPI	2007=100	Bulwiengesa
CREP	City c's commercial real estate price index, deflated by state-level CPI	2007=100	Bulwiengesa
Non-Developable Area	City c's gross share of land that cannot be developed relative to total area	%	INKAR
Refugees	Share of refugees allocated by the government to city c relative to all refugees in the same year	%	Fed. Stat. Off.
Exposure	City c's product of the share of refugees and the share of non-developable area	%	own calculation
ΔGDP	City c's growth in GDP per capita, deflated by state-level CPI	%	INKAR
Population Density	City c's number of inhabitants per square kilometer	-	INKAR
Refugees in 2009	2009 share of refugees allocated by the government to city c relative to all refugees in 2009	%	Fed. Stat. Off.
Building Permits	City c's inverse of the change in building permits from the 2000-2008 period to 2009-2014	-	INKAR
GIPS spread	The average of the 10-year government bond spread of Portugal, Italy, Greece and Spain relative to Germany	%	FRED
Net Bank Inflows Outside Eurozone	Change in net foreign liabilities outside the Eurozone of German BIS reporting banks	% of GDP	BIS
Net Bank Inflows Inside Eurozone	Change in net foreign liabilities inside the Eurozone of German BIS reporting banks	% of GDP	BIS
Gross Bank Inflows Inside Eurozone	Change in gross foreign liabilities inside the Eurozone of German BIS reporting banks	% of GDP	BIS
Gross Bank Outflows Inside Eurozone	Change in gross foreign assets inside the Eurozone of German BIS reporting banks	% of GDP	BIS
Lending-Deposit Spread	Lending rate is the interest rate charged by banks on short- and medium-term loans to the private sector. Deposit interest rate is the interest rate offered by commercial banks on three-month deposits (Line 60P - Line 60L).	%	IMF IFS
TS	Firm j's tangible fixed assets (Bureau van Dijk code TFAS) as a share of total assets (TOAS)	%	Amadeus
$TS_{Industry}$	The arithmetic mean of TS by 2-digit NAICS code	%	Amadeus
$TS_{2008} * CREP$	Firm j's 2008 tangible assets as a share of total assets inflated by the city-level real commercial real estate price index	%	Amadeus, Bulwiengesa
EQ	Firm j's capital-to-asset ratio (CAPI/TOAS)	%	Amadeus
ROA	Firm j's return on assets (EBIT/TOAS)	%	Amadeus
TA	Firm j's logarithm of total assets (TOAS)	ln(euro)	Amadeus
$\Delta INTEXP$	Change in firm j's logarithm of interest expenses over total debt (INTE/LOAN)	%	Amadeus
$\Delta EMPL$	Change in firm j's logarithm of the number of employees (EMPL)	%	Amadeus
ΔK	Change in firm j's total fixed assets (FIAS) scaled by total assets (TOAS)	%	Amadeus
ΔTFP	Change in firm j's logarithm of TFP computed by following Wooldridge (2009)	%	Amadeus
$\Delta L_{i,j,t}$	Log-difference of the stock of loans of bank i to firm j in quarter-year t	%	Credit Register
Bank Share of Gross Foreign Assets	Bank i's gross foreign assets over total assets	%	Bundesbank
Net Foreign Assets	Bank i's net foreign assets vis-à-vis the euro area over total assets	[0,1]	Bundesbank
Interbank	Bank i's interbank funding-to-deposits ratio	[0,1]	Bundesbank
Capital Ratio	Bank i's regulatory capital-to-asset ratio	%	Bundesbank
Size	Bank i's logarithm of total assets	ln(euro)	Bundesbank
Liquidity	Bank i's liquid assets over total assets	%	Bundesbank
ROA	Bank i's return on risk-weighted assets	%	Bundesbank
NPL	Bank i's non-performing over total loans	%	Bundesbank
Loans	Bank i's loans over total assets	%	Bundesbank

Table A.2 SUMMARY STATISTICS FOR ALL VARIABLES USED IN THE EMPIRICAL ANALYSIS

Variable	Observations	Mean	Median	SD	25th	75th
$\Delta RREP$	466	2.22	2.15	3.48	-0.43	4.49
$\Delta CREP$	466	1.22	1.27	3.19	-0.97	3.10
RREP	466	102.69	99.92	10.58	95.55	108.14
CREP	466	102.42	102.25	10.72	95.74	108.69
Non-Developable Area	466	54.74	54.80	13.60	45.10	66.50
Refugees	466	1.23	0.63	1.83	0.32	1.26
Exposure	466	54.43	35.69	61.85	17.85	65.73
ΔGDP	466	1.01	0.96	4.48	-1.48	2.77
Population Density	466	1530.40	1354.00	773.34	1004.00	2027.00
Refugees in 2009	466	1.25	0.62	1.87	0.35	1.26
Building Permits	466	-5.06	0.39	31.48	-2.42	1.46
GIPS spread	60	2.04	0.46	2.84	0.19	3.22
Net Bank Inflows Outside Eurozone	60	-2.08	-4.28	12.31	-8.52	1.96
Net Bank Inflows Inside Eurozone	60	-2.32	-1.17	6.05	-5.33	1.06
Gross Bank Inflows Inside Eurozone	60	0.13	0.78	4.65	-1.96	2.64
Gross Bank Outflows Inside Eurozone	60	2.46	2.03	6.69	-1.39	4.97
Lending-Deposit Spread	48	2.15	2.05	0.70	1.61	2.50
TS	72,290	38.04	29.63	32.03	8.74	65.52
$\text{TS}_{\text{Industry}}$	90,483	36.41	27.09	18.53	22.35	54.36
$\text{TS}_{2008} * \text{CREP}$	19,972	33.98	21.41	33.40	5.19	59.41
EQ	73,948	26.36	23.85	27.77	8.56	42.76
ROA	42,275	5.48	4.51	12.29	0.75	10.30
TA	75,076	21.09	23.06	4.68	15.62	24.02
$\Delta INTEXP$	29,722	2.62	-0.45	83.42	-33.68	35.72
$\Delta EMPL$	65,776	4.31	0.00	54.85	-0.80	6.24
ΔK	62,043	33.44	0.04	476.42	-0.24	0.65
ΔTFP	28,813	-0.52	0.04	35.51	-9.15	9.49
$\Delta L_{i,j,t}$	723,296	-2.84	-0.83	63.54	-7.34	2.04
Bank Share of Gross Foreign Assets	89,651	58.07	59.82	15.74	50.23	67.78
Net Foreign Assets	29,606	0.0009	-0.00006	0.07	-0.001	0.002
Interbank	27,338	0.0003	0.00	0.009	0.00	0.00
Capital Ratio	28,769	18.90	17.03	14.40	14.59	20.48
Size	29,615	20.76	20.59	1.32	19.87	21.41
Liquidity	29,615	20.91	17.06	15.33	12.62	23.32
ROA	28,583	2.12	1.99	3.46	1.56	2.49
NPL	27,344	3.90	3.30	3.85	2.05	4.89
Loans	29,610	58.52	60.23	15.80	51.01	68.17

Table A.3 LIST OF CITIES, AVERAGE REFUGEE ALLOCATION, AND EXPOSURE MEASURE

Aschaffenburg (0.4, 24.4)	Cottbus (0.3, 18.0)	Fürth (0.4, 20.8)	Kassel (1.4, 54.2)	Mannheim (1.3, 52.3)	Rosenheim (0.2, 9.3)
Augsburg (1.4, 78.2)	Darmstadt (2.3, 152.1)	Gelsenkirchen (1.2, 29.4)	Kempten (0.1, 6.8)	Mönchengladbach (0.8, 42.8)	Rostock (0.6, 38.9)
Bamberg (0.2, 9.5)	Dessau-Roßlau (0.2, 14.6)	Gera (0.1, 9.5)	Kiel (0.9, 43.6)	**München** (9.1, 237.6)	Salzgitter (0.4, 26.2)
Bayreuth (0.4, 20.9)	Dortmund (3.0, 116.4)	Hagen (0.8, 53.8)	Koblenz (0.6, 38.9)	Münster (0.9, 60.6)	Schweinfurt (0.3, 13.1)
Berlin (12.2, 362.3)	Dresden (1.0, 56.6)	**Hamburg** (11.0, 444.7)	Krefeld (0.6, 27.4)	Neumünster (0.4, 18.7)	Solingen (0.4, 21.8)
Bielefeld (1.6, 92.2)	Duisburg (1.9, 73.3)	Hamm (0.5, 31.9)	Köln (4.1, 158.4)	Nürnberg (2.9, 110.9)	Stuttgart (3.0, 147.3)
Bochum (1.3, 38.4)	Düsseldorf (2.6, 102.7)	Heidelberg (0.5, 36.4)	Landshut (0.2, 13.3)	Offenbach (0.9, 44.7)	Suhl (0.1, 7.1)
Bonn (1.6, 81.4)	Eisenach (0.1, 6.5)	Heilbronn (1.0, 62.8)	Leipzig (1.4, 65.7)	Osnabrück (0.5, 26.0)	Trier (0.4, 29.3)
Bottrop (0.3, 17.2)	Erfurt (0.7, 48.4)	Herne (0.5, 11.9)	Leverkusen (0.6, 23.4)	Passau (0.1, 7.2)	Ulm (0.6, 43.0)
Braunschweig (2.6, 30.1)	Erlangen (0.3, 18.6)	Ingolstadt (0.3, 17.3)	Ludwigshafen (0.9, 33.1)	Pforzheim (0.9, 59.6)	Wiesbaden (1.2, 70.2)
Bremen (2.6, 107.4)	Essen (3.2, 104.2)	Jena (0.2, 16.3)	Lübeck (0.6, 39.6)	Potsdam (0.5, 36.0)	Wilhelmshaven (0.2, 13.4)
Bremerhaven (0.4, 20.4)	Flensburg (0.2, 9.2)	Kaiserslautern (0.2, 15.1)	Magdeburg (0.7, 40.6)	Regensburg (0.4, 19.2)	Wolfsburg (0.4, 28.8)
Chemnitz (0.7, 41.3)	Frankfurt (3.7, 156.0)	Karlsruhe (1.3, 67.1)	Mainz (1.0, 47.5)	Remscheid (0.3, 15.6)	Wuppertal (2.2, 111.5)
					Würzburg (0.7, 36.6)

NOTE. The table lists the 79 urban areas defined as cities both in the national accounts and by Bulwiengesa. The numbers in parentheses are the 2009-2014 average value of the share of refugees in total refugees and the value of our exposure measure, defined as the product of the share of refugees and the gross share of non-developable area, respectively. Berlin, Bremen and Hamburg, which are underlined, are city states. Berlin, Hamburg and Munich, in bold font, are the largest German cities and have the three highest average shares of refugees in total refugees over the period 2009-2014.

Table A.4 INDUSTRY CLASSIFICATION

NAICS Code	Industry Name	Average TS (in %)
11	Agriculture	56.2
21	Mining	47.6
22	Energy/Utility	65.2
23	Construction	23.9
31-33	Manufacturing	28.9
42	Wholesale Trade	19.4
44-45	Retail Trade	20.7
48-49	Transport/Warehousing	70.8
51	Information	21.8
52	Finance	37.9
53	Real Estate	56.0
54-56	Technical Services	30.8
61	Education Services	46.1
62	Health Care	63.7
71	Recreation	55.4
72	Accommodation	54.0
81	Other Services	39.2

NOTE. Firms' 2-digit NAICS codes are provided in the Amadeus data set. Average TS is the simple average of the firm-level ratios of tangible assets over total assets by industry.

Macroeconomic Data: Variables Definition and Data Sources

The macroeconomic variables used in the paper are at quarterly or annual frequency, over the period 2001:Q1-2014:Q4, subject to availability, and are defined as follows.[31]

National Property Price and Rent Indexes. The national price index is a regionally weighted average of transaction-based prices for town houses, owner-occupied apartments, and single-family detached homes. The national rent index is a regionally weighted average of transaction-based rents for owner-occupied apartments. The national commercial price index is an average of the commercial property price indexes for office and retail properties in 127 towns and cities. The national commercial rent index is an average of the Bulwiengesa AG indexes for rental of office and retail core properties. Indexes are normalized to 100 in 2009. The price-to-rent ratios are the simple ratio of the price and rent indexes. Source: Deutsche Bundesbank based on Bulwiengesa AG data.

Total Domestic Credit (% of GDP) is "bank lending to domestic non-banks." Credit provided by foreign banks includes the lending provided by both the branches and the subsidiaries of foreign banks. Bank lending provided by domestic banks is the difference between lending provided by all banks and foreign banks. Data originally at monthly frequency converted to quarterly frequency by taking simple averages. Source: Deutsche Bundesbank.

Credit by Borrowers (% of Total) is loans (including bills of exchange) to domestic households, firms, and foreigners, respectively, by all types of banks as a percentage of the total. Source: Deutsche Bundesbank.

Current Account Balance (% of GDP) is the current account balance of Germany vis-a-vis the rest of world as a share of GDP. Euro area current account is the balance vis-a-vis the rest of the euro area. Outside the euro area current account is the difference between the total balance and the euro area balance. Source: Deutsche Bundesbank.

Real GDP (Index, 2009:Q1=100) is the real GDP index for Germany, Portugal, Italy, Greece and Spain, normalized to 100 in 2009:Q1. Source: FRED.

Immigration is the number of immigrants into Germany. **Emigration** is the number of emigrants. **Net immigration** is the difference. Source: Statistisches Bundesamt. See https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Wanderungen/Tabellen/wanderungen-alle.html.

Nominal Bond Yield is the 10-year government bond yield (percent per annum). The **VIX index** is the CBOE Volatility Index. Source: FRED.

[31] For Bundesbank data see https://www.bundesbank.de/Navigation/EN/Statistics/Enterprises_and_households/System_of_indicators/system_of_indicators.html.

Capital Flows and Real Estate: Procyclicality and Asset Class Size

Uribe and Schmitt-Grohé (2017) estimate that the the correlation between net capital flows, as measured by the current account balance, and output is more than 0.6 in the United States and about 0.3 on average for all countries over the period 1965-2010, with no group of countries (rich or poor, small or large) displaying negative correlations. Davis and Van Nieuwerburgh (2015) report that the correlation of residential investment and house prices with output is also about 0.6 for the United States. Cesa-Bianchi, Cespedes and Rebucci (2015) estimate that the correlation between residential house price changes and GDP growth is about 0.3 in both advanced and emerging economies. In Germany, the correlation between real GDP growth and commercial real property price changes is 0.46 during the longest period for which the data are available (2005-2016) and 0.66 during the 2009-2014 period considered in this paper. The correlation between real GDP growth and residential real property price changes is 0.2 over the 2005-2016 period and 0.54 over the 2009-2014 period.

As Davis and Van Nieuwerburgh (2015) observe, for the United States, "the value of the *real estate* asset class is enormous". In the case of Germany, buildings, structures and land represent slightly less than 70 percent of households' net worth according to official data, while residential and non-residential *fixed* capital is more than 80 percent of the total capital stock according to the World Penn Tables. Germany, however, has one of the lowest home ownership rates in the world at about 50 percent, and household leverage is low and it declined during the post-GFC period, with household credit to GDP on a downward trend since 2000.

B Robustness Analysis Appendix For Online Publication

Table B.1 THE GIPS SPREAD AND BANK FLOWS: ROBUSTNESS

	Country-Level	Country-Level	Country-Level	Country-Level	Country-Level	Bank-Level
	(1) Net Bank Inflows Outside Eurozone	(2) Net Bank Inflows Inside Eurozone	(3) Gross Bank Inflows Inside Eurozone	(4) Gross Bank Outflows Inside Eurozone	(5) Lending-Deposit Spread	(6) Bank Share of Foreign Assets
Spread_t	0.485	0.976***	-0.026	-1.002**	-0.133***	-0.246***
	(1.086)	(0.330)	(0.339)	(0.404)	(0.041)	(0.030)
Bank Controls	-	-	-	-	-	Yes
Macro Controls	-	-	-	-	-	Yes
Bank FE	-	-	-	-	-	Yes
Obs	32	32	32	32	32	86,129
R^2	0.010	0.206	0.000	0.186	0.260	0.864

NOTE. The regressions in this table are the same as in Table 1 in the paper. However, they are based on quarterly data from 2007:Q1 to 2014:Q4. The regression in column (6) is based on the full sample period of 2000:Q1 to 2014:Q4, but includes the following bank and macroeconomic control variables: bank size (log of total assets), the capital-to-asset ratio, liquid assets relative to total assets, the return on assets, the loan-to-asset ratio and the share of non-performing loans to total loans, as well as real GDP growth, the inflation rate (log change in the CPI consumer index). All variables are defined as in the Data Appendix. Heteroskedasticity-robust standard errors are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.2 BANK FLOWS, REAL ESTATE EXPOSURE, AND CITY BUSINESS CYCLES: ALTERNATIVE INSTRUMENTS IN THE EXPOSURE MEASURE

	Population Density	Refugees in 2009	Building Permits
	(1) ΔGDP	(2) ΔGDP	(3) ΔGDP
$\text{Spread}_{t-1} \times \text{Exposure}_{t-1}$	0.004*	0.001*	0.001**
	(0.002)	(0.001)	(0.001)
Exposure_{t-1}	-0.194	-	-0.109**
	(0.131)		(0.052)
Time FE	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Obs	466	466	466
R^2	0.462	0.460	0.459

NOTE. The regressions are based on annual city-level data over the period 2009-2014. The dependent variable is GDP growth. The main regressors are the city-level exposure measure, and its interaction with the GIPS spread. The exposure in column (1) is the product of the gross share of non-developable area and population density; in column (2) it is the product of the share of refugees measured time-invariantly in 2009 and the gross share of non-developable area; and in column (3) it is the product of the share of refugees and the inverse of the change in building permits during the boom period (2009-2014) relative to the non-boom period (2000-2008). All of the regressions add both city and time fixed effects. Heteroskedasticity-robust standard errors clustered at the city level are shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.3 BANK FLOWS, REAL ESTATE COLLATERAL, FIRM CREDIT ACCESS: ROBUSTNESS

	(1)	(2)	(3)	(4)	(5)
	ΔL	ΔL	ΔL	ΔL	ΔL
$\text{Spread}_{t-1} \times \text{TS}_{t-4}$	0.013***	0.015***	0.016***	0.014***	0.014***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$\text{Spread}_{t-1} \times \text{EQ}_{t-4}$	-0.008*	-0.004	-0.009		
	(0.003)	(0.003)	(0.003)		
$\text{Spread}_{t-1} \times \text{ROA}_{t-4}$		-0.047***	-0.045***		
		(0.003)	(0.003)		
$\text{Spread}_{t-1} \times \text{TA}_{t-4}$			0.128***		
			(0.003)		
Firm-Year FE	Yes	Yes	Yes	Yes	Yes
Bank-Time FE	Yes	Yes	Yes	Yes	Yes
Obs	568,128	410,649	410,649	387,734	512,985
R^2	0.145	0.145	0.145	0.136	0.141

NOTE. These regressions are based on quarterly data from 2009:Q1 to 2014:Q4. The dependent variable is the log difference in loan volumes of bank i to firm j in quarter-year t, as in Table 9. In Column (1)-(3), in addition to main regressor as in Table 9, the specification includes also the interactions between the GIPS spread and the firm-level capital-to-asset ratio (Column 1), between the GIPS spread and the firm-level return on assets (Column 2), and between the GIPS spread and firm size (measured with the log of total assets in Column 3). Column (4) drops 2009 and 2010 observations during the period of government intervention with guarantees. Column (5) measures TS_{t-4} with the 2008 firm-level of tangible asset ratios TS_{2008} as in Table 9, but without inflating it with commercial property prices. All regressions include bank-time and firm-year fixed effects. The standard errors are clustered at the bank-firm level and shown in parentheses. *, ** and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.