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Channeling the Iron Ore Super-cycle: The Role of Regional Bank Branch Networks in Emerging Markets*

Abstract

The role of the financial system to absorb and to intermediate commodity boom induced windfall gains efficiently presents one of the most pressing issues for developing economies. Using an exogenous increase in iron ore prices in March 2005, I analyse the role of regional bank branch networks in Brazil in reallocating capital from affected to non-affected regions. For the period from March 2004 to March 2006, I find that branches directly exposed to this shock by their geographical location experience an increase in deposit growth in the post-shock period relative to non-affected branches. Given that these deposits are not reinvested locally, I further show that branches located in the non-affected region increase lending growth depending on their indirect exposure to the booming regions via their branch network. Even tough, these results provide evidence against a Dutch Disease type crowding out of the non-iron ore sector, further evidence suggests that this capital reallocation is far from being optimal.

Keywords: banking, financial development, natural resources

JEL classification: G11, G21, O16, Q32, Q33

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1. Introduction

One of the major challenges for developing and emerging market economies and their financial system is to absorb and manage windfall gains that are induced by periods of rapid commodity price increases. As many emerging markets and other developing economies are main producers of commodities such as agricultural or mineral products, booming periods can spur economic growth in the short-run. The downside to this specialization in commodity production is that commodity prices in general have been found to be much more volatile than for example manufactures even since the 18^{th} century (Jacks et al., 2011). Moreover, Van der Ploeg and Poelhekke (2009) have provided evidence that volatility in commodity prices causes per capita output to become more volatile with subsequent severe negative consequences for long-term economic growth. Hence, commodity price volatility in itself can be seen as one important part of the natural resource curse story.

The financial market and its development might provide a key mechanism to turn the curse into a blessing. Empirical evidence suggests that more developed financial markets can absorb real economic shocks (see, e.g. Beck et al., 2006 or Larrain, 2006) and can support the intersectoral reallocation of output away from sectors that contribute more to the overall volatility, and thus, reduce the long term volatility in GDP growth (Manganelli and Popov, 2015). In the light of financial market integration as an important feature of financial market development, recent literature has shown that regional branch networks can facilitate the transmission of local liquidity shocks to other parts of the domestic economy (see, e.g. Gilje et al., 2016, Bustos et al., 2016 or Levine et al., 2018).

In this paper, I show that these networks can provide a key mechanism for commodity exporting economies to overcome or mitigate the curse in natural resources as those networks facilitate the transmission of capital away from the commodity sector. As commodity and especially mineral production is often geographically very concentrated, cross-regional banking networks provide an important institution to distribute potential welfare gains. Using an exogenous unique shock in iron ore prices on March 2005, I provide evidence that regional braches networks located in affected regions in Brazil report higher growth rates in deposits relative to non-affected branches. Most notably, bank branches located in the non-affected regions report higher lending growth depending on their indirect exposure to the shock via their branch networks. However, I find that those branches increase lending more rapidly that do report a higher return on asset volatility in the post-shock period but not higher returns on assets. Additionally, from the pre-shock perspective, I find that those branches increase lending more strongly that are positively correlated in their returns on assets with their banking conglomerate. This suggests that this windfall in liquidity is not used for diversification purposes. These results show that the increase in lending might be less efficient.

To identify how capital is reallocated, I use the rapid increase in iron ore prices on March 2005, when prices rose by 71.5 percent driven by a change in the outlook on external iron ore demand of Chinese steel mills. As Brazil accounts for 31 percent of world iron ore exports (in USD values) end of 2004, this rapid increase was accompanied by an drastic increase in iron ore revenues for the main Brazilian mining company Companhia Vale do Rio Doce, CVRD, today known as Vale.[1] Due to revenue based mining royalties, mine expansion and performance based employee compensation in the iron ore industry, income in municipalities with iron ore mining activity should increase in response to this price shock. As this local windfall results in increased deposit supply for local bank branches, excess capital for reallocation to other regions is only available if this deposit windfall is not reinvested locally. Contrary to this situation could be a scenario where loan demand and/or bank loan supply increases due to the economic activity in the iron ore region. If this scenario dominates then it is possible that branch networks might actually reallocate capital away from the non-affected region to the iron ore sector. This crowding-out scenario in lending would be in line with the so called phenomenon of the Dutch Disease (see, e.g., Neary, 1988 or Lartey, 2008) which is often an essential part of the natural resource curse story.[2]

In general, irrespectively of the direction of capital reallocation as a response to an unexpected liquidity shock in this study, the banking literature has argued that two necessary frictions are needed

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[1] CVRD reported an increase in iron ore gross revenues by 85.1% which was an increase of 3.4 bn USD. This information is based on the Form 20-F for the 2005. CVRD/Vale has to file this annual report for the US Securities and Exchange Commission (SEC) on an annual basis since its shares are in connection with the registration of American Depositary Shares pursuant to the requirements of the New York Stock Exchange.
Form 20-F is available at:
http://www.vale.com/brasil/EN/investors/information-market/annual-reports/20f/Pages/default.aspx

[2] The term Dutch Disease is often used to describe how a booming commodity sector and the subsequent real-exchange rate appreciation can lead to a crowding-out in the non-commodity tradeable sector (see, e.g., Lartey, 2008). In this paper, I focus only on whether the banking branch network supports a regional crowding out in lending from the non-iron ore region to the iron ore region.

for such a shock to propagate. First, local bank branches have to be restricted in their access to external finance, and thus, are more reliable on local deposits as a funding source. This limitation in funding access constrains banks in undertaking all profitable investment projects. Since the empirical analysis focuses on regional bank branches in an emerging market economy, it is very likely that these branches face even more frictions in access to external finance than for example bank branches in financially more developed economies such as the US. Apart from this liability-side friction, a second friction on the asset-side must hold. This friction stems from the fact that banks differ in the set of information they possess about specific borrowers, and therefore, face different lending costs. Banks that have such a cost advantage should increase lending (see, e.g., Gilje et al., 2016). Since evidence has found that brick and mortar presence of banks reduce informational frictions and monitoring costs for local borrowers (see, e.g., Degryse and Ongena, 2005; Berger et al., 2005 or Agarwal and Hauswald, 2010), local bank branches which are the subjects of this analysis should extend lending given their informational advantage over banks that have no local branch presence.

The results of this study highlight that bank branches and their networks indeed do reallocate windfall capital away from the regional iron ore sector to other non-affected regions. First, this indicates that these regional bank branch networks and their ability to reduce informational frictions at the local level do play an important role to keep at least part of the windfall in local liquidity within the domestic economy, and second, it provides evidence that at least the regional branch network of the banking system in Brazil is not afflicted by a Dutch Disease phenomenon.

However, potential welfare and policy implications drawn from these findings may also hinge on the efficiency of this capital reallocation process. What is also a-priori unclear is whether banks manage this liquidity windfall to diversify their lending portfolio. To address these crucial points, I employ a multiplicative interaction framework, where I find that those branches increase lending more strongly which report a higher standard deviation in their returns on assets in the post-shock period, but do not report higher returns on assets. Given that these results for the standard deviations do not hold for the pre-shock period, these results suggest that branches respond to the windfall in liquidity by realizing riskier projects that do not contribute to a higher return on assets on average. Conversely to the notion that banks might use this windfall in liquidity to diversify their portfolio, I additionally find that those branches report higher lending rates that are more positively correlated in their returns on assets with their banking conglomerate in the pre-shock period. Overall, this provides evidence that liquidity was not allocated efficiently and bank lending portfolios became more concentrated, and thus, more prone to idiosyncratic shocks.

To the best of my knowledge, this is the first study that documents how regional financial market integration affects the transmission of commodity price induced windfall gains, and hence, contributes to several strands in the literature.

The first strand of literature that this paper contributes to is the financial development and natural resource dependency nexus literature. This literature evaluates the role of financial sector development on its ability to mitigate the negative effects of natural dependency on macroeconomic performance. In a very recent paper, Beck and Poelhekke (2017) analyze the role of the financial sector in intermediating natural resource based windfall gains in a cross-country setting. Using exogenous changes in commodity world prices, they find a rather limited role of the financial sector which is even more severe for countries with less conductive institutional frameworks and repressed financial systems. Furthermore, they also find that investment quality decreases which might present a rational for the observed slow aggregate economic growth of resource rich countries. In a similar vein, Van der Ploeg and Poelhekke (2009) find that the resource curse is less pronounced for countries with well developed financial sectors. Identification of this this mitigating effect, however, might be limited due to three reasons. First, evidence has also shown that financial development itself might be influenced by natural resource dependency (see, e.g., Bhattacharya and Hodler, 2014), second, variables that capture financial market development such as private credit to GDP are quite coarse, and third, disentangling supply from demand effects is impossible. In contrast to theses studies, my analysis is based on micro founded within country data at the regional branch level which takes the bank branch network as one central feature of financial market development as given and further allows to account for regional demand effects, and thus, avoids the common drawbacks of this strand of literature.

The second strand of literature I contribute to, examines specific failures of the absorption and intermediation capacity of the financial system in emerging markets. In contrast to the first strand, this literature uses within country bank level data and exogenous external shocks in funding to identify the effect of financial market frictions in the intermediation process. Khwaja et al. (2010), for example, exploit an unexpected non commodity related capital inflow in an emerging market to identify the curbing effect of sluggish backward-looking credit limits on bank lending to firms. This barrier of effective intermediation is ultimately based on informational frictions that are prevalent within emerging markets that endanger not just the intermediation but also the absorption of windfall liquidity. Very recent evidence by Andersen et al. (2017) shows that petroleum rents can even be channeled out of the economy to financial off-shore centers if institutional checks and balances are weak. Thus, windfall liquidity that could be invested domestically is channeled out of the economy with serious repercussions on domestic development. Theoretically, van der Ploeg and Venables (2012, 2013) show that it can be even efficient from the individuals perspective to shift wealth out of the economy via, for example, foreign investment conduits in the case of inefficient domestic financial markets. By analyzing the role of bank branch networks in reducing informational frictions within the domestic economy, I show that at least part of the liquidity stemming from an external commodity price shock can be retained and intermediated within the domestic economy.

More generally, I contribute to the literature that examines the role of regional branch networks in cross-regional capital reallocation. This literature is also in terms of its empirical setting and identification strategy the closest to my analysis. Gilje et al. (2016), for example, provide evidence that regional branch networks help to integrate U.S. lending markets. This suggests that even in times of well developed securitization markets, arm's length finance provided by bank branches remains an important factor for financial market integration. In a further contribution, Bustos et al. (2016) find that capital reallocation via branch networks can be an important driver for structural transformation processes within an economy.[3] On a more negative note, Chakraborty et al. (2018) show that banks, being exposed to the house price boom in the US from 1988-2006 via their branch network, crowd out lending in the commercial market to firms as the lending in the mortgage market intensifies. Hence, by restricting firms access to bank credit, they show that house price hikes can have negative spillover effects to other parts of the domestic economy via bank branch networks. By examining commodity price booms and the role of branch networks in an emerging market context, my study extents this

[3] In contrast to my analysis, both Bustos et al. (2016) and Gilje (2016) use a positive shock in technology that leads to an exogenous increase in productivity and local liquidity.

strand of literature by focusing on commodity price shocks which are among the most common and economically relevant shocks that developing markets are exposed to.

Finally, there is also the extensive literature on how unexpected liquidity shocks are transmitted via the bank lending channel to the real economy. For example, Khwaja and Mian (2008) analyze the effect of an negative liquidity shock in Pakistan which was caused by unanticipated nuclear tests on bank lending to firms. They show that the effect of the sudden collapse of the US dollar deposit market on firm financial health depends critically on its access to alternative funding sources. Exploiting a different liquidity shock based on the 1998 Russian default event, Phillip Schnabl (2012) finds that the lending channel is also relevant for internationally active banks in transmitting liquidity shocks to other economies. Ongena et al. (2015) provide similar evidence for the international lending channel by using the default event of Lehman Brother to show that internationally borrowing banks reduce their lending to medium sized firms in Eastern Europe and Turkey relative to locally funded banks. These studies highlight the bank lending channel as an important driver of international financial contagion. Focusing more explicitly on the role of interbank linkages, Iyer and Peydró (2011) show that the failure of a large bank in India can result in higher deposit withdrawals for banks that are highly interconnected to the failed bank via the interbank market. Additionally, they provide evidence that interbank market contagion can have potential real effects in terms of lower bank profits and reductions in net-bank loan supply.

In contrast to these studies, my study is also the first – at least as far as I am aware of – to show how regional financial market integration in developing economies can absorb and reallocate liquidity caused by global commodity price volatility. More specifically, this finding highlights the role of bank branch networks in an international context.

The rest of the paper is organized as follows. Section 2 discusses the iron ore price event, the institutional features of the iron ore market as well as the implications of this event for Brazil. Sections 3 describes the data employed for this analysis, while section 4 presents the methodology and identification approach of the empirical analysis. Section 5 reports the empirical results of this study and section 6 concludes.

2. Brazil and the iron ore hike

On March 2005, global iron ore prices – induced by a rapid increase in external demand – experienced by far their largest rise since the 1980s. This 71.5 percent price hike was not just the largest relative price increase but lifted the price itself to a new record high (see: Figure 1).[4] This extreme jump also marked the beginning of the so called "Iron Ore Super-Cycle" which describes a period where iron ore prices further followed a extreme strong positive trend. However, this booming period found an abrupt end in March 2011 when iron ore prices fell dramatically until December 2016 by 146.3 USD (-78.2 percent). Apart from these trends another feature of iron ore prices is that its volatility picked up dramatically with the beginning of the "Iron Ore Super-Cycle". Before the 2005 price event, iron ore prices were relatively stable and exerted a volatility of about 9.1 percent while in the period from 2005m2 to 2016m12 iron price volatility rose drastically to a considerable 43.4 percent.[5]

To exploit this hike in iron ore prices in March 2005 as an exogenous event, two necessary conditions have to be fulfilled. First, the increase in iron ore prices must be driven by external factors, and second, this rapid change in iron ore prices has to be unexpected. Regarding the first condition, the price increase was due to a combination of two factors. While the demand for iron ore by Chinese steel mills picked up dramatically, Chinese own iron ore mines exerted high operational costs which led to several mine closures within China. Being unable to saturate domestic iron ore demand due to limited domestic production capacity, Chinese steel mines were much more dependent on foreign iron ore (Sukagawa, 2010). Hence, the Brazilian economy faced a rapid increase in external demand of iron ores which fulfils the first condition. Second, with the absence of a future markets in iron ores it is much harder to gauge whether this price movement was unexpected by the Brazilian banking system. However, to shed light on whether the iron ore price hike was unexpected, it is necessary to understand the iron ore pricing system in the period of consideration.[6] Given the limited number of buyers and sellers in the world market, iron ore prices were negotiated on a yearly basis under the so

[4] As iron ore prices were negotiated on a yearly basis at that time, Figure 1 depicts the corresponding yearly values. Most of the time these yearly prices were announced during the respective year and became retroactively effective in January in case for the European contracts (see below).

[5] Volatility is calculated as the standard deviation of year-on-year growth rates of monthly iron ore prices. Monthly iron ore price data used for calculation is from the IMF Primary Commodity Prices database and reflects world iron ore prices for standardized iron ore quality of 62 FE content.

[6] Spot markets in iron ore were only established between 2008/2009.

called Champion Negotiation system. In secret negotiations between individual buyers and sellers, prices and quantities were negotiated. The first pair of buyers and sellers that was able to agree on a particular price provided the benchmark price for the entire industry during that year. One of the primary aims for both sellers and buyers was to keep iron ore prices stable over time (see, e.g., Sukagawa, 2010). On February 22nd 2005, CVRD was able to reach a price agreement with the Japanese steelmaker Nippon Steel Cooperation (NSC) to set the iron ore benchmark for the entire industry.[7] In accordance with this benchmark price, CVRD agreed during March 2005 with most of their clients. Generally under this pricing regime, contract with Asian consumers became effective in April of the corresponding year while the contract with European consumers became effective in January of this year. When price negotiations set prices at a later date during that year these contracts became retroactively effective for the corresponding starting month of each contract (CVRD ARFS, 2004, p. 100). Since CVRD price negotiations with Asian customers were concluded in February, these prices became effective in April 2005, while European contracts became immediately effective in March. This feature of yearly price setting explains also the iron ore price movement depicted in Figure 1.

[Figure 1 here]

There are three main reasons to support the assumption that this pricing event was unexpected for the Brazilian banking system. First, since price negotiations between producers and consumers were conducted in secrecy, other economic agents were left uniformed during this negotiation process. Second, CVRD itself communicated, for example, in their annual report for the year 2004 that iron ore prices were notably stable over time and this was due to the previously described Champion Negotiation system and that because of this there was no need to hedge against iron ore price movements (see, e.g., CVRD ARFS, 2004, p. 155 or CVRD F-20, 2004, p. 63). Finally, news reports on February 23rd 2005 about the settlement of iron ore price suggest that the price hike was due to the fear of Nippon Steel that Chinese future iron ore demand would leave Nippon Steels own demand

[7] CVRD press release available: http://www.vale.com/canada/EN/investors/information-market/press-releases/Pages/precos-de-minerio-de-ferro-para-2005.aspx

unsaturated if prices would have remained at low levels. Furthermore, it is reported that the increase in prices was an “exceptional increase” which sent “shock waves” through the entire steel industry (see, e.g., CNN International, 2005). Thus, even with the non-existence of iron ore future markets, it is very likely that this rapid increase in iron ore prices was at least from the perspective of the Brazilian banking system unexpected. On the contrary, given that future markets can provide hedging opportunities, the absence of these markets for iron ore ensure also that hedging operations cannot impact local iron revenues.[8]

Since Brazil is one of the main producers and exporters of iron ores this global increase in iron ore prices should increase not just iron ore revenues of mining companies but also via employee profit sharing plans, local mining royalties (the CEFM) and local mine expansions local income within affected municipalities (Gurmendi, 2009 and CVRD F-20, 2004, p. 102). At the end of 2004, Brazil was the leading iron ore exporter with a share of 30.6 percent of total world iron ore exports in US Dollar values. Furthermore, iron ore is also the main mineral ore that Brazil exports accounting for 84 percent of all Brazilian mineral ores exports including gold and accounting for around 11 percent of primary commodity exports in 2004.[9] Since mineral ore production is much more geographically concentrated than other commodity production, local economic dependence on mining activity should be more pronounced. Iron ore production was mainly limited to only 3 out of 27 federal units while, for example, soy production took place in 19 out of 27 federal units in 2004.[10] The main federal units where iron ore mines are located are Minas Gerais, Mato Grosso do Sul and Pará.[11]

Further evidence for the “Iron Ore Super-Cycle” can be seen in Figure 2, which depicts monthly iron ore exports from Brazil to the rest of the world.

[Figure 2]

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[8] If iron ore prices were hedged, this would have been a severe issue for the identification strategy.

[9] Data source is the UN comtrade database. Primary commodities include SITC 0: food and live animals; SITC 1: beverages and tobacco; SITC 2: crude materials, inedible, except fuel; SITC 3: Mineral fuels, lubricants, and related material; SITC 4: Animal and vegetable oils, fats, and waxes, and SITC 68: Nonferrous metals.

[10] Information on local soy production is taken from the Instituto Brasileiro de Geografia e Estatística (IBGE).

[11] In the period of consideration, there are also two very small and new mines in Rio Grande do Norte. Since these are negligible in size and located in municipalities where no bank branch is present, Rio Grande do Norte is not included in this analysis. These issues do not exist, however, in the three federal units.

Despite the volatility of monthly iron ore export values, the iron ore price event in March 2005 is clearly visible in the time series, and thus, should also matter for these municipalities located in Minas Gerais, Mato Grosso do Sul and Pará.

Apart from the exposure to the world iron ore prices, Brazil and in particular its banking system provide a perfect setting to study the role of branch networks in an emerging markets context. In 2004, the Brazilian banking system consisted of 16,829 branches located all across Brazil and covering around 57 percent of all 5,578 municipalities within Brazil. Notably, the federal unit of Minas Gerais where most iron ore mines are located report with 1,809 bank branches the second largest amount of physical bank presence while the financial center of Brazil Sao Paulo accounts for 5,495 branches at the end of 2004. The other two federal units Mato Grosso do Sul and Pará report 214 and 252 bank branches, respectively.[12] Even though, these federal units have relatively low absolute number of bank presence these branches are spread over 77 municipalities in Mato Grosso do Sul and 144 municipalities in Pará, while Minas Gerais consists of 853 municipalities. From the international perspective, bank branch network penetration in Brazil was in 2005 the highest amongst Latin American economies. With 18.324 commercial bank branches per 100,000 adults, Brazil is far above the average bank network penetration in Latin America which was around 11.676.[13]

3. Data and sample

To analyze and identify the effect of the local iron ore liquidity shock and its transmission via branch networks I combine three unique datasets. The first dataset is the ESTBAN dataset of the Banco Central do Brasil which contains balance sheet and income information on a monthly frequency for the complete universe of Brazilian bank branches. Crucially for the identification strategy, this dataset also contains information on the geographical location of these branches, such that, I can identify the branch presence at the municipality level. The granularity of information available in this dataset is even superior to data sets normally used to study the branch network channel like, e.g., the Summary

[12] Official numbers from the Banco Central do Brasil. Municipality coverage figures are based on own calculations.

[13] Data for Brazil is only available since 2005 – data source: World Bank Indicator: FB.CBK.BRCH.P5

of Deposits from the Federal Insurance Deposit Corporation (FDIC) in the US which only contains information on local branch deposits (see, e.g., Gilje et al., 2016 or Cortés and Strahan, 2017).

In addition, to control for effects on the level of the bank conglomerate of each branch network, I use the Call Reports from the Banco Central do Brasil which also contains granular balance sheet and income statement information on a monthly frequency. Both datasets are collected by the Banco Central do Brasil for regulatory purposes.

The third and final main dataset employed, is from the Brazilian Ministry of Mines and Energy (MME) and contains iron ore royalty (CFEM) payment information on a monthly basis. As these payments are revenue based with a fixed tax rate of 2 percent in the case of iron ore, this allows me to identify the iron ore revenue at the municipality level. Furthermore, 65 percent of these royalty payments remain for the local municipality governments while the rest is distributed to the respective government of the federal unit and the central government of Brazil (see, e.g., Gurmendi, 2009, Section 6 of Law 7,990/89 and Section 2 of Law 8,001/90).

Equipped with this granular monthly data, I use the period from 2004m3 and 2006m3 as my sample period. The choice for this period ensures a clean identification of the price event since I can rule out any other price movement for iron ore within this period. For my geographical sample, I use all branches located in municipalities in federal units where iron ore mines are located. Figure 3 depicts the geographical sample employed for the empirical analysis.

[Figure 3 here]

As mentioned above, due to the geographical concentration of mineral commodity production, there are only three federal units within Brazil that contain municipalities with iron ore revenue. For identification purposes, I only use those municipalities which report continuously iron ore exposure during the sample period from 2004m3 and 2006m3. This procedure ensures that iron ore mine closure during this period is accounted for. In some cases, municipalities report very low and infrequent iron ore revenue values. These municipalities are also omitted from the analysis. As a cross-check of this procedure, I used satellite images provided by Google Maps to detect iron ore mine sites which is only possible as Brazil has – with the one exception – only open pit mines. In total, there are 21 municipalities with continuous iron ore exposure. While 19 municipalities are directly located in the Iron Ore Quadrangle in Minas Gerais, Pará only resides the Carajás Mine in Parauapebas which is, however, the worlds largest iron ore mine in the world. In Figure 3, municipalities with iron ore presence are colored in blue. To account for spillover effects, the empirical analysis excludes all bordering municipalities which are colored in grey in Figure 3.

The empirical analysis which consists of two interrelated parts, focuses in a first step on the effect of the iron ore price shock on local branch deposits, and second, on the effect of this shock on bank branch lending in the non-affected region via regional branch networks. Apart from the network exposure variables which will be discussed in greater detail in the next section, I also control for various variables at the branch as well as the headquarter level of the bank which are frequently used in the literature (see, e.g., Gilje et al., 2016). At the branch level these variables include the log of assets, the deposit to total asset ratio, the liquid asset to total asset ratio, the commercial and industrial loan to asset ratio, the consumer loan to asset ratio, the mortgage loan to asset ratio and the loan to deposit ratio. At the headquarter level, I control for these variables as well and include further the capital to asset ratio.[14] Since my dependent variables are defined as a change in log deposits or a change in log loans and all controls are based on balance sheet items these controlling variables are lagged by one month. To account for outliers, all variables are winsorize at the 1st and 99th percentile. Table A1 reports the summary statistics for the first part of the analysis and Table A2 reports these statistics for the second part.

In addition, these tables report for each dependent variable whether there is a statistically significant difference in the trend in the pre-shock period between affected and non-affected branches which would indicate a violation of the parallel trend assumption. For the control variables, I also report whether there is a statistical differences in means between the groups of affected and non-affected banks in the pre-shock period. For this procedure, I employ the difference of normalized means proposed by Imbens and Wooldrigde (2009). I find that there are only significant differences in normalized means in the second part of my analysis. However, it is relatively unlikely that these

[14] As capital is not managed at the bank branch level, I control for the capital to asset ratio for the respective headquarter of the bank.

structural differences in the banks balance sheet items affect the likelihood of a branch belonging to the highly affected group as this depends more on the bank branch structure of the conglomerate which is relatively stable across time. Nevertheless I implemented as a so called "horse race" as a robustness test to rule out that these structural differences might drive my results.[15]

4. Methodology

To identify the effect of the iron ore shock on local branch deposits and trace the subsequent capital reallocation process channeled via bank branch networks, I follow an empirical strategy that consists of two interrelated parts. This methodological approach is closely related to other studies that have focused on bank branch networks and their potential role in capital reallocation (see, e.g. Gilje et al., 2016 or Bustos et al., 2016). In the first part, I analyze the effect of the iron ore shock on local bank branch deposits. Since performance based employee compensation in the iron ore industry, iron ore revenue based royalty payments and mine expansion programs channel this international shock in iron ore prices to regional municipalities with iron ore exposure, local income, and thus, local branch deposits should experience an increase.[16]

However, whether there is excess capital supply for those regional bank branches depends on whether these branches themselves do not increase their lending activity. If local affected branches increase lending activity, irrespectively whether due to an increase in loan supply or demand, this will either mitigate the excess capital supply or lead to a shortage in local capital.[17]

This extreme scenario of capital shortage could lead to a Dutch Disease type phenomenon where the booming natural resource sector crowds out lending to other sectors of the economy. Thus, the branch network might even reallocate capital away from the non-affected sectors to the booming sectors by

[15] These Variables anyhow are controlled for. Employing a "horse race" further analyzes potential non-linearities. Especially, the differences in normalized means for the interaction model variables in Table A2 are just for completeness.

[16] As iron ore supply is price inelastic in the short-run, the increase iron ore revenue is predominantly based on the price increase in 2005m3.

[17] It is not clear a-priori whether a price boom in the iron ore region increases regional loan demand due to an increase in economic activity or whether banks find it more profitable to increase lending to the booming iron ore sector or whether both effects occur simultaneously.

cutting their lending in the non-iron ore sector. A similar effect has been found in a different context by Chakraborty et al. (2018) where the rapid increase in house prices in the US has lead to a crowding out effect of mortgage loans on commercial loans to firms.

In the second part of the empirical analysis, I examine whether branches in the non-affected region increase their lending activity depending on their exposure to the iron ore shock via their branch network. Hence, the first stage tests the necessary conditions for a cross-regional capital reallocation to start. But even if the first stage provides evidence for local excess capital, banks might potentially opt not to invest this windfall within the domestic economy. Arguing that branch networks reduce informational frictions at the local level, branch networks might contribute to keep at least part of the liquidity windfall within the domestic economy. Thus, evidence of capital reallocation via branch networks to the non-affected region would provide evidence that branch networks might help to retain this windfall capital that are induced by external shocks.

The identification procedure for both empirical parts relies on the exogenous shock in iron ore prices on March 2005, and therefore, I implement a difference-in-differences approach to examine the effect of this shock on local deposits (first part) as well as on the lending of branches in the non-affected region (second part).

Estimation Equation (1) presents the stylized empirical model of the first part of the empirical analysis:

$$\Delta log(deposits)_{i,m,t} = \mu_{i,m} + \tau_t + \beta_1[Affected_{i,m} \times Post_t] + \gamma' Bank_{i,m,t-1} + \varepsilon_{i,m,t} \quad (1)$$

The primary dependent variable in this part of the analysis is the change in log deposits of branch of bank i located in municipality m at month t. The changes are computed on a month-over-month basis. I further control for branch fixed effects $\mu_{i,m}$ and time fixed effects τ_t. Within this empirical setting the main variable of interest is the interaction of $[Affected_{i,m} \times Post_t]$. With the fixed effects structure implemented in Equation (1), the parameter β_1 presents the difference-in-differences between branches that are affected by their geographical location to branches which are not affected due to their geographical location in the post-shock period. Thus, the variable $Affected_{i,m}$ is a timeinvariant dummy variable that equals 1 for all bank branches that are located in a municipality that reports iron ore revenues and zero otherwise. The time-variant dummy variable $Post_t$ determines the post period and equals 1 for all month after February 2005 to March 2006 and zero otherwise.

In the baseline of Estimation (1), I additionally control for branch- and headquarter-specific characteristics which are lagged by one month to avoid collinearity concerns.[18] These characteristics $Bank_{i,m,t-1}$ include the size of the branch or bank measured by the log of total assets, the funding structure which is measured by the deposit to asset ratio, the liquidity risk which is captured by the liquid asset to total asset ratio and the loan to deposit ratio. To account for differences in banks' and branches' business models, I include the C&I (commercial and industrial) loan to total asset ratio, the consumer loan to total asset ratio and the mortgage to total asset ratio. Finally, on the bank headquarter level, I control for the capital to asset ratio which should capture the financial health of the banking conglomerate. In order to ensure consistent estimates, standard errors are clustered at the bank headquarter level. For this specification, the estimation sample consist of all branches in the municipalities of Minas Gerais, Mato Grosso do Sul and Pará with the exception of those municipalities which share a common border with an affected municipality. These municipalities are omitted to account for potential spillover effects.

The structure of the estimation procedure of the second part of the empirical analysis is similar to the first part. However, there are three differences to the first part that are crucial for the identification strategy. Estimation Equation (2) depicts the empirical model for the second part of the empirical analysis:

$$\Delta log(loans)_{i,m,t} = \mu_{i,m} + \vartheta_{m,t} + \beta_2[NWKEP_i \times Post_t] + \gamma' Bank_{i,m,t-1} + \varepsilon_{i,m,t} \qquad (2)$$

Since I want to analyze the cross-regional capital reallocation, the dependent variable in this model is the month-over-month change in logged outstanding loans of branches of bank i in municipality m in month t. The first crucial difference is that branches are not affected by their geographical location anymore but are exposed to the iron ore shock via their branch network exposure. As most branch

[18] The variable definitions used for this analysis can be found in Table A3 in the appendix.

networks have at least one branch in an affected region, the network exposure measure $NWKEP_i$ captures the degree of affectedness and is calculated in accordance to Equation (3):

$$NWKEP_i = log\left[\left(\sum_m IronOreRevenue_{m,pre-shock} \times MarketShare_{i,m,pre-shock}\right)/N_i\right] \quad (3)$$

This $NWKEP_i$ measure is inspired by the property exposure variable employed by Cortés and Strahan (2017). First, the $NWKEP_i$ measure assigns the iron ore revenue of the municipality to a specific bank branch by weighting this revenue by the branch specific market share within this municipality. Second, this value is added up across all municipality for each banking conglomerate i. This value is the total exposure of the bank conglomerate to the iron ore shock. However, as larger branch networks also imply a larger set of markets or municipalities in the non-affected region to invest in, I additionally weight this measure by the number of non-affected municipalities. Similar to Cortés and Strahan (2017) this value is logged to reduce skewness of this measure. In order to avoid endogeneity concerns, I take for the iron ore revenue and the branch market share their respective averages six month prior to the shock.[19] In the baseline estimation I calculate the market share based on pre-shock deposits. Additional robustness is provided by using alternative measures. Further, the $Post_t$ variable is exactly defined as in Equation (1).

The second crucial difference to the first part is that I employ municipality-time fixed effects instead of ordinary time fixed effects. This fixed effect structure ensures that common municipality loan demand can be controlled for. Since in the first part geographical variation ensures identification, one cannot and should not control for common regional demand effects. However, as the first part is not interested in separating regional demand and supply at the branch level, controlling for common demand factors becomes unnecessary.[20]

Finally, the third important difference is that in the second part of the analysis, I exclude all municipalities with iron ore exposure and their bordering municipalities.[21] Therefore, the parameter of

[19] To avoid endogeneity concerns, these six month include the period from 2004m8 to 2005m1 as the price announcement occurs in 2005m2.

[20] Actually, the first part will also employ the change of logged loans outstanding as a dependent variable, filtering out potential regional demand effects would be misleading.

[21] The latter is done to account for potential spillover effects.

the interaction $[NWKEP_i \times Post_t]$ identifies the effect of the iron ore shock on branches' lending supply in not directly affected regions via their bank branch network exposure to the iron ore shock. Additional control variables and the clustering of standard errors are consistent with the first part of the analysis.

This empirical strategy allows me to test the specific reallocation process via the branch networks. Under the assumption that lending growth does not outpace the deposit growth rate, the finding $\beta_1 > 0$ implies that bank branches report excess capital in the affected regions that is available for cross-regional reallocation. Which implies further for the second part of the analysis that $\beta_2 \geq 0$. Finding $\beta_2 > 0$ in the second part of the analysis suggests that capital is reallocated away from the iron ore region to the non-iron ore region.

Under the alternative scenario, where $\beta_1 = 0$ or lending growth outpaces the deposit growth rate, the implication for Equation (2) is $\beta_2 \leq 0$. Finding $\beta_2 < 0$ in the second part of the analysis suggests that capital is reallocated in the opposite direction. Hence, these results would suggest that the regional branch network could be contaminated by the so called "Dutch Disease" problem.

5. Results

Based on this methodological structure, I start with the results of the first part of the empirical analysis by focusing on the difference between branches located in affected municipalities relative to branches located in non-affected municipalities. Thereby, I test explicitly whether the necessary conditions for cross-regional capital reallocation via branch networks are valid (Tables 1 and 2) and provide further robustness of theses results (Tables 3 and 4).

This is followed by the second part of the empirical analysis that examines the impact of the iron shock via the branch networks on bank branch lending behavior in the non-affected region (Table 5). This is followed by a battery of sensitivity analysis (Tables 6 - 8).

Finally, employing multiplicative interaction models, I evaluate for which branches in the non-affected regions the lending channel is more pronounced which allows me to gauge potential inefficiencies of the capital reallocation process.

5.1. Local effects on regional branches – part one

The results of the baseline estimation (Equation 1) of the first part of the empirical analysis are reported in Table 1. To capture local income effects caused by the external shock in iron prices, the deposit growth rate is the main dependent variable. As income within these regions is likely to increase due to employee compensation and mining royalty payments, this windfall in local income presents a windfall gain in local bank deposits. The variable of interest within this difference-in-differences setup is the interaction term $\left[Affected_{i,m} \times Post_t\right]$ which is always included in the specifications in columns I to IV of Table 1. In all specifications, I control for bank branch fixed effects as well as month fixed effects. Robust standard errors are clustered at the bank headquarter level and the sample period is from 2004m3 to 2006m3.

[Table 1 here]

Across all four specification, I find empirical evidence that bank branches located in municipalities with iron ore exposure report on average statistically significantly larger deposit growth rates than bank branches located in non-affected regions in the post-shock period when accounting for pre-shock differences. This effect is even statistically significant at the 10 percent level when including no additional control variables (column I). Since the effect of the iron ore shock occurs at the municipality-branch level, I first include branch control variables (column II) and then I further add control variables of the corresponding bank headquarter (column III). For these specifications, the difference-in-differences effect becomes statistically significant at the 1 percent level. Affected bank branches report about a 2 percentage point higher deposit growth rate on average than non-affected branches relative to the pre-shock period. This effect even remains statistically significant for the 5 percent level when employing a completely balanced sample.

Regarding the control variables, I find that smaller branches report larger growth rates in deposits. This is intuitively clear as smaller branches are more likely to be exposed to larger deposits inflows relative to their size. This is especially the case for new branches that start with very few deposits that might drastically increase. For the rest of the control variables there is no clear theoretically predictions. Bank branches with larger deposit to asset ratios further report statistically significantly lower growth rates as well as branches that are more active in the mortgage market. Bank branches with higher loan to deposit ratios report statistically significantly larger deposit growth rates. On the headquarter level, I find that branches belonging to a headquarter with a higher commercial and industrial loan to asset ratio report statistically significantly higher deposit growth rates. This applies also for branches which headquarter is more active in the mortgage market and has a higher ratio of liquid to total assets. The loan to deposit ratio of the headquarter seems to have a statistically significant negative effect on the deposit growth rates. Even though, the signs of these control variables have no clear theoretical predictions, controlling for bank and branch characteristics, such as, for example, differences in business models seems to be important. Differences between the parameter signs of headquarter and branch variables point to differences in the organizational and behavioral structures of these entities. This approach further shows that using headquarter as well as bank branch control variables allows me to control for these differences. In comparison to previous studies that lack important information at the bank branch level, this presents a clear advantage of my analysis.

Whether there is excess capital available for cross regional reallocation, depends further on branch lending activity in the affected region. As branch deposits increase, banks might respond by increasing their lending activity, such that no excess capital for reallocation would be available. Another issue could be that banks find it more profitable to invest in the booming sector, and thus, find themselves in severe need to finance these additional loans. Under this scenario, banks might even decide to cut lending in the non-booming region (see, e.g., Chakraborty et al., 2018). In order to rule out these potential scenarios and to identify the dominance of the local income channel, I re-estimate the baseline estimation (Equation 1) and employ the lending growth rate as the main dependent variable. Table 2 reports the results of this procedure.

[Table 2 here]

Across all four specifications, there is no statistically significant difference in the loan growth rate between affected and non-affected branches in the post period. The parameter value even seems to decrease drastically in absolute size when estimating this specification on a balanced panel. Thus, I conclude that bank branches in the affected region indeed seem to report excess capital.

Additional to these results, I provide further sensitivity analysis for this first part of the analysis. First, the lending growth specification of Equation (1) can only test the rejection of the null hypothesis, and thus, provides no direct evidence that lending does not increase. To overcome this shortcoming, I estimate an outpacing equation which tests whether the deposit growth rate reacts more strongly to the iron ore shock than the lending growth rate. Hence, I re-estimate the baseline estimation (Equation (1)) and use the difference between the deposit and lending growth rate as the depending variable. A positive significant parameter value of the $Affected$ and $Post$ interaction provides direct evidence that the deposit growth rate indeed outpaces the lending growth rate for the affected branches relative to the non-affected branches in the post-shock period. These results are reported in specification I and II of Table 3.

As my dependent variables are so far defined as growth rates, one could argue that it is not clear whether the level of deposits does increase or not. The choice of growth rates instead of levels, however, has the clear advantage of being less susceptible to generate findings that suffer from spurious correlation which might occur due to any non-stationarity of the time series used in the model. Since the estimation is based on a 25 month sample period, such an issue might arise. Nevertheless, for further robustness I also report the commonly used log level specifications for both the level of deposits and loans.[22] The corresponding results are reported in specification III and IV of Table 3.

[Table 3 here]

For the first two specifications of Table 3, column I and II, one can reject the null hypothesis that the deposit and lending growth rate increase on the same pace for the affected municipalities relative to not-affected municipalities at the 5 percent level. The positive parameter sign of the difference-in-differences provides direct evidence that the iron ore shock leads to an outpacing of the lending

[22] A more sophisticated estimation method for such a level equation, would be a Poisson Pseudo - Maximum Likelihood estimation where the level of deposits and loans would be used instead the log specification.

growth rate by the deposit growth rates by around 2 percentage points on average for branches located in affected municipalities. Furthermore, column III and IV show that the results found for the growth rate specification also hold for the level of deposits and loans. While there is a positive significant difference-in-differences effect for the level of deposits which is significant at the 5 percent level at least, there is no statistically significant effect for the level of loans.

Table 4 presents further robustness of the baseline estimation of the first part of the econometric analysis. First, I perform a placebo test for the deposit growth rate and the outpacing equations (column I and II). For this purpose, I generate a random assignment of branches to the groups of affected and non-affected with the same ratio as in the actual sample. This placebo test is used for the deposit growth rate and outpacing equations as these are the most important results of the baseline estimation that yield statistically significant results. Given that the second part of the econometric analysis relies on the branch network exposure measure defined in accordance to Equation (3), I test whether the degree of affectedness matters for the deposit growth rate, lending growth rate and the difference between both growth rates within the group affected branches. I define as the iron ore exposure measure of the specific bank branch i located in the municipality m according to Equation (4).

$$IronOreExposure_{i,m} = \log(IronOreRevenue_{m,pre-shock} \times MarketShare_{i,m,pre-shock}) \qquad (4)$$

Equation (4) is closely related to Equation (3), with the only difference that it is not added up at the headquarter level but calculated at the specific branch level. This ex-ante exposure measure is then used to test within the sample of the affected branches whether the degree of affectedness also matters for the deposit growth rate, lending growth rate and the outpacing equation. The corresponding results are displayed in columns III, IV and V in Table 4, respectively.

[Table 4 here]

The results in the first two columns show that the difference in difference effect of the randomly assigned affected group provides no statistically significant results at any convenient level. P-values and standard errors are extremely large. These insignificant results provide further evidence that the effect found in the baseline estimation is indeed related to the iron ore shock and not due to any random assignment.

Concerning the iron ore exposure variable in the within analysis (column III-V), I can replicate the results found for the standard difference-in-differences approach. As the parameter of the interaction $[IronOreExposure_{i,m} \times Post_t]$ is positive and statistically significant at the 5 percent level for the deposit growth rate (column III) and the outpacing equation (column V), it is negative and not statistically significant at any convenient confidence level for the deposit growth rate (column IV).

Moreover, I also teste whether there was any violation of the parallel trend assumption in the pre-shock period for each individual dependent variable employed in this analysis. For this purpose, I use the first difference of each dependent variable and calculate whether there is a statistically significant difference between the group means of the affected and non-affected branches. P-values for this tests are around or above 0.8 which shows that these values are far away of any rejection of the zero hypothesis that the parallel trend assumption holds.[23]

Overall, I find very robust evidence that the iron ore shock leads to an increase in local bank branch deposits which does not increase the lending activity of these branches. Thus, this provides evidence that there is excess regional capital that is available for cross-regional capital reallocation via bank branch networks to the non-affected region. This finding already restricts the potential outcomes of the second analysis to $\beta_2 \geq 0$ in Equation (2) and implies, on a positive note, that one should not find a Dutch Disease type of credit-crowding out effect in the second part of the analysis.

5.2. Cross-regional capital reallocation – part two

In this section, I turn to the second part of my empirical analysis. The corresponding baseline results are reported in Table 5. Excluding branches in the directly affected regions and bordering

[23] These results are depicted in Table A1.

municipalities, enables me to trace the iron ore price induced liquidity shock that is propagated via internal capital markets to branches in the non-affected region. This exposure of the individual branch to the liquidity shock via the corresponding branch network is calculated in accordance to Equation (3) and captures the degree of affectedness. Thus, the variable of interest, the interaction $[NWKEP_i \times Post_t]$, is always included in the analysis. The dependent variable is the lending growth rate. To control for common loan demand effects at the municipality level, municipality-time fixed effects are included in every specification. Robust standard errors are clustered at the bank headquarter level and the sample period is from 2004m3 to 2006m3.

[Table 5 here]

Across all specifications, I find strong evidence that a larger bank branch network exposure increases the lending growth rate in the post-shock period at the 5 percent level of statistical significance at least. In the first specification where no controls are included, a one percent higher network exposure increases the lending growth rate by around 0.3 percentage points (column I). Since the network measure is likely to be confounded by variables at the headquarter level, the second specification includes the headquarter controls first (column II) before adding also branch controls in the third specification (column III). Under these specifications, a one percent higher network exposure increases the lending growth rate by approximately 0.4 percentage points at the 1 percent level of statistical significance. While the number of observations is hold constant across the first three specifications, in the fourth specification, where I restrict my sample to be completely balanced, results remain statistically significant at the 5 percent level. These results suggest that branch networks facilitate the transmission of capital away from affected regions to non-affected regions, thus providing the means to retain this local windfall in capital within the domestic economy.

To test the robustness of these results, I provide a large battery of sensitivity analysis. The first set of robustness tests is reported in Table 6. As the network exposure measure (see: Equation (3)) is based on the market shares of a bank branch within a municipality (see: Equation (3)), there are different ways to calculate such a market share. The most plausible option is employed in the baseline analysis by using the pre-shock amount of deposits of a branch relative to its competitors within the respective municipality. Alternatively, I use the pre-shock number of branches of a bank i relative to the number of branches of competing banks within a specific municipality. Next, I use analogously the amount of branch assets to compute a third version of this market shares. Column I and II of Table 6 report these results when these market shares are used for the calculation of the network exposure measure.

Since not all iron prices become effective on March 2005, but one month later in the case of Asian contracts, I change the sample period from 2004m4 to 2006m4 with the Post dummy that equals one for all month after 2005m3 (column III).

Trying to identify the bank lending channel that is whether banks increase their loan supply in response to a liquidity shock, also involves to successfully control for loan demand effects. The first best approach suggested by the empirical banking literature is to use credit register data on the individual loan level and to employ a within-borrower estimation procedure similar to Khwaja and Mian (2008) or Jiménez et al. (2014). Unfortunately, one drawback of this data type is that it often omits the organizational structures within a banking conglomerate such as branch networks which renders this type of data as unsuitable for my analysis. Nevertheless, employing municipality-time fixed effects on a monthly frequency, enables me to control for common loan demand at the municipality level.

As another robustness test, I employ an even more granular approach to control to branch specific regional demand effects following Aiyar (2012). Equation (5) describes the construction of this demand control:

$$DMC_{i,m,t} = \sum_{j \in J} s_{i,j,m,t} \times \Delta TBL_{i,j,m,t} \tag{5}$$

This demand control $DMC_{i,m,t}$ exploits the heterogeneity in sectoral loan exposures across banks within a specific municipality. In a first step, one calculates the bank branch i's exposure $s_{i,j,m,t}$ to a specific sector j within the local economy m. This exposure is measured as the share of sectoral specific loan types such as consumer loans, commercial and industrial loans, mortgage loans, agricultural loans and agro-industrial loans. This is multiplied by $\Delta TBL_{i,j,m,t}$ which denotes the change in total lending of this loan type j by all other banks except bank i within the specific municipality. Finally, these sectoral specific changes weighted by the exposure share are added up across all sectoral loan types at the branch level of bank i within the municipality m. Column V in Table 6 reports the results when this demand control is included in the estimation. In order to evaluate differences in the results in comparison to the baseline, the baseline results of the second stage without this demand control are reported in column IV.

[Table 6 here]

Results presented in columns I and II confirm that the results established in the baseline estimation remain qualitatively and quantitatively unaltered when calculating the network exposure measure by different market share definitions. Also accounting for the fact that some contracts become valid in 2005m4, does not alter the results so far established. Finally, including the branch specific demand control similar to Aiyar (2012), yields a positive and highly statistically significant effect of the network exposure variable to the iron ore shock at the 1 percent level. In comparison to the baseline (see: column IV), parameters are very similar in size and the corresponding standard errors of both parameters suggest that there is no statistically significant difference between both specifications. Thus, even when including a more conservative control for loan demand that also picks up partially supply effects, does not alter the main findings.

In a second set of robustness checks, I use disaggregated loan information instead of focusing on the overall lending activity of banks in the non-affected region. In particular, I use the commercial and industrial loan growth rate and the consumer loan growth rate as the main dependent variables. Examining these categories, can inform whether lending might have real effects via investment in the case of C&I loans or whether it supports only consumption in the case of consumer loans.[24] The corresponding results are depicted in columns I and II in Table 7.

[24] It is important to note that also consumer can impact firm investment by consumer behavior. Nevertheless as consumer loans are more susceptible to behavior, enhanced access to C&I loans directly influences firm investment.

In another robustness test, I also perform a placebo test for the second part of the analysis. I estimate the baseline estimation for the period from 2002m5 to 2004m5. Since there are two positive, but moderate, iron ore price increases in this period on Mai 2003 and January 2004, I want to show that even under these slight increases in comparison to the 71.5 percent price hike, the effect found in the baseline sample can only be explained by the actual hike that occurs on March 2005 (Table 7, column III).[25]

In another robustness test (Table 7, column IV), I expand the geographical sample of the baseline estimation by including also municipalities that share a common border with those federal units where iron ore mining activity is reported.[26] The network size N_i of the network exposure measure (see Equation (3)) is adjusted accordingly to this increase in the geographical sample.

[Table 7 here]

The results of this set of robustness checks can be summarized in the following way. First, I find evidence that the liquidity shock that is transmitted through branch networks leads to a statistically significant positive effect on commercial and industrial loan growth, while the effect is not statistically significant for the consumer growth rate at any convenient level of statistical significance. On a positive note, one could argue that this provides evidence that the liquidity shock is mainly used to support firms' financing needs directly. Second, the placebo test supports the notion that the effect found in the empirical analysis is really driven by the price hike on March 2005 and not by previous pricing events. Also including neighboring municipalities of the federal units with mining activity, does not alter the results established of the baseline estimation.[27]

[25] These previous price increases where of course less strong than the 71.5 percent increase, the 2003m5 increase was about 9 percent and the 2004m1 increase about 18.6 percent.

[26] For this specification, I dropped two regional banks of São Paulo, BANESPA and Nossa Caixa, which have strong ties to the financial center of São Paulo, to avoid spillover effects from this financial center as this study focuses on regional effects.

[27] Table A4 reports further robustness analysis when adding additional control variables to the baseline specification of Table 5 column III. These include the return on assets, loan loss provisions to total loans, the headquarter portfolio risk profile and the administrative costs to total assets. Additionally, I estimated the baseline specification of Table 5 column III and used different clustering schemes for the standard errors. Table A5 summarizes these results. The baseline results remain statistically significant to these procedures at the 5 percent level at least.

Nevertheless, it is still possible that the difference-in-differences effect found so far is driven by another non-linearity at the headquarter or branch network level. To address this potential endogeneity, I implement a "horse race" between the $[NWKEP_i \times Post_t]$ interaction and other competing non-linearities. Each of the non-linearities is an interaction between a headquarter variable and the $Post_t$ dummy. I also introduce a new headquarter variable that measures the portfolio risk profile of the headquarter.[28] This measure is based on the rating of assets by the headquarter as reported by the Call Reports of the Banco Central do Brasil. It consists of 8 levels of operational risk from the best rating AA to the worst rating H. In order to calculate the operational risk measure, I assign a number to each of these 8 levels ranging from 1, as the lowest risk level, to 8, for the highest level of risk. The overall headquarter risk measure is simply the average risk level. Table 8 summarizes the results of this "horse race" test by depicting the significance and the parameter value of the interaction of interest, while the first column displays the competing non-linearity included.[29]

[Table 8 here]

Overall, adding these additional competing non-linearities does not affect the results established so far. In all nine specifications, the positive difference-in-differences effect remains at least statistically significant at the 5 percent level and the parameter values stay nearly unaltered between about 0.4 to 0.45 depending on the specification. Thus, I conclude that the $[NWKEP_i \times Post_t]$ interaction survives also this "horse race" test which strengthens the case that the results obtained so far are not due to omitted non-linearities.

Finally, I test whether the empirical specifications used for this second part of the econometric analysis might suffer from a violation of the parallel trend assumption. As the network exposure variable measures the degree of affectedness the procedure to test any violation of the parallel trend

[28] Including this variable additionally to the baseline estimation as a further control (Table 5, column III), does not alter the results established so far in any qualitative or quantitative way. Results of this specification can be found in Table A4 in the appendix.

[29] I have further extended this horse race to a "horse race championship" by including all baseline control variables at the branch level plus further additional variables as competing non-linearities. Results remain statistically significant at the 5 percent level at least. Table A6 summarizes these results. The complete result table of this procedure is available upon request.

assumption is slightly different in comparison to the first stage. First, one has to define a criterion to separate the sample into two groups. I define the group of being affected for those branches that have a network value that is larger or equal to the 75th percentile and the group of non-affected is defined for values below the 25th percentile. For robustness, I have also used the median split to define both groups. Second, I calculate the first difference of the dependent variables to capture any trend in the dependent variables. Third, I evaluate whether there is a statistically significant difference between the group means of being affected and not being affected in the pre-shock period. Table A2 in the appendix report these results for the 75th and 25th percentile split. Relatively large p-values suggest that there are no statistically significant trends between both groups in the pre-shock period.[30]

To summarize, the second part of the empirical analysis provides robust evidence that excess capital is indeed reallocated via branch networks away from the affected region to the non-affected region where bank branches increase lending depending on their network exposure. Interestingly, the effect is primarily driven by the C&I loans and not by consumer loans as for the latter category no statistically significant results could be established.

5.3. Evaluating the intermediation process

In a final stage, I want to provide a more detailed analysis on the intermediation process that has been established so far by my empirical analysis. Even if bank branches do increase lending in the non-affected region, it is not clear a-priori whether, for example, banks start financing more riskier projects and/or more profitable projects. It could be that the lender suffers from a free cash-flow agency problem (Jensen (1986)), where managers choose to overinvest in unprofitable projects.

Furthermore, banks might use this windfall in liquidity in order to diversify their existing portfolio by financing new projects that are negatively correlated with the banks' overall portfolio, and thus, following the portfolio choice theory in the spirit of Markowitz (1952).

For this purpose, I estimate a multiplicative interaction model in the context of a difference-in-differences analysis. This procedure evaluates whether there is a non-linearity within the difference-in-differences effect β_2 of Equation (2). To this end, I estimate a triple interaction model which is in line

[30] This result also applies to the median split. These additional results are also available upon request.

with the stylized empirical model depicted by Equation (6). The parameters β_{2a} and β_{2b} are the parameters of interest as these are used to inform about the overall marginal effect for any value of the modifying variable Z.

$$\Delta log(loans)_{i,m,t} = \mu_{i,m} + \vartheta_{m,t} + \beta_{2a}[NWKEP_i \times Post_t] + \beta_{2b}[NWKEP_i \times Post_t \times Z] + \beta_3 Z + \beta_4[Z \times Post_t] + \beta_4[NWKEP_i \times Post_t] + \cdots + \varepsilon_{i,m,t} \quad (6)$$

For a correct specification of this interaction model, all modifying variables have to be included in this estimation equation which also includes all constitutional terms of the triple interaction.[31] However, if these terms are already accounted for by the underlying fixed effects structure of the empirical model, these terms will not be included (see Brambor et al., 2006).

The first analysis focuses on the return on assets of bank branches and their corresponding volatility.[32] To evaluate the potential non-linearity these modifying variables are calculated for the pre-shock and post-shock period. This further can shed light on whether there is a potential causal connection if there is a difference between post-shock and pre-shock results. Table 9 columns I to IV report these corresponding results. Additionally, I use the correlation of the return on assets between the individual branch to its corresponding banking conglomerate as the modifying variable to evaluate whether banks increase diversification as a result of the liquidity windfall. Because portfolio choice theory is based on the ex-ante expectations, this correlation is calculated for the pre-shock period.[33] The corresponding results are reported in Table 9 column V.

[Table 9 here]

Standard result tables are only partially informative regarding the results obtained from the interaction analysis, as one cannot infer the standard errors of the overall marginal effect of the difference-in-

[31] These constitutional terms also include all two-way interactions of the triple interaction term.
[32] As it is impossible to calculate the standard deviation or the correlation at a monthly frequency, I opt for a triple interaction model for the baseline analysis.
[33] For the pre-shock period, I use two years prior to the iron ore shock.

differences. Hence, only marginal effects plots with the corresponding confidence intervals are important for a thorough analysis of the overall marginal effect.[34]

Focusing on the triple interaction term, there is no statistically significant effect for the pre-shock and post-shock return on asset specifications. That means, irrespectively of their pre-shock or post-shock returns on assets, branches increase their lending in the non-affected region depending on their network exposure to the iron ore shock.[35]

Interestingly, in terms of the standard deviation of the returns on assets, there is a highly significant effect for the post-shock specification, while the effect is completely muted for the pre-shock period. Figure 4 depicts the corresponding overall marginal effect of the difference-in-differences conditional to the standard deviation of the branches' returns on assets for the post-shock period.

[Figure 4 here]

The effect for the pre-shock specification is not just insignificant, the slope of the overall marginal effect that accounts for the non-linearity is flat and very close to zero. These results indicate that especially those branches increase lending more rapidly that also report a higher standard deviation in the post-shock period. Since this effect is completely muted for the pre-shock period, it seems to be the case that branches realize more riskier projects due to the liquidity windfall. This is even more problematic as the return on asset specification suggest that branches do not invest more in projects which report higher returns.

Finally, further results suggest that banking conglomerates do not use the windfall in liquidity to diversify their portfolio. Instead, I find evidence that banks' overall portfolio becomes more concentrated as those branches increase their lending more extensively that are more correlated with the banking conglomerate in terms of the returns on assets. Figure 5 depicts this overall marginal effect of the interaction between the network exposure and the post dummy variable on the lending

[34] See Brambor et al. (2006) for the correct analysis and specification of interaction models.

[35] In the case of the return on assets, I have also estimated the standard specification Equation (2) with the returns on assets as the dependent variable. In this robustness, I have also found no statistically significant effect of the difference-in-differences. Results of this procedure are of course available upon request.

growth rate conditional to the pre-shock correlation between the branch's return on assets to its corresponding banking conglomerate.

[Figure 5 here]

Figure 5 confirms that the lending effect is more pronounced and statistically significant for branches that report positive values for the return on asset correlations.

This portfolio concentration effect might even have negative repercussions on the stability of the banking conglomerate and implications for the stability of the domestic banking system as a whole. Combining this with the evidence that branches also seem to invest in more riskier projects, this risk change in the overall portfolio might even be amplified by the risk taking of individual branches. To summarize, even though bank branches seem to be useful for cross-regional capital reallocation of windfall gains stemming from commodity boom periods, managing this liquidity windfall efficiently seems to be challenging as banking conglomerate portfolios become more concentrated, and thus, more vulnerable to idiosyncratic shocks, and furthermore, bank branches seem to invest in more riskier projects without receiving any risk premium on top of their returns.

6. Conclusion

This paper addresses whether regional bank branch networks might provide a potential mechanism for developing economies to absorb and to manage capital windfalls caused by external commodity price booms. Since literature has shown that bank branch presence reduces informational frictions at the local level within the domestic economy, branch networks might also help to retain local windfall liquidity within the domestic economy by transmitting this windfall in liquidity to other non-affected regions. The cross-regional capital reallocation via branch networks becomes even more relevant in the case of mineral commodities as mineral production is often geographically very concentrated.

Focusing on Brazil, as the worlds leading exporter in iron ores with relatively established bank branch networks, I exploit an external rapid increase in world iron ore prices on March 2005, to identify the effect of the shock on cross-regional capital reallocation by bank branch networks. The empirical strategy is further divided into two interrelated parts. In the first part, I provide robust evidence that local bank branches in the affected region report excess capital that is available for cross-regional reallocation. Since further evidence shows that local affected bank branches do not increase lending in the booming iron ore regions, these results rule out any Dutch Disease type of regional crowding out of the non-iron ore sector.

The second part of the analysis examines the lending activity of bank branches in the non-affected region, and hence, provide the key findings of the overall analysis. Given that these branches are not exposed to the iron ore shock by their geographical location, identification is solely based on the branch's exposure to the shock via its corresponding network of branches that belong to the same banking conglomerate. The key finding is that bank branch networks indeed increase lending in the non-affected regions depending on their network exposure.

However, additional analysis reveals that the intermediation process is far from being perfect. Banks do not seem to diversify their portfolio but results suggest that the shock related increase in lending seems to increase portfolio concentration risks of banks. Moreover, these risks might be even amplified by their branches own lending decisions as these branches appear to finance riskier projects that do not seem promise higher risk premium on top of their returns.

In the end, these results provide evidence for policy makers in emerging and developing economies to favor policies that foster banks' branching activities. Being exposed to local windfalls in capital due to commodity dependence, branch networks facilitate the absorption and intermediation process of these windfalls at the regional level and can help to drive the economic transformation process within the domestic economy. Nevertheless, evidence also calls for caution as these intermediation processes at least in the case of Brazil do not seem to be optimal. Thus, frictions that limit the efficiency in lending must also be considered by policy makers. Understanding the underlying factors of these frictions also provide an area for future research. Ultimately, this study is the first to provide robust evidence that bank branch networks are an important tool for cross-regional capital reallocation of windfall liquidity due to an external commodity price shock.

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Tables and Figures

Table 1: The Iron Ore Shock and Local Deposit Growth Rates

Dep. Var.: Deposit Growth Rate	**I**	**II**	**III**	**IV**
Affected x Post	0.856*	2.637***	1.939***	2.136**
	(0.453)	(0.803)	(0.653)	(0.771)
BR: ln(total assets)		-30.36***	-33.41***	-35.99***
		(4.451)	(3.116)	(2.760)
BR: Deposits to Total Asset Ratio		-1.454***	-1.481***	-1.633***
		(0.175)	(0.177)	(0.173)
BR: Liquid Assets to Total Asset Ratio		0.0386	0.0343	-0.00501
		(0.0648)	(0.0691)	(0.115)
BR: C&I Loan to Asset Ratio		0.00236	-0.0373	-0.00646
		(0.0614)	(0.0430)	(0.0282)
BR: Consumer Loan to Asset Ratio		0.120	0.0509	-0.0396
		(0.126)	(0.128)	(0.0844)
BR: Mortgage to Asset Ratio		-0.119**	-0.105**	-0.112**
		(0.0418)	(0.0474)	(0.0472)
BR: Loan to Deposit Ratio		0.00572***	0.00596***	0.00573***
		(0.00158)	(0.00153)	(0.00164)
HQ: ln(total assets)			15.31	14.24
			(9.718)	(9.648)
HQ: Deposits to Total Asset Ratio			-0.251	-0.214
			(0.184)	(0.188)
HQ: Liquid Assets to Total Asset Ratio			0.337***	0.231*
			(0.118)	(0.121)
HQ: C&I Loan to Asset Ratio			1.250**	0.855*
			(0.470)	(0.442)
HQ: Consumer Loan to Asset Ratio			0.997	0.616
			(0.910)	(0.714)
HQ: Mortgage to Asset Ratio			6.084***	5.609***
			(1.828)	(1.787)
HQ: Loan to Deposit Ratio			-0.257***	-0.249**
			(0.0894)	(0.0943)
HQ: Capital to Asset Ratio			-0.311	-0.348
			(0.568)	(0.571)

Table 1 continued…

	I	II	III	IV
Month FE	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES
Observations	36,560	36,560	36,560	31,475
R-squared	0.043	0.191	0.196	0.200

Notes: This table reports the baseline results of the first part that analyzes the effect of the iron ore price shock on deposit growth rates of branches in affected municipalities relative to branches in non-affected municipalities. The estimation sample contains all municipalities of federal units (UFs) that have iron ore mines (Minas Gerais, Pará and Mato Grosso do Sul) from 2004m3 to 2006m3. The dependent variable is the change in log deposits of bank i in municipality m in month t. The variable of interest is the interaction between the Affected and the Post dummy. The Affected dummy equals one for all branches which are located in a municipality with iron ore production while the Post variable equals one for all month after 2005m2. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains time and branch fixed effects. The number of observations is hold constant across the first three specifications and specifications IV reports results based on a balanced panel. Neighboring municipalities of affected municipalities are excluded to account for potential spill-over effects. Standard errors are clustered at the bank headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 2: The Iron Ore Shock and Local Loan Growth Rates

Dep. Var.: Loan Growth Rate	**I**	**II**	**III**	**IV**
Affected x Post	0.507	0.490	0.259	0.0700
	(0.650)	(0.549)	(0.549)	(0.413)
BR: ln(total assets)		-11.50***	-11.87***	-12.52***
		(2.485)	(1.503)	(1.103)
BR: Deposits to Total Asset Ratio		0.0785***	0.0591***	0.0442*
		(0.0205)	(0.0120)	(0.0212)
BR: Liquid Assets to Total Asset Ratio		-0.131***	-0.114***	-0.0994***
		(0.0383)	(0.0233)	(0.0321)
BR: C&I Loans to Asset Ratio		-0.310***	-0.321***	-0.274***
		(0.0737)	(0.0619)	(0.0453)
BR: Consumer Loans to Asset Ratio		-0.0690*	-0.0589	-0.0635*
		(0.0352)	(0.0342)	(0.0327)
BR: Mortgages to Asset Ratio		-0.0634**	-0.0576**	-0.0406**
		(0.0288)	(0.0239)	(0.0149)
BR: Loan to Deposit Ratio		-0.000586	-0.000512	-0.000393
		(0.000413)	(0.000421)	(0.000445)
HQ: ln(total assets)			-1.969	3.050
			(8.349)	(4.710)
HQ: Deposits to Total Asset Ratio			-0.165*	-0.164**
			(0.0817)	(0.0656)
HQ: Liquid Assets to Total Asset Ratio			0.123	0.00223
			(0.0875)	(0.0767)
HQ: C&I Loans to Asset Ratio			0.610*	0.447*
			(0.340)	(0.244)
HQ: Consumer Loans to Asset Ratio			0.417	-0.0298
			(0.317)	(0.190)
HQ: Mortgages to Asset Ratio			1.626	1.583*
			(0.999)	(0.763)
HQ: Loan to Deposit Ratio			-0.250***	-0.241***
			(0.0497)	(0.0374)
HQ: Capital to Asset Ratio			-0.115	0.115
			(0.389)	(0.301)

Table 2 continued…

	I	II	III	IV
Month FE	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES
Observations	36,560	36,560	36,560	31,450
R-squared	0.209	0.254	0.260	0.198

Notes: This table reports the baseline results of the first part that analyzes the effect of the iron ore price shock on local lending growth rates of branches in affected municipalities relative to branches in non-affected municipalities. The estimation sample contains all municipalities of federal units (UFs) that have iron ore mines (Minas Gerais, Pará and Mato Grosso do Sul) from 2004m3 to 2006m3. The dependent variable is the change in log deposits of bank i in municipality m in month t. The variable of interest is the interaction between the Affected and the Post dummy. The Affected dummy equals one for all branches which are located in a municipality with iron ore production while the Post variable equals one for all month after 2005m2. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains time and branch fixed effects. The number of observations is hold constant across the first three specifications and specifications IV reports results based on a balanced panel. Neighboring municipalities of affected municipalities are excluded to account for potential spill-over effects. Standard errors are clustered at the bank headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 3: Robustness - Outpacing and Level Specifications

	I	II	III	IV
Dep. Var.:	Deposit-Lending GrowthRate	Deposit-Lending GrowthRate	ln(Deposits)	ln(Loans)
Affected x Post	2.220**	1.912**	0.0648**	0.0443
	(0.884)	(0.788)	(0.0230)	(0.0376)
Branch controls included:	YES	YES	YES	YES
HQ controls included:	NO	YES	YES	YES
Month FE	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES
Observations	31,450	31,450	31,450	31,450
R-squared	0.180	0.181	0.968	0.988

Notes: This table reports sensitivity analysis of the baseline results of the first part. Specifications I and II evaluate whether deposit growth outpaces the lending growth rate. Thus, the dependent variable for both specifications is the difference in the deposit and lending growth rate of branch of bank i in municipality m at month t. Specifications III and IV analyze the difference in differences effect of the iron ore shock on the level of deposits and loans. Therefore, the dependent variables are logged deposits and logged loans for each branch of bank i in municipality m at month t. The estimation sample contains all municipalities of federal units (UFs) that have iron ore mines (Minas Gerais, Pará and Mato Grosso do Sul) from 2004m3 to 2006m3. The variable of interest is the interaction between the Affected and the Post dummy. The Affected dummy equals one for all branches that are located in a municipality with iron ore production while the Post variable equals one for all month after 2005m2. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains time and branch fixed effects. The number of observations is hold constant across all specifications and is based on a balanced panel. Neighboring municipalities of affected municipalities are excluded to account for potential spill-over effects. Standard errors are clustered at the bank headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 4: Robustness - Placebo and Within Group Analysis

	I	II	III	IV	V
Dep. Var.:	Deposit Growth Rate	Dep. – Lend. Growth Rate	Deposit Growth Rate	Loan Growth Rate	Dep. – Lend. Growth Rate
RandomAffected x Post	-0.297	0.166	—	—	—
	(1.057)	(1.397)			
IronOreExposure x Post	—	—	0.849**	-0.0381	1.106**
			(0.353)	(0.189)	(0.442)
Controls included:	YES	YES	YES	YES	YES
Month FE	YES	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES	YES
Observations	31,450	31,450	1,969	1,969	1,969
R-squared	0.200	0.181	0.250	0.218	0.258

Notes: This table reports sensitivity tests of the first part of the empirical analysis which focuses on deposit growth and loan growth of bank branches located in the affected municipalities relative to bank branches that are located in non-affected municipalities. Specifications I and II perform a placebo test by assigning a random affectedness dummy to bank branches. The dependent variables are the deposit growth rate and the difference between the deposit and lending growth rate. Control variables included are in accordance to Table 1 specification IV. The panel is completely balanced. The estimation sample contains all municipalities of federal units (UFs) that have iron ore mines (Minas Gerais, Pará and Mato Grosso do Sul) from 2004m3 to 2006m3. Neighboring municipalities of affected municipalities are excluded to account for potential spill-over effects. Standard errors are clustered at the headquarter level. Specifications III to V perform an within group analysis by focusing on the degree of affectedness within the group of affected branches. The dependent variables are the deposit growth rate, the lending growth rate and the difference between both. The variable of interest is the interaction of the six month pre-shock iron ore exposure (IronOreExposure) of the individual branch and the Post dummy. This dummy variable equals one for all month after 2005m2. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains time and branch fixed effects. Standard errors are clustered at the bank headquarter and month level. and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 5: Cross-Regional Capital Reallocation

Dep. Var.: Loan Growth Rate	**I**	**II**	**III**	**IV**
NWKEP x Post	0.294**	0.368***	0.404***	0.243**
	(0.131)	(0.122)	(0.137)	(0.106)
BR: ln(total assets)			-10.94***	-12.20***
			(1.721)	(1.251)
BR: Deposits to Total Asset Ratio			0.0696**	0.0569*
			(0.0274)	(0.0288)
BR: Liquid Assets to Total Asset Ratio			-0.0717**	-0.0835**
			(0.0318)	(0.0307)
BR: C&I Loan to Asset Ratio			-0.265***	-0.264***
			(0.0513)	(0.0520)
BR: Consumer Loan to Asset Ratio			-0.0904**	-0.0886**
			(0.0431)	(0.0345)
BR Mortgage to Asset Ratio			-0.0341**	-0.0359**
			(0.0138)	(0.0135)
BR: Loan to Deposit Ratio			-0.000488	-0.000373
			(0.000474)	(0.000502)
HQ: ln(total assets)		0.0227	4.324	3.926
		(4.517)	(5.144)	(4.205)
HQ: Deposits to Total Asset Ratio		-0.204**	-0.112	-0.130*
		(0.0722)	(0.0746)	(0.0731)
HQ: Liquid Assets to Total Asset Ratio		0.0130	0.0555	-0.00126
		(0.0529)	(0.0679)	(0.0629)
HQ: C&I Loan to Asset Ratio		0.149	0.418	0.283
		(0.203)	(0.253)	(0.228)
HQ: Consumer Loan to Asset Ratio		0.0303	0.0448	-0.153
		(0.180)	(0.253)	(0.180)
HQ: Mortgage to Asset Ratio		0.634	1.149	1.081
		(0.785)	(0.802)	(0.732)
HQ: Loan to Deposit Ratio		-0.253***	-0.195***	-0.199***
		(0.0401)	(0.0414)	(0.0474)
HQ: Capital to Asset Ratio		0.250	-0.121	-0.0505
		(0.202)	(0.206)	(0.240)

Table 5 continued…

	I	II	III	IV
Municipality x Month FE	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES
Observations	27,097	27,097	27,097	25,700
R-squared	0.374	0.377	0.401	0.384

Notes: This table reports the baseline results of the second stage which analyzes the capital reallocation from iron dependent municipalities to non-affected municipalities via branch networks. The dependent variable is the change in log outstanding loans of bank i in municipality m in month t. To identify the increase in loan growth in the non-affected region, all affected municipalities and their neighboring municipalities are excluded. Thus, the estimation sample contains all municipalities that are not directly affected in federal units (UFs) with mine presence in Brazil (Minas Gerais, Mato Grosso do Sul and Pará) from 2004m3 to 2006m3. The variable of interest is the interaction of the branch network exposure (NWKEP) of the banking network and the Post dummy for the post-shock period. This dummy variable is equal to one for all month after 2005m2. The market shares used to calculate the network exposure measure are also based on six month ex-ante deposit shares of the affected branches. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains municipality-time fixed effects and branch fixed effects. The number of observations is hold constant across the first three specifications while in specification IV a balanced sample is used. Neighboring municipalities of affected municipalities are excluded to account for potential spill-over effects. Standard errors are clustered at the headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 6 : Market Share, Event Definition and Additional Demand Control

Dep. Var.: Loan Growth Rate	**I**	**II**	**III**	**IV**	**V**
NWKEP(branch share) x Post	0.434**				
	(0.153)				
NWKEP(asset share) x Post		0.366***			
		(0.123)			
NWKEP x Post2005m4			0.352**		
			(0.139)		
NWKEP x Post				0.404***	0.383***
				(0.137)	(0.128)
DMC					-0.985**
					(0.410)
BR: controls	YES	YES	YES	YES	YES
HQ: controls	YES	YES	YES	YES	YES
Municipality x Month FE	YES	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES	YES
Observations	27,097	27,097	27,134	27,097	27,097
R-squared	0.401	0.401	0.401	0.401	0.409

Notes: This table reports the results of sensitivity analysis of the baseline results of the second stage. The dependent variable is the change in log outstanding loans of bank i in municipality m in month t. To identify the increase in lending in the non-affected region, all affected municipalities and their neighboring municipalities are excluded, thus the geographical sample contains all non-affected municipalities in Federal Units with mine presence in Brazil (Minas Gerais, Mato Grosso do Sul and Para). The variable of interest is the interaction branch exposure of the banking network (NWKEP) and the Post dummy for the post-shock period. In the first specification, the market shares used to calculate network exposure measure (NWKEP) are also based on the six month average of the branch share within the respective municipality prior to the shock and analogously, the second specification employs the network exposure measure based on the ex-ante asset share. In specification three, the Post dummy is equal to one for all month after 2005m3 and the sample period is from 2004m4 to 2006m4. The fifth estimation includes further a variable that controls for credit demand in line with Aiyar (2012), while specification depicts the baseline result of Table 5 (III) for comparison purposes. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains municipality-time fixed effects and branch fixed effects. Standard errors are clustered at the headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 7: Robustness - Loan Types and Placebo Test

	I	II	III	IV
Dep. Var.:	C & I Loan Growth Rate	Consumer Loan Growth Rate	Loan Growth Rate	Loan Growth Rate
NWKEP x Post	0.390**	0.222		
	(0.149)	(0.241)		
NWKEP x Post2003m5			-0.239	
			(0.192)	
NWKEP x Post				0.420***
				(0.134)
BR: controls	YES	YES	YES	YES
HQ: controls	YES	YES	YES	YES
Municipality x Month FE	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES
Sample	Mining UF	Mining UF	Mining UF	incl. municipalities bordering to mining UFs
Observations	27,097	17,992	27,473	34,734
R-squared	0.492	0.401	0.620	0.403

Notes: This table reports the results of sensitivity analysis of the second stage estimation for different subcategories of loans and placebo tests. The first specification uses the C&I loan growth rate and the second specification uses the consumer loan growth rate as the dependent variable (column I and II). The third specification (column III) estimates the baseline estimation of the second part for the moderate price increase of 9% in 2003 which occurred 2003m5. The Post dummy is set to 2003m5 in specification three and the estimation period is adjusted accordingly to 2002m5 to 2004m5. The fourth specification repeats the baseline estimation on an extended geographical sample. Apart from Minas Gerais, Mato Grosso do Sul and Para, it contains additional municipalities that share a common border to these UFs. Thus, the sample also includes municipalities in Amazonas, Ampá, Bahia, Espírito Santo, Goiás, Maranhão, Mato Grosso, Paraná, Rio de Janeiro, Rondônia, Roraima, São Paulo and Tocantins. To identify the increase in lending in the non-affected region, all affected municipalities and their neighboring municipalities are excluded, thus the geographical sample contains all non-affected municipalities in Federal Units with mine presence in Brazil. The variable of interest is the interaction Network exposure (NWKEP) of the banking network and the Post dummy for the post-shock period. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains municipality-time fixed effects and branch fixed effects. Standard errors are clustered at the headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 8: Robustness - Horse Race

	Dep. Var.: Loan Growth Rate
Additional Interaction included:	**NWKEP x Post:**
HQ: ln(total assets) x Post	0.450**
	(0.190)
HQ: Deposits to Total Asset Ratio x Post	0.403***
	(0.138)
HQ: Liquid Assets to Total Asset Ratio x Post	0.434***
	(0.151)
HQ: C&I Loan to Asset Ratio x Post	0.408***
	(0.140)
HQ: Consumer Loan to Asset Ratio x Post	0.399**
	(0.151)
HQ: Mortgage to Asset Ratio x Post	0.408***
	(0.139)
HQ: Loan to Deposit Ratio x Post	0.394***
	(0.136)
HQ: Capital to Asset Ratio x Post	0.401***
	(0.139)
HQ: Portfolio Risk Profile x Post	0.454**
	(0.160)

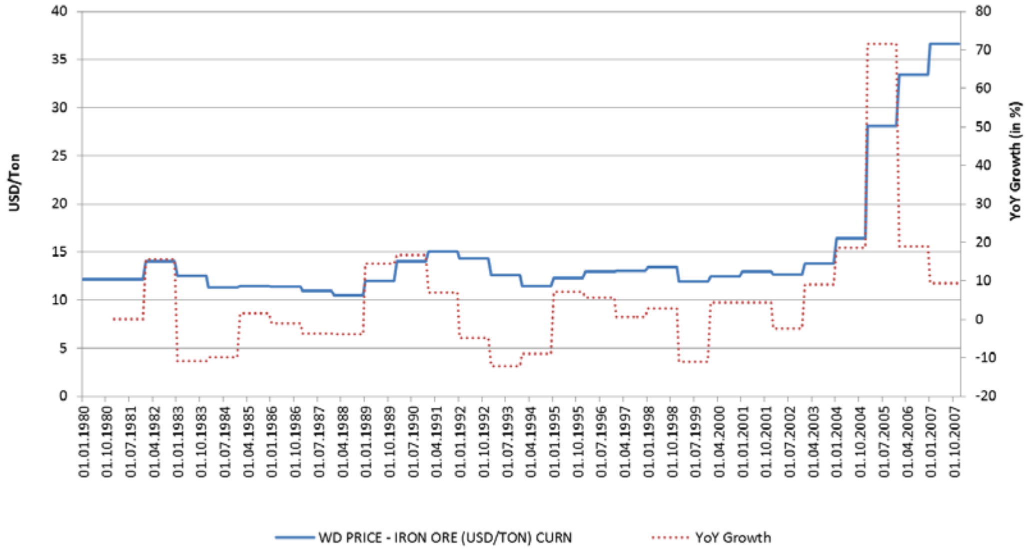
Notes: This table summarizes the results of further sensitivity analysis of the second stage. The estimation specification is identical to the baseline estimation (Table 5 column III) with the exception that further interactions are added to the model. Each row of the second column reports the parameter and statistical significance of the main variable of interest which is the interaction between the network exposure (NWKEP) variable and the Post dummy. The first column reports the respective competing non-linearity that is included. The abbreviation HQ denotes that the variable is based on the bank headquarter. Every specification contains municipality-time fixed effects and branch fixed effects. Standard errors are clustered at the headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table 9: Evaluating the intermediation process

Dep. Var.: Loan Growth Rate	**I**	**II**	**III**	**IV**	**V**
NWKEP x Post	0.318	0.521*	0.416*	0.0874	0.331***
	(0.196)	(0.300)	(0.223)	(0.110)	(0.110)
NWKEP x Post x RoA (pre-shock)	0.0421				
	(0.0861)				
NWKEP x Post x RoA (post-shock)		-0.0552			
		(0.118)			
NWKEP x Post x SdvRoA (pre-shock)			-0.00354		
			(0.193)		
NWKEP x Post x SdvRoA (post-shock)				0.305***	
				(0.0725)	
NWKEP x Post x CorrRoA					1.192**
					(0.539)
Controls included...	YES	YES	YES	YES	YES
All constitutive terms included...	YES	YES	YES	YES	YES
Municipality x Month FE	YES	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES	YES
Observations	27,097	27,073	26,960	27,048	26,960
R-squared	0.401	0.401	0.395	0.402	0.396

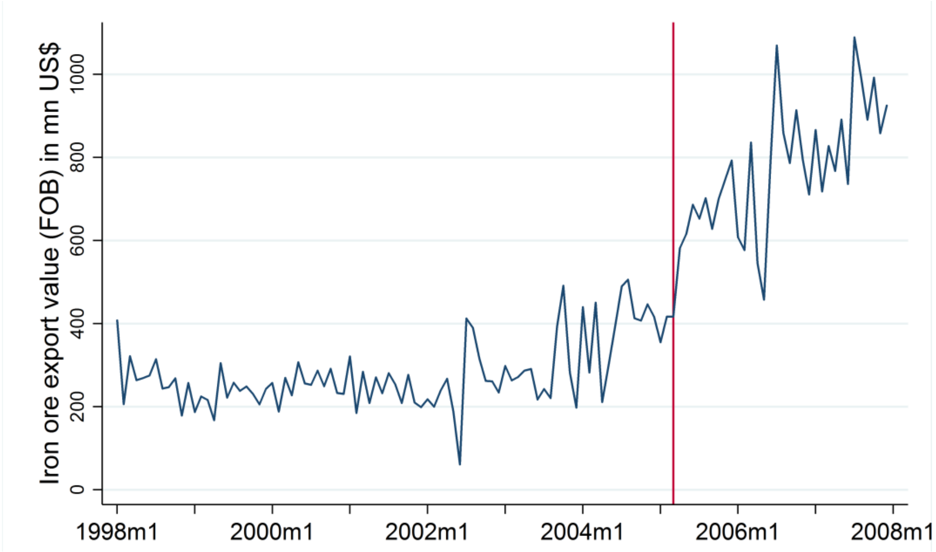
Notes: This table reports the results of the interaction model of the second part of the empirical analysis. The dependent variable is the change of log outstanding loans of branches in the non-affected region. The interaction between the network exposure measure and the post dummy is augmented to a triple interaction model. The additional modifying variables are the branch's specific return on assets based on the pre-shock and the post-shock period (columns I and II), the standard deviation of the respective returns based on the pre-shock and the post-shock period (columns III and IV), and finally, the correlation of the returns on assets between the individual branch and its corresponding banking conglomerate based on the pre-shock period. All specifications include the constitutive terms of the triple interaction model and the usual controls from the baseline estimation of the second part of the analysis (Table 5 column III). To identify the increase in loan growth in the non-affected region, all affected municipalities and their neighboring municipalities are excluded. The estimation sample contains all municipalities that are not directly affected in federal units (UFs) with mine presence in Brazil (Minas Gerais, Mato Grosso do Sul and Pará) from 2004m3 to 2006m3. Every specification contains municipality-time fixed effects and branch fixed effects. Neighboring municipalities of affected municipalities are excluded to account for potential spill-over effects. Standard errors are clustered at the headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Figure 1: Iron ore prices and growth rates between 1980-2007



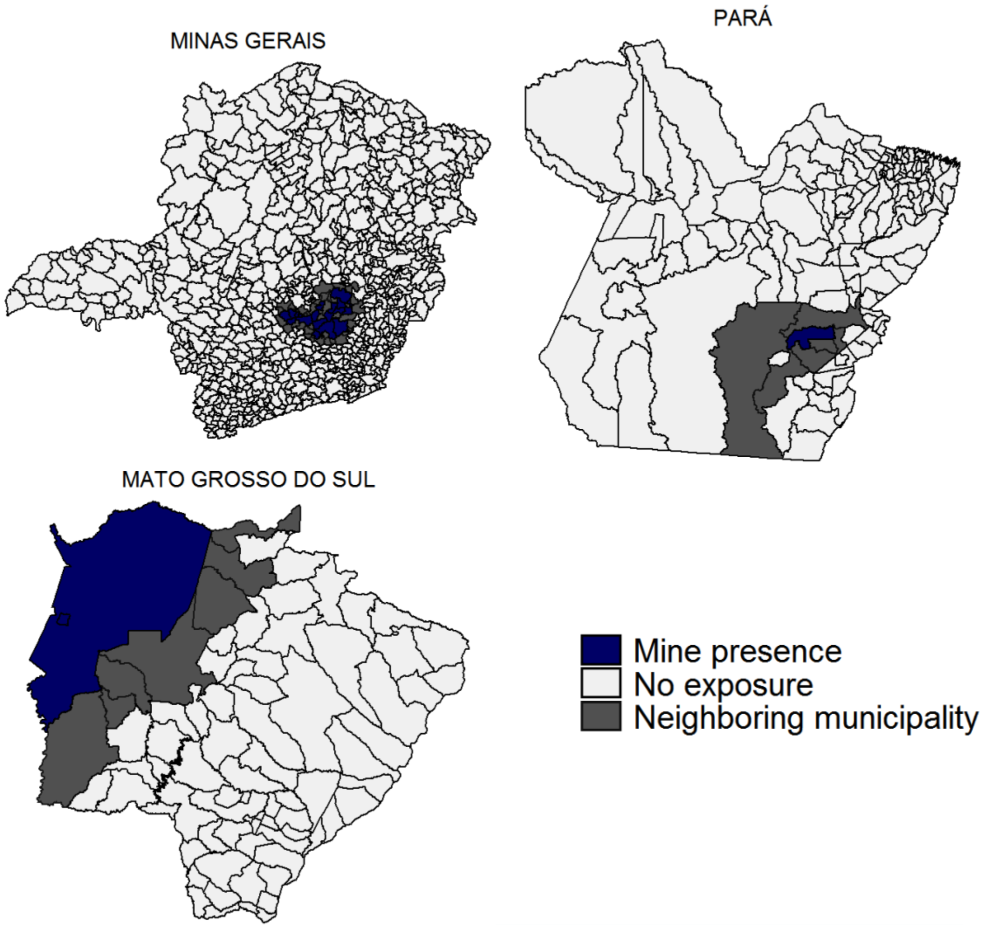
Notes: This figure depicts the iron ore price development from 1980 to 2007 and the corresponding year on year growth rates. While the solid line presents the price level, the dotted line depicts the year-on-year growth rate. Data source: IMF Primary Commodity Prices database on monthly frequency.

Figure 2: Brazilian iron ore export values from 1998-2007



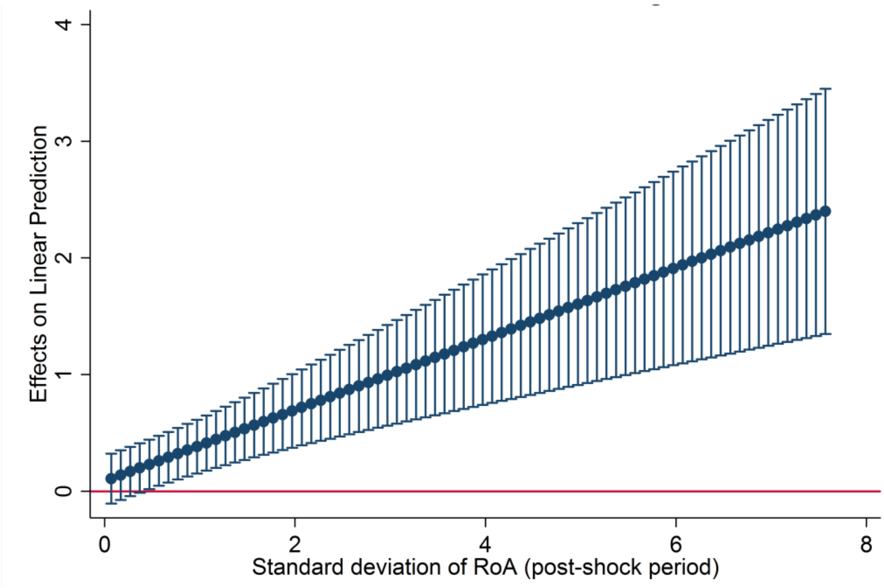
Notes: This figure depicts monthly iron ore export values in current USD from Brazil to the rest of the world from 1998m1 to 2007m12. The vertical red line marks the price event in March 2005. Data source: Ministry of Industry, Foreign Trade and Services (MDIC).

Figure 3: Municipalities with iron ore exposure in Brazil



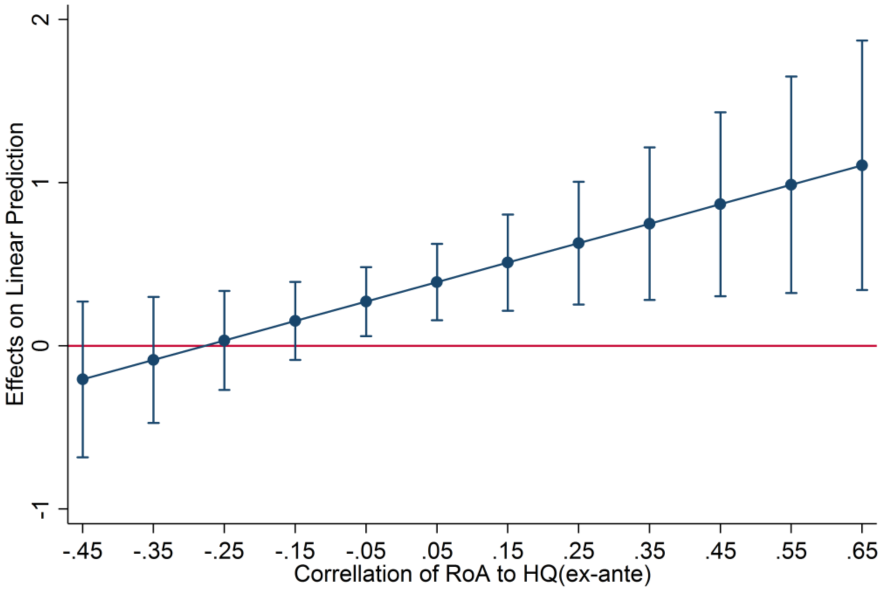
Notes: This figure depicts the geographical sample employed for the empirical analysis. The sample contains all municipalities within Minas Gerais, Mato Grosso do Sul and Pará. Municipalities that are blue-colored, report iron ore revenues during the sample from 2004m3-2005m3. Grey-colored municipalities depict bordering (neighboring) municipalitiesof those with iron ore revenues. The remaining municipalities do not report any iron ore exposure. Data for iron ore revenues is from the Brazilian Ministry of Mines and Energy (MME).

Figure 4: Marginal Effect of the branch network effect on lending conditional to the standard deviation of branches' return on assets in the post-shock period



Notes: This figure depicts the overall marginal effect of the interaction between the network exposure measure and the post dummy on the lending growth rate of branches located in the non-affected region conditional on the standard deviation of branches' return on assets in the post-shock period. The vertical axis captures the size of the marginal effect and the horizontal axis depicts the corresponding value of the modifying variable. The range of the horizontal axis is defined by actual values of the modifying variable used in the analysis. Dots present the estimated marginal effect and the corresponding whiskers depict the 95 percent confidence interval.

Figure 5: Marginal Effect of the branch network effect on lending conditional to the correlation of branches' return on assets to the returns on assets of the banking conglomerate in the pre-shock period.



Notes: This figure depicts the overall marginal effect of the interaction between the network exposure measure and the post dummy on the lending growth rate of branches located in the non-affected region conditional on the correlation between return on assets between the individual branch and its corresponding banking conglomerate in the pre-shock period. The vertical axis captures the size of the marginal effect and the horizontal axis depicts the corresponding value of the modifying variable. The range of the horizontal axis is defined by actual values of the modifying variable used in the analysis. Dots present the estimated marginal effect and the corresponding whiskers depict the 95 percent confidence interval.

Appendix

Table A1: Summary Statistics - Part 1

Variable	mean	sdv	min	max	Shock Affected Yes	Shock Affected No	p-value
Dependent Variables:							
Δ ln(Deposits)	1.7156	22.1013	-79.8506	88.6727	-0.0412	0.0570	0.9376
Δ ln(Loans)	3.2023	9.6686	-37.0945	44.2211	0.1306	-0.0008	0.7865
Δ ln(Deposits) - Δ ln(Loans)	-1.5212	24.6740	-93.5940	94.7749	-0.2085	0.0760	0.8389
ln(depoits)	-0.4107	1.1375	-4.2590	3.7785	0.0261	0.0282	0.7911
ln(loans)	0.8013	1.4603	-3.5615	5.6584	0.0367	0.0363	0.9344
Branch-Level:					**Yes**	**No**	**normalized dif.**
IronOreExposure	10.1594	2.3393	4.0708	13.3398	.	.	.
ln(assets)	1.4725	1.2009	-1.8259	7.0100	1.4915	1.2983	0.1217
Deposits / Total Assets	21.4992	12.9322	0.0364	88.4065	22.0162	22.2485	-0.0123
Liquidity / Total Assets	4.7306	5.6887	0.0323	27.0184	4.1622	4.3242	-0.0246
C&I Loans / Total Assets	35.6068	24.2415	1.9953	98.1541	34.4919	34.9155	-0.0116
Consumer Loans / Total Assets	4.1661	6.1152	0.0000	50.0811	4.1947	4.0344	0.0190
Mortgages / Total Assets	3.7605	11.7805	0.0000	61.1834	3.6468	4.5932	-0.0530
Loans / Deposits	537.4731	1216.9290	17.9697	20595.7400	287.8723	515.0518	-0.2100
Headquarter-Level:							
ln(assets)	10.7504	1.2043	5.5881	11.8443	10.5447	10.5686	-0.0154
Deposits / Total Assets	51.8126	8.7413	18.6259	74.6130	50.1752	49.7078	0.0405
Liquidity / Total Assets	17.5767	10.1394	0.9287	38.2102	17.3287	17.5247	-0.0126
C&I Loans / Total Assets	14.8410	6.6471	1.7278	42.0230	14.5833	14.2959	0.0296
Consumer Loans / Total Assets	5.7390	3.7163	0.0293	17.0246	6.4593	5.4079	0.1813
Mortgages / Total Assets	2.1137	3.3343	0.0000	11.7356	2.5657	2.1841	0.0791
Loans / Deposits	51.9460	19.1806	19.6051	139.1465	51.9432	52.0419	-0.0038
Capital / Total Assets	8.1083	4.6776	3.4827	36.4112	8.8517	8.1377	0.1068

Notes: This table provides the summary statistics for the first part of the empirical analysis. These include the mean, standard deviation (sdv), the minimum (min) and maximum (max) values for each variable for the entire sample. For the dependent variables, the mean of the first difference for the affected and non-affected branches are reported separately for the pre-shock period (see: columns Shock Affected: Yes and No). The summary statistics of the IronOreExposure measure are based on the sample of the within analysis. The corresponding p-values report whether there is a statistically significant difference in the trends of both groups. For the control variables, the normalized means of the affected and non-affected groups and their difference are reported. * reports the statistically significance for this normalize difference in means (Imbens and Wooldridge (2009)) The columns Shock Affected “Yes” and “No” report the mean of both groups..

Table A2: Summary Statistics - Part 2

					Shock Affected		
Variable	**mean**	**sdv**	**min**	**max**	**NWKEP>=pctl(75)**	**NWKEP<=pctl(25)**	**p-value**
Dependent Variables:							
Δ ln(Loans)	2.6273	9.4118	-37.095	44.2211	0.1770	0.0405	0.5665
Δ ln(C&I Loans)	2.8942	8.7263	-31.196	36.6730	0.2726	0.0766	0.3992
Δ ln(Consumer Loans)	3.0586	12.5162	-42.395	70.6128	-0.2995	-0.3524	0.8678
Branch-Level:					**NWKEP>=pctl(75)**	**NWKEP<=pctl(25)**	**normalized dif.**
ln(assets)	1.6875	1.1883	-1.8259	7.0100	1.9064	1.0289	0.5321*
Deposits / Total Assets	20.1255	12.4035	0.0364	88.4065	23.0404	22.4569	0.0323
Liquidity / Total Assets	4.3208	5.1339	0.0323	27.0184	3.0543	6.6309	-0.4816*
C&I Loans / Total Assets	38.7990	25.0657	1.9953	98.1541	35.1859	53.3353	-0.6006*
Consumer Loans / Total Assets	4.4656	6.5447	0.0000	50.0811	6.6105	6.1625	0.0450
Mortgages / Total Assets	4.8720	13.3072	0.0000	61.1834	0.0000	0.0053	-0.0547
Loans / Deposits	627.5868	1355.2350	17.9697	20595.7	463.7823	736.7763	-0.1404
Return on Assets	1.7059	1.3939	-2.2195	6.0515	1.3960	2.7503	-0.7483*
Loan Loss Provision to Total Loans	1.792439	3.4488	0.0000	21.7945	0.0401	2.6048	-0.6795*
RoA (pre-shock)	1.7155	1.2824	-1.1749	5.3608	1.3966	2.7301	0.8013*
RoA (post-shock)	1.6740	1.2418	-1.3214	5.5109	1.4513	2.5245	-0.6551*
SdvRoA (pre-shock)	0.5430	0.5500	0.0598	5.3201	0.4050	0.6329	-0.3795*
SdvRoA (post-shock)	0.6667	1.1511	0.0695	7.6006	0.3613	1.2152	-0.4633*
CorrRoA	0.0673	0.2188	-0.4408	0.6311	0.0592415	0.198377	-0.4719*
Headquarter-Level:							
NWKEP	7.9251	1.9350	0.0000	9.6389	.	.	.
ln(assets)	10.6321	1.2899	5.5881	11.8443	10.9343	9.8252	0.6537*
Deposits / Total Assets	52.3375	9.2496	18.6259	74.6130	43.9150	53.1082	-0.7015*
Liquidity / Total Assets	16.9852	9.9689	0.9287	38.2102	9.8235	26.6933	-1.5957*
C&I Loans / Total Assets	15.1127	7.3223	1.7278	42.0230	13.8770	14.9004	-0.1508
Consumer Loans / Total Assets	4.4656	6.5447	0.0000	50.0811	6.5674	5.5124	0.1910
Mortgages / Total Assets	2.4725	3.6274	0.0000	11.7356	0.2650	1.6622	-1.8694*
Loans / Deposits	52.1091	19.5765	19.6051	139.147	66.0119	5.9067	1.2259*
Capital / Total Assets	8.3519	4.9358	3.4827	36.4112	9.5002	8.0905	0.1770

Table A2 continued…

Variable	mean	sdv	min	max	NWKEP>=pctl(75)	NWKEP<=pctl(25)	normalized dif.
Return on Assets	21.2772	15.75206	3.1720	89.0758	19.75567	19.45086	0.015
Loan Loss Provision to Total Loans	9.6114	3.5641	1.9686	26.3682	6.8897	11.0217	-0.8371*
Administrative Costs to Total Assets	0.4990	0.1632	0.1445	1.2980	0.5106675	0.5141969	-0.0139*
Portfolio Risk Profile	2.8944	0.5127	1.6080	3.9529	2.8066	2.7370	0.1066

Notes: This table provides the summary statistics for the second part of the empirical analysis. These include the mean, standard deviation (sdv), the minimum (min) and maximum (max) values for each variable for the entire sample. For the dependent variables, the mean of the first difference for the affected and non-affected branches are reported separately for the pre-shock period. As the branch network exposure measure (NWKEP) measures the degree of affectedness, the group of affected branches is defined here as the 75th percentile and the group of non-affected branches are defines as the 25th percentile. The corresponding p-values report whether there is a statistically significant difference in the trends of both groups. The columns "NWKEP>pctl(75)" and "NWKEP><pctl(25)" report the mean values for both groups of the first difference. For the control variables, the normalized means of the affected and non-affected groups and their difference are reported. * reports the statistically significance for this normalize difference in means (Imbens and Wooldridge (2009)). The columns "NWKEP>pctl(75)" and "NWKEP><pctl(25)" report the mean values for both groups.

Table A3: Variable and measure definitions

Variable	Definition	Unit; Level
Δ ln(Deposits)	monthly change in log deposits	%; branch
Δ ln(Loans)	monthly change in log loans outstanding	%; branch
Δ ln(Deposits) - Δ ln(Loans)	difference in the monthly changes of logged deposits and logged loans outstanding	%; branch
ln(depoits)	log of deposits	ln; branch
ln(loans)	log of loans outstanding	ln; branch
Δ ln(C&I Loans)	monthly change in log commercial and industrial loans outstanding	%; branch
Δ ln(Consumer Loans)	monthly change in log consumer loans outstanding	%; branch
Affected	Dummy equal to one if a branch is located in a municipality that reports iron ore mining revenues	0/1; branch
IronOreExposure	$IronOreExposure_{i,m} = \log(IronOreRevenue_{m,pre-shock} \times MarketShare_{i,m,pre-shock})$	ln; branch level
NWKEP	$NWKEP_i = log\left[\left(\sum_m IronOreRevenue_{m,pre-shock} \times MarketShare_{i,m,pre-shock}\right)/N_i\right]$	ln; bank branch network
IronOreRevenue	Actual amount of iron ore revenue per municipality. This value is used to for the IronOreExposure and NWKEP measures. For these measures I take the six month pre-shock average value.	level; municipality
MarketShare	This variable is used for the calculations of the Iron Ore Exposure and NWKEP measures. For these measures I use the six month pre-shock average of the branch market share within a given municipality. For the baseline estimations, I use the absolute amount of branch deposits to calculate this market share. As a robustness I use branch's total assets and the number of offices per bank within a municipality to calculate this market share.	%; bank branch
N	Number of markets/municipalities of a particular bank within the non-affected region.	level; headquarter
Post	Dummy equal to one for the period 2005m3-2006m3	0/1; branch and headquarter
ln(assets)	log of the total asset side	ln; branch and headquarter
Deposits / Total Assets	Ratio of total deposits to total assets	%; branch and headquarter
Liquidity / Total Assets	Ratio of liquid to total assets of the branch or bank	%; branch and headquarter

Table A3 continued…

Variable	Definition	Unit; Level
C&I Loans / Total Assets	Ratio of commercial and industrial loans to total assets	%; branch and headquarter
Consumer Loans / Total Assets	Ratio of consumer loans to total assets	%; branch and headquarter
Mortgages / Total Assets	Ratio of mortgage loans to total assets	%; branch and headquarter
Loans / Deposits	Ratio of loans to deposits	%; branch and headquarter
Capital / Total Assets	Ratio of equity to total assets	%; headquarter
Portfolio Risk Profile	Average Risk Rating of headquarter assets, where 1 is the lowest level of risk and 8 is the highest risk level	1-8; headquarter
Return on Assets	Return on assets	%; branch and headquarter
Loan Loss Provision to Total Loans	Ratio of loan loss provision to total loans	%; branch and headquarter
Administrative Costs to Total Assets	Ratio of administrative costs relative to total assets	%; branch and headquarter
RoA (pre-shock)	Average return on assets in the pre-shock period by branch	%; branch
RoA (post-shock)	Average return on assets in the post-shock period by branch	%; branch
SdvRoA (pre-shock)	Standard deviation of the return on assets in the pre-shock period by branch	%; branch
SdvRoA (post-shock)	Standard deviation of the return on assets in the post-shock period by branch	%; branch
CorrRoA	Correlation in the returns on assets between the branch and its banking conglomerate	%; branch

Notes: This table provides a description of the variables being used for the empirical analysis. The data source is the ESTBAN database and the Call Reports from the Banco Central do Brasil. Data on local iron ore revenues per municipality are from the Ministério de Minas e Energia.

Table A4: Additional control variables - part two

Dep. Var.: Loan Growth Rate	**I**	**II**	**III**	**IV**
NWKEP x Post	0.373**	0.504***	0.409***	0.372***
	(0.136)	(0.144)	(0.142)	(0.121)
Controls included...	YES	YES	YES	YES
BR: Return on Assets	-0.115			
	(0.0985)			
HQ: Return on Assets	-0.0362*			
	(0.0208)			
BR: Loan Loss Provision to Total Loans		0.993**		
		(0.437)		
HQ: Loan Loss Provision to Total Loans		-0.448**		
		(0.164)		
HQ: Portfolio Risk Profile			-3.634*	
			(2.019)	
HQ: Administrative Costs to Total Assets				-3.935
				(2.829)
Municipality x Month FE	YES	YES	YES	YES
Branch FE	YES	YES	YES	YES
Observations	27,041	27,097	27,097	27,097
R-squared	0.398	0.410	0.402	0.401

Notes: This table reports the results of additional robustness tests of the baseline specification for the second stage by adding further additional control variables. These variables are the return on assets, loan loss provisions to total loans, the portfolio risk profile measure and the administrative costs to total assets. The dependent variable is the change in log outstanding loans of bank i in municipality m in month t. To identify the increase in loan growth in the non-affected region, all affected municipalities and their neighboring municipalities are excluded. Thus, the estimation sample contains all municipalities that are not directly affected in federal units (UFs) with mine presence in Brazil (Minas Gerais, Mato Grosso do Sul and Pará) from 2004m3 to 2006m3. The variable of interest is the interaction of the branch network exposure (NWKEP) of the banking network and the Post dummy for the post-shock period. This dummy variable is equal to one for all month after 2005m2. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. Since all control variables are based on balance sheet items, they are lagged by one month. Every specification contains municipality-time fixed effects and branch fixed effects. Neighboring municipalities of affected municipalities are excluded to account for potential spill-over effects. Standard errors are clustered at the headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table A5: Robustness - Standard Error Clustering

Cluster	NWKEP x Post
branch	0.404***
	(0.0875)
branch & date	0.404**
	(0.148)
branch x date	0.404***
	(0.0659)
HQ & date	0.404**
	(0.152)
HQ x date	0.404***
	(0.117)
microregion	0.404***
	(0.0747)
microregion & date	0.404**
	(0.145)
microregion x date	0.404***
	(0.0632)
mesoregion	0.404***
	(0.0764)
mesoregion & date	0.404***
	(0.140)
mesoregion x date	0.404***
	(0.0750)

Notes: This table summarizes addition sensitivity analysis of the baseline results of the second part of the empirical analysis. The estimation procedure follows exactly the specification III of Table 5 while different clustering of robust standard errors are employed. In the first column the set of standard errors employed is defined and the second column reports the parameter values of the interaction between the network exposure variable NWKEP and the Post dummy. "HQ" is the abbreviation for headquarter. The corresponding standard errors are depicted in parentheses and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

Table A6: Robustness - Horse Race Championship

	Dep. Var.: Loan Growth Rate
Additional Interaction included:	**NWKEP x Post:**
BR: ln(total assets) x Post	0.309**
	(0.137)
BR: Deposits to Total Asset Ratio x Post	0.431***
	(0.150)
BR: Liquid Assets to Total Asset Ratio x Post	0.366**
	(0.129)
BR: C&I Loan to Asset Ratio x Post	0.483***
	(0.149)
BR: Consumer Loan to Asset Ratio x Post	0.410**
	(0.147)
BR: Mortgage to Asset Ratio x Post	0.408***
	(0.137)
BR: Loan to Deposit Ratio x Post	0.516**
	(0.189)
BR: Return on assets	0.425***
	(0.134)
BR: Loan Loss Provision to Total Loans	0.438**
	(0.187)
HQ: Returns on assets	0.369**
	(0.144)
HQ: Loan Loss Provision to Total Loans	0.332**
	(0.133)
HQ: Administrative Costs to Total Assets	0.385***
	(0.125)

Notes: This table summarizes the results of further sensitivity analysis of the second stage. The estimation specification is identical to the baseline estimation (Table 5 column III) with the exception that further interactions are added to the model. Each row of the second column reports the parameter and statistical significance of the main variable of interest which is the interaction between the network exposure variable and the event dummy. All constitutive terms of the interactions are included. The abbreviations BR: and HQ: denote whether a variable is related to the individual branch or its headquarter, respectively. The first column Every specification contains municipality-time fixed effects and branch fixed effects. Standard errors are clustered at the headquarter level and ***, **, and * denote the 1%, 5% and 10% level of significance, respectively.

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