Spatial Dutch Disease and the Financial Propagation of Commodity Booms

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This draft: March 2026

PRELIMINARY DRAFT. DO NOT CIRCULATE.

Abstract

We study how multi-branch banks transmit Dutch disease across regions following a natural resource boom. We propose a mechanism in which a commodity boom increases deposits at banks with presence in resource-producing regions, enabling these banks to expand lending in both resource and non-resource regions. This cross-regional channeling of funds relaxes financial constraints in non-resource regions, generating localized Dutch disease even in areas without direct commodity exposure. Using detailed bank-firm-loan microdata from Peru, a small open economy that experienced a mining boom in the 2000s, we document that banks more exposed to mining receive greater deposits and expand lending across all regions, with credit growth leaning toward the non-tradable sector. Firms connected to the mining boom through their banks increase hiring, particularly in non-tradables. We then build a spatial model with multi-branch banks to quantify the aggregate effects of this mechanism. Our results indicate that the banking system plays an important role in the spatial propagation of Dutch disease, suggesting that managing resource booms requires attention to financial regulation.

Keywords: Regional Dutch disease, spatial bank transmission channel, commodity booms
JEL codes: F41, G21, R11

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1 Introduction

There is a long debate about the effects of natural resources on the economy (Corden and Neary 1982). The traditional result of a boom in natural resources, be it in quantities or in prices, is the Dutch disease, whereby commodity booms reallocate labor from tradables to non-tradables in resource regions. While the study of the Dutch disease has been mostly focused on its aggregate economy-wide effects, there is a recent interest on studying whether Dutch disease could also arise at the local level (Allcott and Keniston 2018; Aragón and Rud 2013; Benguria, Saffie, and Urzua 2023). These regional analyses ignore the financial system, although banks do operate across regions, with their lending decisions channeling funds from natural resource regions to non-natural resource regions. This raises a natural question: does the banking system propagate Dutch disease beyond resource regions, and what kind of growth does it generate?

In this paper, we study how multi-branch banks transmit the Dutch disease across regions after a natural resource boom. More specifically, we propose a propagation mechanism that goes from natural resource booms to non-resource regions via the domestic banking system. After a natural resource boom, Dutch disease arises in these resource-rich regions: local wages rise, the tradable sector shrinks, and the non-tradable sector expands. At the same time, banks receive more deposits in these regions where natural resource-related activities take place. This prompts banks to expand their loan supply to firms locally. However, because some banks also have branches in other regions, loan supply also expands in places not directly exposed to the natural resource boom. Then, this channeling of funds relaxes financial constraints and increases income in non-resource regions, which is then followed by Dutch disease.

We first show the existence of this propagation mechanism empirically, and then we proceed to analyze its aggregate effects with a theoretical model. In the empirical part, we use data from Peru, a small open economy (SOE) that experienced a mining price boom in the 2000s. Importantly, this country shows significant regional heterogeneity when it comes to exposure to mining activity. Only some regions were directly exposed to the mining boom, but Dutch disease arose even in non-exposed regions during this episode. As we will discuss later, our evidence shows this is partially due to banks reallocating funds from regions exposed to the boom to non-exposed regions.

We document several empirical results using detailed matched bank-firm-loan microdata from Peru. We exploit the heterogeneity in the banking system, where banks have branches located in mining and non-mining regions. Thus, different banks have different exposures to the mining boom. We first find that banks more exposed to the mining sector receive more deposits during the mining boom. Then, more exposed banks increase their lending in both mining and non-mining regions, providing support to the cross-border bank reallocation mechanism. We also find that

lending growth disproportionately shifts towards the non-tradable sector. Lastly, to show there are real effects at the end of the chain, we find that firms that are exposed to mining through their banks increase their hiring, with an emphasis in non-tradable sector firms. Therefore, we see that this mechanism brings a loan and labor reallocation across sectors, even in non-mining regions.

Our results indicate that banks have an important role in the spatial propagation of the Dutch disease beyond resource-producing regions. This is especially important when it comes to managing resource booms, as it is not a matter of fiscal policy anymore (i.e., taxes, transfers), but also a financial regulation issue. Additionally, it is important to point out that the mechanism we outline in this paper is not specific to small open economies. This mechanism holds in any country where natural resource activities are regionally concentrated and there is a banking system that operates branches across regions. Regional Dutch disease may show up beyond SOEs.[1] What we show here is that multi-branch banks transmit sectoral reallocation to regions with no direct commodity exposure. In our argument, the main point is the internal capital market of the banking system in countries with regionally concentrated resource booms, which operates regardless of the size of the economy.

We then provide a model to interpret these patterns. In our setting, commodity boom raises deposits at exposed branches, lowers bank funding costs, and reduces loan rates in both mining and non-mining regions through internal fund reallocation. Because non-tradable production is more credit-intensive than tradable production, the banking response amplifies the standard spending effects of a commodity boom, and helps explain why Dutch-disease-type reallocation can arise even where mining income is absent.

Literature review. Our results relate to different literatures. First, we relate to the wider Dutch disease or resource curse literature (Corden and Neary 1982; van der Ploeg 2011), as well as to the more recent efforts to see its regional effects within countries (Allcott & Keniston, 2018; Benguria, Saffie, & Urzua, 2023). We contribute to this literature by considering the banks as an additional vector of transmission for the Dutch disease across regions.

Second, our paper relates to the wider literature that studies the effects of terms of trade and commodity price fluctuations in SOEs (Kose, 2002; Mendoza, 1995; Salter, 1959; Schmitt-Grohé & Uribe, 2018; Swan, 1963). By providing evidence of a new financial propagation mechanism of commodity shocks in SOEs that works through the banking system, we also connect to papers that study how financial frictions interact with commodity shocks (Agarwal, Duttagupta, & Presbitero, 2020; Drechsel & Tenreyro, 2018; Shousha, 2016).

Third, we connect with the literature that uses detailed bank and loan microdata to study how

[1] See Sachs and Warner (2001) and van der Ploeg (2011) for a cross-country discussion on the natural resource curse. See Allcott and Keniston (2018), Michaels (2011), and Papyrakis and Gerlagh (2007) for discussion on the regional effects of natural resource booms in the US.

banks propagate shocks across firms, sectors, and geographies (Agarwal, Duttagupta, & Presbitero, 2020; Bustos, Garber, & Ponticelli, 2020; Federico, Hassan, & Rappoport, 2023; Gilje, Loutskina, & Strahan, 2016; Iyer et al., 2014; Paravisini, 2008; Peek & Rosengren, 2005; Schnabl, 2012). Here, our contribution lies in finding that banks do not just reallocate liquidity across regions, but that they also export Dutch disease across such regions.

Section 2 provides details on the global mining price boom and the Peruvian economy. Section 3 introduces a simple model from which we derive testable predictions. Section 4 introduces the data. Section 5 presents the empirical evidence. In Section 6 we introduce the theoretical framework. Finally, Section 7 concludes.

2 Setting

From the early 2000s to the mid-2010s, the world experienced a mining commodity price boom, mainly driven by a demand expansion from China (Fernández, Schmitt-Grohé, & Uribe, 2023). This boom represented a substantial shock for those SOEs where the mining commodity sector plays an important role. In this paper, we focus on Peru, a SOE with significant mining commodity production.

Peru is an ideal setting for examining the financial propagation mechanism of commodity booms in SOEs. First, Peru contains several different geographic regions that produce a diverse basket of mining commodities.[2] Thus, we observe variation across different geographic regions and minerals. Second, Peru holds a modest global market share for these commodities, so it is reasonable to assume it is a price taker in these markets.[3] Lastly, in this period, Peru boasted a financial sector with diverse banks that had heterogeneous geographic presence.[4].

Global mining price boom and the Peruvian economy. In Panel (a) of Figure 1 we report the evolution of the weighted mining commodity price index for the minerals specific to Peru, as well as the mining exports.[5] We see mining prices more than tripled between 2003 and 2011, with exports tracking closely. Moreover, Panel (b) of Figure 1 shows mining is geographically concentrated in a few southern and central highland regions, providing cross-regional variation in exposure.

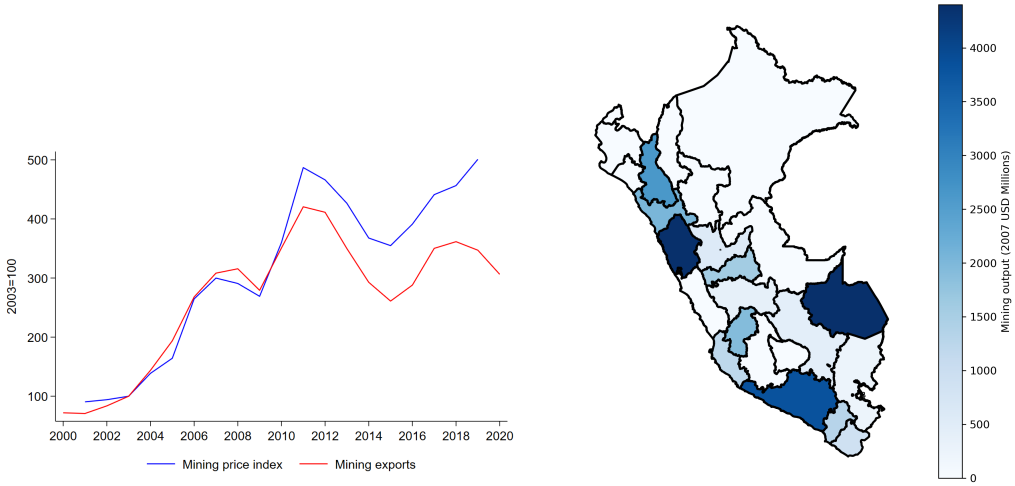
[2]Peru mainly produces copper, gold, iron, lead, silver, tin, and zinc. The country also produces other minerals like aluminum, molybdenum, nickel, or platinum, although in smaller quantities. Appendix Figure A.1 shows the export heterogeneity across different minerals.

[3]We present the world output shares for Peru in 2011, one of the peak years of the mining commodity price boom, in Appendix Table A.1.

[4]We provide more detail on banks in Section 4.

[5]The minerals included are copper, iron, gold, lead, molybdenum, silver, tin, and zinc.

Figure 1: Mining sector and heterogeneous regional exposure to mining



(a) Mining prices and exports (b) Heterogeneous mining exposure, 2011

Note: Mining prices and exports series are expressed in domestic currency and deflated using the GDP deflator, unless otherwise noted.

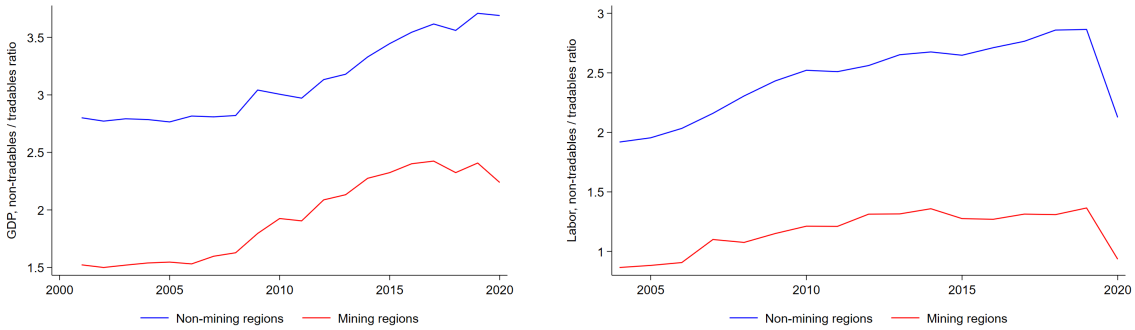
In the Peruvian context, mining income reaches local households mainly through the canon minero: a fiscal transfer that redistributes half of mining corporate tax to subnational governments in mining-producing regions. These funds finance public investment and local spending. Crucially, the canon is allocated by production location, so it flows exclusively to mining regions and cannot directly account for the economic changes in non-mining regions that we document below (Aragón and Rud 2013; Daza 2024; Murillo and Sardon 2024).

Furthermore, we argue that local income does not significantly increase because of labor and intermediate linkages, as the mining sector is weakly linked to the rest of the economy. For instance, in 2007, it only employed 1 percent of the total labor force, while it only demanded 2 percent of the domestically supplied goods and services.

GDP and labor increased relatively more in the non-tradable sector. Figure 2 shows the evolution of the non-tradables to tradables ratio in GDP and labor. First, we see that this ratio rises in mining regions after the mining price boom, which is the telltale sign of Dutch disease occurring in these places.

Surprisingly, we also see that non-mining regions experience sectoral reallocation despite receiving no direct mining income, suggesting a transmission channel beyond local spending effects. This is the central puzzle: non-mining regions, which receive no direct mining income, nonetheless exhibit sectoral reallocation. In what follows, we argue that the candidate explanation is the banking channel, which implies that banks collect deposits from mining regions and allocate credit

Figure 2: GDP and labor by region and sector



(a) GDP by region and sector (b) Labor by region and sector

Note:Mining regions are those whose total mining transfers places above the median. Mining sector excluded from calculations.

across the economy, transmitting the Dutch disease to regions with no mining exposure.

Deposits increased relatively more in mining regions. Panel (a) of Figure 3 shows that the deposits ratio between mining regions and non-mining regions grew during the boom, meaning that deposits in mining regions grew faster than in the non-mining parts of the country.

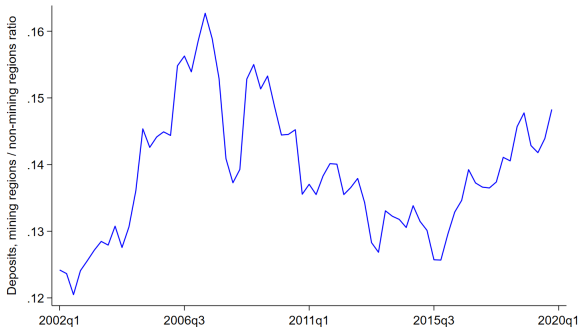
Moreover, we see that the ratio tracks the behavior of the mining commodity prices from Panel (a) of Figure 1. This suggests that there is an income effect at work: mining regions receive a higher income from the boom, part of which ends up as deposits in local bank branches.[6] More importantly, just as the boom is an income shock for mining regions, here we see the boom also represents a positive liquidity shock for banks with branches located in mining regions.

Loans increased relatively more in the non-tradable sector. Panel (b) of Figure 3 shows the evolution of loans by region, while Panel (c) of Figure 3 presents the evolution of the non-tradables to tradables firm loan ratio. In mining regions, loans grow, accompanied by a sectoral reallocation. This is consistent with the Dutch disease prediction: as the mining boom shifts economic activity toward non-tradables, loan demand follows.

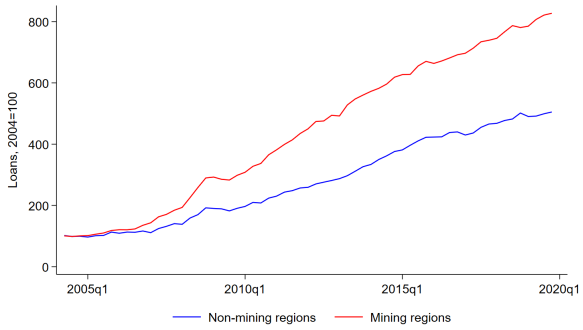
The interesting results arise once we see what occurs in non-mining regions. First, despite the fact that deposits increased relatively more in mining regions, the mining price shock propagates to lending in regions not directly exposed to mining. In a result similar to that of Gilje, Loutskina, and Strahan (2016), this suggests that banks are reallocating part of the liquidity collected in mining regions to expand lending in non-mining regions.

[6]One caveat is that regional deposit aggregates reflect the location of bank branches rather than the economic origin of income. Mining firms headquartered in non-mining regions book deposits outside mining areas, which attenuates the measured difference. The true concentration of mining-related deposits in exposed branches is likely larger than the figure suggests.

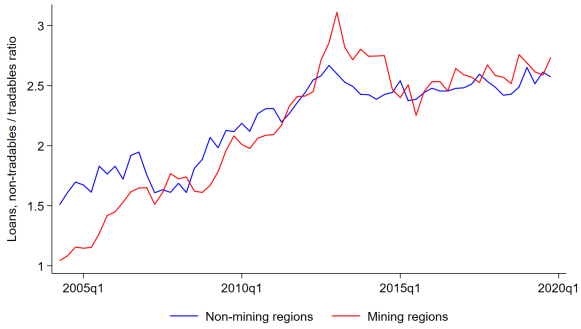
Figure 3: Deposits and loans by region



(a) Deposits by region



(b) Loans by region



(c) Loans by region and sector

Note:Mining regions are those whose total mining transfers places above the median. Mining sector excluded from loan calculations.

Second, sectoral reallocation in credit is also present in regions with no direct mining activity. This suggests that banks play a role in the rise of the Dutch disease in non-mining regions.

Discussion. The facts stated here suggest that the banking system may play a quantitatively significant role in the spatial propagation of the Dutch disease beyond resource-producing regions. If so, financial regulation, and not just fiscal policy, becomes a relevant tool for managing commodity booms.

Moreover, while we use this SOE setting due to the empirical convenience of the plausibly exogenous commodity prices, we argue that this mechanism is not specific to SOEs. Any country with geographically concentrated commodity production and a banking system that operates across regions faces the same channel. What our setting highlights is that multi-branch banks not only reallocate liquidity (Gilje 2019; Gilje, Loutskina, and Strahan 2016), but in doing so they transmit sectoral reallocation (i.e., Dutch disease) to regions with no direct commodity exposure. Here, the key ingredient is the internal capital market of the banking system, which operates identically in

countries with regionally concentrated resource booms, regardless of the size of their economies.

3 Predictions

In this section, we provide a simple analytical framework that will guide our empirical analysis in Section 5. For this, we start from the structural model of Section 6, but modify it with a series of simplifying assumptions. We leave the technical details for Appendix B.

We have a SOE with two geographic regions and banks. There is a mining region M and a non-mining region NM, with each region being indexed by i. We also consider a rest of the world. The mining region has an endowment of minerals $M_M > 0$ whose price p_M is exogenously determined in the world market, while the non-mining region has no mineral endowment. The model has a single period with two stages. In the first stage, households deposit their income in banks and banks allocate funds across branches. In the second stage, firms borrow from banks, produce, and pay wages. Thus, deposit quantities are determined before lending decisions, so that credit conditions in the second stage are shaped by the deposit inflows of the first stage.

Each region has a population N_i of households, with a total regional income Y_i. Households supply labor inelastically, receive wage income, and allocate expenditure across a locally produced non-tradable good NT and a freely traded homogeneous tradable good T with Cobb-Douglas preferences and non-tradable expenditure share α. Moreover, households in the mining region also receive a per-capita mining dividend $T_M^M = p_M M_M / N_M$ that goes into their income. Here, we assume that household deposit their income in the first stage and withdraw them in the second stage. Moreover, deposit returns are small relative to labor and mining income, so that total expenditure E_i approximately equals total income ($E_i \approx Y_i$). Labor is immobile across regions but perfectly mobile across sectors within each region.

On the firm side, tradable and non-tradable goods are produced under constant returns to scale and perfect competition using only labor. However, firms in each sector must finance a fraction ϕ^s of their wage bill through bank loans, with $\phi^{NT} \geq \phi^T$, reflecting the greater dependence of non-tradable producers (construction, local retail, personal services) on local bank lending.[7] The tradable good is traded costlessly both across domestic regions and with the rest of the world. Since the tradable price p^T is pinned by the rest of the world, the tradable zero-profit condition $p^T = \mu_i^T w_i / A_i^T$ determines wages in each region, where $\mu_i^T = 1 + \phi^T (R_i^L - 1)$ is the credit cost wedge and R_i^L is the regional loan rate.

[7] In Appendix Figure A.2, we use the 2007 economic census data to confirm this assumption. We construct the external finance dependence statistic (Rajan & Zingales, 1998) to show that the non-tradable sector depends more on external finance (i.e., bank loans) than the tradable sector.

The banking sector consists of multi-region banks, indexed by b, each operating branches in both regions. Households deposit their income at local branches with exogenous shares ω_{ib}, so branch-level deposits $D_{ib} = \omega_{ib} Y_i$ scale one-for-one with regional income. The deposit rate at each branch is a decreasing function of deposits in that branch, $r^D_{ib} = r^D(D_{ib})$ with $r^{D'} < 0$, capturing the reduced-form implication that branches receiving larger inflows need not compete as aggressively for funding.

In an adaptation of Eaton and Kortum (2002), banks can route funds internally across regions at an iceberg routing cost $\theta \geq 1$, so the unit cost of sourcing funds from region m for lending in region i is $\kappa_{mib} = (1 + r^D(D_{mb}))\theta_{mi}$, where $\theta_{mi} = 1$ if $m = i$ and θ otherwise. Each bank's funding capacity for lending in region i is a cost index $\Phi_{ib} = \sum_m \kappa_{mib}^{-\rho}$, where $\rho > 0$ governs the elasticity of substitution across funding sources, and the bank-level loan rate is $R^L_{ib} = \Gamma \Phi_{ib}^{-1/\rho}$. The regional loan rate aggregates across banks via a CES structure. Under this setting, a mining boom raises deposits at exposed branches, lowers their cost of funds, expands funding capacity, reduces loan rates, and compresses credit cost wedges, with non-tradable wedges falling by more than tradable wedges because $\phi^{NT} > \phi^T$.

In what follows, we present the main predictions of this simplified model.[8] More specifically, we show how a mining price boom first generates Dutch disease in the mining region. Then, we show how this shock propagates through banks to the non-mining region. Lastly, we find that the non-mining region also suffers from Dutch disease.

3.1 Preamble: Dutch disease in the mining region

Proposition 1 (Dutch disease in the mining region)**.** *A mining boom increases non-tradable employment and decreases tradable employment in the mining region. This occurs through three channels: a spending channel, a credit amplification channel, and a wage channel.*

The premise of the propagation mechanism is that a mining price boom ($\Delta p_M > 0$) increases non-tradable employment n^{NT}_M and decreases tradable employment n^T_M in the mining region. There are three channels at work. First, the spending channel says that higher mining income directly raises demand for non-tradables. Second, there is a credit amplification channel, by which the mining boom raises deposits and expands loans in local bank branches at the mining region. Given that non-tradables require more financing that tradables, the former benefit more from the loan expansion. Third, the mining region faces higher wages, which reduce labor demand in both tradables and non-tradables.

[8] We interchangeably use the term "mining price boom" and, more broadly, "mining boom".

The first two channels (spending, and credit amplification) increase non-tradable employment. In our model, the wage adjustment partially offsets but does not reverse the result. We find that

$$\frac{dn_M^{NT}}{dp_M} > 0, \qquad \frac{dn_M^{T}}{dp_M} = -\frac{dn_M^{NT}}{dp_M} < 0. \tag{1}$$

Equation 1 shows the Dutch disease premise of our model. Labor reallocates from tradables to non-tradables. Moreover, the SOE assumption is essential: since p^T is exogenous, tradable producers cannot raise output prices to compete for labor.

3.2 Prediction 1: More exposed banks receive more deposits

Prediction 1 (More exposed banks receive more deposits)**.** *A mining boom increases deposits at bank b.*

Differentiate total deposits D_b with respect to p_M, holding wages fixed (partial equilibrium) to obtain

$$\left.\frac{\partial D_b}{\partial p_M}\right|_w = \omega_{Mb} \left.\frac{\partial Y_M}{\partial p_M}\right|_w = \omega_{Mb} M_M > 0. \tag{2}$$

Since the expression 2 above is strictly increasing in ω_{Mb}, banks with a larger branch share in the mining region absorb a proportionally larger share of the mining income windfall. In general equilibrium, wages adjust (as shown in subsequent predictions), which generates an additional deposit response through income effects. However, the partial equilibrium result establishes the key cross-sectional prediction: controlling for equilibrium wage effects, the heterogeneous deposit response across banks is driven by ω_{Mb}.

Bank exposure ω_{Mb}. More exposed banks receive larger deposit inflows from M. The cross-sectional variation in deposit responses is fully characterized by relative branch shares: for any two banks b and b',

$$\frac{\partial D_b / \partial p_M}{\partial D_{b'} / \partial p_M} = \frac{\omega_{Mb}}{\omega_{Mb'}}.$$

Then, ω_{Mb} governs the strength of this prediction.

3.3 Prediction 2: More exposed banks expand lending in both regions

Prediction 2 (More exposed banks expand lending in both regions)**.** *A mining boom increases bank b's funding capacity and lowers its loan rate in both the mining and non-mining regions. The effects are proportional to* ω_{Mb}*.*

Bank b's funding capacity Φ_{ib} for lending in each region is

$$\Phi_{Mb} = \big(1 + r^D(D_{Mb})\big)^{-\rho} + \big[\big(1 + r^D(D_{NMb})\big)\theta\big]^{-\rho}, \tag{3}$$

$$\Phi_{NMb} = \big(1 + r^D(D_{NMb})\big)^{-\rho} + \big[\big(1 + r^D(D_{Mb})\big)\theta\big]^{-\rho}. \tag{4}$$

From equations 3 and 4, a higher funding capacity shows a larger ease for the banks to source their funds that go into lending. Since $r^{D'} < 0$, Φ_{ib} is strictly increasing in D_{ib} (lower local sourcing cost) and strictly increasing in D_{jb} (lower cross-region sourcing cost).

From Prediction 1, we have that banks in the mining region increase their deposits. Higher funding translates into these banks charging lower interest rate R^L_{ib} in both regions. Thus, equation 5 shows their lending market share s_{ib} also rises in both regions. Moreover, the magnitude of this effect is increasing in ω_{Mb}.

$$\left.\frac{\partial s_{ib}}{\partial p_M}\right|_w > 0 \quad \text{for } i \in \{M, NM\}, \qquad \text{increasing in } \omega_{Mb}. \tag{5}$$

Routing ease $\theta^{-\rho}$**.** The cross-region passthrough of the funding-capacity response is

$$\frac{\partial \Phi_{NMb}/\partial p_M}{\partial \Phi_{Mb}/\partial p_M} = \theta^{-\rho}.$$

For every unit of funding-capacity gain that the shock creates for lending in M, only $\theta^{-\rho}$ units of funding-capacity gain reach lending in NM. So it is the passthrough factor: what fraction of the local credit improvement reaches the other region.

Two parameters interact here: θ governs the unit cost of moving funds across regions, while ρ governs how aggressively the bank's cost index penalizes expensive sources. Both lower θ (easier routing) and lower ρ (less substitutability, higher dispersion, bank is more willing to draw on expensive cross-region sources) increase cross-region transmission. Then, a high ρ is an incentive for banks to keep funds local, while funds pool across regions with a low ρ.

3.4 Prediction 3: Lending composition shifts towards non-tradables

Prediction 3 (Lending composition shifts towards non-tradables)**.** *A mining boom raises the non-tradable share of lending in both the mining and non-mining regions.*

Define λ_i^{NT} as the non-tradable loan share in each region, so

$$\lambda_i^{NT} = \frac{\phi^{NT} n_i^{NT}}{\phi^T (N_i - n_i^{NT}) + \phi^{NT} n_i^{NT}}.$$

We have that λ_i^{NT} is strictly increasing in n_i^{NT}, so

$$\frac{d\lambda_i^{NT}}{dp_M} = \frac{\partial \lambda_i^{NT}}{\partial n_i^{NT}} \frac{dn_i^{NT}}{dp_M} > 0, \qquad i \in \{M, NM\}. \tag{6}$$

Equation 6 shows that loans flow towards non-tradables in both regions. Two forces tilt the loan portfolio toward non-tradables. First, the employment reallocation effect: Dutch disease shifts labor from tradables to non-tradables (Proposition 1 and Proposition 4), mechanically increasing non-tradable loan demand since $L_i^{NT} = \phi^{NT} w_i n_i^{NT}$. Second, the differential credit intensity effect: because $\phi^{NT} > \phi^T$, each worker who moves from tradables to non-tradables generates more loan demand in her new sector than she shed in her old one. The two forces reinforce each other: the mining boom both reallocates workers toward non-tradables and the reallocated workers demand disproportionately more credit.

Credit dependence differential $\phi^{NT} - \phi^T$. With $\phi^{NT} > \phi^T$, a fall in R_i^L reduces μ_i^{NT} by more than μ_i^T, so that

$$\frac{\partial \mu_i^{NT}}{\partial R_i^L} - \frac{\partial \mu_i^T}{\partial R_i^L} = \phi^{NT} - \phi^T > 0. \tag{7}$$

Equation 7 shows that when R_i^L falls (due to the mining-driven deposit inflow), non-tradable production costs decline relative to tradable production costs. This creates a direct cost advantage for non-tradables beyond the spending channel. Since non-tradable prices fall relative to tradables (holding wages fixed), non-tradable output and employment expand by more than they would under common ϕ, further amplifying the loan-share tilt. When the gap is zero ($\phi^{NT} = \phi^T$), there is no relative cost distortion and the differential cost channel vanishes entirely.

3.5 Prediction 4: Banks propagate Dutch disease to the non-mining region

Prediction 4 (Banks propagate Dutch disease to the non-mining region)**.** *A mining boom generates Dutch disease in the non-mining region through the banking channel. The mechanism operates through exposed banks whose mining-region deposit inflows lower funding costs for lending in the non-mining region.*

Banks exposed to the mining boom in the mining region expand their lending in the non-mining region too. This eases financing costs in the non-mining region and increases its income. Then, labor reallocates from tradables to non-tradables.

$$\frac{dn_{NM}^{NT}}{dp_M} = -\frac{\alpha N_{NM}}{(\mu_{NM}^{NT})^2}\phi^{NT}\underbrace{\frac{\partial R_{NM}^{L}}{\partial p_M}}_{<0} > 0, \tag{8}$$

which is strictly increasing in ϕ^{NT}.

Non-tradable credit dependence ϕ^{NT}. This is the direct amplifier of propagation into real outcomes. Equation 8 shows the employment response is proportional to ϕ^{NT}. Higher non-tradable credit dependence amplifies the propagation of Dutch disease, as it means a given decline in R_{NM}^{L} translates into a larger reduction in μ_{NM}^{NT} and a larger increase in non-tradable employment.

3.6 Discussion: Why propagation operates through banks, not goods trade

A natural question is whether the mining boom could propagate to the non-mining region through goods trade rather than through the banking sector. In the model, it cannot, and the reason is the small open economy assumption. In a closed economy, the trade channel would operate as follows:

$$p_M \uparrow \Rightarrow \text{excess demand for } T \text{ in } M \Rightarrow p^T \uparrow \Rightarrow w_{NM} \uparrow \Rightarrow n_{NM}^{NT} \uparrow, n_{NM}^{T} \downarrow .$$

The SOE assumption shuts this channel down entirely. With p^T pinned by the rest of the world, any excess demand for tradables in the mining region is met by imports at the world price, and any excess supply in the non-mining region is exported at the world price. The tradable price cannot move in response to domestic shocks, so the chain breaks at the second link and instead we have:

$$p_M \uparrow \Rightarrow \text{excess demand for } T \text{ in } M \Rightarrow \text{imports from ROW} \Rightarrow p^T \text{ unchanged} \not\Rightarrow NM.$$

Now, with the trade channel closed, consider what paths remain from p_M to outcomes in NM. Wages in the non-mining region are $w_{NM} = p^T A^T_{NM}/\mu^T_{NM}$. Since p^T and A^T_{NM} are exogenous, wages can only change if the tradable cost wedge μ^T_{NM} changes, which requires a change in R^L_{NM}. Labor is immobile across regions, so there is no migration channel. Mining income accrues only to mining-region households ($T^M_{NM} = 0$), so there is no direct income transfer. The banking channel, through which deposit inflows in M lower funding costs for lending in NM, is therefore both necessary and sufficient for propagation.

This has a useful empirical implication. If propagation operated through goods trade, it would affect all firms in NM equally through a common price shift. The fact that propagation operates through banks means it generates cross-sectional variation: firms borrowing from more exposed banks receive larger credit shocks, which is the variation exploited in our empirical strategy.

4 Data

For our empirical analysis, we combine several data sources that result in a matched bank-sector-region-loan dataset for the Peruvian economy from 2005 to 2019 with quarterly frequency. As our focus is on the production side, we consider firm loans only. The total Peruvian financial system is composed of banks and other non-bank institutions (*cajas municipales*, *cajas rurales*, and *financieras*), which offer financial services but at a smaller scale than banks. Here, we broadly use the term banks to encompass all these financial institutions. We report summary statistics for the loans and banks in Appendix Table 1.

To construct our dataset, first, we exploit the Peruvian credit registry. This rich dataset provides end-of-quarter loan-level information on the lending institution, the borrowing firm, and the outstanding loan amount. We aggregate the information by bank, sector, and region. We have loan information for the 25 geographic regions of Peru and 55 productive sectors (2-digit ISIC Rev. 3.1). Moreover, we exclude the mining sector to isolate the indirect effects of commodity price shocks on non-mining lending. Interestingly, as Table 1 shows, there is significant heterogeneity in the geographic footprint of banks. Some banks have a stronger presence in mining regions than others.

Second, we retrieve end-of-quarter bank balance sheet data from the Peruvian banking regulator (SBS). We have information for 30 banks. As usual in empirical finance literature, we treat merged financial institutions as single entities ex-ante and combine their balance sheets.

Third, to study the effects of financial propagation on the real economy, we use firm employment information. This includes monthly information on the number of workers reported by all Peruvian firms with a tax ID.

Table 1: Bank statistics

	Mean	Std. dev.	Min.	Max.
Assets (bill. USD)	2.83	6.67	0.00	41.89
Deposits (bill. USD)	1.81	4.13	0.00	26.28
Firm loans (bill. USD)	0.89	2.03	0.00	11.42
Number of regions	14.14	7.95	2	25
Number of mining regions	7.28	4.07	1	12

Note: Table shows information for the 30 banks considered in the analysis. For those banks that merged during this period, we consider them one entity and add their accounts.

Fourth, we retrieve international commodity prices from the Peruvian Central Bank database. We have information on copper, iron, gold, lead, molybdenum, silver, tin, and zinc prices. We then obtain the physical mining output from the Ministry of Energy and Mines (MINEM) and construct a region-specific mining commodity price index with weights defined by the relative mining output within each region. Under the SOE assumption, we consider these prices to be exogenous to the Peruvian economy. All commodity prices are deflated by the US deflator and normalized taking 2007 as the base year. All the other variables are expressed in Peruvian soles (PEN) and, similarly, deflated by the Peruvian price index to the base year 2007.

5 Empirical evidence

The goal of this section is to empirically test the four predictions from Section 3. By doing so, we also demonstrate the existence of the financial propagation mechanism that generates geographic spillovers of the mining commodity boom through the banking system.

Consistent with our previous notation, for this section, we define the subscripts b for lending institutions (thereafter, simply *banks*), i for geographic region, s for economic sector, t for time period, and f for firm.

5.1 Deposits

We first establish that banks exposed to mining activity experienced an increase in their deposit growth, by following a strategy in the spirit of Gilje, Loutskina, and Strahan (2016). We rely on the exogeneity assumption for mining commodity prices in a SOE and exploit the heterogeneous regional exposure to such prices across banks to estimate

$$\Delta \ln (D_{bt}) = \beta Z_{bt} + \gamma_b + \lambda_t + \Gamma X_{b,t-1} + \epsilon_{bt}, \tag{9}$$

where D_{bt} are total deposits for bank b in period t, γ_b is a bank fixed effect, λ_t is a period fixed effect, $X_{b,t-1}$ is a vector of time-varying bank control variables, and Z_{bt} is a liquidity shock defined as

$$Z_{bt} = \sum_i share_{ib,t_0} \times windfall_{it}. \tag{10}$$

The liquidity shock Z_{jt} captures the heterogeneous exposure to the mining commodity price boom of banks across regions. In particular, $share_{ib,t_0}$ is the share of deposits of bank b in region i at the initial period t_0, which corresponds to the average share between the years 2002 and 2004. We measure $windfall_{it}$ as the variation of international mining prices, scaled by lagged mineral production, in the spirit of Garmaise and Natividad (2021)[9]. Finally, we standardize the instrument such that its mean is zero and its standard deviation is one.

Our baseline regression includes period and bank fixed effects, which control for time-varying aggregate shocks and unobservable time invariant bank preferences. We also include a vector of bank-level lagged controls, such as (log-)assets, non-performing loan ratio, liquidity ratio, deposit-assets ratio, administrative cost-assets ratio, and foreign debt exposure. As it is standard in the literature, we cluster standard errors at bank level.

We present the results in Table 2. We do find a significant, positive effect of the liquidity instrument on the growth rate of deposits. Given an average growth rate of deposits of 2.67 pp, our preferred specification (Column 2) delivers an estimator of 0.7 pp. That is, one additional standard deviation of the liquidity shock leads, on average, to an increment of deposit growth rate in around 26% of its mean. This result confirms Prediction 1: banks that are geographically exposed to mining regions register an increase in their deposits after a mining price shock.

The sizable effect is not driven by time-varying bank controls (Column 1), or by bank size (Columns 3 and 4). In particular, Columns 3 and 4 respectively show that the interaction with a dummy for the four largest Peruvian banks (the *Big Four*) and a dummy for large banks (banks with assets above the median in 2005) are statistically not significant. Moreover, in these specifications, the main coefficient remains stable.

[9]Specifically, it is defined as $windfall_{it} = \sum_{\forall m}(p_{m,t-1} - p_{m,t}) \times q_{m,t-1}$, where m is the index of all the minerals extracted in region i; p and q are respectively price and quantity. We use real prices (base year 2007) and winsorize $windfall_{it}$ at 0.5-99.5 level to mitigate the influence of outliers. In the Appendix, we show results are robust under no winsorization.

Table 2: Effect of Liquidity Shock (Bartik) on deposits

	(1) $\Delta \ln(Dep)$	(2) $\Delta \ln(Dep)$	(3) $\Delta \ln(Dep)$	(4) $\Delta \ln(Dep)$
Liquidity Shock	0.0102**	0.00728**	0.00723**	0.00776**
	(0.00480)	(0.00352)	(0.00348)	(0.00354)
Liquidity Shock × D(Big4)			0.00144	
			(0.00429)	
Liquidity Shock × D(LargeBank)				-0.00140
				(0.00516)
Bank Controls	No	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Y Mean	0.0267	0.0267	0.0267	0.0267
N	2204	2204	2204	2204
Adj-R^2	0.260	0.287	0.287	0.287

Note: Standard errors clustered at bank level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.2 Loans

We now turn to study if more exposed banks increased loans by reallocating liquidity across regions, and particularly to the non-tradable sector. We perform this analysis at two different levels. First, we use aggregate data at the bank-region-sector-period level.[10] Then, we use more granular data, which is defined at the bank-region-firm-period level.

Aggregate data. For this section, we take into account all *business loans* originated by a particular bank b in region i and sector s within period t. Define the following reduced-form regression

$$\Delta \ln (L_{ibst}) = \beta Z_{ibt} + \eta_{it} + \gamma_{st} + \mu_{is} + \alpha_b + \Gamma X_{b,t-1} + \epsilon_{ibst}, \tag{11}$$

where L_{ibst} are aggregate business loans in a bank-region-sector-period cell and Z_{ibt} is a leave-one-out version of the liquidity shock, $Z_{ibt} = \sum_{i' \neq i} share_{i'b,t_0} \times windfall_{i't}$, which excludes windfall shocks in region i to avoid mechanical demand correlation.[11] For similar reasons, we exclude

[10] As suggested by Gutierrez, Jaume, and Tobal (2023) the advantage of using aggregate data at geographic unit level is that we are less concerned with SUTVA violation due to local spillovers or input-output linkages.

[11] Following the suggestion by Borusyak, Hull, and Jaravel (2022), we re-normalize the instrumental variable shares such that they add up to one.

mining sectors from all our regression samples.

We consider an extensive set of fixed effects. η_{it} indicates region-time fixed effects that absorb demand shocks (Gilje, Loutskina, & Strahan, 2016; Khwaja & Mian, 2008). We also include sector-period fixed effect γ_{st} to absorb financial dependence or time-varying shocks that differentially affect sector, and region-sector fixed effect μ_{is} to absorb time-invariant unobservables such as region expertise or local comparative advantage in a specific industry. As in the previous section, we incorporate a bank fixed effect α_b and lagged bank-level controls $X_{b,t-1}$.

Table 3 presents the results. In Column 1, we find a statistically significant and positive effect of liquidity shocks on loan growth rate: one standard deviation of the shock leads to an increase in around 10% (=0.005 pp/0.05 pp) of the mean. This finding confirms Prediction 2. Thus, after a mining price shock, banks with larger geographic exposure to the mining sector increase their lending across all regions.

Next, we analyze whether there is a difference depending on the sector of the borrower. Column 2 suggests the effect is roughly twice as large for *non-tradable* sectors, compared to tradable sectors. Then, we empirically confirm Prediction 3. After the mining price shock, banks that are geographically exposed to the mining sector expand their lending favoring the non-tradable sector over the tradable sector.

We further explore other dimensions of heterogeneity. In Column 3, we introduce an interaction with using a dummy variable for large banks. We do not find evidence that our results are driven by bank size. In Column 4, we use an interaction with a dummy variable for mining regions. Interestingly, we find credit growth is slower in mining regions when compared to non-mining regions, suggesting again that liquidity *moves* across space.

Granular data. Our rich dataset allows us to further refine our results by using more granular data from the credit registry, from which we extract information of loans issued by banks b to firms f with headquarters located in region i and in period t.[12] With this, we seek to exploit the fact that individual firms are heterogeneously exposed to commodities through their banking relationships.

Consider the following firm level shift-share instrument $\mathbb{Z}_{ft}$, defined as

$$\mathbb{Z}_{f(i)t} = \sum_b share_{f(i)b,t-1} \times Z_{ibt}, \tag{12}$$

[12] We assume that firms obtain loans from bank branches located in the same region as their headquarters.

Table 3: Effect of Liquidity Shock (Bartik) on loans

	Baseline	Heterogeneity		
	(1)	(2)	(3)	(4)
	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$
Shock	0.00542**	0.00644***	0.00614***	0.00826***
	(0.00219)	(0.00233)	(0.00186)	(0.00270)
Shock × D(Tradable)		-0.00321***		
		(0.00101)		
Shock × D(LargeBank)			-0.00222	
			(0.00422)	
Shock × D(MinReg)				-0.00616*
				(0.00335)
Bank Controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Region-Time FE	Yes	Yes	Yes	Yes
Sector-Time FE	Yes	Yes	Yes	Yes
Sector-Region FE	Yes	Yes	Yes	Yes
Y Mean	0.0512	0.0512	0.0512	0.0512
N	459531	459531	459531	459531
Adj-R^2	0.0197	0.0197	0.0197	0.0197

Note: Standard errors clustered at bank level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

where $share_{fb,t-1}$ is the share of credit of firm f in bank b at time $t-1$, and Z_{ibt} is the liquidity shock at bank-region-time level we computed in the previous section. In the spirit of Alfaro, Garcia-Santana, and Moral-Benito (2021) and Manaresi and Pierri (2024), we posit the reduced form regression

$$\Delta \ln \left(L_{ft} \right) = \beta \mathbb{Z}_{f(i)t} + \alpha_f + \eta_{is(f)t} + \hat{\lambda}_{ft} + \epsilon_{ft}, \tag{13}$$

where L_{ft} indicates total outstanding loans of firm f in period t; α_f and $\eta_{is(f)t}$ are, respectively, fixed effect defined at firm and region-sector-time level. We also estimate and control for firm-level demand shocks $\hat{\lambda}_{it}$, as in Cingano, Manaresi, and Sette (2016).[13]

[13] As common in the literature, we focus on a sample of firms with multiple bank relationships (Khwaja & Mian, 2008), which allows to estimate the demand shock.

Table 4: Effect of Liquidity Shock (Bartik) on credit - Firm level

		Baseline		Tradable	Non-Trad.
	(1)	(2)	(3)	(4)	(5)
	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$
Liquidity Shock	0.00168**	0.00522**	0.00448***	0.00140	0.00503***
	(0.000720)	(0.00211)	(0.00171)	(0.00437)	(0.00186)
Sector-Region-Time FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Demand Shock	No	No	Yes	Yes	Yes
Full Sample	Yes	Yes	No	No	No
Only Large Firms	No	Yes	Yes	Yes	Yes
Y Mean	-0.0116	0.00554	0.00554	0.00853	0.00496
N	6203517	1670207	1670207	271499	1398708
Adj-R^2	0.00629	0.0115	0.337	0.333	0.338

Note: Standard errors clustered at firm level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4 shows the results. Again, we exclude mining firms and standardize the reduced form shock. Across all specifications, we find a positive effect of liquidity shock on firm-level credit growth. This confirms that Prediction 2 also holds with the more granular data.

Moreover, Column 3 shows that the result is mostly driven by large firms (top quartile in size distribution). More importantly, Columns 4 and 5 show that the result applies to set of non-tradable firms, but not for tradable firms, which is consistent with our aggregate results and with Prediction 3.

5.3 Labor

To assess the real effects of our commodity boom-induced financial shock, we now use firm-level employment data. We estimate the following specification:

$$\Delta \ln \left(N_{ft} \right) = \beta \mathbb{Z}_{f(i)t} + \alpha_f + \eta_{is(f)t} + \hat{\lambda}_{ft} + \epsilon_{ft}, \tag{14}$$

where N_{ft} indicates the number of employees of firm f in period t. We present the results in Table

5. It should be noted that the sample is smaller than in our previous table, since we implemented two adjustments and excluded firms with (1) either only one worker, or missing data; and/or (2) with a negligible outstanding loan amount during their lifespan.[14]

Our preferred estimator, Column 2, indicates a significant, positive, and sizable effect of around 1.6%, which is almost twice the mean employment growth rate. In Columns 3 and 4, we show this result is driven by non-tradable firms, while the effect on tradable firms is statistically indistinguishable from zero.

In Tables 6 and 7, we further investigate whether this effect is differentiated across mining and non-mining regions. We find that the effect occurs in the non-tradable sector in both regions. More importantly, this empirically confirms Prediction 4. For firms located non-mining regions, but exposed to the mining price shock through their banks, the labor composition shifts towards non-tradables. This represents the onset of the Dutch disease through the banking system in non-mining regions.

Table 5: Effect of Liquidity Shock (Bartik) on labor - Firm level

	Baseline		Tradable	Non-Trad.
	(1)	(2)	(3)	(4)
	$\Delta \ln(N)$	$\Delta \ln(N)$	$\Delta \ln(N)$	$\Delta \ln(N)$
Liquidity Shock	0.0139**	0.0160**	-0.00779	0.0201***
	(0.00641)	(0.00673)	(0.0185)	(0.00722)
Sector-Region-Time FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes
Demand Shock	No	Yes	Yes	Yes
Y Mean	0.00810	0.00813	0.00844	0.00807
N	103765	102403	16254	86149
Adj-R^2	0.0981	0.162	0.166	0.161

SE clustered at firm level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[14] In particular, firms with only one, zero or missing workers suffer from misreporting, or are simply self-employment activities. We also exclude firms with an insignificant use of external finance over their life cycle: we exclude firm that never reach a minimum threshold of PEN 20 000 (roughly USD 6 000 as of 2019) outstanding loan amount during their lifespan.

Table 6: Effect of Liquidity Shock on labor - Firm level - Mining Regions

	Baseline		Tradable	Non-Trad.
	(1)	(2)	(3)	(4)
	$\Delta \ln(N)$	$\Delta \ln(N)$	$\Delta \ln(N)$	$\Delta \ln(N)$
Liquidity Shock	0.0351**	0.0359**	0.0196	0.0370**
	(0.0159)	(0.0168)	(0.0586)	(0.0174)
Sector-Region-Time FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes
Demand Shock	No	Yes	Yes	Yes
Y Mean	0.00692	0.00676	0.0134	0.00605
N	25996	25652	2470	23182
Adj-R^2	0.166	0.222	0.294	0.215

SE clustered at firm level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Effect of Liquidity Shock on labor - Firm level - Non-Mining Regions

	Baseline		Tradable	Non-Trad.
	(1)	(2)	(3)	(4)
	$\Delta \ln(N)$	$\Delta \ln(N)$	$\Delta \ln(N)$	$\Delta \ln(N)$
Liquidity Shock	0.00900	0.0116	-0.00993	0.0157**
	(0.00697)	(0.00731)	(0.0192)	(0.00790)
Sector-Region-Time FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes
Demand Shock	No	Yes	Yes	Yes
Y Mean	0.00849	0.00859	0.00756	0.00881
N	77769	76751	13784	62967
Adj-R^2	0.0711	0.138	0.147	0.136

SE clustered at firm level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Model

6.1 Environment

Regions. There are S domestic regions indexed by $i \in \{1, \ldots, S\}$. Additionally, we model a rest of world (ROW), indexed by 0.

Timing. The model is static but features two within-period stages: morning (income is received and deposits are chosen) and evening (consumption and production revenues are realized). Each domestic region i is endowed with a measure of residents N_i.

Mining endowment. Region $i \in \{0, 1, \ldots, S\}$ has an exogenous mining resource endowment $M_i \geq 0$. Mining output is sold to ROW at a price $p_M > 0$, which in equilibrium will be common across regions. Mining revenue is

$$Y_i^M \equiv p_M M_i.$$

We assume mining revenue is rebated locally and equally to residents of the region where it is generated as a lump-sum dividend received in the morning:

$$T_i^M \equiv \frac{Y_i^M}{N_i} = \frac{p_M M_i}{N_i}.$$

Thus total morning resources available to residents of region i equal $w_i + T_i^M$ per capita. Notice that mining is pure rent: it uses no local labor and no loans, and it is not consumed locally.

6.2 Domestic households

Each domestic region $i \in \{1, ..., S\}$ has measure of consumers N_i. In the morning, households receive wage income and a lump-sum mining dividend T_i^M.They allocate these resources to consumption in the evening.

Preferences. Households consume a local non-tradable and a composite tradable good. For a household ω in region i choosing bank b, utility is

$$U_{ib}(\omega) = \ln C_{ib}(\omega),$$

where the consumption index $C_{ib}(\omega)$ has an upper CES nest between tradables and non-tradables, and a lower Armington CES nest across tradable origins

$$C_{ib} = \left(\left(C_{ib}^{T} \right)^{\frac{\epsilon-1}{\epsilon}} + \left(C_{ib}^{NT} \right)^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \qquad C_{ib}^{T} = \left(\sum_{r=0}^{r=S} c_{rib}^{T \ \frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \qquad C_{ib}^{NT} = c_{iib}^{NT}$$

Demand for deposits. We assume that consumers need the means to store their morning earnings so that they can consume in the evening. However, they need to choose a specific bank branch that is available at their location. Deposits yield a benefit of r_{ib}^{D}. Each consumer ω draws a vector of preferences ε_b over banks from a type-I extreme value distribution with shape parameter ν. So, total benefits are $\ln C_{ib}^{*}(\omega) + \varepsilon_b$. Aggregating over households, the share of households holding checking deposits in bank b in region i is:

$$d_{ib} = \frac{\exp\left(\ln C_{ib}^{*}/\nu\right)}{\sum_{b'} \exp\left(\ln C_{ib'}^{*}/\nu\right)} = \frac{\exp\left(\ln\left(1+r_{ib}^{D}\right)/\nu\right)}{\sum_{b'} \exp\left(\ln\left(1+r_{ib'}^{D}\right)/\nu\right)} = \frac{\left(1+r_{ib}^{D}\right)^{1/\nu}}{\sum_{b'}\left(1+r_{ib'}^{D}\right)^{1/\nu}}$$

where C_{ib}^{*} solves the maximization problem

$$\max \ln C_{ib} \qquad \text{s.t.} \sum_{r} p_{ri} c_{ri} = \left(w_i + T_i^{M}\right)\left(1 + r_{ib}^{D}\right) \qquad C_{ib} = \left(\left(C_{ib}^{T} \right)^{\frac{\epsilon-1}{\epsilon}} + \left(C_{ib}^{NT} \right)^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}}$$

$$\text{and} \qquad C_{ib}^{T} = \left(\sum_{r=0}^{r=S} c_{rib}^{T \ \frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \qquad C_{ib}^{NT} = c_{iib}^{NT}$$

Therefore, deposits in region i on bank b are:

$$D_{ib} = d_{ib}\left(w_i + T_i^{M}\right) N_i$$

We allow for an outside option $b = 0$ with an exogenous deposit rate of $r_{i0} = 0$.

Demand for goods. Conditional on the chosen bank branch b, households in region i enter the evening with a single expenditure budget equal to their morning income gross of the bank's deposit return. They then allocate this budget across the tradeable composite and the local non-tradeable according to CES preferences, and within tradeables across origins according to an Armington aggregator. So, given bank choice b, households in region i has total evening expenditure

$$E_{ib} = \left(w_i + T_i^{M}\right)\left(1 + r_{ib}^{D}\right) N_i.$$

The CES implies expenditure shares:

$$X_{ib}^T = E_{ib}\left(\frac{P_i^T}{P_i}\right)^{1-\epsilon}, \qquad X_{ib}^{NT} = E_{ib}\left(\frac{p_i^{NT}}{P_i}\right)^{1-\epsilon}.$$

with the composite (tradeable/non-tradeable) price index

$$P_i = \left((P_i^T)^{1-\epsilon} + (p_i^{NT})^{1-\epsilon}\right)^{\frac{1}{1-\epsilon}}$$

and the price of tradeable goods as

$$P_i^T = \left(\sum_{r=0}^{S}(p_{ri}^T)^{1-\eta}\right)^{\frac{1}{1-\eta}}$$

In the first part, we pin down total spending on tradeables for households choosing bank b in location i, X_{ib}^T. We then splits this tradeable spending across origin regions r as a function of delivered prices. So, within tradeables,

$$X_{rib}^T = \left(\frac{p_{ri}^T}{P_i^T}\right)^{1-\eta} X_{ib}^T = \left(\frac{p_{ri}^T}{P_i^T}\right)^{1-\eta}\left(\frac{P_i^T}{P_i}\right)^{1-\epsilon} E_{ib}.$$

Intuition. It's helpful to interpret the allocation of total budgets in two steps. First, the CES aggregator between tradeables and non-tradeables allocates the total budget E_{ib} to tradeables: $X_{ib}^T = E_{ib}\left(\frac{P_i^T}{P_i}\right)^{1-\epsilon}$, so ϵ governs how sensitive the {tradeable expenditure share} is to the tradeable price P_i^T relative to the overall index P_i. Second, conditional on the tradeable spending X_{ib}^T, the Armington aggregator allocates that spending across origins: $X_{rib}^T = \left(\frac{p_{ri}^T}{P_i^T}\right)^{1-\eta} X_{ib}^T$, so η governs substitution {across origins} in response to relative delivered prices p_{ri}^T/P_i^T. Thus, the {total} response of X_{rib}^T to a change in p_{ri}^T combines (i) within-tradeables substitution across origins (the η margin) and (ii) reallocation between tradeables and non-tradeables through P_i^T (the ϵ margin). Formally, letting $s_{rib}^T \equiv X_{rib}^T/X_{ib}^T$ and $s_{ib}^T \equiv X_{ib}^T/E_{ib}$, the own-price elasticity can be written as

$$\frac{\partial \ln X_{rib}^T}{\partial \ln p_{ri}^T} = (1-\eta)\left(1-s_{rib}^T\right) + (1-\epsilon)s_{rib}^T\left(1-s_{ib}^T\right),$$

which highlights the within-tradeables substitution term (driven by η) and the between-sector term (driven by ϵ). The first term,$(1-\eta)\left(1-s_{rib}^T\right)$, is the standard Armington {within-tradeables} effect: when p_{ri}^T rises, expenditure is reallocated away from origin r toward other tradeable origins, and this force is stronger the smaller is r's initial shares$_{rib}^T$. The second term, $(1-\epsilon)s_{rib}^T\left(1-s_{ib}^T\right)$,

captures the {between-sector} effect: a higher p_{ri}^T raises the tradeable price index P_i^T, which reduces total spending on tradeables relative to the local non-tradeable; this channel matters more when origin r is an important tradeable source (high s_{rib}^T) and when tradeables are not already taking (almost) the entire budget (so $1 - s_{ib}^T$ is sizable).

This result has some practical implications. For example, a rise inp_{ri}^T triggers substitution away from origin r within tradeables (governed by η), but if tradeables and non-tradeables are complements ($\epsilon < 1$), the resulting increase in the overall tradeables price index can also shift the budget share toward tradeables and away from non-tradeables, partially offsetting the within-tradeable substitution---especially when r is a large source of tradeables.

Aggregating over banks. Since bank choice is idiosyncratic, aggregate goods demand in region i integrates over the distribution of bank choices summarized by shares d_{ib}. Because deposits only affect the household through the gross return $(1 + r_{ib}^D)$, bank heterogeneity enters goods demand through an average gross return. We define the average gross deposit return as

$$\bar{R}_i^D = \sum_b d_{ib}(1 + r_{ib}^D),$$

Aggregating across bank choices using shares d_{ib}:

$$X_{ri}^T = \sum_b d_{ib} X_{rib}^T = \left(\frac{p_{ri}^T}{P_i^T}\right)^{1-\eta} \left(\frac{P_i^T}{P_i}\right)^{1-\epsilon} N_i \left(w_i + T_i^M\right) \sum_b d_{ib} \left(1 + r_{ib}^D\right).$$

so expenditure in goods produced in location r and consumed in i:

$$X_{ri}^T = \left(\frac{p_{ri}^T}{P_i^T}\right)^{1-\eta} \left(\frac{P_i^T}{P_i}\right)^{1-\epsilon} N_i \left(w_i + T_i^M\right) \bar{R}_i^D$$

and non-tradeable expenditure in i is

$$X_i^{NT} = \sum_b d_{ib} X_{ib}^{NT} = \left(\frac{p_i^{NT}}{P_i}\right)^{1-\epsilon} N_i \left(w_i + T_i^M\right) \bar{R}_i^D$$

Intuitively, $\bar{R}_i^D$ is the expected gross return on deposits for a representative household in region i, averaging across bank choices using d_{ib}. In summary, deposit returns affect goods demand only through the scalar $\bar{R}_i^D$, which scales total resources available for evening consumption in region i. Relative prices determine how that scaled expenditure is split between tradeables and the local non-tradeable (via ϵ), and within tradeables across origins (via η).

Trade costs and delivered prices. Buying tradables across locations is subject to iceberg trade costs. Let $\tau_{ri} \geq 1$ denote the iceberg trade cost for tradables shipped from origin $r \in \{0, 1, \ldots, S\}$ to destination $i \in \{1, \ldots, S\}$, with$\tau_{ii} = 1$. Producer prices are p_r^T for $r \geq 1$ and p_0^T for ROW. Delivered prices are

$$p_{ri}^T \equiv \tau_{ri} p_r^T.$$

6.3 ROW households

ROW is indexed by 0 and has no banking sector. In the evening, ROW consumes (i) the mining good and (ii) a tradable composite.

Preferences. ROW preferences are Cobb--Douglas between mining consumption C_0^M and the tradable composite C_0^T:

$$U_0 = \left(C_0^M\right)^{(\alpha_M)} \left(C_0^T\right)^{(1-\alpha_M)}, \qquad \alpha_M \in (0,1).$$

ROW's tradable composite aggregates tradables produced in regions $r \in \{0, \ldots, S\}$:

$$C_0^T = \left(\sum_{r=0}^{S} \left(c_{r0}^T\right)^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}, \qquad \eta > 1.$$

Demand for tradable goods and mining goods. Let $E_0 = (T_0 + w_0) N_0$ denote ROW total evening expenditure. ROW's budget is Cobb--Douglas implies expenditure shares:

$$X_{M0} \equiv p_M C_0^M = \alpha_M E_0, \qquad X_0^T \equiv P_0^T C_0^T = (1 - \alpha_M) E_0.$$

Armington implies the allocation of ROW tradable expenditure across origins:

$$X_{r0}^T = \left(\frac{p_{r0}^T}{P_0^T}\right)^{1-\eta} X_0^T, \qquad r = 0, 1, \ldots, S.$$

where the ROW tradable price index is

$$P_0^T = \left(\sum_{r=0}^{S} \left(p_{r0}^T\right)^{1-\eta}\right)^{\frac{1}{1-\eta}}.$$

and delivered tradable prices satisfy

$$p_{r0}^T \equiv \tau_{r0} p_r^T, \qquad r = 0, 1, \ldots, S.$$

6.4 Domestic production

In each location i there are two representative firms (or two sectors): a {tradeable} producer (T) and a {non-tradeable} producer (NT). In the morning, firms set up production and choose inputs and finance any required upfront payments. In the evening, they sell output.

Technology. Both sectors use labor only and exhibit constant returns to scale:

$$y_i^T = A_i^T n_i^T, \qquad y_i^{NT} = A_i^{NT} n_i^{NT},$$

where n_i^T and n_i^{NT} denote labor employed in each sector, and $A_i^T, A_i^{NT} > 0$ are sector-specific productivities.

Demand for loans. Producing in the morning requires paying wages upfront, before revenue is realized in the evening. We assume that sector $s \in \{T, NT\}$ in region i must finance a fraction ϕ_i^s of its wage bill with a loan from local banks at gross interest rate (R_i^L), while the remaining fraction is financed with internal funds at gross opportunity cost $R = (1 + r)$. This captures the opportunity cost of funds if these are financed internally. The parameter ϕ_i^s is a reduced-form measure of financing needs/constraints and may vary across regions and sectors. For instance, it captures differences across regions in the availability of internal capital to finance inputs; or in the degree at which firms could be able to frictionlessly access a national market with a homogeneous rate; or in other determinants of financing needs, such as the length of the production process.

Thus, sector-s loan demand in region i is

$$L_i^s = \phi_i^s w_i n_i^s.$$

It is convenient to summarize financing costs by an effective gross wedge on labor payments:

$$\mu_i^s \equiv 1 + \phi_i^s \left(R_i^L - 1 \right) + (1 - \phi_i^s) (R - 1),$$

so the effective unit labor cost faced by sector s is $c_i = \mu_i^s w_i$.

Unit costs and input demands. With CRS and labor-only production, unit cost in sector s is

$$c_i^s = \frac{\mu_i^s w_i}{A_i^s}, \qquad s \in \{T, NT\}.$$

Let p_i^T and p_i^{NT} denote producer prices in location i for tradeables and non-tradeables, respectively.

Cost minimization implies that the labor demand required to produce y_i^s satisfies

$$n_i^s = \frac{y_i^s}{A_i^s}, \qquad s \in \{T, NT\}.$$

Using the zero-profit condition under perfect competition,

$$p_i^s = c_i^s = \frac{\mu_i^s w_i}{A_i^s}, \qquad s \in \{T, NT\}.$$

6.5 ROW production

ROW (region 0) has a single productive sector, tradables (T). ROW has no non-tradable sector and no banking sector.

Technology. ROW tradable output is produced using labor only with constant returns to scale:

$$y_0^T = A_0^T n_0^T,$$

where n_0^T is labor employed in ROW tradables and $A_0^T > 0$ is ROW productivity.

Unit costs and input demands. ROW firms do not borrow and pay wages contemporaneously, so marginal cost is w_0 / A_0^T. Under perfect competition,

$$p_0^T = \frac{w_0}{A_0^T}.$$

Cost minimization implies

$$n_0^T = \frac{y_0^T}{A_0^T}$$

6.6 Banks

Individual banks and routing. Each bank b operates branches in multiple regions. A branch raises deposits locally and can route those funds to any destination where it makes loans. Routing

is costly: to deliver one dollar of loanable funds from source s to destination i, the bank must ship $\theta_{sib} \geq 1$ dollars from s, with $\theta_{iib} = 1$. This routing structure is the banking analogue of iceberg trade costs: deposits are raised locally, but making loans elsewhere requires moving funds through the bank's internal network, and routing frictions θ_{sib} capture any combination of regulatory, operational, informational, or balance-sheet costs associated with moving funds from s to i within bank b. At this stage we remain agnostic about the structure of these frictions: θ_{sib} may be fully bilateral and bank-specific, or it may factor into separate origin and destination components (or other restricted forms).

At destination i, bank b's loan supply is a continuum of infinitesimal transactions indexed by ℓ. Let $q_{ib}(\ell)$ denote the quantity of loan services in transaction ℓ. The CES aggregate quantity of loan services provided by bank b in i is

$$Q_{ib} = \left(\int q_{ib}(\ell)^{\frac{\sigma-1}{\sigma}} \, d\ell \right)^{\frac{\sigma}{\sigma-1}},$$

here $\sigma > 1$ is the elasticity of substitution across transactions (loan varieties). The continuum of transactions ℓ can be interpreted as a continuum of differentiated loan contracts or borrower relationships (e.g., different maturities, collateral types, industries, or screening/monitoring needs). Transaction ℓ delivers $q_{ib}(\ell)$ units of {loan services}, and the CES aggregator Q_{ib} summarizes how these many small relationships combine into the bank's overall lending capacity in destination i. Modeling transactions as infinitesimal is a convenient way to obtain routing shares: bank b chooses a funding source separately for each transaction based on its realized delivered funding cost.

Sourcing cost. For a transaction delivered to i, sourcing one unit of funds from region s has a baseline cost

$$\kappa_{sib} \equiv (1 + r^D_{sb})\theta_{sib},$$

where r^D_{sb} is the net deposit rate offered by bank b in source region s and θ_{sib} is the iceberg routing cost. This is a gross cost because deposits are a liability that must be repaid as principal plus interest in the evening. To deliver \$1 of lendable funds in destination i, the bank must raise θ_{sib} dollars of deposits in source s (due to the iceberg routing cost), and each deposited dollar raised in the morning must be repaid in the evening at the gross factor $(1 + r^D_{sb})$. Therefore the total repayment burden associated with funding \$1 delivered to i from s is $(1 + r^D_{sb})\theta_{sib}$, which motivates the definition $\kappa_{sib} \equiv (1 + r^D_{sb})\theta_{sib}$.\footnote{Why not use the net deposit rate r^D_{sb}? Because the bank does not repay only interest: it must repay the principal as well. Using r^D_{sb} alone would incorrectly treat deposits as if borrowing \$1 required repaying onlyr^D_{sb} dollars, whereas the correct

repayment is $1 + r^D_{sb}$ dollars per dollar deposited.}

Idiosyncratic route efficiencies. For each transaction ℓ, bank b draws route-specific efficiencies $\{z_{sib}(\ell)\}_s$ that are i.i.d.\ across ℓ and independent across sources s. The realized unit cost of funding transaction ℓ from source s is

$$\tilde{\kappa}_{sib}(\ell) = \frac{\kappa_{sib}}{z_{sib}(\ell)} = \frac{(1 + r^D_{sb})\theta_{sib}}{z_{sib}(\ell)}.$$

Intuitively, $z_{sib}(\ell)$ captures idiosyncratic, loan-specific advantages in sourcing from s (e.g., liquidity conditions, internal limits, or processing efficiencies) that vary across transactions. Because these shocks are independent across sources, different loans may be optimally funded from different regions even within the same destination i and bank b. Thus, for each transaction, the bank compares effective delivered funding costs across sources and routes the loan to the lowest-cost region:

$$s^*(\ell) = \arg\min_m \tilde{\kappa}_{mib}(\ell).$$

The corresponding CES unit cost (loan-rate index) in destination i for bank b is

$$R^L_{ib} = \left(\int \left[\min_m \tilde{\kappa}_{mib}(\ell) \right]^{1-\sigma} d\ell \right)^{\frac{1}{1-\sigma}}$$

We interpret R^L_{ib}as the unit cost (in dollars) of one unit of loan services supplied by bank b in destination i. In equilibrium this object corresponds to the gross loan rate faced by borrowers.

Distributional assumption and the bank-level loan rate. Assume $z_{sib}(\ell) \sim$ FrÃ©chet(T_{sb}, ρ) with shape $\rho > 1$ and scale $T_{sb} > 0$. Standard Frechet algebra implies that the gross loan rate charged by bank b in destination i (the CES price index across transactions) is

$$R^L_{ib} = \Phi_{ib}^{-\frac{1}{\rho}} \left[\Gamma\left(\frac{\rho - \sigma + 1}{\rho} \right) \right]^{\frac{1}{1-\sigma}},$$

where

$$\Phi_{ib} \equiv \sum_m T_{mb} \kappa_{mib}^{-\rho}.$$

The term Φ_{ib} summarizes the overall funding capacity of bank b for lending in i. Sources with higher scale T_{sb} (more efficient internal funding capacity) or lower delivered costs $\kappa_{mib} = \left(1 + r^D_{mb}\right) \theta_{mib}$

contribute more to Φ_{ib} and therefore lower the loan rate R^L_{ib}. In this sense, Φ_{ib}plays the same role as 'multilateral resistance' in trade: it aggregates all potential sources into an effective funding supply for lending in i. A larger Φ_{ib} lowers the cost of supplying loans.

Routing shares and bilateral funding flows. The same logic yields the share of bank b's lending in i that is funded from source s:

$$\frac{F_{sib}}{L_{ib}} = \frac{\Phi_{sib}}{\Phi_{ib}}, \qquad \Phi_{sib} \equiv T_{sb}\,\kappa_{sib}^{-\rho},$$

so bilateral funding flows satisfy

$$F_{sib} = \frac{\Phi_{sib}}{\Phi_{ib}} L_{ib}.$$

This expression has a gravity-like interpretation: holding fixed total lending L_{ib}, the fraction funded from s rises with T_{sb} and falls with the delivered funding cost $\kappa_{sib} = \left(1 + r^D_{sb}\right)\theta_{sib}$, with elasticity$\rho$. Here, the shape parameter ρ governs how sensitive routing is to cost differences: higher ρ makes the bank more likely to concentrate funding in the lowest-cost sources.

Loan supply in dollars. The dollar supply of loans by bank b in location i is

$$L_{ib} = R^L_{ib} Q_{ib}.$$

6.7 Loan aggregators

Final loan product in each location. In each location i, a perfectly competitive loan aggregator combines loan services from different banks into a final loan-service bundle that is demanded by firms. The aggregator has CES technology with elasticity of substitution $\sigma_b > 1$:

$$Q_i = \left(\sum_b \zeta_{ib} Q_{ib}^{\frac{\sigma_b - 1}{\sigma_b}} \right)^{\frac{\sigma_b}{\sigma_b - 1}},$$

where $\zeta_{ib} > 0$ is a bank-destination shifter. The corresponding unit cost (loan-price index) in location i is

$$R^L_i = \left(\sum_b \zeta_{ib} \left(R^L_{ib} \right)^{1-\sigma_b} \right)^{\frac{1}{1-\sigma_b}}.$$

Demand across banks. Cost minimization by the loan aggregator implies CES demand for bank-b loan services:

$$L_{ib} = L_i \cdot \frac{\zeta_{ib} \left(R_{ib}^L\right)^{1-\sigma_b}}{\sum_c \zeta_{ic} \left(R_{ic}^L\right)^{1-\sigma_b}},$$

where L_i is total dollar lending delivered in location i.

From the firm side, total loan demand in location i is the sum across sectors $s \in \{T, NT\}$:

$$L_i \equiv \sum_{s \in \{T,NT\}} L_i^s = \sum_{s \in \{T,NT\}} \phi_i^s w_i n_i^s$$

6.8 Market clearing and equilibrium

This section rewrites the equilibrium conditions as a two-block system in wages $\{w_i\}_{i=0}^S$ and deposit rates $\{r_{ib}^D\}_{i=1,\ldots,S;\, b}$. Given a guess (w, r^D), all other objects are pinned down by the expressions derived above (loan-rate indices, bank loan demands, routing shares, goods demands, and wedges). The equilibrium is a fixed point of these two blocks. Before defining them, we establish a preliminary result that pins down the mining price p_M and hence the mining dividends $\{T_i^M\}_{i=0}^S$.

Mining-market clearing. ROW mining demand is $C_0^M = \alpha_M E_0 / p_M$, while mining supply is inelastic and equals $\sum_{i=0}^S M_i$. Market clearing implies

$$\frac{\alpha_M \left(w_0 + T_0^M\right) N_0}{p_M} = \sum_{i=0}^S M_i.$$

Since mining revenues are rebated locally, the ROW mining dividend satisfies $T_0^M = p_M \frac{M_0}{N_0}$ and ROW expenditure is $E_0 = (w_0 + T_0^M) N_0$. Substituting into the market-clearing condition and solving yield

$$\frac{\alpha_M \left(w_0 + p_M \frac{M_0}{N_0}\right) N_0}{p_M} = \sum_{i=0}^S M_i \Rightarrow p_M = \frac{\alpha_M w_0 N_0}{\sum_{i=0}^S M_i - \alpha_M M_0}$$

and therefore, for every region $i \in \{0, 1, \ldots, S\}$,

$$T_i^M = \frac{p_M M_i}{N_i}.$$

6.8.1 Block A: Loans and deposits

ROW has no banking sector. Accordingly, deposits, lending, and routing are defined only over domestic locations $i \in \{1, \ldots, S\}$ and domestic funding sources $r \in \{1, \ldots, S\}$.

Given wages w and deposit rates r^D, this block computes the implied loan-rate indices, bank loan allocations, and within-bank routing flows, and then updates r^D so that---branch by branch---deposits raised locally equal the total (iceberg-adjusted) funding withdrawn to supply loans. Combining (i) firms' total loan demand in destination i L_i, (ii) the CES allocation of that demand across banks L_{ib}, and (iii) within-bank routing across sources F_{rib}, implies that bank b's funding flow from source r to i is:

$$F_{rib} = \frac{\Phi_{rib}}{\Phi_{ib}} \left(L_i \cdot \frac{\zeta_{ib} \left(R_{ib}^L\right)^{1-\sigma_b}}{\sum_c \zeta_{ic} \left(R_{ic}^L\right)^{1-\sigma_b}} \right) = \frac{\Phi_{rib}}{\Phi_{ib}} \left(\sum_{s \in \{T,NT\}} \phi_i^s \frac{p_i^s y_i^s}{\mu_i^s} \cdot \frac{\zeta_{ib} \left(R_{ib}^L\right)^{1-\sigma_b}}{\sum_c \zeta_{ic} \left(R_{ic}^L\right)^{1-\sigma_b}} \right)$$

Intuitively, Φ_{rib}/Φ_{ib} is bank b's routing share from source r into lending at destination i, while the CES term allocates destination-wide loan demand L_i across banks.

Branch-level deposit-market clearing requires that deposits raised at branch (r, b) equal the total deposits withdrawn from that branch to fund lending across destinations, accounting for iceberg routing costs θ_{rib}:

$$D_{rb} = \sum_{i=1}^{S} \theta_{rib} F_{rib}$$

Substituting the expression for F_{rib} and household deposit demand yields, for each $b \geq 1$,

$$\sum_{i=1} \theta_{rib} \frac{\Phi_{rib}}{\Phi_{ib}} \left(\sum_{s \in \{T,NT\}} \phi_i^s \frac{p_i^s y_i^s}{\mu_i^s} \cdot \frac{\zeta_{ib} \left(R_{ib}^L\right)^{1-\sigma_b}}{\sum_c \zeta_{ic} \left(R_{ic}^L\right)^{1-\sigma_b}} \right) = \frac{\left(1 + r_{rb}^D\right)^{1/\nu}}{\sum_{b'} \left(1 + r_{rb'}^D\right)^{1/\nu}} \left(w_r + T_r^M \right) N_r, \text{for} b, r \geq 1$$

The outside option $b = 0$ absorbs deposits but does not fund loans, so the branch balance-sheet condition applies only for $b \geq 1$. All objects on the left-hand side are functions of (w, r^D) through the within-bank loan-rate index and routing terms:

$$R_{ib}^L = \Phi_{ib}^{-\frac{1}{\rho}} \left[\Gamma\left(\frac{\rho - \sigma + 1}{\rho} \right) \right]^{\frac{1}{1-\sigma}}$$

$$\kappa_{sib} = \left(1 + r_{sb}^D\right) \theta_{sib}$$

$$\Phi_{sib} = T_{sb} \kappa_{sib}^{-\rho}$$

$$\Phi_{ib} = \sum_m T_{mb} \kappa_{mib}^{-\rho}$$

$$p_i = \mu_i^s \frac{w_i}{A_i}$$

$$\mu_i^s \equiv 1 + \phi_i^s \left(R_i^L - 1 \right) + \left(1 - \phi_i^s \right) (R - 1)$$

Taken together, these conditions imply an updating map $r^D \mapsto \mathcal{T}^D(w, r^D)$: given wages w, deposit rates adjust until each branch's deposit inflows match its implied funding outflows. In equilibrium, r^D is a fixed point of this map.

6.8.2 Block B: Goods and labor

Given deposit rates r^D (hence $\bar{R}_i^D$ and the financing wedges μ_i^T, μ_i^{NT}), this block computes goods prices and demands and then updates wages w so that goods-market clearing together with labor-market clearing holds in every region and sector, including ROW.

Sectoral labor demands. From the household demand system, tradable expenditure shipped from origin r to domestic destination i is\[

$$X_{ri}^T = \left(\frac{p_{ri}^T}{P_i^T} \right)^{1-\eta} \left(\frac{P_i^T}{P_i} \right)^{1-\epsilon} N_i \left(w_i + T_i^M \right) \bar{R}_i^D, \qquad i \geq 1,\ r \geq 0,$$

while ROW's tradable expenditure on origin r is

$$X_{r0}^T = \left(\frac{p_{r0}^T}{P_0^T} \right)^{1-\eta} (1 - \alpha_M)(w_0 + T_0^M) N_0, \qquad r \geq 0.$$

Non-tradable expenditure is

$$X_i^{NT} = \left(\frac{p_i^{NT}}{P_i} \right)^{1-\epsilon} N_i \left(w_i + T_i^M \right) \bar{R}_i^D, \qquad i \geq 1,$$

and $X_0^{NT} = 0$ (ROW has no non-tradable sector).

Under CRS and perfect competition, sectoral revenues equal effective labor payments:

$$p_r^T y_r^T = \mu_r^T w_r n_r^T, \qquad p_r^{NT} y_r^{NT} = \mu_r^{NT} w_r n_r^{NT},$$

with $\mu_0^T = 1$ for ROW, and $y_0^{NT} = n_r^{NT} = p_r^{NT} = 0$.

Tradable goods-market clearing is

$$\sum_{i=1}^{S} X_{ri}^T + X_{r0}^T = p_r^T y_r^T, \qquad r = 0, 1, \ldots, S,$$

and non-tradable market clearing (domestic only) is

$$X_r^{NT} = p_r^{NT} y_r^{NT}, \qquad r = 1, \ldots, S.$$

These conditions imply sectoral labor demands

$$n_r^T = \frac{\sum_{i=1}^{S} X_{ri}^T + X_{r0}^T}{\mu_r^T w_r}, \qquad r = 0, 1, \ldots, S,$$

and

$$n_r^{NT} = \frac{X_r^{NT}}{\mu_r^{NT} w_r}, \qquad r = 1, \ldots, S.$$

we can express sectoral labor demands as functions of goods demands

$$n_r^T = \frac{\sum_{i=1} X_{ri}^T + X_{r0}^T}{\mu_r^T w_r} \qquad \text{and} \qquad n_r^{NT} = \frac{X_r^{NT}}{\mu_r^{NT} w_r} \text{for } r \geq 1$$

Domestic labor market clearing. Substituting demand into goods-market clearing and imposing$n_r^T + n_r^{NT} = N_r$ yields, for each domestic region $r = 1, \ldots, S$,

$$\frac{1}{\mu_r^T}\left[\sum_{i=1}\left(\frac{p_{ri}^T}{P_i^T}\right)^{1-\eta}\left(\frac{P_i^T}{P_i}\right)^{1-\epsilon} N_i\left(w_i + T_i^M\right)\bar{R}_i^D + \left(\frac{p_{r0}^T}{P_0^T}\right)^{1-\eta}(1-\alpha_M)(w_0 + T_0^M)N_0\right]$$
$$+ \frac{1}{\mu_r^{NT}}\left[\left(\frac{p_r^{NT}}{P_r}\right)^{1-\epsilon} N_r\left(w_r + T_r^M\right)\bar{R}_r^D\right] = N_r w_r.$$

where the price indices are

$$P_i = \left((P_i^T)^{1-\epsilon} + (p_i^{NT})^{1-\epsilon}\right)^{\frac{1}{1-\epsilon}}, \qquad P_i^T = \left(\sum_{r=0}^{S}(p_{ri}^T)^{1-\eta}\right)^{\frac{1}{1-\eta}},$$

and the producer and delivered prices satisfy

$$p_r^s = \mu_r^s \frac{w_r}{A_r^s}, \qquad p_{ri}^T = \tau_{ri} p_r^T.$$

and the average gross deposit return is

$$\bar{R}_i^D = \sum_b \frac{(1+r_{ib}^D)^{1/\nu}}{\sum_{b'}(1+r_{ib'}^D)^{1/\nu}}(1+r_{ib}^D).$$

ROW labor market clearing. For ROW, impose $n_0^T = N_0$ together with tradable-market clearing for origin 0:

$$\sum_{i=1}^{S} \left(\frac{p_{0i}^T}{P_i^T}\right)^{1-\eta} \left(\frac{P_i^T}{P_i}\right)^{1-\epsilon} N_i \left(w_i + T_i^M\right) \bar{R}_i^D + \left(\frac{p_{00}^T}{P_0^T}\right)^{1-\eta} (1-\alpha_M)(w_0 + T_0^M)N_0 = N_0 w_0.$$

Taken together, these conditions define an updating map $w \mapsto \mathcal{T}^w(w, r^D)$: given deposit rates r^D (and hence $\bar{R}^D$ and wedges μ), wages adjust until goods and labor markets clear in every region. In equilibrium, w is a fixed point of this map (up to a normalization).

6.8.3 Equilibrium

Definition of Equilibrium. Given model parameters $\{\epsilon, \eta, \nu, \rho, \sigma, \sigma_b, R, \alpha_M, \phi_i^T, \phi_i^{NT}, \zeta_{ib}\}$, endowments $\{N_i, M_i\}_{i=0}^S$, productivities $\{A_i^T\}_{i=0}^S$ and $\{A_i^{NT}\}_{i=1}^S$, trade costs $\{\tau_{ri}\}_{r=0,\ldots,S;\, i=0,\ldots,S}$, banking frictions $\{\theta_{sib}\}_{sib}$ and productivities $\{T_{sb}\}_{sb}$ (both defined for domestic sources $s = 1, \ldots, S$ and domestic destinations $i = 1, \ldots, S$) and the outside-option deposit rate $r_{i0}^D = 0$, and given mining dividends $\{T_i^M\}_{i=0}^S$ and the mining pricep_M are pinned down by mining-market clearing, we define two operators.

Deposit--loans block (Block A). Given (w, r^D), compute the implied loan-rate indices, bank-level loan allocations, and within-bank routing flows, and update deposit rates via

$$r^{D\prime} = \mathcal{T}^D(w, r^D)$$

so that branch-by-branch deposit-market clearing holds for all domestic branches (r, b) with $r = 1, \ldots, S$ and $b \geq 1$.

Goods--labor block (Block B). Given (w, r^D), compute goods prices, demands, and wedges,

and update wages via

$$w' = \mathcal{T}^w(w, r^D)$$

so that goods-market clearing and labor-market clearing hold in every region $i = 0, 1, \ldots, S$

Equilibrium. Let the combined equilibrium operator be

$$\mathcal{T}(w, r^D) \equiv \big(\mathcal{T}^w(w, r^D),\ \mathcal{T}^D(w, r^D)\big).$$

An equilibrium is a pair (w^*, r^{D*}) such that

$$(w^*, r^{D*}) = \mathcal{T}(w^*, r^{D*}),$$

together with the allocations and prices implied by households' optimal deposit and consumption choices, firms' optimal input and borrowing choices, and banks' optimal routing, and with a normalization (e.g. $w_1^* = 1$) to pin down the numeraire.

6.9 SOE limit

This section defines a SOE limit in the spirit of Alvarez and Lucas (2007) and Demidova et al. (2024). We scale the entire domestic economy by $\lambda \to 0$ while keeping ROW fixed. We adjust bilateral trade costs from domestic regions to ROW so that ROW prices are pinned down abroad (independent of domestic outcomes), while trade among domestic regions and ROW imports into the domestic economy remain well-defined.

6.9.1 Assumptions

For each $\lambda > 0$, define a scaled economy with:

$$N_i(\lambda) = \lambda N_i, \qquad M_i(\lambda) = \lambda M_i, \qquad i = 1, \ldots, S,$$

while ROW is fixed: $(N_0, M_0, A_0^T, \alpha_M)$ do not depend on λ. Internal technologies and frictions are fixed: $\{A_i^T, A_i^{NT}\}_{i\geq 1}$, $\{T_{sb}\}_{s,b}$, $\{\theta_{sib}\}_{s,i,b}$, and internal trade costs $\{\tau_{ri}\}_{r,i\geq 1}$ do not depend on λ.

ROW-to-domestic trade costs $\{\tau_{0i}\}_{i\geq 1}$ are fixed.

Domestic-to-ROW trade costs scale as:

$$\lim_{\lambda\to 0} \frac{\tau_{i0}(\lambda)}{\lambda^{-1/(\eta-1)}} = \tilde{\tau}_{i0} \in (0, \infty), \qquad i = 1, \ldots, S.$$

6.9.2 Proposition

Under Assumption SOE, as $\lambda \to 0$:

(i) Mining is priced abroad. The mining price converges to a constant $\bar{p}_M > 0$ pinned down by ROW, and thus mining dividends converge to

$$T_i^M(\lambda) \to \bar{p}_M \frac{M_i}{N_i}, \qquad i = 1, \ldots, S.$$

(ii) External demand is summarized by shifters. For each domestic tradable origin $r = 1, \ldots, S$, the ROW component of tradable demand converges to a constant shifter $\chi_{r0} \geq 0$ so that, in the domestic tradable market-clearing condition, the term X_{r0}^T is replaced by $\left(\mu_r^T \frac{w_r}{A_r^T}\right)^{1-\eta} \chi_{r0}$.

(iii) The domestic market clearing conditions reduce to the following two blocks for (w, r^D) over domestic regions $r = 1, \ldots, S$ (and banks $b \geq 1$):

Banking market (Block A)**.** For each $r = 1, \ldots, S$ and $b \geq 1$,

$$\sum_{i=1}^{S} \theta_{rib} \frac{\Phi_{rib}}{\Phi_{ib}} \left(\sum_{s \in \{T, NT\}} \phi_i^s \frac{p_i^s y_i^s}{\mu_i^s} \cdot \frac{\zeta_{ib} \left(R_{ib}^L\right)^{1-\sigma_b}}{\sum_c \zeta_{ic} \left(R_{ic}^L\right)^{1-\sigma_b}} \right) = \frac{\left(1 + r_{rb}^D\right)^{1/\nu}}{\sum_{b'} \left(1 + r_{rb'}^D\right)^{1/\nu}} \left(w_r + \bar{p}_M \frac{M_r}{N_r} \right) N_r.$$

Goods--labor market (Block B)**.** For each $r = 1, \ldots, S$,

$$\begin{aligned} &\frac{1}{\mu_r^T} \left[\sum_{i=1}^{S} \left(\frac{p_{ri}^T}{P_i^T} \right)^{1-\eta} \left(\frac{P_i^T}{P_i} \right)^{1-\epsilon} N_i \left(w_i + \bar{p}_M \frac{M_i}{N_i} \right) \bar{R}_i^D + \left(\mu_r^T \frac{w_r}{A_r^T} \right)^{1-\eta} \chi_{r0} \right] \\ &\quad + \frac{1}{\mu_r^{NT}} \left[\left(\frac{p_r^{NT}}{P_r} \right)^{1-\epsilon} N_r \left(w_r + \bar{p}_M \frac{M_r}{N_r} \right) \bar{R}_r^D \right] = N_r w_r. \end{aligned}$$

6.9.3 Equilibrium

Definition of Equilibrium. Given model parameters $\{\epsilon, \eta, \nu, \rho, \sigma, \sigma_b, R, \alpha_M, \phi_i^T, \phi_i^{NT}, \zeta_{ib}\}$, domestic endowments $\{N_i, M_i\}_{i=1}^S$, domestic productivities $\{A_i^T, A_i^{NT}\}_{i=1}^S$, internal trade costs $\{\tau_{ri}\}_{r=1,\ldots,S;\, i=1,\ldots,S}$ and ROW-to-domestic trade costs $\{\tau_{0i}\}_{i=1,\ldots,S}$, banking frictions $\{\theta_{sib}\}_{s,i,b}$ and bank productivities $\{T_{sb}\}_{s,b}$ (both defined for domestic sources $s = 1, \ldots, S$ and domestic destinations $i = 1, \ldots, S$), and the outside-option deposit rate $r_{i0}^D = 0$, and given the {SOE objects pinned down abroad} $\bar{p}_M$ and $\{\chi_{r0}\}_{r=1}^S$ from Proposition 9.2, we define two operators.

Deposit--loans block (Block A). Given (w, r^D), compute the implied loan-rate indices, bank-level loan allocations, and within-bank routing flows, and update deposit rates via

$$r^{D\prime} = \mathcal{T}^{D,\mathrm{SOE}}(w, r^D)$$

so that branch-by-branch deposit-market clearing holds for all domestic branches (r, b) with $r = 1, \ldots, S$ and $b \geq 1$, where incomes use the SOE mining dividend $T_r^M = \bar{p}_M M_r / N_r$.

Goods--labor block (Block B). Given (w, r^D), compute goods prices, demands, and wedges, and update wages via

$$w' = \mathcal{T}^{w,\mathrm{SOE}}(w, r^D)$$

so that domestic goods-market clearing and labor-market clearing hold for every domestic region $r=1,\dots,S$, with external demand summarized by $\{\chi_{r0}\}_{r=1}^{S}$ and mining priced at $\bar{p}_M$.

Equilibrium. Let the combined SOE equilibrium operator be

$$\mathcal{T}^{\mathrm{SOE}}(w, r^D) \equiv \big(\mathcal{T}^{w,\mathrm{SOE}}(w, r^D),\ \mathcal{T}^{D,\mathrm{SOE}}(w, r^D)\big).$$

An SOE-limit equilibrium is a pair (w^*, r^{D*}) such that

$$(w^*, r^{D*}) = \mathcal{T}^{\mathrm{SOE}}(w^*, r^{D*}),$$

together with the allocations and prices implied by households' optimal deposit and consumption choices, firms' optimal input and borrowing choices, and banks' optimal routing. No normalization is possible.

7 Conclusions

This paper argues banks can generate spatial spillovers following commodity booms. We find that banks reallocate loans across regions, from commodity-rich regions to non-commodity regions. However, in doing so, they also generate instances of Durch disease in non-commodity regions.

The next step is to take the model to the data and perform counterfactual exercises. In particular, we are interested in evaluating the policy relevance of financial regulation alongside fiscal or monetary tools in managing resource booms for developing countries, and to understand to what extent internal financial integration can amplify or mitigate the effects of external shocks, such as changes in commodity prices, on SOEs.

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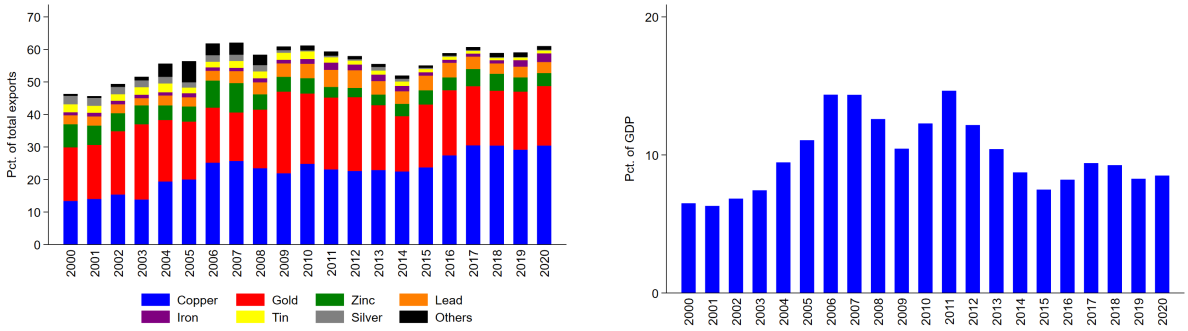
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A Empirical appendix

A.1 Summary Statistics

Figure A.1: Mining sector as percentage of total exports and GDP



(a) Mining exports as pct. of total exports

(b) Mining as pct. of GDP

Note: Panel (a) shows the evolution of the participation of different minerals in the total exports. Panel (b) shows the evolution of the participation of the mining sector in GDP.

Table A.1: Mining production ranking of Peru, 2011

Mineral	Share of total world output	Largest competitors
Copper	8%	CHL: 33%, CHN: 8%, USA: 7%
Gold	6%	CHN: 14%, AUS: 10%, USA: 9%
Zinc	10%	CHN: 34%, AUS: 12%, USA: 10%
Lead	5%	CHN: 50%, AUS: 13%, USA: 7%
Tin	12%	CHN: 49%, IDN: 17%, BOL: 8%
Silver	15%	MEX: 18%, CHN: 16%, AUS: 7%
Iron	<1%	CHN: 45%, AUS: 17%, BRA: 13%

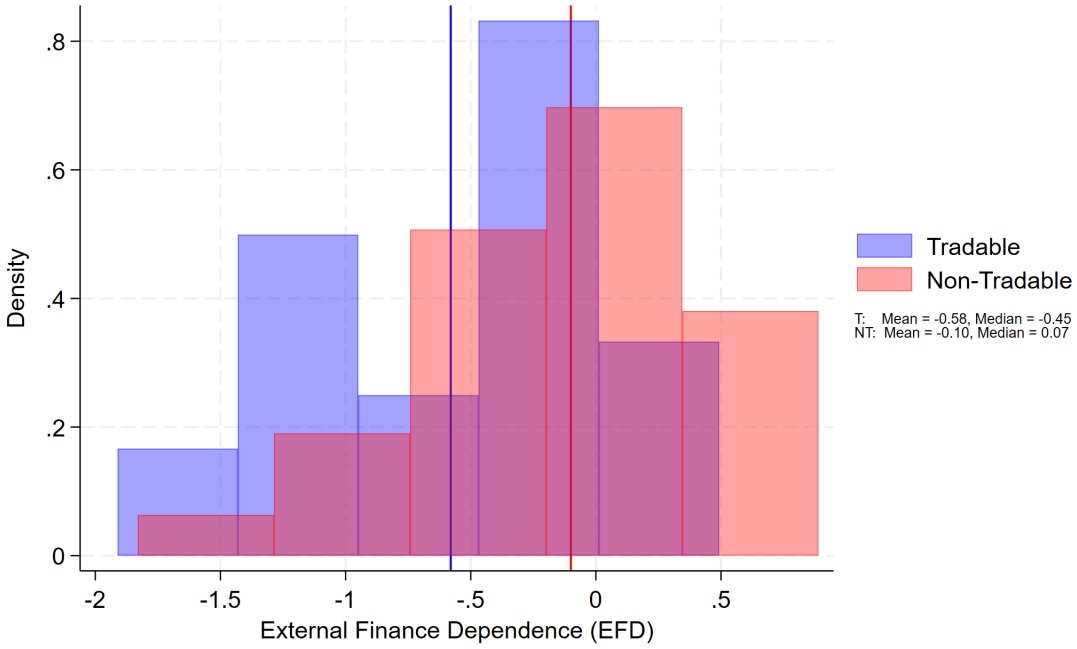
Note: Figure shows share of Peruvian output over total world output for each of the listed mining commodities.
Source: United States Geological Survey.

A.2 External Financial Dependence Index

In the spirit of Rajan and Zingales (1998), we compute external financial dependence (hereafter, EDF) ratios for Peruvian firms. We use the 2008 Economic Census (CENEC) to compute, for each firm f, $EFD_f = \frac{KE_f - CF_f}{KE_f}$, where KE corresponds to capital expenditures and CF to cash flow from operations.[15] We then take the median value within a 2-digit ISIC (Rev. 3.1) cell to define our sectoral EDF indices.

Figure A.2 shows the distribution of sectoral EDF ratios by tradable/non-tradable sector status. We find that, consistent with our theoretical assumption, non-tradable sector are on average more dependent on external finance than tradable sectors (-0.10 against -0.58, respectively). Comparison of median values shows a similar pattern (0.07 for non-tradables vs -0.45 for tradables).

Figure A.2: Distribution of sectoral EFD indices



Note: Figure shows the distribution of the external financial dependence statistic (Rajan & Zingales, 1998) across regions.

[15] We exclude informal firms (i.e. firms with no tax ID) from the sample, as they are exhibit low levels of financial inclusion and our regression sample focuses on formal firms.

A.3 Additional Empirical Results

Table A.2: Effect of Liquidity Shock (Bartik) on deposits. No Winsorizing

	(1) $\Delta \ln(Dep)$	(2) $\Delta \ln(Dep)$	(3) $\Delta \ln(Dep)$	(4) $\Delta \ln(Dep)$
Liquidity Shock	0.00899**	0.00710**	0.00707**	0.00687**
	(0.00402)	(0.00296)	(0.00293)	(0.00257)
Liquidity Shock × D(Big4)			0.00286	
			(0.00530)	
Liquidity Shock × D(LargeBank)				0.00118
				(0.00534)
Bank Controls	No	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Y Mean	0.0267	0.0267	0.0267	0.0267
N	2204	2204	2204	2204
Adj-R^2	0.260	0.287	0.287	0.287

Note: Standard errors clustered at bank level. Shock is not winsorized.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Effect of Liquidity Shock (Bartik) on deposits

	(1) $\Delta \ln(Dep)$	(2) $\Delta \ln(Dep)$	(3) $\Delta \ln(Dep)$
Liquidity Shock	0.00728**	0.00525*	0.00636**
	(0.00352)	(0.00284)	(0.00309)
Liquidity Shock × Post2014		0.00630	
		(0.00996)	
Bank Controls	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Entry Year × Time	No	No	Yes
Y Mean	0.0267	0.0267	0.0267
N	2204	2204	2204
Adj-R^2	0.287	0.287	0.307

Note: Standard errors clustered at bank level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.4: Effect of Liquidity Shock (Bartik) on loans

	Full Sample				T	NT
	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$
Shock	0.00542**	0.00456*	0.00565**	0.00551**	0.00312	0.00651***
	(0.00219)	(0.00264)	(0.00211)	(0.00236)	(0.00223)	(0.00231)
Shock × D(Lima)		0.00506				
		(0.00351)				
Shock × D(Big4)			-0.0101			
			(0.00739)			
Shock × EFDRatio				0.000231		
				(0.00196)		
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Y Mean	0.0512	0.0512	0.0512	0.0512	0.0436	0.0549
N	459531	459531	459531	459531	149947	309584
Adj-R^2	0.0197	0.0197	0.0198	0.0197	0.0162	0.0217

Note: Standard errors clustered at bank level. EFD corresponds to sectoral external fin. dependence ratio as in Rajan and Zingales (1998).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Effect of Liquidity Shock (Bartik) on loans

	Full Sample				T	NT
	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$
Shock	0.00542**	0.00456*	0.00565**	0.00551**	0.00312	0.00651***
	(0.00219)	(0.00264)	(0.00211)	(0.00236)	(0.00223)	(0.00231)
Shock × D(Lima)		0.00506				
		(0.00351)				
Shock × D(Big4)			-0.0101			
			(0.00739)			
Shock × EFDRatio				0.000231		
				(0.00196)		
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Y Mean	0.0512	0.0512	0.0512	0.0512	0.0436	0.0549
N	459531	459531	459531	459531	149947	309584
Adj-R^2	0.0197	0.0197	0.0198	0.0197	0.0162	0.0217

Note: Standard errors clustered at bank level. EFD corresponds to sectoral external fin. dependence ratio as in Rajan and Zingales (1998).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.6: Effect of Liquidity Shock (Bartik) on loans - No Winsorizing

	Baseline	Heterogeneity		
	(1)	(2)	(3)	(4)
	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$
Shock	0.00759***	0.00930***	0.00840***	0.00840***
	(0.00224)	(0.00262)	(0.00210)	(0.00199)
Shock × D(Tradable)		-0.00542***		
		(0.00154)		
Shock × D(LargeBank)			-0.00339	
			(0.00392)	
Shock × D(MinReg)				-0.00180
				(0.00424)
Bank Controls	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
Region-Time FE	Yes	Yes	Yes	Yes
Sector-Time FE	Yes	Yes	Yes	Yes
Sector-Region FE	Yes	Yes	Yes	Yes
Y Mean	0.0512	0.0512	0.0512	0.0512
N	459531	459531	459531	459531
Adj-R^2	0.0198	0.0198	0.0198	0.0198

Note: Standard errors clustered at bank level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.7: Effect of Liquidity Shock (Bartik) on credit - Firm level - No Winsor.

		Baseline		Tradable	Non-Trad.
	(1)	(2)	(3)	(4)	(5)
	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$	$\Delta \ln(L)$
Liq. Shock	0.00133*	0.00380*	0.00372**	0.00146	0.00410**
	(0.000696)	(0.00210)	(0.00170)	(0.00441)	(0.00184)
Sector-Region-Time FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Demand Shock	No	No	Yes	Yes	Yes
Full Sample	Yes	Yes	No	No	No
Only Large Firms	No	No	Yes	Yes	Yes
Y Mean	-0.0116	0.00554	0.00554	0.00853	0.00496
N	6203517	1670207	1670207	271499	1398708
Adj-R^2	0.00629	0.0115	0.337	0.333	0.338

Note: Standard errors clustered at firm level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Simplified model appendix

In this section, we outline the simplified model from Section 3, with which we make our predictions. This is simplified version of the larger model in Section 6.

B.1 Simplified equations

The simplified version of the model is characterized by the following system of equations for the two domestic regions $i \in \{M, NM\}$.

Income:

$$Y_i = (w_i + T_i^M)N_i, \qquad \text{with } T_M^M = p_M M_M / N_M \text{ and } T_{NM}^M = 0. \tag{B.15}$$

Deposits:

$$D_{ib} = \omega_{ib} Y_i. \tag{B.16}$$

Deposit rates:

$$r_{ib}^D = r^D(D_{ib}), \qquad r^{D\prime} < 0. \tag{B.17}$$

Sourcing costs:

$$\kappa_{iib} = 1 + r^D(D_{ib}), \qquad \kappa_{jib} = \left[1 + r^D(D_{jb})\right]\theta, \quad j \neq i. \tag{B.18}$$

Funding capacity:

$$\Phi_{ib} = \kappa_{iib}^{-\rho} + \kappa_{jib}^{-\rho}, \qquad j \neq i. \tag{B.19}$$

Bank loan rates:

$$R_{ib}^L = \Gamma \Phi_{ib}^{-1/\rho}. \tag{B.20}$$

Regional loan rate:

$$R_i^L = \left(\sum_b \zeta_{ib} (R_{ib}^L)^{1-\sigma_b} \right)^{1/(1-\sigma_b)}. \tag{B.21}$$

Cost wedges:

$$\mu_i^T = 1 + \phi^T (R_i^L - 1), \qquad \mu_i^{NT} = 1 + \phi^{NT} (R_i^L - 1). \tag{B.22}$$

Wages:

$$w_i = \frac{p^T A_i^T}{\mu_i^T}. \tag{B.23}$$

Non-tradable employment:

$$n_i^{NT} = \frac{\alpha N_i}{\mu_i^{NT}} \left(1 + \frac{T_i^M}{w_i} \right). \tag{B.24}$$

Tradable employment:

$$n_i^T = N_i - n_i^{NT}. \tag{B.25}$$

Loan demand:

$$L_i^T = \phi^T w_i n_i^T, \qquad L_i^{NT} = \phi^{NT} w_i n_i^{NT}. \tag{B.26}$$

B.2 Preamble: Dutch disease in the mining region

Lemma 1 (Wages and the tradable cost wedge)**.** *From Equation B.23, wages are inversely related to the tradable cost wedge:*

$$w_i = \frac{p^T A_i^T}{\mu_i^T} \qquad \Longrightarrow \qquad \frac{\partial w_i}{\partial \mu_i^T} = -\frac{p^T A_i^T}{(\mu_i^T)^2} < 0.$$

Equivalently, $\partial \ln w_i / \partial \ln \mu_i^T = -1$*. Wages are determined by the tradable sector alone; the non-tradable wedge* μ_i^{NT} *does not enter the wage equation.*

Lemma 2 (Sensitivity of cost wedges to the loan rate)**.** *From Equation B.22:*

$$\frac{\partial \mu_i^T}{\partial R_i^L} = \phi^T, \qquad \frac{\partial \mu_i^{NT}}{\partial R_i^L} = \phi^{NT}. \tag{B.27}$$

Since $\phi^{NT} \geq \phi^T$, the non-tradable wedge is weakly more sensitive to changes in R_i^L than the tradable wedge.

Lemma 3 (Non-tradable employment decomposition)**.** *From Equation B.24, non-tradable employment in region M is:*

$$n_M^{NT} = \frac{\alpha N_M}{\mu_M^{NT}} \left(1 + \frac{T_M^M}{w_M}\right) = \frac{\alpha N_M}{\mu_M^{NT}} + \frac{\alpha N_M}{\mu_M^{NT}} \frac{p_M M_M / N_M}{w_M}.$$

The first term is the non-tradable employment that would prevail with zero mining income. The second term captures the additional non-tradable employment due to the mining dividend. Note that non-tradable employment depends on μ_M^{NT} (the non-tradable wedge), while wages depend on μ_M^T (the tradable wedge). Both wedges respond to R_M^L, but at different rates.

Proposition 1 (Dutch disease in the mining region)**.** *A mining boom increases non-tradable employment and decreases tradable employment in the mining region. This occurs through three reinforcing channels: a spending channel, a credit amplification channel, and a differential cost channel.*

Proof. The total effect of p_M on n_M^{NT} operates through:

$$\frac{dn_M^{NT}}{dp_M} = \underbrace{\left.\frac{\partial n_M^{NT}}{\partial p_M}\right|_{\mu_M^{NT}, w_M}}_{\text{Spending channel}} + \underbrace{\frac{\partial n_M^{NT}}{\partial \mu_M^{NT}} \frac{d\mu_M^{NT}}{dp_M}}_{\text{NT cost channel}} + \underbrace{\frac{\partial n_M^{NT}}{\partial w_M} \frac{dw_M}{dp_M}}_{\text{GE wage adjustment}}. \tag{B.28}$$

Spending channel. Holding μ_M^{NT} and w_M fixed:

$$\left.\frac{\partial n_M^{NT}}{\partial p_M}\right|_{\mu_M^{NT}, w_M} = \frac{\alpha}{\mu_M^{NT} w_M} M_M > 0. \tag{B.29}$$

Higher mining income directly raises demand for non-tradables.

Credit amplification channel. The mining boom raises deposits at exposed branches in M, which lowers deposit rates (since $r^{D'} < 0$), reduces sourcing costs $\kappa_{M,M,b}$, raises funding capacity Φ_{Mb}, and lowers loan rates R_M^L . Lower R_M^L reduces both cost wedges, but by different amounts (Lemma 2):

$$\frac{\partial \mu_M^T}{\partial p_M} = \phi^T \frac{\partial R_M^L}{\partial p_M} < 0, \qquad \frac{\partial \mu_M^{NT}}{\partial p_M} = \phi^{NT} \frac{\partial R_M^L}{\partial p_M} < 0. \tag{B.30}$$

The direct effect of μ_M^{NT} on non-tradable employment:

$$\frac{\partial n_M^{NT}}{\partial \mu_M^{NT}} = -\frac{\alpha N_M}{(\mu_M^{NT})^2}\left(1 + \frac{T_M^M}{w_M}\right) < 0. \tag{B.31}$$

Combining Equations B.30 and B.31:

$$\frac{\partial n_M^{NT}}{\partial \mu_M^{NT}} \frac{\partial \mu_M^{NT}}{\partial p_M} = \underbrace{\left(-\frac{\alpha N_M}{(\mu_M^{NT})^2}\left(1 + \frac{T_M^M}{w_M}\right)\right)}_{<0} \underbrace{\phi^{NT} \frac{\partial R_M^L}{\partial p_M}}_{<0} > 0. \tag{B.32}$$

The credit channel amplifies the spending channel: lower R_M^L reduces μ_M^{NT}, which directly raises non-tradable employment.

Differential cost channel. With $\phi^{NT} > \phi^T$, the fall in R_M^L reduces μ_M^{NT} by more than μ_M^T. This generates an additional amplification through relative costs. Substituting $w_M = p^T A_M^T / \mu_M^T$ into Equation B.24:

$$n_M^{NT} = \frac{\alpha N_M}{\mu_M^{NT}} + \frac{\alpha p_M M_M \mu_M^T}{\mu_M^{NT} p^T A_M^T}. \tag{B.33}$$

The second term depends on the ratio μ_M^T / μ_M^{NT}, which rises when R_M^L falls:

$$\frac{\partial}{\partial R_M^L}\left(\frac{\mu_M^{NT}}{\mu_M^T}\right) = \frac{\phi^{NT} - \phi^T}{(\mu_M^T)^2} > 0 \quad \text{when } \phi^{NT} > \phi^T. \tag{B.34}$$

So when R_M^L falls, μ_M^{NT} / μ_M^T falls: non-tradable production costs decline relative to tradable production costs. Since the ratio μ_M^T / μ_M^{NT} in the expression above rises, non-tradable employment increases further. This is the differential cost channel: it operates even holding the spending effect fixed, purely through the asymmetric response of sectoral cost wedges to credit conditions.

GE wage adjustment. Lower μ_M^T raises wages via Equation B.23:

$$\frac{dw_M}{dp_M} = -\frac{p^T A_M^T}{(\mu_M^T)^2} \phi^T \frac{\partial R_M^L}{\partial p_M} > 0. \tag{B.35}$$

The effect of wages on non-tradable employment through income:

$$\frac{\partial n_M^{NT}}{\partial w_M} = -\frac{\alpha N_M}{\mu_M^{NT}} \frac{T_M^M}{w_M^2} < 0.$$

Higher wages reduce the mining dividend relative to the wage (T_M^M / w_M falls), which partially offsets the direct spending effect. However, total income $Y_M = w_M N_M + p_M M_M$ rises, so the net effect on non-tradable employment is positive.

Combining. All three channels (spending, credit amplification, and differential cost) increase non-tradable employment. The wage adjustment partially offsets but does not reverse the direct effects. Therefore:

$$\frac{dn_M^{NT}}{dp_M} > 0, \qquad \frac{dn_M^T}{dp_M} = -\frac{dn_M^{NT}}{dp_M} < 0. \tag{B.36}$$

Labor reallocates from tradables to non-tradables. The SOE assumption is essential: since p^T is exogenous, tradable producers cannot raise output prices to compete for labor.

□

B.3 Prediction 1: More exposed banks receive more deposits

For a given bank b, total deposits D_b across both regions are:

$$D_b \equiv D_{Mb} + D_{NMb} = \omega_{Mb} Y_M + \omega_{NMb} Y_{NM}.$$

Prediction 1 (More exposed banks receive more deposits)**.** *A mining boom increases deposits at bank b.*

Proof. Differentiate total deposits with respect to p_M, holding wages fixed (partial equilibrium):

$$\left.\frac{\partial D_b}{\partial p_M}\right|_w = \omega_{Mb} \left.\frac{\partial Y_M}{\partial p_M}\right|_w = \omega_{Mb} M_M > 0. \tag{B.37}$$

The result follows from $Y_M = w_M N_M + p_M M_M$ (Equation B.15) so $\partial Y_M / \partial p_M|_w = M_M$. The term $\omega_{NMb} \partial Y_{NM} / \partial p_M|_w = 0$ because $T_{NM}^M = 0$, so at fixed wages the non-mining region's income does not change. Since the expression above is strictly increasing in ω_{Mb}, banks with a larger branch share in the mining region absorb a proportionally larger share of the mining income windfall.

In general equilibrium, wages adjust (as shown in subsequent predictions), which generates an additional deposit response through income effects. However, the partial equilibrium result establishes the key cross-sectional prediction: controlling for equilibrium wage effects, the heterogeneous deposit response across banks is driven by ω_{Mb}.

□

Bank exposure ω_{Mb}. More exposed banks receive larger deposit inflows from M. The cross-sectional variation in deposit responses is fully characterized by relative branch shares: for any two banks b and b',

$$\frac{\partial D_b / \partial p_M}{\partial D_{b'} / \partial p_M} = \frac{\omega_{Mb}}{\omega_{Mb'}}.$$

Then, ω_{Mb} governs the strength of this prediction.

B.4 Prediction 2: More exposed banks expand lending in both regions

Lemma 4 (Funding capacity and mining exposure)**.** *Bank b's funding capacity for lending in each region is:*

$$\Phi_{Mb} = \left(1 + r^D(D_{Mb})\right)^{-\rho} + \left[\left(1 + r^D(D_{NMb})\right)\theta\right]^{-\rho}, \tag{B.38}$$

$$\Phi_{NMb} = \left(1 + r^D(D_{NMb})\right)^{-\rho} + \left[\left(1 + r^D(D_{Mb})\right)\theta\right]^{-\rho}. \tag{B.39}$$

Since $r^{D'} < 0$, Φ_{ib} is strictly increasing in D_{ib} (lower local sourcing cost) and strictly increasing in D_{jb} (lower cross-region sourcing cost).

Proof. Substitute Equation B.17 and the symmetric routing cost into Equation B.19. For the monotonicity, differentiate with respect to D_{ib}:

$$\frac{\partial \Phi_{ib}}{\partial D_{ib}} = -\rho \left(1 + r^D(D_{ib})\right)^{-\rho-1} r^{D'}(D_{ib}) > 0,$$

since $r^{D'} < 0$. The cross-region derivative is analogous, scaled by $\theta^{-\rho}$.

□

Prediction 2 (More exposed banks expand lending in both regions)**.** *A mining boom increases bank b's funding capacity and lowers its loan rate in both the mining and non-mining regions. The effects are proportional to* ω_{Mb}*.*

Proof. Differentiate Φ_{ib} with respect to p_M, holding wages fixed. Since $\partial D_{Mb}/\partial p_M|_w = \omega_{Mb} M_M$ (Prediction 1) and $\partial D_{NMb}/\partial p_M|_w = 0$:

$$\left.\frac{\partial \Phi_{Mb}}{\partial p_M}\right|_w = \underbrace{-\rho \left(1 + r^D(D_{Mb})\right)^{-\rho-1} r^{D'}(D_{Mb})}_{>0} \omega_{Mb} M_M > 0, \tag{B.40}$$

$$\left.\frac{\partial \Phi_{NMb}}{\partial p_M}\right|_w = \underbrace{-\rho \left[\left(1 + r^D(D_{Mb})\right)\theta\right]^{-\rho-1} \theta r^{D'}(D_{Mb})}_{>0} \omega_{Mb} M_M > 0. \tag{B.41}$$

Since $R^L_{ib} = \Gamma \Phi_{ib}^{-1/\rho}$ (Equation B.20), differentiating:

$$\left.\frac{\partial R^L_{ib}}{\partial p_M}\right|_w = -\frac{\Gamma}{\rho} \Phi_{ib}^{-\frac{1}{\rho}-1} \left.\frac{\partial \Phi_{ib}}{\partial p_M}\right|_w < 0. \tag{B.42}$$

Bank b's loan rate falls in both regions. Since $\sigma_b > 1$, the CES loan aggregator from Equation B.21 implies that bank b's lending share $s_{ib} \equiv L_{ib}/L_i$ satisfies:

$$s_{ib} = \frac{\zeta_{ib} (R^L_{ib})^{1-\sigma_b}}{\sum_c \zeta_{ic} (R^L_{ic})^{1-\sigma_b}}. \tag{B.43}$$

Differentiating with respect toR^L_{ib}:

$$\frac{\partial \ln s_{ib}}{\partial \ln R^L_{ib}} = (1 - \sigma_b)(1 - s_{ib}) < 0 \quad \text{since } \sigma_b > 1. \tag{B.44}$$

So when R^L_{ib} falls, s_{ib} rises. Since $\partial R^L_{ib}/\partial p_M < 0$ and the magnitude is increasing in ω_{Mb}, more exposed banks expand their lending share in both regions:

$$\left.\frac{\partial s_{ib}}{\partial p_M}\right|_w > 0 \quad \text{for } i \in \{M, NM\}, \qquad \text{increasing in } \omega_{Mb}. \tag{B.45}$$

□

Routing ease $\theta^{-\rho}$. By taking the ratio of Equations B.40 and B.41, we can find the expression that governs the spatial reach of the funding shock. The cross-region passthrough of the funding-capacity response is:

$$\frac{\partial \Phi_{NMb}/\partial p_M}{\partial \Phi_{Mb}/\partial p_M} = \theta^{-\rho}.$$

For every unit of funding-capacity gain that the shock creates for lending in M, only $\theta^{-\rho}$ units of funding-capacity gain reach lending in NM. So it is the passthrough factor: what fraction of the local credit improvement reaches the other region.

Two parameters interact here: θ governs the unit cost of moving funds across regions, while ρ governs how aggressively the bank's cost index penalizes expensive sources. Lower θ (easier routing) and lower ρ (less substitutability, higher dispersion, bank is more willing to draw on expensive cross-region sources) both increase cross-region transmission. Then, a high ρ is an incentive for banks to keep funds local, while funds pool across regions with a low ρ.

B.5 Prediction 3: Lending composition tilts towards non-tradables

Lemma 5 (Sectoral loan demands and the non-tradable loan share)**.** *From Equation B.26, sectoral loan demands in region i are $L_i^T = \phi^T w_i n_i^T$ and $L_i^{NT} = \phi^{NT} w_i n_i^{NT}$. The non-tradable share of total lending in region i is:*

$$\lambda_i^{NT} \equiv \frac{L_i^{NT}}{L_i} = \frac{\phi^{NT} n_i^{NT}}{\phi^T n_i^T + \phi^{NT} n_i^{NT}}. \tag{B.46}$$

Lemma 6 (Monotonicity of the non-tradable loan share)**.** *The non-tradable loan share λ_i^{NT} is strictly increasing in n_i^{NT}:*

$$\frac{\partial \lambda_i^{NT}}{\partial n_i^{NT}} = \frac{\phi^{NT}\phi^T N_i}{\left(\phi^T n_i^T + \phi^{NT} n_i^{NT}\right)^2} > 0, \tag{B.47}$$

where we used $n_i^T = N_i - n_i^{NT}$ (Equation B.25) so that $\partial n_i^T / \partial n_i^{NT} = -1$.

Proof. Write $\lambda_i^{NT} = \phi^{NT} n_i^{NT} / \left(\phi^T (N_i - n_i^{NT}) + \phi^{NT} n_i^{NT}\right)$ and differentiate. The numerator of the derivative is $\phi^{NT}[\phi^T (N_i - n_i^{NT}) + \phi^{NT} n_i^{NT}] - \phi^{NT} n_i^{NT} (\phi^{NT} - \phi^T) = \phi^{NT}\phi^T N_i > 0$.

□

Prediction 3 (Lending composition tilts towards non-tradables)**.** *A mining boom raises the non-tradable share of lending in both the mining and non-mining regions.*

Proof. From Proposition 1 and Proposition 4 (derived below), n_i^{NT} rises in both regions following a mining boom. By Lemma 6, λ_i^{NT} is strictly increasing in n_i^{NT}, so:

$$\frac{d\lambda_i^{NT}}{dp_M} = \frac{\partial \lambda_i^{NT}}{\partial n_i^{NT}} \frac{dn_i^{NT}}{dp_M} > 0, \qquad i \in \{M, NM\}. \tag{B.48}$$

To see that the loan-share tilt exceeds the employment-share tilt, compare the non-tradable loan share with the non-tradable employment share $e_i^{NT} \equiv n_i^{NT}/N_i$. Since $\phi^{NT} > \phi^T$:

$$\lambda_i^{NT} = \frac{\phi^{NT} n_i^{NT}}{\phi^T (N_i - n_i^{NT}) + \phi^{NT} n_i^{NT}} > \frac{n_i^{NT}}{N_i} = e_i^{NT}, \tag{B.49}$$

where the inequality follows because $\phi^{NT}/\phi^T > 1$ overweights the non-tradable sector in the loan portfolio relative to its employment share.

Two forces tilt the loan portfolio toward non-tradables. First, the employment reallocation effect: Dutch disease shifts labor from tradables to non-tradables (Proposition 1 and Proposition 4), mechanically increasing non-tradable loan demand since $L_i^{NT} = \phi^{NT} w_i n_i^{NT}$. Second, the differential credit intensity effect: because $\phi^{NT} > \phi^T$, each worker who moves from tradables to non-tradables generates more loan demand in her new sector than she shed in her old one. Formally, the incremental loan demand from reallocating one worker is $(\phi^{NT} - \phi^T) w_i > 0$. The two forces reinforce each other: the mining boom both reallocates workers toward non-tradables and the reallocated workers demand disproportionately more credit.

□

Credit dependence differential $\phi^{NT} - \phi^T$. With $\phi^{NT} > \phi^T$, a fall in R_i^L reduces μ_i^{NT} by more than μ_i^T (Lemma 2):

$$\frac{\partial \mu_i^{NT}}{\partial R_i^L} - \frac{\partial \mu_i^T}{\partial R_i^L} = \phi^{NT} - \phi^T > 0. \tag{B.50}$$

Therefore, when R_i^L falls (due to the mining-driven deposit inflow), non-tradable production costs decline relative to tradable production costs. This creates a direct cost advantage for non-tradables beyond the spending channel. Since non-tradable prices fall relative to tradables (holding wages fixed), non-tradable output and employment expand by more than they would under common ϕ,

further amplifying the loan-share tilt. When the gap is zero ($\phi^{NT} = \phi^{T}$), there is no relative cost distortion and the differential cost channel vanishes entirely.

B.6 Prediction 4: Banks propagate Dutch disease to the non-mining region

Lemma 7 (Non-tradable employment in the non-mining region)**.** *Since $T^{M}_{NM} = 0$, Equation B.24 simplifies to:*

$$n^{NT}_{NM} = \frac{\alpha N_{NM}}{\mu^{NT}_{NM}}, \qquad n^{T}_{NM} = N_{NM}\left(1 - \frac{\alpha}{\mu^{NT}_{NM}}\right). \tag{B.51}$$

There is no direct spending channel from mining income. The only channel through which p_M affects NM is through the cost wedges μ^{T}_{NM} and μ^{NT}_{NM}.

Prediction 4 (Banks propagate Dutch disease to the non-mining region)**.** *A mining boom generates Dutch disease in the non-mining region through the banking channel. The mechanism operates through exposed banks whose mining-region deposit inflows lower funding costs for lending in the non-mining region.*

Proof. **Step 1: Mining deposits lower sourcing costs from M.** From Prediction 1, a mining boom raises deposits at exposed branches in M: $\partial D_{Mb}/\partial p_M|_w = \omega_{Mb} M_M > 0$. Since $r^{D'} < 0$ (Equation B.17), deposit rates at these branches fall:

$$\left.\frac{\partial r^{D}_{Mb}}{\partial p_M}\right|_w = r^{D'}(D_{Mb})\omega_{Mb} M_M < 0. \tag{B.52}$$

This reduces the sourcing cost $\kappa_{M,NM,b} = (1 + r^{D}(D_{Mb}))\theta$ (Equation B.18) for lending in NM funded from M.

Step 2: Lower sourcing costs raise funding capacity in NM. From Lemma 4:

$$\left.\frac{\partial \Phi_{NMb}}{\partial p_M}\right|_w = -\rho\left[\left(1 + r^{D}(D_{Mb})\right)\theta\right]^{-\rho-1}\theta r^{D'}(D_{Mb})\omega_{Mb} M_M > 0. \tag{B.53}$$

This is strictly positive for $\theta < \infty$ and increasing in ω_{Mb}. The economic mechanism is transparent: the mining deposit inflow lowers the cost at which bank b can source funds from M for lending in NM, raising its effective funding capacity.

Step 3: Lower bank funding costs reduce the regional loan rate. From Prediction 2:

$$\left.\frac{\partial R^L_{NMb}}{\partial p_M}\right|_w = -\frac{\Gamma}{\rho}\Phi_{NMb}^{-\frac{1}{\rho}-1}\left.\frac{\partial \Phi_{NMb}}{\partial p_M}\right|_w < 0, \qquad \text{increasing in magnitude with } \omega_{Mb}.$$

Through the CES aggregator (Equation B.21), the regional loan rate falls:

$$\left.\frac{\partial R^L_{NM}}{\partial p_M}\right|_w = \sum_b s_{NMb}\frac{R^L_{NM}}{R^L_{NMb}}\left.\frac{\partial R^L_{NMb}}{\partial p_M}\right|_w < 0, \tag{B.54}$$

where $s_{NMb} = \zeta_{NMb}\left(R^L_{NMb}\right)^{1-\sigma_b} / \sum_c \zeta_{NMc}\left(R^L_{NMc}\right)^{1-\sigma_b}$ is bank b's lending share. The magnitude of the decline in R^L_{NM} depends on the lending shares of exposed banks in NM.

Step 4: Lower loan rates reduce cost wedges asymmetrically. From Equation B.22:

$$\left.\frac{\partial \mu^T_{NM}}{\partial p_M}\right|_w = \phi^T\left.\frac{\partial R^L_{NM}}{\partial p_M}\right|_w < 0, \tag{B.55}$$

$$\left.\frac{\partial \mu^{NT}_{NM}}{\partial p_M}\right|_w = \phi^{NT}\left.\frac{\partial R^L_{NM}}{\partial p_M}\right|_w < 0. \tag{B.56}$$

Since $\phi^{NT} > \phi^T$, the non-tradable wedge falls by more:

$$\left|\frac{\partial \mu^{NT}_{NM}}{\partial p_M}\right| = \frac{\phi^{NT}}{\phi^T}\left|\frac{\partial \mu^T_{NM}}{\partial p_M}\right| > \left|\frac{\partial \mu^T_{NM}}{\partial p_M}\right|. \tag{B.57}$$

Step 5: Wages rise and non-tradable costs fall relatively more. From Equation B.23:

$$\frac{dw_{NM}}{dp_M} = -\frac{p^T A^T_{NM}}{(\mu^T_{NM})^2}\phi^T\frac{\partial R^L_{NM}}{\partial p_M} > 0. \tag{B.58}$$

Wages in NM rise even though NM receives no mining income directly. Additionally, the ratio μ^{NT}_{NM}/μ^T_{NM} falls, making non-tradable production relatively cheaper.

Step 6: Higher wages raise income and non-tradable demand. Since $Y_{NM} = w_{NM}N_{NM}$ (Equation B.15):

$$\frac{dY_{NM}}{dp_M} = N_{NM}\frac{dw_{NM}}{dp_M} > 0.$$

Non-tradable demand rises: $dX^{NT}_{NM}/dp_M = \alpha dY_{NM}/dp_M > 0$.

Step 7: Dutch disease in NM. Differentiating Equation B.51 with respect to p_M:

$$\frac{d\, n_{NM}^{NT}}{d\, p_M} = -\frac{\alpha\, N_{NM}}{(\mu_{NM}^{NT})^2} \underbrace{\frac{d\mu_{NM}^{NT}}{dp_M}}_{<0} > 0, \tag{B.59}$$

$$\frac{d\, n_{NM}^{T}}{d\, p_M} = -\frac{d\, n_{NM}^{NT}}{d\, p_M} < 0. \tag{B.60}$$

Labor reallocates from tradables to non-tradables in NM. Note that n_{NM}^{NT} depends on μ_{NM}^{NT} (not μ_{NM}^{T}), so the non-tradable credit dependence ϕ^{NT} is the relevant parameter for the direct employment effect. This means:

$$\frac{dn_{NM}^{NT}}{dp_M} = -\frac{\alpha N_{NM}}{(\mu_{NM}^{NT})^2} \underbrace{\frac{d\mu_{NM}^{NT}}{dp_M}}_{<0} = -\frac{\alpha N_{NM}}{(\mu_{NM}^{NT})^2} \phi^{NT} \underbrace{\frac{\partial R_{NM}^{L}}{\partial p_M}}_{<0} > 0, \tag{B.61}$$

which is strictly increasing in ϕ^{NT}.

□

Non-tradable credit dependence ϕ^{NT}. This is the direct amplifier of propagation into real outcomes. Equation B.61 shows the employment response is proportional to ϕ^{NT}. Higher non-tradable credit dependence amplifies the propagation of Dutch disease, as it means a given decline in R_{NM}^{L} translates into a larger reduction in μ_{NM}^{NT} and a larger increase in non-tradable employment.

B.7 Limiting cases

The model nests several important special cases that illuminate when the banking channel is active and when it shuts down.

Financial autarky ($\theta \to \infty$). When routing funds across regions is prohibitively costly, $\kappa_{M,NM,b} \to \infty$, so the contribution of M-sourced funds to Φ_{NMb} vanishes. The spatial passthrough $\theta^{-\rho} \to 0$: no fraction of the mining-region funding shock reaches the non-mining region. The banking channel is shut down and Dutch disease is confined to M. Banks still intermediate deposits locally, but they cannot transmit the credit shock across space.

Frictionless routing ($\theta = 1$). At the opposite extreme, $\kappa_{M,NM,b} = \kappa_{M,M,b}$, so the credit shock is transmitted at full strength: $\theta^{-\rho} = 1$. The non-mining region receives the same funding-cost reduction as the mining region. This is the upper bound on propagation; any $\theta > 1$ attenuates it.

No credit dependence ($\phi^T = \phi^{NT} = 0$). Cost wedges reduce to $\mu_i^T = \mu_i^{NT} = 1$ regardless of R_i^L. Credit conditions have no effect on production costs, wages, or employment. The banking sector still exists, banks collect deposits and make loans, but the real economy is insulated from credit conditions. Dutch disease in M reduces to the pure spending channel, and there is no propagation to NM.

Common credit dependence ($\phi^{NT} = \phi^T = \phi > 0$). The banking channel still operates: Prediction 1 and Prediction 2 are unchanged, and the credit amplification channel in Proposition 4 and Proposition 1 remains active. However, the differential cost channel vanishes: both wedges respond equally to R_i^L, so there is no relative cost advantage for non-tradables from the credit expansion. The sectoral asymmetry ratio $\phi^{NT}/\phi^T = 1$, the excess wedge response $\phi^{NT} - \phi^T = 0$, and the loan-share tilt in Prediction 3 collapses to the employment-share tilt ($\lambda_i^{NT} = e_i^{NT}$). Dutch disease still occurs, but its credit-driven component is symmetric across sectors.

Inelastic deposit rates ($r^{D'} \to 0$). Deposit inflows have no effect on the cost of funds: r_{ib}^D does not respond to D_{ib}, so sourcing costs κ_{mib} and funding capacity Φ_{ib} are unaffected by p_M. The entire credit channel is shut down. This case is equivalent to setting $r^D = 0$ in the full model's cost-index structure, which would make Φ_{ib} a constant. Dutch disease in M reduces to the spending channel alone, and there is no propagation to NM. This limiting case makes precise the role of $|r^{D'}|$ as the switch' for the banking mechanism: without deposit-rate sensitivity, deposit quantities cannot affect credit conditions.