Price Convergence Through a Financial Network: Does Financial Integration Impact Price Integration in Real Sectors?

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Financial development matters for real economic activities (King and Levine, 1993), which furthers economic growth (e.g., Black and Strahan, 2002) and impacts international trade (Paravisini et al., 2015; Caballero et al., 2018).

While international financial integration may lead to higher correlations in consumption and GDP across countries (Imbs, 2006), large welfare gains by risk sharing (Colacito and Croce, 2010), and alleviations in capital scarcity (Hoxha et al., 2013), the real effects of domestic financial integration have long been understated. In an advanced economy such as the United States, it is assumed that financial markets have been highly integrated since early times. Only recently has more research attention been cast on US banking integrations due to deregulation between the late 1970s and mid-1990s. These integrations expanded interstate trade by 17-25 percent (Michalski and Ors, 2012), explained up to one-fourth of the rise in cross-state house price correlation (Landier et al., 2017), and increased output synchronization by 13 percent of its standard deviation (Goetz and Gozzi, 2019). However, less is known about the past of developed countries and developing countries either due to a lack of data or because it is difficult to distinguish the impact of domestic financial integration from that of trade integration.

By examining a unique *domestic exchange market* during *the Chinese Civil War* (1945-49, hereinafter referred to as 'the Civil War'), this paper identifies the effect of domestic financial integration on commodity price integration in an underdeveloped economy. I measure financial integration and price integration by capital flow costs and commodity price convergence rates across cities, respectively. The domestic exchange market enabled interregional money transfers. Unlike today, money still had to be shipped across cities. The price of domestic exchange bills, the *domestic* exchange rate, would reflect the costs and risks of shipping money and is thus a good measure for capital flow costs. In the domestic exchange network, any two cities were connected directly (for bilateral exchanges) or indirectly via a financial hub city (for multilateral exchanges). As illustrated in **Figures 1-3** in the appendix, multilateral clearing between the city pair and the financial hub could reduce the amount of money shipped and decrease capital flow costs between the city pair. When commodity transportation between the city pair did not go through the financial hub, negative shocks to the hub from battles in the Civil War would mainly impede capital flows rather than the trade flows between these two cities. Therefore, the unique exchange market structure and geographic features separate the domestic exchange network from the trade network, which provides a channel to investigate whether dysfunction in the financial network would impair cross-regional price integration by impeding capital flows.

To implement this research design, I first compile a dataset by hand collection and digitization from numerous archived sheets[1] stored in microfilms at the National Library of China, as displayed in **Figure 4**. The data set contains six commodities' daily prices across 20 leading cities and daily domestic exchange rates across 58 city pairs from December 1945 to April 1949. I also document the detailed information[2] of 104 major battles in the Civil War, as shown in **Figure 5**. Furthermore, as displayed in

[1] Sources: *The Financial Weekly* and *The Credit News*, published by the Central Bank of the Republic of China.
[2] For each battle, I documented location, duration, number of soldiers involved, and casualties.

Figure 6, the domestic exchange networks are recovered according to Ma (2016) and my data collection from historical newspapers.

I then adopt a general convergence model to examine which factors affect the commodity price convergence:

$$\Delta p_{c,t} = \beta \cdot p_{c,t-1} + \Gamma_0 \cdot X_{c,t-1} + \Gamma_1 \cdot X_{c,t-1} \cdot p_{c,t-1} + Lags + FEs + \varepsilon_{c,t} \quad [1]$$

where $p_{c,t}$ is the price differentials between a city pair c at time t, the **first** term on the right side of **Equation [1]** indicates an auto convergence trend, while the **third** term represents shifts in convergence trend due to a vector of variables. *Lags* represent lagged terms of $\Delta p_{c,t}$ and *FEs* are various forms of fixed effects. A positive (negative) coefficient ahead of a variable indicates that it decelerates (accelerates) the price convergence. A more specific **Equation [2]** estimates the impact of capital flow costs on convergence

$$\Delta p_{k,c,t} = \beta \cdot p_{k,c,t-1} + \gamma_0 \cdot |DR_{c,t-1}| + \gamma_1 \cdot |DR_{c,t-1}| \cdot p_{k,c,t-1} + Controls + Lags + FEs + \varepsilon_{c,t} \quad [2]$$

where $p_{k,c,t}$ is the price differentials in commodity k between a city pair c at time t and $|DR_{c,t}|$ represents the absolute premium percentage in domestic exchange rates, reflecting the capital flow costs. As previously stated, to resolve the simultaneity issue between trade integration (auto convergence trend) and financial integration (capital flow costs), I create an indirect war risk measure as an instrumental variable for the exchange rate between a city pair. This measure calculates the average effects from battles to the city pair **only** via all hubs connecting them. The financial network effect is thereby identified: battles around a financial hub undermined the channel of multilateral clearings between the hub and a connected city pair, thus raising the absolute premium in the exchange rates. This change impeded the capital flows between the city pair and decelerated the price convergence accordingly.

Finally, I use the commodity prices to construct a cross-city inflation rate panel with a weighted average method. I further adopt the panel to test a weak form of purchasing power parity (PPP) hypothesis as displayed in **Equation [3]**: the inflation rate differentials between a city pair c, $\Pi_{c,t}$, were positively correlated with the percentage changes in domestic exchange rates, $\%\Delta\ in\ DR_{c,t}$:

$$\Pi_{c,t} = \theta_0 \cdot \Pi_{c,t-1} + \theta_1 \cdot (\%\Delta\ in\ DR_{c,t}) + \theta_2 \cdot (\%\Delta\ in\ DR_{c,t-1}) + FEs + \varepsilon_{c,t} \quad [3]$$

The main findings and contributions of this paper are fourfold. First, I show that the domestic exchange market provided an efficient channel for price convergence across regions, even in an underdeveloped economy with political uncertainty. During the Civil War, any pair of cities with a direct domestic exchange connection exhibited faster commodity price convergence (a half-life of 22.17 days) than those making payments only via a financial hub (23.73 days). These half-lives are much smaller than studies on other countries or in other periods, such as approximately nine years in the United States (Cecchetti et al., 2002), three to six weeks in Mexico (Elberg, 2016), and on average 2.35 months in China during the late 1990s (Fan and Wei, 2006). This paper makes quantitative contributions to a strand of literature that investigates the institutional role and efficacy of the domestic exchange market before the introduction of the central banking system (Garbade and Silber, 1979; Bodenhorn, 1992; Phillips and Cutler, 1998; Knodell, 1998; and James and Weiman, 2010).

Second, in the domestic exchange network, a weaker connection to a financial hub due to battles decelerated the commodity price convergence between two other cities connected to it by four to eight percent, as displayed in **Table 1**. This result contributes to the research on market integration (Shiue, 2002; Jacks, 2006; Ejrnæs and Persson, 2010; and Hynes et al., 2012) with the implication that a financial system could play an essential role in leading market integration in addition to the influences from information and transport technology, institutional barriers to trade, geography, and monetary regimes.

Third, this paper applies the classical PPP theory to a domestic case: as displayed in **Table 2**, I show that one percent depreciation in the domestic exchange rate was associated with a 0.2-0.3

percentage point reduction in inflation rate differential. Numerous studies have tested multiple forms of PPP across countries using different currencies in both the long term and short term (Abuaf and Jorion, 1990; Rogoff, 1996). Other studies have also examined countries using the same currency as in a monetary union (Rogers, 2007). However, when they turn to an intra-national case, most studies view 'nominal exchange rates' as one across regions due to their unawareness of domestic exchange rates. Therefore, this paper is the first to confirm that a weak form of PPP existed between domestic exchange rates and cross-regional prices, to the best of my knowledge.

Finally, this paper is related to studies on China's economy concerning domestic financial integration (Keller et al., 2015 and Ma and Zhao, 2020) and its integration with the rest of the world (Jacks et al., 2017). While Keller et al. (2015) show that China's capital market was much less efficient than Britain's in the eighteenth and nineteenth centuries, my work, similar to Ma and Zhao (2020), reveals that the evolution in China's financial system developed more than expected relative to its status as an agricultural economy no later than the early twentieth century. As noted in Gat (2008), China's world share of GDP (32.9 percent) in 1820 was much higher than that (8.9 percent) in 1913. The great contrast between financial advance and economic falling-behind would motivate a revisit on the main driving force of China-West divergence.

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Appendix

Figure 1: Bilateral Domestic Exchanges

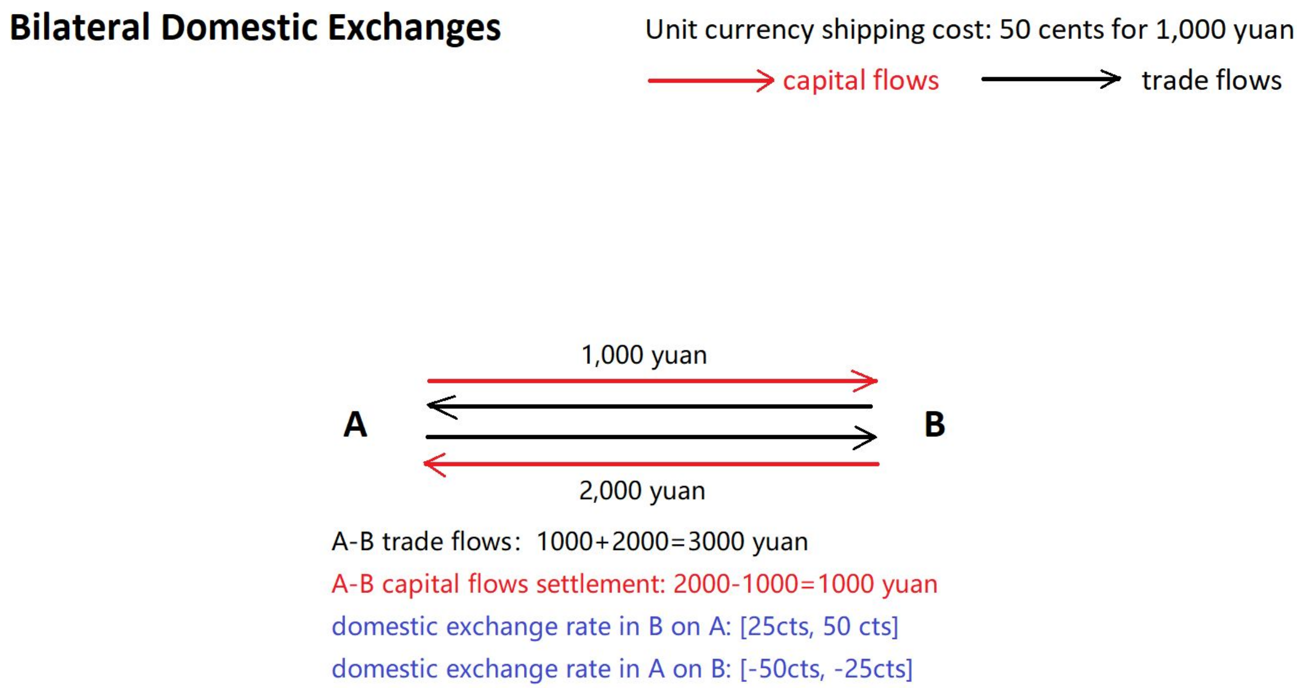


Figure 2: Multilateral Domestic Exchanges without Battle Shocks

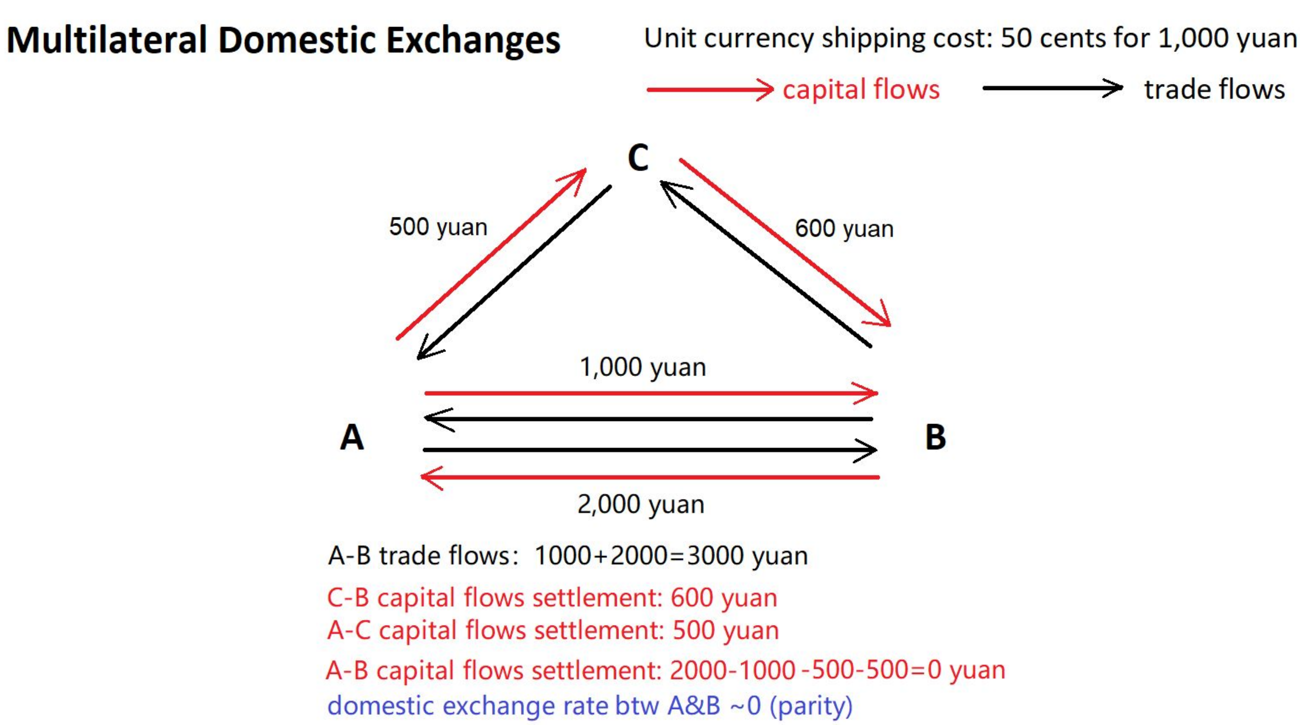


Figure 3: Multilateral Domestic Exchanges with Battle Shocks

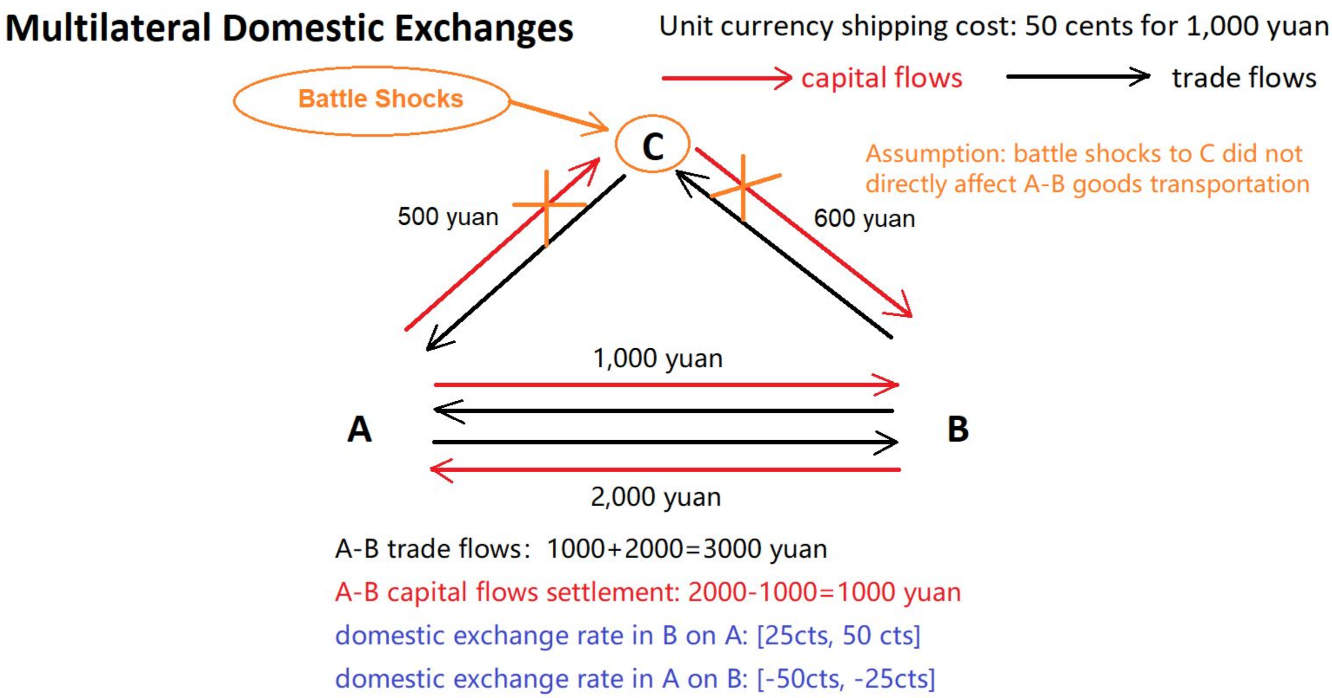


Figure 4: Collecting Sheets from an Archive Microfilm with a Film Projector

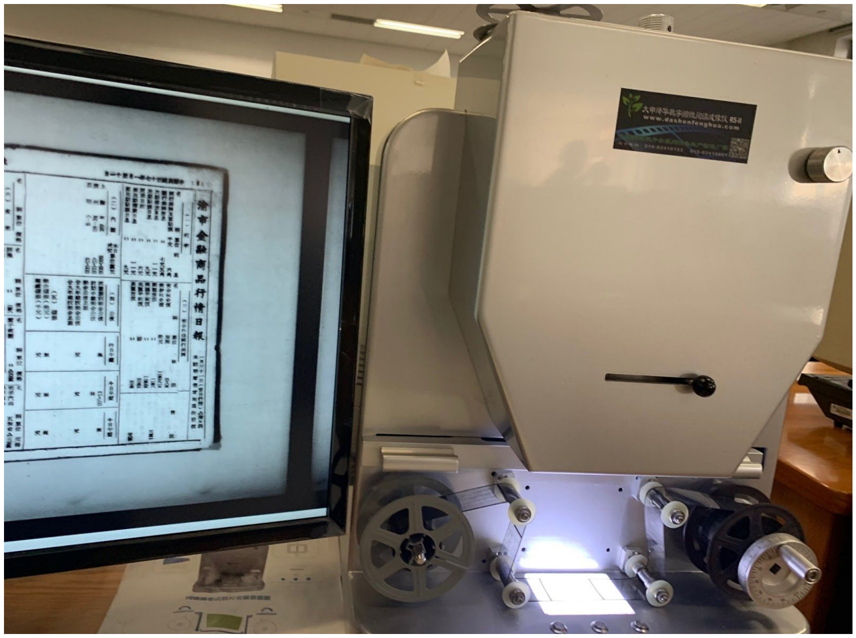


Figure 5: Major Battles in the Chinese Civil War (October 1945-April 1949)

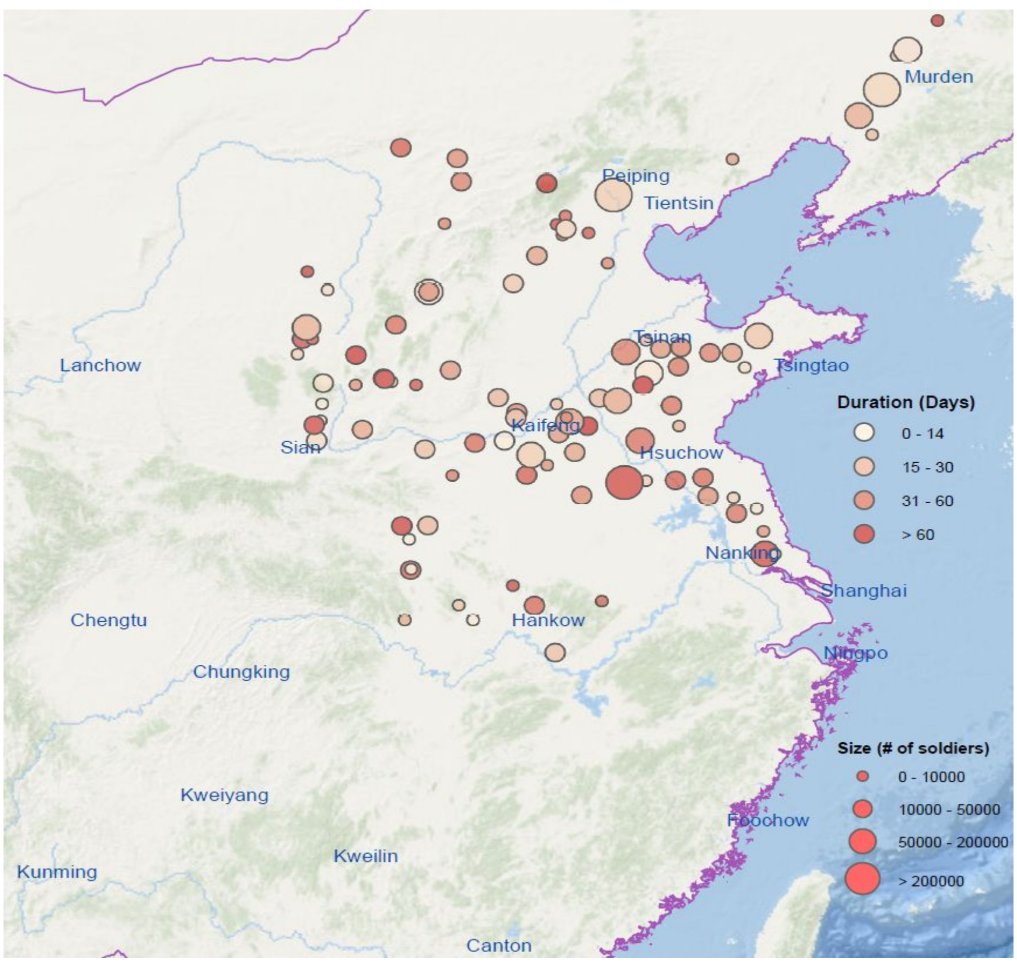
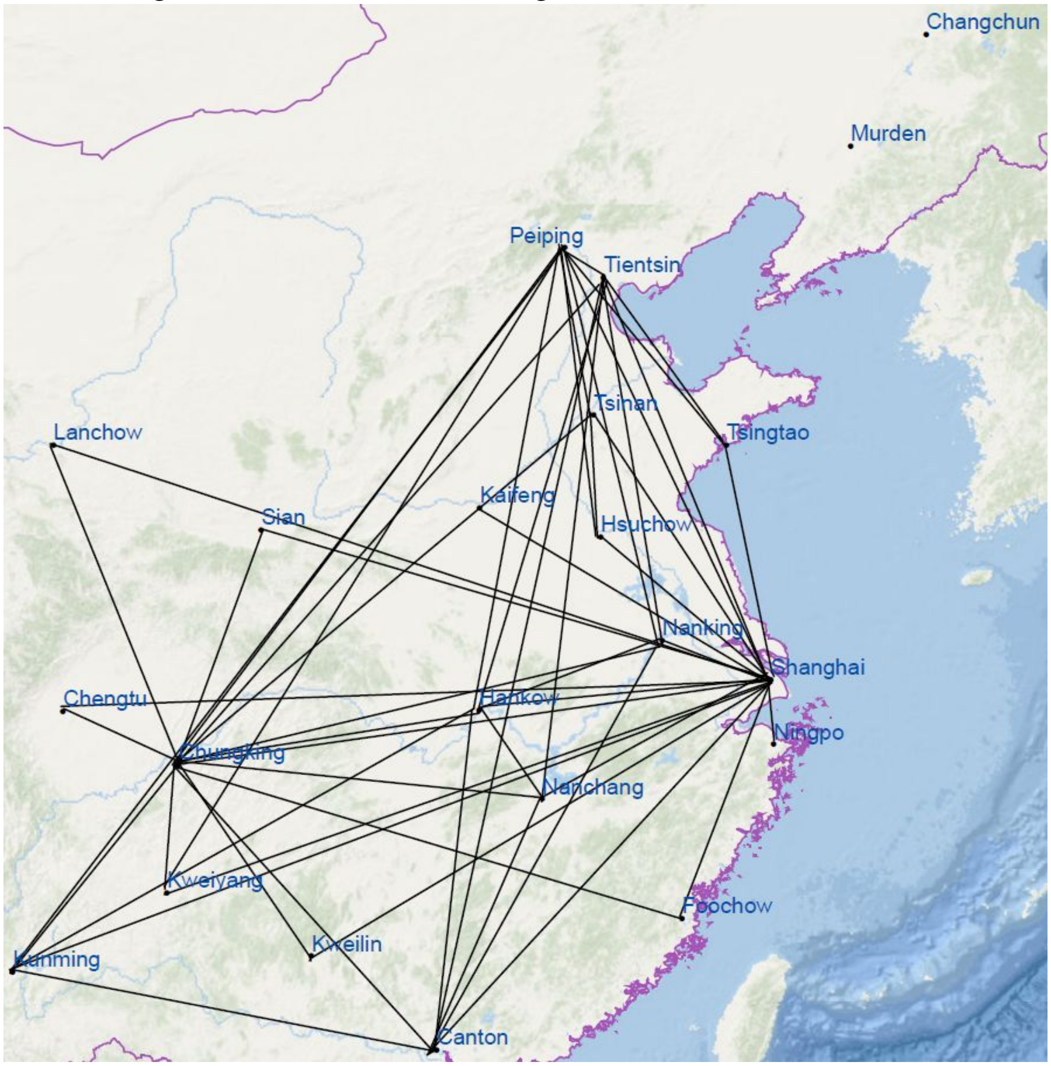


Figure 6: The Domestic Exchange Network in China: 1945-49



Note: A black edge connecting two cities represents a direct domestic exchange (link) between the city pair.