Networked Leaders in the Shadow of the Market – A Chinese Experiment in Allocating Land Conversion Rights

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Abstract: Concerns over the loss of cultivated land in China have motivated a system of centrally mandated annual land use quotas effective from provincial down to township levels. To facilitate efficient land allocation, a groundbreaking policy in the Zhejiang province allowed sub-provincial units to trade land conversion quotas. We theoretically model and empirically estimate the drivers of local government participation in this program to shed light more broadly on the drivers of local government decision-making. We find robust support for three sets of factors: administrative autonomy at the sub-provincial level, market forces, and prior network connections of local government leaders.

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1 Introduction

What drive the decision-making of local government leaders in China? We examine a unique policy experiment in the Zhejiang Province of China in which sub-provincial level governments were empowered to trade land conversion rights with one another (Zhang et al. 2014, Chau-Zhang 2012, Wang et al. 2010). The program allowed local governments to more flexibly manage urban development and preservation objectives at the local level, while safeguarding province-wide obligation to the central government to preserve agricultural land. This experiment offers a rare look at the endogenous formation of local government matches as buyer-seller pairs of land conversion quotas. We argue that an examination of the determinants of such matches can generate new insights on the drivers local government decision-making. Does administrative autonomy matter? Do market forces matter? Do personal traits such as the network ties of local government leaders matter?

Administrative decentralization – the devolution of decision-making power to local level government units – is a subject of longstanding interest particularly as a determinant of governance effectiveness to deliver public services (Inman and Rubinfeld 1997). The issue has also been singled out by current Chinese leaders as one of the center stage reform directives on the policy agenda today (Feigenbaum and Ma 2014, CRI 2013, SCMP 2013). This directive was preceded by numerous attempts by lower level governments to petition for socio-economic decision-making authority (Yu and Gao 2013).[1] One of the key advantages of administrative decentralization is better targeting through better recognition of local demand and cost conditions (Coase 1960, Besley and Coate 2003, Barankay and Lockwood 2007) as long as accountability of the local leaders is assured (de Melo and Barenstein 2001, Bardhan and Mookherjee 2006). The need for better targeting in China is acute particularly in land use planning where an elaborate system of planning quotas down to the township level is in place often without particular regards to market forces (Zhang et al. 2014). Indeed, despite drastic differences in local conditions, the centrally mandated farmland preservation rate is set at 85% for most localities with allowable deviations of no more than 1 - 2% (Wang et al. 2010).

In addition to administrative autonomy, to what extent do market forces exert influence on local governments' decision making? In the case of China, across all provinces between 1999 - 2006, net revenue from land leases for private non-agricultural purposes makes up almost a third of

[1] These include for example the authority to make basic production construction projects, infrastructural investments, or technical upgrades (Zhejiang Provincial Government 1992, 2002, 2008, Yu and Gao 2013).

local extra-budgetary revenue on average at the provincial level.[2] Government revenue per hectare of leased land, ranging from $0.34 million yuan per hectare in Xinjiang to $1.82 million yuan per hectare in Tianjin, shows significant correlation with provincial level construction land demand and supply conditions (Chau and Zhang 2011). Based on these figures alone, beneficial opportunities for arbitrage exist. The Zhejiang experiment contends that these arbitrage opportunities exist even within a province across sub-provincial jurisdictions.

As an additional factor that can potentially shape local government decision-making, a growing literature suggests that the personal traits of government leaders matter (Jones and Olken 2005, Göhlmann and Vaubel 2007, Chattopadhyay and Duflo 2004). In the context of China, a central government policy directive since 1962 requires that all local government leaders at county level or above be rotated at regular intervals (Huang 2002).[3] Respectively for county-level and prefectural level government leaders, the rotation will be within prefecture, and within province, for example. The system is expected to prevent political capture, promote accountability, and facilitate information exchange (Wu 2010). In the context of land conversion quota trading, where market based incentives for mutually beneficial exchange in land conversion quotas can function only when transaction costs are not too high (Coase 1937, Williams 1975, 1981, Stavins 1995), these leader qualities can play a particularly important role in mitigating transaction costs facing networked leaders.

This paper examines the salience of these three sets of issues through the lens of the policy of land conversion quota trading in the Zhejiang province of China. In compliance with the Chinese Constitution, land use allocation is founded on a system of public land ownership either by collectives or by the state, as well as an extensive system of centrally mandated annual quotas that governs the rate of land conversion from agricultural to non-agricultural uses. The land conversion quota trading scheme in Zhejiang in September 1999 was a unique provincial level initiative created to facilitate sub-provincial units with excess demand for land conversion quotas to negotiate directly with units with under-utilized supply (Ministry of Agriculture of the People's Republic of China

[2]Revenue that local governments collect from the leasing and the transfer of land use rights for non-agricultural purposes is fully retained within the local government by law (Beijing Local Taxation Bureau 2003) as part of extra-budgetary revenue. Extra-budgetary revenue is made up of a number of revenue items not included as part of provincial budgetary revenue, and hence beyond the monitoring of the National People's Congress. This includes revenues and income of institutional and administrative units, specialized funds held by state-owned enterprizes, and fees and incomes collected from local enterprises.

[3]There are five levels of government in China. The central government, provincial level units, prefecture level units, counties, and townships. In addition, there are also numerous villages below the township level (Lin, Tao, and Liu 2003).

2004, Tong and Chen 2008 and Wang et al. 2009).[4] For a period of five years of uninterrupted operation from 1999 - 2003,[5] we compile a novel dataset based on internal statistics from the Zhejiang Provincial Department of Land and Resources. The data reveal that the trading scheme received popular support, with 570 land conversion quota trade activities across the 99 sub-provincial units (including counties or county level cities, urban districts and urban jurisdictions) in the five year period. However, as will be seen in greater detail in Section 2, participation was by no means universal. Furthermore, participation did not appear to be random. We are thus motivated by the question, what drive local government leaders to act?

The approaches we adopt to address these questions are two-fold. We propose a model of land conversion quota trade incorporating administrative autonomy, market forces, and government leader connections as potential drivers. We then empirically test the implications of the model by putting together a dataset combining information on land conversion quota transactions, proxies for administrative autonomy, market forces, as well as a novel dataset on network connections of local government leaders, including birthplace linkages, educational linkages, and career linkages.

In so doing, this paper contributes to three sets of literatures. First, to the literature on tradeable permits, be they emission permits (Chichilnisky and Heal 1995), development rights allowances (Mills 1980), or land conversion quotas (Tavares 2003, Thornes and Simon 1999) as in our case, we introduce a sorting theory of matching (Becker 1973) in which the price and volume of each transaction is individually and simultaneously negotiated, and the matching of buyers and sellers is endogenously determined from the same distribution of heterogeneous localities.[6] We derive the joint output of a match from first principles, so that the roles respectively of administrative autonomy, market forces, and network connections that mitigate against transaction costs can be shown.

In a pure competitive equilibrium without government leader network connections, the extent of administrative autonomy as well as the size of the transaction cost is shown to dictate the boundary between active and inactive leaders. Among active leaders, equilibrium exhibits negative

[4]In Fujian, Guangdong, and Jiangsu, programs that allow construction land use quotas to be gained from land consolidation efforts can also be found. However, Zhejiang is the only province in which the policy of land conversion quota trading (*tudi zhengli zhedi zhibiao*) was officially sanctioned by the province (Wang et al. 2010).

[5]In 2003, the national Ministry of Land and Resources issued a Notice that prohibited the assignment the land conversion zones without Ministry approval. The number of land conversion quota transaction was drastically reduced from a high of 247 transactions province-wide in 2002 to 2 transactions in 2004. In 2004, the Zhejiang province also set up the equivalent of a land conversion quota bank that allows local governments to better identify the location of available supply, and to seek available buyers.

[6]This is in contrast to the standard sorting setup in which the set of buyers, sellers, and their characteristics are exogenously given (Sattinger 1993).

assortative matching, linking localities with high demand with localities with low demand for land quotas. Conditional on administrative autonomy and transaction costs, the equilibrium is constrained efficient, consistent with Becker (1973). But when select leader pairs may be connected and as such privy to private informational advantages that mitigate against transaction costs, network mediated trade presents an alternative option relative to the pure market based outcome. Our model shows interestingly that an examination of the determinants of trade conditional on having a network connection can generate insights on whether and how network-induced trade, despite their ability to reduce transaction cost, can nonetheless introduce match distortions relative to the market based outcome.

Contributing to the empirical literature on tradeable permits more generally, this paper presents to the best of our knowledge first evidence on the determinants of inter-governmental transactions in tradeable permits. Existing studies in this area are typically concerned with: the productivity / efficiency implications of the trading scheme (Tietenberg 1999); the ability of the program to fulfill preservation and / or environmental goals ((Montero 1999)), and the participation of firms and individuals (Machemer and Kaplowitz 2002). Furthermore, in all cases, the studies concern almost exclusively developed country programs (Johnston and Madison 1997, McConnell, Kopkits and Walls 2005, Talberg and Swoboda 2013). Developing country studies are limited to case studies to date[7] and none has provided econometric evidence on performance of tradeable development rights programs in a developing country.

This paper also relates to the broad literature on jurisdictional competition in the presence of fiscal decentralization (Tiebout 1956, Qian and Roland 1998). Notably, in this literature, local government leaders are typically assumed to possess administrative autonomy in all matters of local socio-economic governance. Our model, as well as the empirical evidence provided here, suggest that in fact such an assumption may not always be taken for granted.

Finally, this paper extends the literature on the role of leader characteristics in determining policy outcomes (Olken and Jones 2005) by introducing government leader networks as an additional contributing factor. In this regard, a growing literature has already demonstrated the importance of networks determining the pattern of international trade (Grief 1993), the performance of venture capital funds (Hochberg et al. 2007), the quality of exports (Feenstra et al. 1999), and the cost of search particularly in differentiated product markets (Rauch 1999), for example. Our knowledge base is extremely limited concerning the role of government leader network in driving

[7]See for example Coria and Sterner (2010) for the case of tradeable emissions permit in Chile.

policy decisions on matters of interdependent concerns. This is particularly interesting in the case of China, where the effectiveness of the rotation system of personnel management has in fact not yet received any rigorous scrutiny to date. As we will show, linkages to different locations developed over the course of the career of a local leader is of paramount importance in the types of trade we are studying.

For identification, our baseline model is a proportional hazard model (Cox 1972). The econometric specification is based on a gravity setup, which simultaneously accounts for the importance of sources of influence originating from both the buyer and the seller locations. This model ascertains the trade hazard rate among buyer-seller locations depending on the characteristics of the two parties. The model is semiparametric, and does not depend on particular assumptions on the distribution of time to trade. This baseline model is followed by a series of robustness checks, incorporating first trade event regressions, logit analysis on the proportion of matches, specifications that account for two-way causality, unobserved heterogeneity and different types of network connections, for example. Three sets of results are notable, covering market forces, administrative decentralization, and network connections between local governments.

First, using GDP per capita as a proxy for construction land use demand, we confirm that indeed land demand factors contribute significantly to the likelihood of a match between potential buyer and sellers location pairs, and does so in opposite directions – higher GDP per capita in a buyer locality raises the likelihood of a match, while higher GDP per capita in a seller locality lowers the likelihood of a match. This is among the most robust of our findings and holds for all of the specifications we have worked with. In addition, other scale factors such as land area, whether the location is a county or a district have also be accounted for. These are consistently and statistically significant throughout.

Second, we develop a proxy measure for administrative decentralization. We make use of a 1992 policy notice from the Zhejiang provincial government that gave a list of 13 sub-provincial governments additional adminsitrative authority over their own socio-economic affairs, including decision making authority on infrastructure projects and the like.[8] This policy notice is the first official policy document on the devolution of administrative authority from the Zhejiang Province (Yu and Gao 2013, Zhejiang Provincial Government 1992).[9] Interestingly, we find that being a buyer county located in one of these thirteen counties is associated with a significantly increased

[8]These include: Xiaoshan, Yuhang, Yinxian, Cixi, Yuyao, Haining, Tongxiang, Shaoxing, Huangyan, Jiaxing, Pinghu, Haiyan, and Jiaojiang (Yu and Gao 2013, Zhejiang Provincial Government 1992).

[9]The next policy document which targeted a generally broaden of the decentralization of administrative authority was published in 2002 (Yu and Gao 2013, Zhejiang Provincial Government 2002).

likelihood of land conversion quota trade. This provides suggestive evidence that administrative authority is indeed a key factor affecting the demand for land conversion quotas.

Third, we collected a novel dataset based on published resumes of each county/district head and county/district party leader (*shuji*) during the period of our analysis. We consider four types of networks: career networks to capture work location experience, birthplace networks, education networks to capture education location linkages, and a fourth one that includes all three. For each of the four types of networks, we define two districts as connected if at least one of the two leaders in the two localities is linked with the other location. Our findings show that of the four network variables, both the overall network variable and the career network variable contribute positively to the likelihood of a match. This result consistently significant and robust in our estimations.

Finally, we also interact the network variable with local GDP per capita. The results are interesting. We find that conditional on having a network connection, higher GDP per capita in a buyer locality can in some cases decrease the likelihood of match, contrary to expectations, and contrary also to the results we find from overall population of local governments. Though this result is not significant in some of our specifications, our theoretical framework offers one possible answer. Namely, that government leader network link leaders that are from relatively affluent localities. Consequently, localities that should otherwise be buyers in a market without transactions may be turned into sellers when trade is mediated via networks. Furthermore, even more affluent buyers may well refrain from network mediated trade, precisely because the associated match distortion from the market based outcome is too great. That said, we find that the land conversion quota program is effective overall in matching locations of high demand with those with low demand, even accounting for the fact that trade mediated via network operate slightly differently.

The rest of this paper is organized as follows. In Section 2, we describe in greater detail the policy environment and the specific features of the Zhejiang land conversion quota trading scheme. In Section 3, a sorting theory of land conversion quota trade in presented and the empirical implications of the determinants of trade are explained. Section 4 describes the data, and Section 5 discusses our identification strategy. Section 6 discusses the main findings results of our baseline estimations. Section 7 is devoted to a series of robustness checks and Section 8 concludes.

2 The Zhejiang Land Conversion Quota Trading Scheme

The 1986 Law of Land Administration is the inaugural piece of comprehensive land legislation enacted in China. An amendment in 1998 focussed on agricultural land use, and by January 1999,

a new system of land use planning quotas became effective. These planning quotas governed the permissible allocation of land to non-agricultural uses in all regions and jurisdictions in China. National level planning quotas in effect between 1997 - 2010 for example required at a minimum no less than 128 million hectares of reserved cultivated land in total, while conversions from cultivated to construction land must not exceed 1.97 million hectares (Chau and Zhang 2012). Relevant particularly for local governments that desire flexibility, Article 18 of The Regulations on the Implementation of the Land Administration Law states a nation-wide policy directive, aimed at encouraging local governments who wish to expand the allocation of construction land by engaging in raising the supply of cultivated land through land consolidation (Ministry of Agriculture of the People's Republic of China 2002, Wang, Tao and Tong 2009).[10] Specifically, the Article states that

> "People's governments at all local levels should, pursuant to the comprehensive land use planning, take measures to press ahead with land consolidation. Sixty percent of the area of the newly-added cultivated land through land consolidation can be used as compensation quotas for cultivated land occupied for construction."

A similar 1998 Zhejiang province notice flexibly interprets this Article, and stipulates that 72% of the total areas of added effective cultivation can be used as rewarded quota for approved infrastructure, core village, small town and industrial district (Zhang et al. 2014). These decisions created powerful incentives for local governments to engage in land consolidation. Strikingly, the addition of new cultivated land in China during the 1999 - 2006 period reached a total of 3.5 million hectares. This is greater than the amount of land approved for use in construction projects. Nonetheless, accounting for other sources of land loss such as natural hazards, and agricultural reorganization, there was an overall decline in the total amount of arable land (Chau and Zhang 2011). Furthermore, excess demand for land conversion quota continue to persist in some locations, while in other locations, land conversion quotas were under-utilized. The land conversion quota trading scheme in Zhejiang in September 1999 was created specifically to facilitate locations with excess demand for land conversion quotas to negotiate directly with locations with under-utilized supply. Both the price and the volume of these transactions were negotiated between buyers and sellers, subject to approval from the Zhejiang Bureau of Land and Resources (Wang et al. 2010, and Zhang et al. 2014).

[10] According to Article 41 of the Land Administration Law of the People's Republic of China, land consolidation refers to the consolidation of fields, ponds, roads, woods and villages to raise the quality and increase the supply of cultivated land (Zhang et al. 2014).

We collect a novel data set based on internal statistics from the Zhejiang Provincial Department of Land and Resources on both the incidence as well as the buyer-seller pairs that participated in the trade in land conversion quotas. As noted, there are altogether 570 land quota trade activities across counties/districts in Zhejiang province during 1999 to 2003. For each trading activity, the data set records the names of the exporting and importing jurisdiction, the year the trade took place, the areas being traded, and the price being paid. We illustrate in Figure 1 buyer localities, seller localities, localities that both bought and sold, and localities that neither bought nor sold in the five year period between 1999 - 2003. The land conversion quota trade began in 1999, with only 11 trading activities during that year. The number of trade increased significantly to 83 in year 2000, further increased by 149 in 2001, peaked in 2002 at a recorded high of 247 events, and decreased to 80 trading activities in 2003.

As can be seen, the program appears to be well-received, although a number of other features are also notable. First, the number of localities that never traded is small in most years but non-trivial. Second, seller locations and buyer locations are quite stable over time, indicating that location specific forces may be at play. Third, there are multiple localities that both bought and sold during the same year, though not with the same partner. Motivated by these observations, we ask, what factors determine this market-based matching of buyer and seller locations? We first turn to a theoretical examination of these issues.

3 A Model of Land Conversion Quota Trade

Consider an economy made up of a continuum of potential land consolidation locations of measure one. A government policy mandates that (i) all locations are subject to construction land use quotas, and (ii) engaging in land consolidation to increase the supply of agricultural land can generate additional construction quotas. Let construction land use in excess of the quota be given by $x \geq 0$, and the preference of each location with respect to x be approximated by a strictly concave quadratic utility function:

$$U(x, \beta) = \alpha + \beta x - \gamma x^2/2, \quad \alpha, \beta, \gamma > 0.$$

We assume that the total land consolidation cost needed to generate extra construction land quota is quadratic in x, at $cx^2/2$, with $c > 0$.

In order to focus on locational heterogeneity in terms of the willingness to pay for over the quota construction land use, we assume that β differs along the locational continuum, with all else

equal. Specifically, we assume that β follows a uniform distribution in the positive interval $[\beta^-, \beta^+]$.

Self-Sufficiency

As benchmark, we define a self-sufficient equilibrium as one in which each location engages in land consolidation to satisfy local over-the-quota construction land demand. Such an equilibrium solves a planning problem which maximizes $U(x, \beta)$ net of the cost of land development, $cx^2/2$. Let $x^o(\beta)$ denote the corresponding solution, with

$$x^o(\beta) = \frac{\beta}{\gamma + c}.$$

The associated welfare of the location is

$$u^o(\beta) \equiv U(x^o(\beta), \beta) - cx^o(\beta)^2/2 = \alpha + \frac{1}{2}\frac{\beta^2}{\gamma + c}.$$

β matters clearly both in terms of the quantity $x^o(\beta)$ as well the equilibrium willingness to pay $\partial U(x, \beta)/\partial x|_{x=x^o(\beta)} = \beta c/(\gamma + c)$. These differences in equilibrium willingness to pay across locations in turn presents the motivation for trade in land conversion quota across locations.

Quota-Neutral Gains from Trade

As discussed in Section 2, the policy of land conversion quota trading facilitates construction land use beyond autarky levels in some localities, as it rewards land consolidation beyond local needs in other localities. Consider any location with demand parameter β_b in search a partner location, say with demand parameter β_s to be determined endogenously in the sequel, from which trade conversion quotas can be purchased:

- the buyer location consolidates $x_b(\beta_b, \beta_s)$ amount of land for own consumption, and consumes an additional $m(\beta_b, \beta_s) \geq 0$ units of imported quota;
- a seller location engages in the consolidation of $x_s(\beta_b, \beta_s)$ amount of land for own consumption and an additional $e(\beta_b, \beta_s) \geq 0$ units as exported quota;
- the buyer location compensates the seller location by a monetary transfer of $p(\beta_s)$ amount in competitive equilibrium to be endogenously determined below;
- there is a transaction cost associated with all negotiated trades to be shared between the buyer and the seller, $T \geq 0$;

- trade between matched buyer-seller pairs can be struck down ex post due for example to administrative uncertainty. $q \in [0,1]$ denotes the likelihood that trade between a matched pair is ultimately consummated.

We account for the maximal joint gains from trade by any buyer-seller pair (β_b, β_s) by a joint expected surplus function $S(\beta_b, \beta_s)$. Pick any pair of $\beta \in [\beta^-, \beta^+]$, and denote the larger of the two β_b, and the smaller of the two β_s. If they are the same, then assign $\beta_b = \beta = \beta_s$. The joint expected surplus function chooses a positive vector of local consumption (x_b, x_s), and trade volumes (m, e) to maximize the sum of the expected gains in welfare in the two locations over and above autarky levels $u^o(\beta_b)$ and $u^o(\beta_s)$:[11]

$$\begin{aligned} S(\beta_b, \beta_s) \equiv \quad & \max_{x_s, x_b, e, m} \quad q\left[U(x_s, \beta_s) - c(x_s + e)^2/2 - u^o(\beta_s)\right] \\ & + q\left[U(x_b + m, \beta_b) - c(x_b)^2/2 - u^o(\beta_b)\right] - T \end{aligned} \tag{1}$$

subject to the constraint that

$$e = m.$$

The first term in parenthesis is the expected gains from trade in the exporter location, and the second term in parenthesis the importer location's expected gains from trade. The constraint $e = m$ ensures that the policy of land quota trading does not exceed aggregate construction land use quota at the trading pair level.[12] The solution to (1) is given by:[13]

$$S(\beta_b, \beta_s) = \max\{q\theta\left(\beta_b - \beta_s\right)^2 - T, 0\}, \quad \theta \equiv c/[4\gamma(\gamma + c)]. \tag{2}$$

As shown, $S(\beta_b, \beta_s)$ is strictly positive for all β_b, and β_s such that $\beta_b - \beta_s > \sqrt{T/q\theta}$, increasing in β_b, decreasing in β_s, and submodular in β_b and β_s.[14] It follows, therefore, across two potential buyers $\beta_b > \beta_b'$, and two potential sellers $\beta_s > \beta_s'$, aggregate surplus is maximized by matching the buyer with the highest demand parameter with the seller with the lowest demand parameter, followed by the buyer with the next highest demand with the seller with the next lowest demand, for by submodularity,

$$S(\beta_b', \beta_s) + S(\beta_b, \beta_s') > S(\beta_b, \beta_s) + S(\beta_b', \beta_s').$$

In what follows, we check to see if negative assortative matching is borne out in equilibrium.

[11] In evaluating the joint expected surplus, the transfer $p(\beta_s)$ of the paying and receiving ends cancel out.

[12] It is straightforward to check that (1) above is a strictly concave problem with a unique solution for every β_s, β_b pair with $\beta_b \geq \beta_s$.

[13] The associated exports and imports of land use quota is given by $e_s = m_b = \frac{1}{2}\frac{\beta_b - \beta_s}{\gamma}$.

[14] To see this, note that for any $\beta_b > \beta_b'$, and $\beta_s > \beta_s'$, $S(\beta_b, \beta_s) + S(\beta_b', \beta_s') < S(\beta_b', \beta_s) + S(\beta_b, \beta_s')$. In standard sorting theories of match formation (Becker 1973, Shimer and Smith 2000), the core allocation entails negative assortative matching where higher β_b are matched with low β_s.

3.1 Competitive Equilibrium and Assortative Matching

We consider a competitive equilibrium, made up of (i) a division of the range of all localities into the set of buyers $\Omega_b \subset [\beta^-, \beta^+]$ and sellers $\Omega_s \subset [\beta^-, \beta^+]$, and (ii) an assignment function $b_s(\beta_b)$ which gives the equilibrium assignment of the seller demand parameter $\beta_s \in \Omega_s$ given buyer demand parameter $\beta_b \in \Omega_b$, and (iii) a competitively determined payment schedule for a seller with β_s from any buyer, $p(\beta_s)$.

In a competitive equilibrium, three conditions are met. First, each potential buyer locality takes the payment schedule $p(\beta_s)$ as given, and chooses seller locality in such a way that the net surplus of the buyer locality is maximized:[15]

$$\max_{\beta_s} S(\beta_b, \beta_s) - p(\beta_s) = \max_{\beta_s} q\theta \left(\beta_b - \beta_s\right)^2 - p(\beta_s) - T. \tag{3}$$

Second, the measure of the range of all sellers is equal to the measure of the range of all buyers, or, $\int_{\beta\in\Omega_s}(1/[\beta^+ - \beta^-])d\beta = \int_{\beta\in\Omega_b}(1/[\beta^+ - \beta^-])d\beta$. Third, localities can freely participate in the trade in land conversion quotas and as such equilibrium expected surplus net of transaction cost is non-negative.

We relegate the details of the proof the properties of the competitive equilibrium to the appendix. In what follows, we provide an intuitive presentation of these properties. First, we find that for all $\beta_s \in \Omega_s$ and $\beta_b \in \Omega_b$, the equilibrium assignment function $b_s(\beta_b)$ is strictly decreasing in β_b consistent with negative assortative matching, and takes the form:

$$b_s(\beta_b) = \beta^+ + \beta^- - \beta_b, \tag{4}$$

so that for example, the buyer location with the highest demand $\beta_b = \beta^+$ is matched with a seller location with the lowest demand for construction land $b_s(\beta^+) = \beta^-$, the next highest demand buyer is matched with the next lowest demand seller, and so on. Furthermore, in competitive equilibrium, the payment schedule is simply given by:

$$p(\beta_s) = \frac{1}{2} S(b_s^{-1}(\beta_s), \beta_s) = \frac{1}{2}\left(q\theta(b_s^{-1}(\beta_s) - \beta_s)^2 - T\right) \tag{5}$$

evaluated at the demand parameter of the assigned buyer in competitive equilibrium, $b_s^{-1}(\beta_s) = \beta^+ + \beta^- - \beta_s$ from (4) above. As such the joint surplus $q\theta(b_s^{-1}(\beta_s) - \beta_s)^2$ is in fact shared between the buyer and seller locations, and the larger the differences in buyer and seller demand for construction land, the larger will be the gains from trading for both the buyer and the seller.

[15] We will assume for now that the associated maximization problem of a potential buyer to be noted below, taken as given $p(\beta_s)$ is strictly concave. Later on, we will show that these assumptions are borne out in equilibrium.

Finally, a non-degenerate range of inactive localities in the mid-range of $[\beta^-, \beta^+]$ can be found. Specifically, the largest β_s that exports land conversion quotas is given by the seller of the marginal trader-pair which breaks even in the presence of transaction cost T:

$$\beta_s^{max} = \max\{\beta_s | S(b_s^{-1}(\beta_s), \beta_s) - T \geq 0\} = \frac{\beta^+ + \beta^-}{2} - \frac{1}{2}(\frac{T}{q\theta})^{1/2}$$

while the smallest β_b that imports land conversion quotas is given by the buyer of the marginal trader-pair which breaks even with $T > 0$:

$$\beta_b^{min} = \min\{\beta_b | S(\beta_b, b_s(\beta_b)) - T \geq 0\} = \frac{\beta^+ + \beta^-}{2} + \frac{1}{2}(\frac{T}{q\theta})^{1/2}.$$

Thus, the range of sellers with positive transaction cost is given by $\Omega_s = (\beta^-, \beta_s^{max}]$ and the range of buyers is given by $\Omega_s = (\beta_b^{min}, \beta^+]$. As a special case, if $T = 0$, all localities except the median locality engage in trade and gain from doing so, as $\beta_b^{min} = \beta_s^{max} = (\beta^+ + \beta^-)/2$.

Now, pick any two locations, say β_b and β_s. Suppose these two locations opt to negotiate an alternative arrangement separate from the market assignment. Using (3) - (5), such a pair generate joint surplus over and above the sum of the expected welfare of these two locations in competitive equilibrium by the amount:

$$\begin{aligned} & S(\beta_b, \beta_s) - [S(\beta_b, b_s(\beta_b)) - p(b_s(\beta_b)) + p(b_s^{-1}(\beta_s))] \\ = \; & -\frac{q\theta}{2}\left(\beta_b - b_s^{-1}(\beta_s)\right)^2 - \frac{q\theta}{2}\left(\beta_s - b_s(\beta_b)\right)^2 \end{aligned} \tag{6}$$

which is strictly negative almost always, and equal to zero if and only if $\beta_s = b_s(\beta_b)$ and $\beta_b = -b_s^{-1}(\beta_s)$. Thus, consistent with Becker (1973), no matches negotiated in the shadow of the market can generate higher joint expected surplus. The question of course is what if there exist network connections mitigate against transaction costs. We turn to this next.

3.2 Network Mediated Trade

We introduce network connected pairs of buying and selling localities with transaction cost T^c. We envisage these connections to reduce transaction costs ($T^c < T$) through better local knowledge of government personnel and better local land market conditions. With $T > 0$, any pair of connected locations (β_b, β_s) can be of one of four types. First, the connected buyer and seller may both be active in a competitive equilibrium, or equivalently $\beta_b \in \Omega_b$ and $\beta_s \in \Omega_s$ and respectively trade with their competitively assigned partners $b_s(\beta_b)$ and $b_s^{-1}(\beta_s)$. The competitively determined reservation income of the two connected parties are $[S(\beta_b, b_s(\beta_b) - T - p(b_s(\beta_b)]$ and $p(\beta_s)/2$ respectively. There are three other cases of interest:

- $\beta_b \in \Omega_b$ and $\beta_s \notin \Omega_s$. The reservation income of the two parties are $[S(\beta_b, b_s(\beta_b) - T - p(b_s(\beta_b)]$ for the buyer and zero for seller;
- $\beta_b \notin \Omega_b$ and $\beta_s \in \Omega_s$. The reservation income of the two parties are given by zero for the buyer, and the competitive equilibrium $p(\beta_s)/2$ for the seller;
- Neither of the two parties are active in competitive equilibrium, in which case the threat point income of the two parties are both given by zero.

Let $S^c(\beta_b, \beta_c)$ denote the expected surplus associated with trade in land conversion quotas between a pair of connected localities, with

$$S^c(\beta_b, \beta_c) = \max\{q\theta(\beta_b - \beta_s)^2 - T^c, 0\}.$$

Suppose that both the buyer and the seller locality are active in competitive equilibrium. Consider the difference

$$\begin{aligned} \Delta S(\beta^b, \beta_s) &= S^c(\beta_b, \beta_s) - [S(\beta_b, b_s(\beta_b)) - p(b_s(\beta_b)) - T] - p(b_s^{-1}(\beta_s)) \\ &= T - T^c - [\frac{q\theta}{2}\left(\beta_b - b_s^{-1}(\beta_s)\right)^2 - + \frac{q\theta}{2}\left(\beta_s - b_s(\beta_b)\right)^2. \end{aligned} \tag{7}$$

With $T^c < T$, trade among networked parties in the shadow of the market can generate strictly higher joint expected surplus relative to the competitive equilibrium, provided that T^c is sufficiently smaller than T, and furthermore, if the distortions from the competitive assignment $((\beta_b - b_s^{-1}(\beta_s))$ and $(\beta_s - b_s(\beta_b)))$ are not too severe. Differentiating $\Delta S(\beta_b, \beta_s)$ with respect to β_b and β_s, an increase in buyer demand decreases the expected joint surplus even more if and only if

$$\beta_s > b_s(\beta_b),$$

or equivalently, if the networked seller has a demand parameter that is higher than the competitive determined pairing $b_s(\beta_b)$. In this case, a further increase in the buyer demand increases the network induced distortion in trader match, and reduces the likelihood of a network induced match.

In sharp contrast, suppose instead that both the buyer and the seller locality are inactive in competitive equilibrium. The difference in expected joint surplus generated in a network mediated trade is given by

$$\Delta S(\beta_b, \beta_s) = \max\{q\theta\left(\beta_b - \beta_s\right)^2 - p(\beta_s) - T^c, 0\}. \tag{8}$$

In this case, connected parties may trade if T^c is not too high. In addition, the likelihood of trade among networked pairs is strictly increasing in β_b. Comparing (7) and (8), it should be evident

the comparative statics of the determinants of trade among networked localities with respect to buyer and seller demand is nuanced, depending on (i) whether network-mediated trade connect localities that are active or inactive in competitive equilibrium, and (ii) whether network-mediated trade introduce distortions in the trade matches relative to the competitive equilibrium. Table 1 summarizes these responses, and include in addition the intermediate cases where either only the buyer is active, or the seller is active in competitive equilibrium,

Table 1. Comparative Statics of $\Delta S(\beta_b, \beta_s)$ with respect to β_b and β_s:

	Both Trade	Only Buyer Trades	Only Seller Trades	Neither Trades
β_b	$\text{sgn}(b_s(\beta_b) - \beta_s)$	$\text{sgn}(b_s(\beta_b) - \beta_s)$	+	+
β_s	$\text{sgn}(b_s^{-1}(\beta_s) - \beta_b)$	-	$\text{sgn}(b_s^{-1}(\beta_s) - \beta_b)$	-

Summarizing the empirical implications of the model, we find that the competitive equilibrium exhibits negative assortative matching among active traders, in that higher demand localities buy land conversion quotas from low demand localities from (4). Furthermore from (2), a reduction in uncertainty associated with whether a agreement struck between localities can be consummated raises the expected surplus associated with trade. From (7), trade among connected locations leads to a strict increase in expected surplus relative to the competitive equilibrium only if network connection lowers the cost of transaction. Finally, from (8) and (9) and summarized in Table 1, a small increase in buyer demand does not change the expected surplus of network mediated trade if network connection does not introduce match distortions $b_s(\beta_b) = \beta_s$ and if the networked buyer is active in competitive equilibrium. Otherwise, there is a variety of possible outcomes. For example, an increase in buyer demand among networked parties can in fact decrease the expected surplus of network mediated trade if the networked seller party has higher demand than the competitive assignment, *and* if the buyer is active in competitive equilibrium.

4 Data Description

We construct a dataset for all the possible jurisdiction pairs in Zhejiang province during 1999 to 2003. Specifically, there are 99 possible traders within the province, including 60 counties (or county level cities) [16], 28 urban districts [17] and 11 urban jurisdictions(*shixiaqu*). Thus, there are 9,801 (99^2) possible trade pairs in each year. Since we have 5 years, the total number of observations in

[16] Quxian and Yinxian were upgraded into Quzhou district and Yinzhou district in 2001 and 2002, respectively. In our dataset, we still treat these two jurisdictions as counties instead of urban districts.

[17] Wuxing and Nanhu districts were founded in 2003, therefore not included in our sample.

our dataset is 49,005 (9801*5).

Land conversion quota trade

Our key variable of interest in this paper is the land conversion quota trading activities between local governments, which is defined at the "exporter*importer*year" level. As stated earlier, the data is collected based on internal statistics from the Zhejiang Provincial Department of Land and Resources. The information contains both the incidence as well as the buyer-seller pairs that participated in the trade in land conversion quotas. There are altogether 570 land quota trade activities across counties/districts in the five year period between 1999 - 2003. Since multiple trade activities can occur between the same pair of exporter and importer in the same year, we collapse multiple trade activities in the same year into one event for each "exporter*importer*year" cell. As a result, there were 352 trading events at the "exporter*importer*year" level during 1999-2003.

The next three sets of variables respectively capture the role of market forces, administrative autonomy, and personal network connections of local government leaders. We use a "gravity equation" style model to investigate the possible factors leading to land conversion quota trade. Consequently, our empirical specification include all three sets of variables for both the selling and the buying jurisdictions.

Market Forces

We capture market forces of each locality by the GDP per capita of the subprovincial district to which the locality belongs. For the years 1999 - 2003, this data is collected from the Statistical Yearbooks of the Zhejiang province (2000-2004). We take GDP per capita to be a proxy for the demand parameter β in the theoretical model. We draw motivation for doing so from the empirical land conversion literature particularly in China. For example, Seto and Kaufmann (2003) presents evidence of a feedback loop that links income growth, consumer demand, and urban expansion in a study of agricultural land conversion in the Pearl River Delta of China. Off-farm wage income is likewise found to be positively associated with agricultural land conversion.[18] From the importer's perspective, our use of per capita income to capture the demand parameter β is in part motivated by these observations. In addition, from the exporter's standpoint, due to fiscal decentralization reforms since 1994, local governments are increasingly reliant on locally collected revenue to finance public goods (Qian and Roland 1998). A low GDP per capita is thus indicative of a unit with ar-

[18]The study also suggest clearly that foreign direct investment, as well as the relative productivity of agricultural and industrial land are important determinants of the rate of agricultural land conversion in the Pearl River Delta.

guably high demand for extra-budgetary revenue for local development purposes.

Administrative autonomy

We seek to gauge the extent to which individual localities are free to make socio-economic decisions on their own, as captured by the parameter q in the theoretical model. Schneider (2003) discusses various ways to measure local administrative autonomy, including the percentage of local revenue from taxes, the percentage of total grants and revenues not accounted for by central transfers, for example. Unfortunately, data on these measures at the county level is not available. Instead, we make use of a policy notice in 1992 by the Zhejiang Provincial Government which gave special authority to 13 select administrative units additional authority over socio-economic affairs:

> "... if it is a nonproduction infrastructure proejct with a total investment of less than 15 million yuan, or if it is a basic production construction project with a total investent of less than 30 million yuan, or if it is a technical upgrading project with a total investment of less than 10 million yuan, it could be examined and approved by the county (or county-level city) governments." (Yu and Gao 2013, Zhejiang Provincial Government 1992)

The list of administrative units included 4 urban districts (namely Xiaoshan, Yuhang, Huangyan and Jiaojiang) and 9 counties (namely Yinxian, Cixi, Yuyao, Haining, Tongxiang, Shaoxing, Jiashan, Pinghu and Haiyan). As a measure of administrative autonomy, we create a dummy variable with a value of one for the 13 administrative decentralized jurisdictions, and zero otherwise.

Connected Leaders

The literature on role of political connections on economic performance and policy effectiveness in China is a very nascent area of research. Qin (2013), for example, tests whether firms with political connections receive preferential treatment through centrally funded capital investment and subsidies based on the working experience of top leaders of the State Council and a panel of manufacturing firms. Qian (2008) provides evidence on the relationship between government enforcement effort to weed out counterfeit products and company relationships with the government. Contrary to these studies our network connection variables captures the potential for the prior personal links, career and education experiences of a leader in lowering the transaction costs of trade. In the model, this reduction is given by the difference $T - T^c$.

For this purpose, we collected the published resumes for each county/district head and county/district party secretary (*shuji*) during 1999 to 2003. The network between county/district A (exporter) and B (importer) is defined in three ways: 1) career network due to working experience; 2) birthplace network, and 3) education network. We define that county/district A (exporter) and B (importer) have network connections in year t if: 1) at least one of the two officials in A (B) has worked in B (A); 2) at least one of the two officials in A (B) was born in B (A); or 3) at least one of the two officials in A (B) graduated from the same university/college with any of the two officials in B (A). Since different types of networks may play different roles in land conversion quota trade decisions, we also create independent measures for network connections in A and B due to birthplace, working experience[19] and education.

Other variables

In addition to the above variables, we also control the following variables which may affect the propensity to trade land conversion quotas between jurisdiction pairs, including: 1) total areas for each possible exporter and importer during 1999 to 2003, which is a measurement of land endowment collected from the Statistical Yearbooks; 2) a dummy variable indicating common border between each possible pair, which measures the geographical closeness of potential trading partners; 3) a dummy variable indicating the same prefecture city for each jurisdiction pair, which measures the institutional closeness; and 4) dummy variables indicating whether the potential exporter and importer are urban areas or not, since the decision making process is likely to differ in urban areas (districts/urban jurisdictions) and surrounding counties.

4.1 Data Summary

Table 2 shows summarizes the key variables used in the estimation. Among all "exporter*importer*year" cells, around 0.7 percent experienced at least one land conversion quota trade. The average GDP per capita during 1999-2003 in the counties/districts is 23,303 yuan (around 3,800 US Dollars). In terms of network connections, around 12.4 percent of the cells have at least one out of the three types of connections. 2.2 percent of the leaders among all the cells have birthplace connections; 3.5 percent have working experience connections; and 8.2 percent share the same university/college networks.

Table 3 provides the descriptive statistics for the 13 decentralized jurisdictions. Compared

[19]The working experience network is defined based on working history in non-birthplace counties/districts.

to the non-decentralized urban districts, the 4 decentralized districts have higher GDP per capita, larger population and more land (Panel A). Interestingly, decentralized urban districts are more active in importing land conversion quotas from other jurisdictions compared to non-decentralized districts. But none of them export land conversion quotas.

Compared to the non-decentralized counties/county level cities, the 9 decentralized county level jurisdictions have higher GDP per capita, larger population, but smaller land areas as suggested in Panel B. Similar to decentralized urban districts, the 9 decentralized counties/county level cities are more active in importing land conversion quotas but less active in exporting land conversion quotas when comparing to the non-decentralized county level units.

5 Identification Strategy

In this paper, we employ a proportional hazards model (Cox 1972) to analyze the potential determinants leading to land conversion quota trade. Let t_j denote time elapsed since the policy of land conversion quota trade begin in 1999. For each exporter*importer pair j, let $h(t_j|x_{jt})$ measure the trade hazard rate – the probability of engaging in land conversion quota trade, conditional on not having done so before t_j.

The model is specified in the following form:

$$h(t_j|x_{jt}) = h_0(t_j)exp(\sum_i x_{ijt}a_i) \tag{9}$$

$h_0(t_j)$ is a baseline hazard function and no parametric assumptions are made on h_0. x_{ijt} represents factor i affecting the hazard function for jurisdiction pair j in year t. a_i are the coefficients to be estimated from the data.

The model is proportional in that the hazard jurisdiction pair j faces is multiplicatively proportional to the baseline hazard. Therefore, the hazard ratio for a unit change in x_{ijt} is $exp(a_i)$. If a_i is significantly positive, it indicates that one unit increase in x_{ijt} increases the hazard of land conversion quota trade by $exp(a_i) - 1$. If a_i is significantly negative, it indicates that one unit increase in x_{ijt} decreases the hazard of trade by $1 - exp(a_i)$.

As introduced in Section 4, we control for the following variables on the right hand side of the proportional hazards model: 1) GDP per capita of the potential importer and exporter in each jurisdiction pair j in year t; 2) dummy variables indicating whether the potential importer and exporter in each jurisdiction pair j is decentralized or not; 3) whether the jurisdiction pair j is linked with a certain type of network in year t; 4) whether jurisdiction pair j is adjacent or not;

5) whether jurisdiction pair j belongs to the same prefecture level city; 6) total land areas for the potential importer and exporter in each jurisdiction pair j; and 7) a dummy variable indicating whether the potential importer and exporter is an urban district or not for each jurisdiction pair j.

The above mentioned proportional hazards model only utilizes the information for the first land conversion quota trade event for a specific jurisdiction pair j. However, this suffers from loss of relevant information since it ignores multiple failures, namely additional land conversion quota trade events in our context. In the dataset, 110 out of 361 trade events are multiple trades which have not been included in the previous set-up of proportional hazards model. Hence, we adopt the counting process approach by Andersen and Gill (1982) to include all the trade events for the proportional hazards model. The modification of Andersen and Gill (1982) to Cox model involves multivariate counting process allowing for recurrent event, which jointly evaluate the log likelihood of n-component multivariate counting process (see section 2.2 of Anderson and Gill (1982)).

6 Main Findings

Table 4 presents the results for proportional hazards model estimations. Columns 1-2 report the results using the information of the first trade event between jurisdiction pairs, while columns 3-4 report the results allowing for multiple trade events in different years between the same jurisdiction pair, following the approach by Andersen and Gill (1982). In each estimation, we include our proxy measures for both the buyer and seller units respectively on market forces, administrative autonomy, and leader connection as discussed in Section 4. In addition to reporting the main result on leader connection (columns 1 and 3), we also report the interactive effect of connection and GDP per capita of exporters and importers in columns 2 and 4. Doing so allows us to ascertain whether leader networks (i) raises the likelihood of a match by lowering transaction cost, and (ii) create match distortions when connected leaders do not conform with the competitively assigned pairing of locations. Finally, we also introduce a host of other variables as discussed in section 4 in order to control for scale, geographic and institutional closeness, and dummy variables distinguishing between urban areas and surrounding counties.

The estimated coefficients are robust across different specifications in Table 4. From these estimates, three broad sets of results can be deduced, respectively covering market forces, administrative autonomy, and leader connections. First, lower (higher) GDP per capita counties/districts are associated with higher likelihood of selling (buying) land conversion quotas (rows 1-2). The coefficients on exporter GDP per capita range from -0.882 to -1.102, translating into hazards ratios

ranging from 0.33 to 0.41. This indicates that if exporter's GDP per capita is increased by 10 percent, the associated trade hazard decreases by 8.1 percent $(1 - exp(ln(1 + 0.1) * -0.882)$ to 10 percent $(1 - exp(ln(1 + 0.1) * -1.102)$. In contrast, the coefficients on importer GDP per capita range from 1.629 to 1.988, which indicates that if importer's GDP per capita is increased by 10 percent, the associated trade hazard increases by 16.8 percent $(exp(ln(1 + 0.1) * 1.629) - 1)$ to 20.9 percent $(exp(ln(1 + 0.1) * 1.988) - 1)$.

Second, administrative decentralized counties/districts are associated with higher likelihood of buying land conversion quotas (rows 3-4). The coefficients on the decentralization status of importers range from 0.36 to 0.394, which suggests that if land conversion quota buyer is from one of the 13 decentralized jurisdictions, it increases the hazard of trade significantly by 43.3 percent $(exp(0.36) - 1)$ to 48.3 percent $(exp(0.394) - 1)$. However, it seems that the decentralization status of exporters does not significantly affect the likelihood of land conversion quota trade, as indicated from the insignificant coefficients. This may be expected since our decentralization variable as discussed in Section 4 mainly covers governance autonomy in areas related to infrastructure, production construction and technical upgrading. These are areas that directly impact the demand side for additional land conversion quotas, rather than the supply side.

Third, network connections significantly increase the likelihood of land conversion quota trade between the two parties (row 5). Three out of the four coefficients are statistically significant at the 10 percent level. The other coefficient is marginally significant as well. If we interpret the magnitude of the effect based on the three significant coefficients, it indicates that being connected with at least one type of the networks enhances the hazard of trade by 29.2 percent $(exp(0.256) - 1)$ to 213.6 percent $(exp(1.143) - 1)$.

The wide range of magnitude for the network coefficients is due to the inclusion of interaction terms between network dummy and GDP per capita of the two parties of potential trade (rows 6-7). The interaction terms are negative in all cases here, and significant only in a handful of cases. Based on our discussion of Table 1 in the theory section, the evidence accordingly does not appear to be consistent with leader connections among trade parties that have lower land demand than the competitive benchmark (e.g. $\beta_s < b_s(\beta_b)$, and $\beta_b < b_s^{-1}(\beta_s)$. If anything, the evidence in Table 4, with negative interaction effect between network connection and importer GDP per capita, points to the possibility that network connections (i) impact buyers that have high enough GDP per capita to be active in competitive equilibrium despite transaction costs, but (ii) the buyers are connected with sellers that have higher demand for land than their competitive assignment. The existence of

match distortion suggests the possibility that localities that would have otherwise acted as buyers in competitive equilibrium are turned sellers of land conversion quotas to locations with even higher demand for land. This is consistent with the picture illustrated in Figure 1, where some counties simultaneously bought and sold land conversion quotas to different peer counties/ districts in the same year.

In addition to the three main findings, Tables 4 and 5 offer a number of additional observations: 1) jurisdictions from the same prefecture city are more likely to trade land conversion quotas with each other, but geographic closeness is not significantly associated with a higher likelihood of trade (rows 8 - 9); 2) larger total area increases the likelihood of being both exporter and importer in land conversion quota trade (rows 10 - 11), and 3) counties are more likely to export land conversion quota while districts are more likely to import (rows 12 - 13).

7 Estimation Issues

In this section, we discuss about a number of estimation issues that can be anticipated in our choice of the baseline proportional hazard model. These include two-say causality, rare event, unobserved heterogeneity, prior trade, and different types of network effects.

7.1 Two-Way Causality

Since trade in land conversion quota trade may in turn affect some of the explanatory variables, such as GDP per capita and network variables in subsequent years, one may worry the possible bias of the results due to two-way causality. In order to avoid such complications, we add to the main results by reporting another set of regressions using only the explanatory variables in their values in year 1999, which is the starting year of the land conversion quota trade project. Therefore, the interpretation of the variations of time to trade is solely based on the initial conditions of each jurisdiction pair.

Table 5 presents the results using only the initial values at year 1999 for all the explanatory variables of jurisdiction pair j. The results are generally similar to the outputs in Table 4. One difference worth noting is that the coefficients for the interaction between network and importer GDP per capita become insignificance in this new setting. A possible explanation is that the loss of variation of GDP per capita due to the adoption of only initial values decreases the significance level of the coefficients on the interaction term.

7.2 Proportion versus Hazards

While the proportional hazard model ascertains the trade hazard rate, one may be interested instead in the proportion of eligible exporter*importer pairs that ultimately trade with one another. We thus presents a series of logit regressions to confirm whether a switch in emphasis from hazard rates to proportions makes a difference to our analysis.

7.3 Rare Event

While many counties/districts in Zhejiang participated in land conversion quota trading, there are many zero entries among all the exporter*importer pairs as shown in Table 2. The relatively few number of trade matches lead to potential concern for biased estimates in maximum likelihood estimations with rare events (King and Zeng 2001). Hence, we estimate a Firth logit regression (Firth, 1993; Heinze and Schemper, 2002) which applies penalized maximum likelihood regression to reduce bias introduced by rare events in maximum likelihood estimates in generalized linear models (similar to King and Zeng (2001)'s approach in modeling rare events in logistic regressions).

7.4 Unobserved Heterogeneity

While we have attempted to account for the influence of decentralization policies, markets, and individual leader characteristics in the likelihood of trade, it is nonetheless possible that the baseline likelihood of trade at the buyer-seller pair level may be governed by unobserved variables that we have not been able to collect information for. These include personal connections not captured in the network variables, other existing relationships whether in rivalry or in cooperation (e.g. competition for footloose foreign enterprises, inter-jurisdictional infrastructure projects). Therefore, we estimate a random effect logit regression which allows a random coefficient for each jurisdiction pair j, which is specified as follows:

$$P(Y_t = 1|x_{ji,t-1}) = F(a_0 + \sum_i x_{ji,t-1}a_i + \eta_j) \tag{10}$$

where η_j is the random intercept for jurisdiction pair j which follows a normal distribution with mean zero and standard deviation of φ. $x_{ji,t-1}$ stands for the same covariates being used in the proportional hazards model, but with one year lag to avoid two-way causality. $F(v) = F_{logit}(v) = \frac{e^v}{1+e^v}$.

7.5 Prior Trade

From our panel data of trade in land conversion quotas, we can also deduce whether any particular trade event is preceded by a prior trade event. Such an event may help to mitigate against transaction costs in subsequent periods. Therefore, in the Firth logit model and random effect logit model, we control for the effect of land conversion quota trade occurred prior to year t on the probability of trade in the current year.

Table 6 presents the results using Firth logit model (columns 1-2) and random effect logit model (columns 3-4). All the time-variant explanatory variables are lagged one year in order to avoid two-way causality. The results are very similar to the ones using proportional hazards model, which ensure the robustness of our findings. In addition, the coefficients on prior trade are significantly positive, which suggest that prior trade enhances the chances of trade in later periods with the same partner.

7.6 Unpacking the Effects of Networks

Different types of networks can have different impact on trade. Therefore, we unpack these in three ways: 1) being connected due to working experience; 2) being connected due to birthplace; and 3) being connected due to university/college education. In order to examine the potential heterogeneous impacts of the three different types of networks on trade, we replace the network variable in previous results with these three separate measures and perform the analysis in Tables 7-9.

Table 7 presents the results using career specific network. Here we display the findings using both proportional hazards models and logit models. The results are very consistent with the results using the broad measure of networks (Tables 4 and 6). However, when we replace the network variable with birthplace specific network (Table 8) and education specific network (Table 9), none of the coefficients on the network variables and the interactions between network and GDP per capita are significant. Based on these results, it would appear that career specific network is the dominant determinant of network linkages on trade in land conversion quotas.

8 Conclusion

What drive the decision-making of local government leaders in China? From the Zhejiang experiment in land conversion quota trading, we draw three main lessons. First, we find that market forces indeed matter. Similar to the predictions of a model in which a continuum of heterogeneous local governments compete in the trade of land conversion quota to maximize the local welfare, we find that our proxy for market demand for construction land predicts both the buyer and the seller behavior of land conversion quotas. Second, we find that this responsiveness can be further enhanced by administrative decentralization reform, where local governments are given more autonomy to make decisions concerning local investment and infrastructural projects. We also find that the personal characteristics of leaders matter as well, and in our context, the prior career experience of a leader in a different locality is shown to be of paramount importance in determining trade outcomes, consistent with transaction cost view that network connections confer informational advantages. Finally, we find that connected pairs of traders may not conform with the competitive assignment, and as such trade mediated by network connections can potentially give rise to a match distortion. This is consistent with the simultaneous two-way trade carried out by some counties/districts as observed in our data.

As policy implications, this study has shown that land conversion quota trade has indeed facilitated in the allocation of land conversion quotas from low demand areas to high demand areas. Interestingly, this efficiency improvement is coupled with improvement in distribution as well as revenue flowed from high income localities to low income localities. Nonetheless, concerns regarding the program's effectiveness remain. For example, there is no study to date on the quality of land consolidation, and furthermore, the agricultural productivity impact of the reform. Second, the Zhejiang example shows the program received popular support, in part because the province has a wide variation in construction land demand, and land consolidation prospects. A natural question is thus whether a provincial level trading program shows the most promise achieving efficiency and distributional goals.

Appendix A

Properties of the Competitive Equilibrium

The first order condition of the maximization problem in (3) evaluated at the equilibrium assignment $b_s(\beta_b)$ is:

$$-2q\theta(\beta_b - b_s(\beta_b)) = p'(b_s(\beta_b)). \tag{11}$$

Totally differentiating the first order condition in (4) with respect to β_b, the equilibrium assignment $b_s(\beta_b)$ is negatively assortative, or

$$b_s'(\beta_b) = \frac{2q\theta}{2q\theta - p''(b_s(\beta_b))} < 0. \tag{12}$$

where it can be confirmed that $2q\theta - p''(b_s(\beta_b)) < 0$ if the second order condition of the maximization problem is to be satisfied.

The negative assortative matching in () above implies that in a competitive equilibrium, the highest $\beta_b = \beta^+$ would match with the lowest $\beta = \beta^-$. As for the rest of the assignment schedule, β_s is matched in equilibrium to β_b if and only if the mass of $\beta \geq \beta_b$ is equal to the mass of $\beta \leq \beta_s$. By assumption of a uniform distribution of β on $[\beta^-, \beta^+]$:

$$\frac{b_s(\beta_b) - \beta^-}{\beta^+ - \beta^-} = \frac{\beta^+ - \beta_b}{\beta^+ - \beta^-} \Leftrightarrow b_s(\beta_b) = \beta^+ + \beta^- - \beta_b.$$

while all locations below the median are seller locations.

As stated in Section 2, with transaction costs T, the largest β_s that export is given by

$$\beta_s^{max} = \max\{\beta_s | S(b_s^{-1}(\beta_s), \beta_s) - T \geq 0\} = \frac{\beta^+ + \beta^-}{2} - \frac{1}{2}(\frac{T}{q\theta})^{1/2}$$

while the smallest β_b that import is given by

$$\beta_b^{min} = \min\{\beta_b | S(\beta_b, b_s(\beta_b)) - T \geq 0\} = \frac{\beta^+ + \beta^-}{2} + \frac{1}{2}(\frac{T}{q\theta})^{1/2},$$

Thus, let the equilibrium payment for the marginal pair $p(\beta_s^{max}, \beta_b^{min})$ be equal to zero. The equilibrium payment function can be achieved by appropriately integrating () above:

$$p(\beta_s) - p(\beta_s^{max}) = \int_{\beta_s^{max}}^{\beta_s} p'(\beta_s)d\beta_s = \int_{(\beta^- + \beta^+)/2}^{\beta_s} -2q\theta(b_s^{-1}(\beta_s) - \beta_s))d\beta_s = \frac{1}{2}[q\theta(b_s^{-1}(\beta_s) - \beta_s)^2 - T.$$

for $\beta_s < \beta_s^{max}$, and zero otherwise. Furthermore, the equilibrium expected buyer surplus is given by

$$S(\beta_b, b_s(\beta_b)) - p(b_s(\beta_b)) - T = \frac{1}{2}[q\theta(\beta_b, b_s(\beta_b))^2 - T$$

for $\beta_b > \beta_b^{min}$ and zero otherwise.

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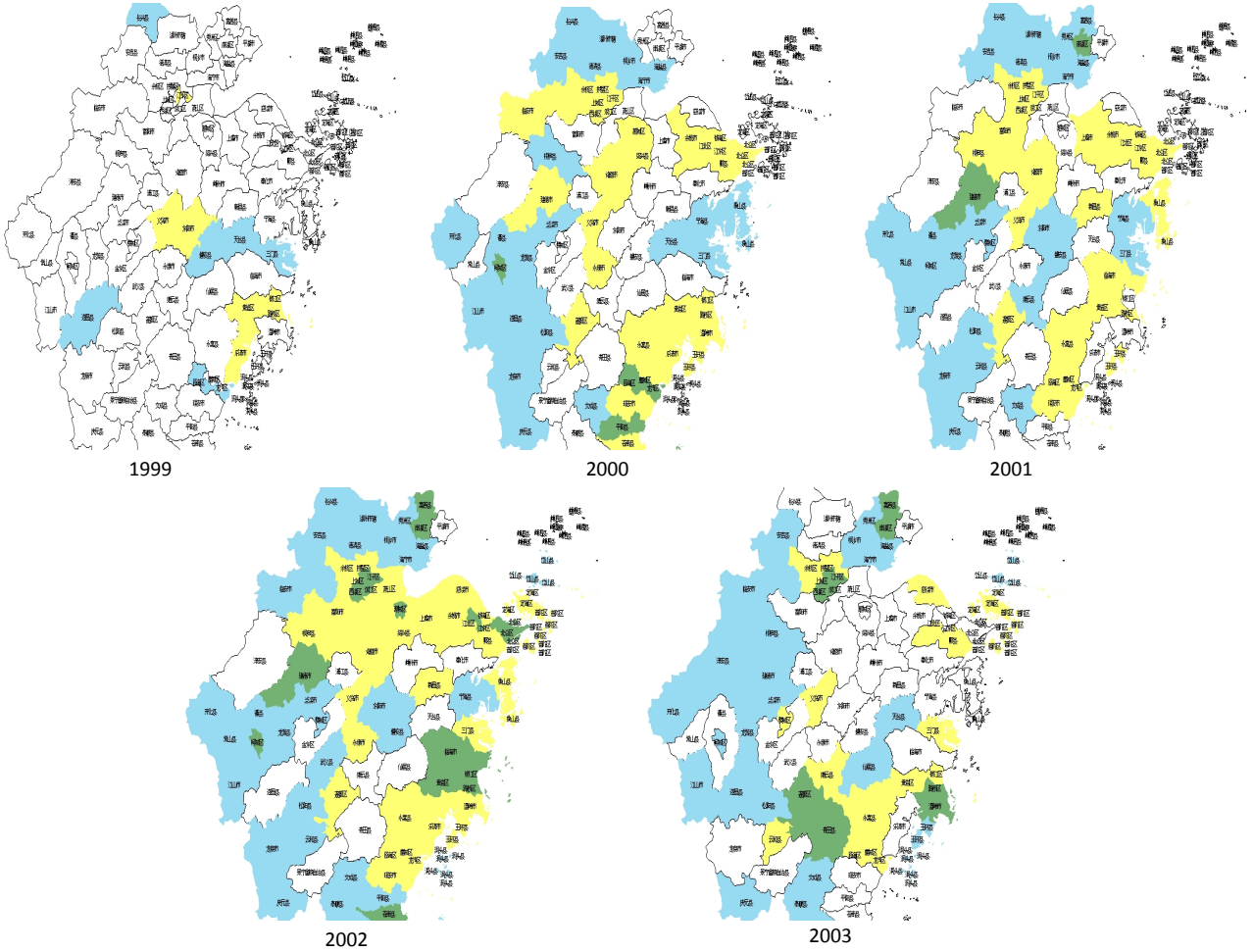
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Figure 1: Land Conversion Quota Trade: 1999-2003 [20]



[20]Note: Export counties are marked in blue; import counties are marked in yellow; counties both exporting and importing are marked in green.

Table 2: Summary of Statistics

Year: 1999-2003; Total number of jurisdictions: 99					
Variables	Obs	Mean	Std. Dev.	Min	Max
Trade activity dummy	48,488	0.007	0.085	0	1
GDP per capita (in 10,000 yuan)	42,804	1.462	0.873	0.295	5.507
Adjacency (dummy)	48,488	0.051	0.220	0	1
Belonging to the same city (dummy)	48,488	0.091	0.288	0	1
Decentralization (dummy)	48,488	0.131	0.338	0	1
Total Area (in sq. kilometer)	48,488	1221.1	829.79	18.1	4452
Urban district (dummy)	48,488	0.444	0.497	0	1
Birthplace networks (dummy)	48,478	0.082	0.329	0	1
Career networks (dummy)	46,744	0.022	0.148	0	1
Education networks (dummy)	46,744	0.035	0.184	0	1
Either of the three networks (dummy)	46,744	0.124	0.274	0	1

Note: Please refer to Section 4 for the data sources of each variable in this table.

Table 3: Descriptive Statistics of Decentralized Jurisdictions

	Panel A: Decentralized Urban Districts *(Yuhang; Xiaoshan; Huangyan; Jiaojiang)*	
	Decentralized Jurisdictions	Non-Decentralized Jurisdictions
GDP per capita (year 2003, 10,000 yuan)	2.74	2.1
Population (year 2003, 10,000 persons)	75.05	36.86
Land area (sq. kilometers)	980.25	405.94
Average number of trade events as importer per jurisdiction (1999-2003)	11.75	2.83
Average number of trade events as exporter per jurisdiction(1999-2003)	0	0.87
	Panel B: Decentralized Counties/County Level Cities *(Cixi; Haining; Haiyan; Jiashan; Pinghu; Shaoxing; Tongxiang; Yuyao; Yinxian)*	
	Decentralized Jurisdictions	Non-Decentralized Jurisdictions
GDP per capita (year 2003, 10,000 yuan)	2.88	1.41
Population (year 2003, 10,000 persons)	64.67	52.45
Land area (sq. kilometers)	925.78	1581.22
Average number of trade events as importer per jurisdiction (1999-2003)	4.44	1.94
Average number of trade events as exporter per jurisdiction(1999-2003)	0.66	5.15

Notes: 1. Among urban districts, 4 out of 28 of them were decentralized in 1992. Among counties and county level cities, 9 out of 60 were decentralized in 1992. 2. The 11 urban jurisdictions (*shixiaqu*) are excluded from the comparison since they are not comparable to an independent county or district.

Table 4: Factors Affecting Land Conversion Quota Trade Between Jurisdiction Pairs

	Proportional Hazards Model			
	(First Trade Event)		**(All Trade Events)**	
Explanatory Variables	[1]	[2]	[3]	[4]
Ln (GDP per capita) of exporter in year t	-1.102	-1.056	-0.962	-0.882
	(0.269)***	(0.301)***	(0.268)***	(0.305)***
Ln (GDP per capita) of importer in year t	1.748	1.988	1.629	1.881
	(0.224)***	(0.251)***	(0.239)***	(0.263)***
Decentralization dummy for exporter	-0.084	-0.071	0.071	0.083
	(0.263)	(0.262)	(0.275)	(0.273)
Decentralization dummy for importer	0.37	0.36	0.394	0.382
	(0.168)**	(0.168)**	(0.180)**	(0.179)**
Connected (Three types) in year t	0.216	1.017	0.256	1.143
	(0.146)	(0.481)**	(0.144)*	(0.497)**
Ln (GDP per capita) of exporter		-0.032		-0.117
* Connected (Three types) in year t		(0.488)		(0.532)
Ln (GDP per capita) of importer		-0.693		-0.69
* Connected (Three types) in year t		(0.353)**		(0.368)*
Adjacent or not	-0.049	-0.037	0.129	0.139
	(0.232)	(0.228)	(0.269)	(0.263)
Belonging to the same prefecture city	1.718	1.693	1.529	1.507
	(0.171)***	(0.173)***	(0.185)***	(0.188)***
Ln (Total area) of exporter in year t	0.247	0.242	0.231	0.229
	(0.068)***	(0.069)***	(0.068)***	(0.069)***
Ln (Total area) of importer in year t	0.369	0.385	0.402	0.421
	(0.087)***	(0.089)***	(0.097)***	(0.099)***
District dummy for exporter	-0.421	-0.425	-0.616	-0.617
	(0.203)**	(0.202)**	(0.216)***	(0.216)***
District dummy for importer	0.814	0.825	1.013	1.019
	(0.175)***	(0.176)***	(0.184)***	(0.185)***
N	37,445	37,445	37,824	37,824

Notes: 1. The coefficients (instead of hazard ratios) are provided for the results of proportional hazards models; 2. Robust clustered standard errors at jurisdiction pair level are provided in parentheses; 3. *** p<0.01; ** p<0.05; * p<0.1.

Table 5: Robustness Check Using Covariates in Year 1999 Values

	Proportional Hazards Model			
	(First Trade Event)		**(All Trade Events)**	
Explanatory Variables	[1]	[2]	[3]	[4]
Ln (GDP per capita) of exporter in 1999	-0.915	-0.645	-0.744	-0.331
	(0.300)***	(0.316)**	(0.299)**	(0.315)
Ln (GDP per capita) of importer in 1999	1.614	1.737	1.429	1.62
	(0.212)***	(0.226)***	(0.240)***	(0.250)***
Decentralization dummy for exporter	-0.199	-0.2	-0.037	-0.039
	(0.257)	(0.255)	(0.272)	(0.271)
Decentralization dummy for importer	0.499	0.499	0.505	0.505
	(0.161)***	(0.161)***	(0.173)***	(0.172)***
Connected (Three types) in 1999	0.286	1.204	0.477	1.785
	(0.171)*	(0.486)**	(0.180)***	(0.494)***
Ln (GDP per capita) of exporter		-0.894		-1.26
* Connected (Three types) in 1999		(0.643)		(0.654)*
Ln (GDP per capita) of importer		-0.36		-0.519
* Connected (Three types) in 1999		(0.403)		(0.424)
Adjacent or not	-0.05	-0.012	0.105	0.158
	(0.231)	(0.228)	(0.271)	(0.263)
Belonging to the same prefecture city	1.642	1.635	1.392	1.382
	(0.186)***	(0.185)***	(0.206)***	(0.203)***
Ln (Total area) of exporter in 1999	0.263	0.265	0.246	0.25
	(0.067)***	(0.068)***	(0.067)***	(0.069)***
Ln (Total area) of importer in 1999	0.459	0.461	0.476	0.481
	(0.091)***	(0.094)***	(0.110)***	(0.114)***
District dummy for exporter	-0.47	-0.44	-0.691	-0.648
	(0.204)**	(0.202)**	(0.219)***	(0.218)***
District dummy for importer	0.902	0.911	1.122	1.137
	(0.171)***	(0.174)***	(0.180)***	(0.185)***
N	38,136	38,136	38,518	38,518

Notes: 1. The coefficients (instead of hazard ratios) are provided for the results of proportional hazards models; 2. Robust clustered standard errors at jurisdiction pair level are provided in parentheses; 3. *** p<0.01; ** p<0.05; * p<0.1.

Table 6: Robustness Check Using Logit Models

Models	**Firth Logit Model**		**Random Effect Logit Model**	
Explanatory Variables	[1]	[2]	[3]	[4]
Ln (GDP per capita) of exporter in year t-1	-0.508	-0.528	-0.695	-0.717
	(0.271)*	(0.315)*	(0.324)**	(0.368)*
Ln (GDP per capita) of importer in year t-1	1.595	1.835	1.984	2.095
	(0.248)***	(0.285)***	(0.326)***	(0.344)***
Decentralization dummy for exporter	0.132	0.142	0.063	0.072
	(0.226)	(0.226)	(0.273)	(0.270)
Decentralization dummy for importer	0.362	0.346	0.353	0.343
	(0.152)**	(0.152)**	(0.187)*	(0.185)*
Connected (Three types) in year t-1	0.287	0.982	0.341	0.723
	(0.171)*	(0.552)*	(0.200)*	(0.646)
Ln (GDP per capita) of exporter		0.157		0.169
* Connected (Three types) in year t-1		(0.485)		(0.573)
Ln (GDP per capita) of importer		-0.782		-0.504
* Connected (Three types) in year t-1		(0.435)*		(0.523)
Adjacent or not	0.247	0.228	0.148	0.14
	(0.220)	(0.222)	(0.278)	(0.276)
Belonging to the same prefecture city	1.103	1.098	1.478	1.441
	(0.197)***	(0.197)***	(0.269)***	(0.266)***
Ln (Total area) of exporter in year t-1	0.23	0.227	0.284	0.276
	(0.092)**	(0.092)**	(0.108)***	(0.107)***
Ln (Total area) of importer in year t-1	0.209	0.214	0.236	0.236
	(0.080)***	(0.081)***	(0.094)**	(0.093)**
District dummy for exporter	-0.536	-0.541	-0.622	-0.624
	(0.169)***	(0.170)***	(0.198)***	(0.197)***
District dummy for importer	0.914	0.919	0.987	0.985
	(0.149)***	(0.150)***	(0.179)***	(0.177)***
Prior trade dummy	3.32	3.306	2.361	2.431
	(0.172)***	(0.172)***	(0.423)***	(0.414)***
N	28,878	28,878	28,878	28,878

Notes: 1. The coefficients (instead of odds ratios) are provided for the results of logit models; 2. Year fixed effects are included in all the columns. 3. Robust standard errors are provided in parentheses; 4. *** p<0.01; ** p<0.05; * p<0.1.

Table 7: Robustness Check using Career Network

Models	**Proportional Hazards Model**				**Firth Logit Model**		**Random Effect Logit Model**	
	(First Trade Event)		**(All Trade Events)**					
Explanatory Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Ln (GDP per capita) of exporter	-1.089	-1.065	-0.939	-0.856	-0.508	-0.468	-0.713	-0.658
	(0.268)***	(0.285)***	(0.265)***	(0.286)***	(0.272)*	(0.297)	(0.329)**	(0.348)*
Ln (GDP per capita) of importer	1.711	1.955	1.594	1.849	1.608	1.884	2.025	2.148
	(0.224)***	(0.237)***	(0.237)***	(0.251)***	(0.248)***	(0.274)***	(0.330)***	(0.334)***
Decentralization dummy for exporter	-0.072	-0.057	0.079	0.089	0.153	0.156	0.097	0.098
	(0.267)	(0.262)	(0.278)	(0.274)	(0.227)	(0.226)	(0.277)	(0.270)
Decentralization dummy for importer	0.401	0.387	0.434	0.419	0.387	0.367	0.384	0.368
	(0.171)**	(0.169)**	(0.183)**	(0.182)**	(0.152)**	(0.152)**	(0.190)**	(0.185)**
Connected (Career)	0.974	1.864	1.087	2.123	0.898	2.114	1.171	2.031
	(0.226)***	(0.534)***	(0.229)***	(0.534)***	(0.243)***	(0.620)***	(0.305)***	(0.746)***
Ln (GDP per capita) of exporter * Connected (Career)		0.165		-0.061		0.126		0.054
		(0.592)		(0.685)		(0.565)		(0.696)
Ln (GDP per capita) of importer * Connected (Career)		-0.944		-0.879		-1.31		-0.962
		(0.394)**		(0.423)**		(0.511)**		(0.634)
Adjacent or not	-0.157	-0.154	0.034	0.036	0.2	0.188	0.054	0.066
	(0.238)	(0.230)	(0.273)	(0.261)	(0.224)	(0.226)	(0.289)	(0.283)
Belonging to the same prefecture city	1.356	1.368	1.083	1.092	0.811	0.826	1.142	1.097
	(0.214)***	(0.216)***	(0.231)***	(0.232)***	(0.224)***	(0.225)***	(0.288)***	(0.282)***
Ln (Total area) of exporter	0.251	0.234	0.238	0.226	0.244	0.226	0.304	0.282
	(0.069)***	(0.069)***	(0.069)***	(0.071)***	(0.092)***	(0.093)**	(0.110)***	(0.109)***
Ln (Total area) of importer	0.355	0.359	0.383	0.387	0.204	0.201	0.234	0.226
	(0.088)***	(0.087)***	(0.098)***	(0.097)***	(0.081)**	(0.081)**	(0.095)**	(0.093)**
District dummy for exporter	-0.456	-0.48	-0.648	-0.665	-0.554	-0.571	-0.658	-0.659
	(0.205)**	(0.202)**	(0.218)***	(0.217)***	(0.169)***	(0.170)***	(0.202)***	(0.198)***
District dummy for importer	0.766	0.767	0.948	0.939	0.866	0.852	0.951	0.93
	(0.174)***	(0.176)***	(0.182)***	(0.184)***	(0.150)***	(0.151)***	(0.182)***	(0.178)***
Prior trade dummy					3.286	3.277	2.238	2.378
					(0.174)***	(0.174)***	(0.432)***	(0.419)***
Year FE	N	N	N	N	Y	Y	Y	Y
N	37,445	37,445	37,824	37,824	28,878	28,878	28,878	28,878

Notes: 1. The coefficients (instead of hazard ratios) are provided for the results of proportional hazards models (Column 1-4); 2. The coefficients (instead of odds ratios) are provided for Firth Logit and Random Effect Logit models. 3. Covariates in year t are used in column 1-4; Covariates in year $t-1$ are used in column 5-8; 4. Robust clustered standard errors are provided in parentheses for column 1-4; Robust standard errors are provided for column 5-8; 5. *** p<0.01; ** p<0.05; * p<0.1.

Table 8: Robustness Check using Birthplace Network

Models	**Proportional Hazards Model**				**Firth Logit Model**		**Random Effect Logit Model**	
	(First Trade Event)		**(All Trade Events)**					
Explanatory Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Ln (GDP per capita) of exporter	-1.119	-1.08	-0.976	-0.895	-0.527	-0.518	-0.713	-0.71
	(0.272)***	(0.280)***	(0.271)***	(0.272)***	(0.272)*	(0.280)*	(0.326)**	(0.337)**
Ln (GDP per capita) of importer	1.766	1.72	1.659	1.582	1.593	1.556	1.999	1.953
	(0.219)***	(0.227)***	(0.232)***	(0.238)***	(0.247)***	(0.253)***	(0.328)***	(0.334)***
Decentralization dummy for exporter	-0.073	-0.077	0.083	0.074	0.142	0.136	0.071	0.059
	(0.264)	(0.264)	(0.276)	(0.276)	(0.226)	(0.226)	(0.273)	(0.276)
Decentralization dummy for importer	0.367	0.375	0.384	0.4	0.359	0.364	0.351	0.361
	(0.168)**	(0.169)**	(0.180)**	(0.182)**	(0.152)**	(0.152)**	(0.188)*	(0.191)*
Connected (Birthplace)	0.278	0.057	0.198	-0.239	0.402	0.038	0.437	-0.416
	(0.232)	(0.875)	(0.243)	(0.904)	(0.249)	(1.027)	(0.312)	(1.222)
Ln (GDP per capita) of exporter * Connected (Birthplace)		-0.507		-1.029		-0.111		-0.233
		(0.912)		(1.004)		(0.839)		(1.068)
Ln (GDP per capita) of importer * Connected (Birthplace)		0.571		1.096		0.459		1.038
		(0.568)		(0.676)		(0.795)		(1.006)
Adjacent or not	-0.028	-0.011	0.148	0.191	0.26	0.269	0.17	0.179
	(0.232)	(0.233)	(0.270)	(0.272)	(0.220)	(0.222)	(0.278)	(0.283)
Belonging to the same prefecture city	1.75	1.74	1.608	1.585	1.163	1.158	1.555	1.571
	(0.184)***	(0.185)***	(0.202)***	(0.206)***	(0.184)***	(0.185)***	(0.262)***	(0.268)***
Ln (Total area) of exporter	0.242	0.238	0.227	0.223	0.224	0.221	0.281	0.279
	(0.069)***	(0.069)***	(0.069)***	(0.070)***	(0.092)**	(0.092)**	(0.108)***	(0.109)**
Ln (Total area) of importer	0.376	0.371	0.417	0.407	0.22	0.22	0.246	0.248
	(0.087)***	(0.088)***	(0.096)***	(0.096)***	(0.080)***	(0.080)***	(0.094)***	(0.095)***
District dummy for exporter	-0.412	-0.419	-0.608	-0.623	-0.53	-0.532	-0.613	-0.622
	(0.202)**	(0.203)**	(0.215)***	(0.217)***	(0.168)***	(0.168)***	(0.198)***	(0.200)***
District dummy for importer	0.833	0.825	1.035	1.02	0.95	0.948	1.021	1.024
	(0.174)***	(0.175)***	(0.185)***	(0.184)***	(0.149)***	(0.149)***	(0.179)***	(0.181)***
Prior trade dummy					3.333	3.327	2.36	2.299
					(0.172)***	(0.172)***	(0.434)***	(0.451)***
Year FE	N	N	N	N	Y	Y	Y	Y
N	37,445	37,445	37,824	37,824	28,878	28,878	28,878	28,878

Notes: 1. The coefficients (instead of hazard ratios) are provided for the results of proportional hazards models (Column 1-4); 2. The coefficients (instead of odds ratios) are provided for Firth Logit and Random Effect Logit models. 3. Covariates in year t are used in column 1-4; Covariates in year $t-1$ are used in column 5-8; 4. Robust clustered standard errors are provided in parentheses for column 1-4; Robust standard errors are provided for column 5-8; 5. *** p<0.01; ** p<0.05; * p<0.1.

Table 9: Robustness Check using Education Network

Models	**Proportional Hazards Model**				**Firth Logit Model**		**Random Effect Logit Model**	
	(First Trade Event)		**(All Trade Events)**					
Explanatory Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Ln (GDP per capita) of exporter	-1.04	-1.209	-0.901	-1.061	-0.44	-0.365	-0.591	-0.524
	(0.275)***	(0.289)***	(0.273)***	(0.292)***	(0.275)	(0.293)	(0.321)*	(0.338)
Ln (GDP per capita) of importer	1.793	1.785	1.651	1.649	1.628	1.647	1.981	1.976
	(0.222)***	(0.233)***	(0.238)***	(0.249)***	(0.248)***	(0.259)***	(0.319)***	(0.325)***
Decentralization dummy for exporter	-0.087	-0.072	0.064	0.073	0.093	0.086	0.035	0.03
	(0.267)	(0.266)	(0.276)	(0.276)	(0.228)	(0.229)	(0.269)	(0.269)
Decentralization dummy for importer	0.367	0.375	0.398	0.404	0.358	0.352	0.349	0.346
	(0.169)**	(0.170)**	(0.181)**	(0.181)**	(0.152)**	(0.152)**	(0.184)*	(0.184)*
Connected (Education)	-0.144	-0.943	0.092	-0.523	-0.056	0.523	-0.067	0.222
	(0.213)	(0.650)	(0.188)	(0.547)	(0.204)	(0.794)	(0.233)	(0.913)
Ln (GDP per capita) of exporter * Connected (Education)		0.982		0.761		-0.43		-0.434
		(0.642)		(0.561)		(0.619)		(0.713)
Ln (GDP per capita) of importer * Connected (Education)		0.002		-0.006		-0.215		0.032
		(0.498)		(0.456)		(0.609)		(0.716)
Adjacent or not	-0.046	-0.064	0.159	0.141	0.258	0.265	0.166	0.174
	(0.236)	(0.237)	(0.274)	(0.274)	(0.223)	(0.223)	(0.274)	(0.274)
Belonging to the same prefecture city	1.81	1.82	1.628	1.637	1.238	1.24	1.6	1.599
	(0.177)***	(0.178)***	(0.201)***	(0.203)***	(0.173)***	(0.173)***	(0.245)***	(0.245)***
Ln (Total area) of exporter	0.263	0.253	0.248	0.24	0.252	0.255	0.303	0.306
	(0.071)***	(0.070)***	(0.070)***	(0.070)***	(0.094)***	(0.094)***	(0.109)***	(0.109)***
Ln (Total area) of importer	0.392	0.393	0.418	0.419	0.222	0.223	0.248	0.245
	(0.089)***	(0.090)***	(0.098)***	(0.100)***	(0.081)***	(0.081)***	(0.093)***	(0.093)***
District dummy for exporter	-0.415	-0.45	-0.626	-0.659	-0.534	-0.52	-0.614	-0.602
	(0.202)**	(0.207)**	(0.218)***	(0.224)***	(0.169)***	(0.169)***	(0.195)***	(0.195)***
District dummy for importer	0.8	0.8	0.991	0.99	0.892	0.894	0.959	0.959
	(0.177)***	(0.177)***	(0.188)***	(0.187)***	(0.150)***	(0.150)***	(0.176)***	(0.175)***
Prior trade dummy					3.332	3.335	2.483	2.494
					(0.172)***	(0.172)***	(0.406)***	(0.406)***
Year FE	N	N	N	N	Y	Y	Y	Y
N	37,445	37,445	37,824	37,824	28,878	28,878	28,878	28,878

Notes: 1. The coefficients (instead of hazard ratios) are provided for the results of proportional hazards models (Column 1-4); 2. The coefficients (instead of odds ratios) are provided for Firth Logit and Random Effect Logit models. 3. Covariates in year t are used in column 1-4; Covariates in year $t-1$ are used in column 5-8; 4. Robust clustered standard errors are provided in parentheses for column 1-4; Robust standard errors are provided for column 5-8; 5. *** p<0.01; ** p<0.05; * p<0.1.