Draft: February 2012

Communication vs. Transportation:

Relative contributions of railways and post offices to British Indian grain price convergence

Tahir Andrabi, Pomona College

Sheetal Bharat[1], University of California, Riverside

Michael Kuehlwein, Pomona College

Abstract

Rice and wheat markets in British India saw a broad convergence in prices across districts during the late nineteenth and early twentieth centuries. Earlier studies stressed the importance of railways in this type of market integration. Andrabi and Kuehlwein (2010), however, argued that railways were capable of explaining only about 20 percent of this price convergence, possibly because of alternative pre-existing transportation networks. This paper adds data on post offices to see if communication advances can explain some of the unexplained price convergence. With the limited data available to us, we find that postal density and railways explain roughly comparable shares of the observed price convergence. Postal density with respect to population appears to be much more important than that with respect to the area or number of towns in a district. We also find little evidence of either complementarity or substitutability between the effects of postal density and railways on price dispersion.

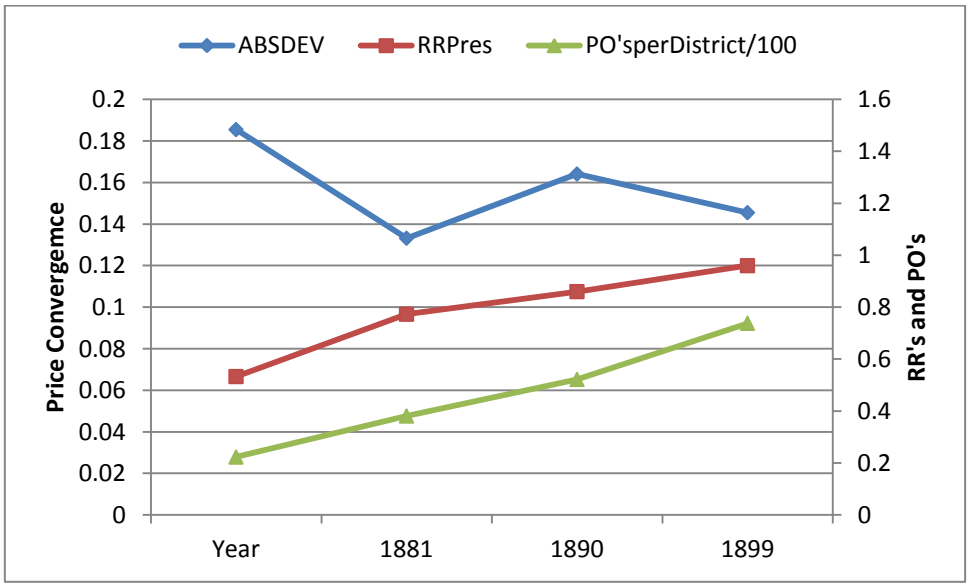
[1] PhD Candidate. Advisor: Professor Susan Carter

Introduction

This paper focuses on one dimension of market integration: price convergence. A body of literature presents reasons for price convergence, both between and within countries (O'Rourke and Williamson 1999). Within countries, the most important contributing factor is often identified to be the construction of railways (Slaughter 2001, Metzer 1974, Dobado and Marrero 2005). That was true in two studies that analyzed grain markets in British India (Hurd 1975 and Mukherjee 1980). Andrabi and Kuehlwein (2010), however, argued that railways were only capable of explaining about 20 percent of the observed price convergence in rice and wheat markets in British India between 1860 and 1920. They found that districts that were not connected by railways experienced price convergence at almost the same rate as connected districts.

Taking a wider view of the question, one can say that arbitrage caused price convergence, rather than the construction of railways specifically. Trade is the final product of a series of activities involving the collection of information, deciding on the appropriate market to target, transporting the goods and selling them. The literature that focuses on railways construction and price convergence has tended to overlook the other critical activities involved. This paper introduces new data on the location of post offices in British India for four specific years: 1881, 1890, 1899, and 1911. We use the data to add the information collection angle to the explanation for price convergence. Before loading rice or wheat onto a railway car and selling it in a district with higher prices, a merchant needs information on those prices. With over 5,000 offices in British India by 1881, the British Indian postal service could provide that information cheaply and conveniently.

Graph 1: Trends in price deviation, railways and post office growth



ABSPDEV: average absolute value of the difference between each district's log price of wheat and the mean log price of wheat.

RRPres: percentage of district headquarters with a railway.

PO'sperDistrict/100: average number of post offices per district divided by 100

Graph 1 illustrates why post office construction might be relevant in explaining grain price convergence in our sample. It displays the general downward trend in wheat price dispersion. The upward trend in railway construction is an obvious reason why researchers looked to railways to explain price convergence. But the number of post offices also trended up wards, suggesting that they too may have played an important role in the convergence process. Indeed, we find that ready access to postal services was an important determinant of the observed price convergence in rice and wheat markets.

Literature Review

Berry (1943) shows that at the same time that steamships appeared in America, price differences for several goods between New Orleans and Cincinnati fell by over 70 percent between 1816 and 1860. Slaughter (2001) found similar results for a different sample of nineteenth century US goods during which an extensive system of canals and railroads was being constructed. Metzer (1974) attributes shrinking inter-provincial price differences in wheat and rye in Russia after 1870 to the nation's growing railway system. O'Rourke and Williamson (1999) note that the decline in the Bavarian/Prussian price differential in wheat and oats from 1854-1904 coincided with Germany's expanding rail system. Dobado and Marrero (2005) argue that railroads accelerated the rate of interstate convergence in Mexican corn prices between1885 and 1908.

Two papers specifically analyse grain market integration in British India. Hurd (1975) reports that the coefficient of variation for district wheat and rice prices dropped 60 percent between 1861 and 1920 while India was building its railways. Mukherjee (1980) finds a similar decline in price dispersion between 1855 and 1912, and links it to railways.

The literature on Indian postal services is very sparse in comparison, and as far as we know, has not been used for a study of India's economic history at all. A few books on the subject were written over a century ago and another few in the last few decades. They give overviews of India's postal history to varying degrees – postal regulation, services offered, changes in postage, runner lines, use of railways, *etc*. We mostly use primary data on the location of post offices to study their impact on price convergence. The secondary literature helps with the background and to interpret our findings.

Railway and postal networks

Lord Dalhousie, on taking over as the Governor-General of India in 1848, took several actions which had the effect of making the large sub-continent smaller. He created a detailed plan for railways in the early 1850s and actively pushed the establishment of telegraph lines under William O'Shaughnessy. A committee appointed to study the functioning of the post recommended some historic changes (uniform postage and abolishing franking, among others) which were implemented in 1854. Dalhousie referred to the post, telegraph and railways as the "three great engines of social improvement" (Parliamentary Papers 1856 [245], 16).

Railways construction began in the mid-1850s in Bombay, Calcutta, and Madras, with lines spreading into the interior. By 1871 all three cities were connected and within two more years, all 20 of India's largest cities were linked. Track mileage grew rapidly from 4,771 miles in 1870 to

35,199 miles by 1920. Railways seem to have been built for three main purposes: commercial, political, and humanitarian. Railways helped to ensure a reliable source of cheap commodities for the home country, they assisted in the defence of the colony, especially in the northwest, and they stood ready to protect citizens in the event of famine (see Andrabi and Kuehlwein [2010] for details). All three motivations appear to have prompted the expansion of the postal network too.

Earlier East India Company officers had made improvements to India's postal system well before Dalhousie took over. Seventeenth century officers were of the opinion that the post should bring in revenue. But it was only in the latter part of the nineteenth century that the post started breaking even. Lord Robert Clive set out the first rules for efficient mail transfer in 1766, and in 1774 Warren Hastings allowed private letters to be carried for a fee. Clive was acting in the interest of maintaining the freshly won trading rights at key ports at the Battle of *Palāshi*, whereas Hastings was trying to secure British finances. Until 1774, postal lines were meant for administrative purposes only.

All revenue collection headquarters were connected with what came to be called the District post or *zamindāri dāk* because these postal lines (*dāk*) were maintained by local landlords (*zamindārs*). They were allowed a reduction in rent in exchange for supplying runners, even though they were not permitted to use them for their personal communication. This formed a dense network throughout the sub-continent, since police and revenue headquarters in districts, sub-divisions and petty divisions served as post offices. Post offices that were opened later specifically with the intention of carrying private letters, what came to be known as the Imperial post, formed a sparse network connecting only large and important cities. During the latter half of the nineteenth century the district post was gradually merged with the Imperial and even the remote rural districts were able to access postal services.

There were four Post Office Acts in the nineteenth century: 1837, 1854, 1866 and 1898.

Table 1: Effects of the Four Post Office Acts of India

Post Office Acts	Major changes
1837	› Enforced a government monopoly of postal services › Tried to ensure uniform postal services across the provinces
1854	› Uniform postage, irrespective of distance, to be prepaid with postage stamps › Establishment of a single postal department for the entire sub-continent
1866	› Franking privileges were curtailed (and abolished in 1873) › Reductions in postage on all categories of mail
1898	› Authority given to postal officers to intercept and detain postal articles that were suspected to undermine British rule in India

Another example of political motivations was the use of field post offices during the Anglo-Afghan wars in 1838, 1878 and 1919. The border districts of Sind and Baluchistan had a sparser postal network than the neighbouring Punjab and Bombay. But temporary field post offices served

critical communication and transportation needs, as the British were trying to protect India from the Russian approach of south Asia through Afghanistan. It was also used against Indian freedom fighters during the first war of independence of 1857. The post proved very important for sharing intelligence about the spread of rebellion at times when telegraph lines had been destroyed by the rebels. The Act of 1898 further reveals government anxiety about their weakening hold over the prized colony. It was around this time that the freedom struggle in India was gaining strength under the aegis of the Indian National Congress. Letters to and from prominent members such as Sarojini Naidu, Gopal Krishna Gokhale and Sir William Wedderburn were intercepted. None of this would have surprised Dalhousie, who thought that the military advantages of the post and telegraph were "too obvious to call for notice." (Parliamentary Papers 1856, 19).

Commercial motivations are apparent in the high and fast growing postal density in the cotton growing and coastal district in Bombay province between 1881 and 1911. In the Poona district the sub-divisions that grew pepper, chillies and onions and exported them to Europe had a much higher postal density than the food growing sub-divisions. The convenience of opium merchants was cited as one of the reasons for offering uniform postage irrespective of distance in 1854.

The Act of 1854 also provided huge benefits to the population at large because of the dramatically low postage. Savings bank and money order services offered by the post in the 1880s were popular among the poorest people. Low postage on newspapers provided access to news – this went a long way towards strengthening the freedom struggle. In the Poona district, new post offices were set up around the construction sites of new canals for protection against drought. Telegraph services were offered through post offices in the 1880s. But these were less accessible and much more expensive than regular post. As of 1881, a flat rate for a letter was 1/32 of a rupee, whereas a telegram cost a rupee. That same year there were about 1,000 telegraph offices and over 5,000 post offices.

Wheat and rice markets

Wheat production and consumption during this period were concentrated in northern India, principally the Punjab and United Provinces. Rice production and consumption occurred more along the east coast including Bengal, Bihar, Orissa, and Madras. Despite high levels of exports of both crops, most production was for domestic purposes. Wheat and rice producing provinces generally had lower prices for the two commodities, but big cities commanded higher prices. Railway conveyance offered merchants significant advantages over alternative sources of transportation in terms of cost, time, and reliability.

There is plenty of anecdotal evidence to show that the post was also being used on a large scale by merchants. An 1851 report by the commission set up to study the functioning of the post cites several instances of merchants using the post to communicate with their agents in distant markets. In fact, their convenience was cited as one of the reasons to make postage calculations depend on just weight and not distance. After 1854, when uniform postage was enacted, theirs was the cheapest rate in the world. According to Clarke (1921, 42) "to such an extent have postage rates been reduced in India that it would be hard to find a man who could not afford to communicate by post with his friends". This would have been especially true for the districts where the district post

had been merged with the Imperial post and many small villages at once became part of a vast network of post offices.

Data

We obtained annual retail wheat and rice price (rupees per *ser* [2.057 lbs]) by district from the 1896 and 1922 issues of *Prices and Wages in India*. They were collected on a fortnightly basis at district headquarters. There are slightly more districts with rice data than wheat, and all of the districts in our wheat sample are in our rice sample.

Railway opening dates by city are available in the 1947 issue of the *History of Indian Railways*. Since our grain prices were measured at district headquarters, the opening date for railways used in our analysis was the first year a railway came to a district headquarters or within 20 miles of it.

Volumes of the *Postal Guide* were published annually starting in 1869. These were meant for the ease of postal sorters and to provide instructions to the people on how to use the various services. Among other things, these volumes contained an alphabetical list of all the towns and villages in British India that had a post office. We have been able to procure and digitise four of these lists – 1881, 1890, 1899 and 1911. Data included in this paper are a count of the number of post offices in each of the districts that we have price data for (163 for rice and 136 for wheat). We measure postal density with respect to district area, number of towns, or population.

As district postal lines got merged with the Imperial line, they got included in the *Postal Guide*. So any district post office that does not appear in the *Postal Guide* (and consequently does not form part of the data for this paper) was also not open to use by private individuals.

The number of post offices in a district ranges from 0 in 1881 to 435 in 1911, but averages about 47 in our wheat and rice samples. We are still collecting data on the number of towns, area, and population of each district in each of our four waves and cross-checking that with our post office data to make sure that the district definitions are consistent. So as a first pass we use 1881 district populations for our full sample and 1891 district areas and numbers of towns. For our wheat sample this translates into about 6 post offices per 100,000 people, 3.5 post offices per 100 square miles, and about 4/10ths of a post office per town or village. The averages for our rice sample were similar. Overall there were railroads in 78 percent of our districts in our sample.

We also have data for 18 native states. However, for at least part of our sample period several of these states had independent postal networks that either did not allow the British government to set up new post offices in their territory or just allowed them to set up a few. This means that the *Postal Guide* list of villages in these native states might not be accurate and the services that they provide might not be at the same level as the post offices in British districts. For this reason, we have dropped all native states from our sample. The one district in our sample that exhibited an implausibly large drop in the number of post offices over time was Jhang, so we excluded it from our estimation too.

Table 2: Summary Statistics

	Balanced Wheat Sample			Balanced Rice Sample		
Variable	N	Mean	SD	N	Mean	SD
ABSPDEV	544	0.161	0.140	652	0.201	0.176
RAILPRES	544	0.781	0.414	652	0.781	0.414
POCAPITA	544	0.057	0.042	652	0.058	0.041
POAREA	544	0.035	0.163	652	0.038	0.163
POTOWN	544	0.420	3.421	652	0.506	3.691
INTERACTCAP	544	0.048	0.046	652	0.048	0.045
INTERACTAREA	544	0.033	0.163	652	0.035	0.164
INTERACTTOWN	544	0.417	3.421	652	0.502	3.691

ABSPDEV is the absolute deviation of log price of grain from the mean

RAILPRES is the presence of a rail line at or near a district headquarters

POCAPITA is the number of post offices per 1,000 persons in a district (using 1881 population)

POAREA is the number of post offices in a district per square mile

POTOWN is the number of post offices per town or village (using 1891 count of villages)

*INTERACTCAP is RAILPRES*POCAPITA*

*INTERACTAREA is RAILPRES*POAREA*

*INTERACTTOWN is RAILPRES*POTOWN*

*N is the total number of observations (136 districts*4 years = 544 observations)*

Model

It is common to invoke the well-known "iceberg" model to explain differences in prices across cities or districts. A certain portion of an iceberg melts as it is being transported across the tropical sub-continent. It will be profitable to transport the iceberg to another district only if the price it will fetch there compensates for the loss in transit. The law of one price therefore dictates that the difference in commodity prices between districts must be no greater than the cost of transport between these two districts. If the difference in prices is greater than this band permits, then arbitrage will be profitable and the result will be price convergence.

That model therefore implies that the only factor that should lead to price convergence between two cities is shrinking transportation costs. That explains why so many studies have looked at the introduction of railways to explain price convergence. However, the model assumes complete information, which may well not have held in nineteenth century India. Without that assumption prices can vary beyond transportation costs. Post offices, on the other hand, can help to provide information about arbitrage opportunities. Farmers or merchants use the post or telegraph to communicate with their agents, friends or family and find out how different prices in other districts are compared with those at their local markets. This tells them how wide the gap is and whether

arbitrage is an option. If prices in another district are higher and profits can be earned after incurring the cost of transport, then the railways or another source of transport can be used to reach that attractive market.

All of this should push prices together. But if post offices do not reach enough producers, there may not be enough arbitrage to drive prices within the transportation cost band. That is where post office density enters. If a district has a higher concentration of post offices it is providing postal access to more producers. Greater access to means of communication means greater access to arbitrage opportunities, which should push prices closer to the band. At some point the band will be reached and additional communication should have little effect. However, changes in the width of the band over time due to innovations in transportation imply a continual need for efficient widespread communication.

Based on this, our regression equation can be written as:

$$LPD_{it} = \alpha + \theta_i + \gamma_t + \beta POD_{it} + \mu POD_{it}^2 + \delta Rail_{it} + \lambda Rail_{it} x POD_{it} + \varepsilon_{it}$$

LPD_{it} is the absolute value of the deviation of the log price of rice or wheat in district *i* at time *t* from the mean log price of rice or wheat for all districts at time *t*. Price convergence would require the absolute log price deviation to decline over time. We use log price deviations so that the postal density and railway coefficients can be interpreted as percentage changes caused by these regressors. *POD* is our post office density variable. The different measures of postal density that we use are post offices per 1,000 persons, post offices per square mile or post offices per town in each district. The quadratic POD variable is meant to capture the potential nonlinear effect of greater communication on price differences mentioned above. *Rail* is an indicator variable which takes a value of one if the district headquarters has a railway line that year and zero otherwise.

An interaction term between railways and post office density is included to allow the arbitrage effects of better information on price differentials to change in the presence of railways. On the one hand, one might imagine post offices to matter more with railways nearby, as railways would provide the means through which price arbitrage takes place. In that case post offices and railways would be complements. On the other hand, they could be substitutes if railways brought with them all the price information that post offices conveyed. Our α is a constant; θ_i is our district fixed effect. It takes care of time invariant unobservable characteristics specific to a district that affect the price of grain. These could include climate, geography (proximity to a port or navigable river) and soil quality. γ_t is our year fixed effect and it takes care of unobservable characteristics specific to a particular year for all districts. There was a significant increase in postal density over this time. Not correcting for year fixed effects could lead to a very high POD coefficient due to a spurious correlation between increasing postal density and decreasing absolute price deviation from the mean. Finally, ε_{it} is the error term. We use standard errors clustered at the district level since conditions in districts are likely to be dependent across years.

Results

Table 3 displays our results for wheat prices within a balanced sample of 136 districts. Results for a slightly larger unbalanced sample are very similar. District fixed effects and time dummy variables are not reported. In the first regression our discrete railway variable enters significantly and the point estimate suggests that the presence of a railway at district headquarters reduces price dispersion by roughly 7 percent. The point estimate is slightly larger than in Kuehlwein and Andrabi (2010), but the dependent variable is also slightly different so the estimate appears to be reasonable. The number of post offices per 1,000 persons in each district is also significant and negative, as hypothesised. The quadratic term is significant at the 10 percent level and is consistent with a decreasing marginal impact on price dispersion. Combined, the two point estimates suggest that at our sample mean of 0.057 post offices per 1,000 persons, post offices reduce price dispersion by 7 percent too. So the magnitude of the effect of post office density on district price dispersion is estimated to be essentially the same as the effect of having a railroad. The interaction term between railways and post office density is insignificant, suggesting neither complementarity nor substitutability between them. We looked into whether this might be sensitive to the presence of other viable modes of transportation, such as ships or roads. However, additional regressions that allowed for interaction between post offices and either railways, being close to the Ganges, or on the Grand Trunk road generated the same results. Perhaps this suggests that the two possibilities of either substitutability or complementarity balance each other out.

The next regression uses post offices per district square mile for our post office density measure. Railways still matter, but neither the linear nor the quadratic versions of this post office variable enter significantly. Again, there is no evidence of any interaction effects. In the next column, we substituted in post offices per town within each district. However, the estimated effects from post offices were weak. In the last column we reran the post office per capital regression but without the insignificant interaction variable. The post office point estimates change a little, but evaluated at the sample mean they still predict that post offices reduce price dispersion by an average of 6 percent.

Table 4 presents the same results using our rice sample. They are broadly similar. The only post office density variable that enters significantly is the number of post offices per 1,000 persons, though in the first regression it is only significant at the 10 percent level. The interaction term continues to be insignificant. One difference is that the presence of railroads is only significant at the 10 percent level in several regressions. Also, we cannot reject the hypothesis that the quadratic term for post offices per capita is zero. Hence, in this data set there is no evidence of diminishing effects of more post offices on price dispersion. In the final column, both the insignificant quadratic and interaction variables have been dropped, with the result that post offices per capita becomes significant at the 5 percent level again. The point estimate evaluated at the mean implies that average post office density reduces price dispersion by about 4 percent, somewhat less than in our wheat sample. The results for our unbalanced sample were similar in all respects.

These results suggest that what matters for post office density is how many there are relative to the population of the district. At least in the wheat sample, the largest effect is when per capita postal density is low, suggesting that establishing new post offices in those settings provides more bang for the buck. This makes sense. A new post office that can suddenly be accessed by thousands of entirely unconnected people has more of an impact on price dispersion than one that

Table 3: Determinants of Absolute Log Price Difference from the Mean

Balanced Wheat Sample

Variable	(1)	(2)	(3)	(4)
Constant	0.268 (0.36)***	0.248 (0.035)***	0.238 (0.028)***	0.259 (0.031)***
RRPres	-0.079 (0.035)**	-0.095 (0.039)**	-0.079 (0.033)**	-0.066 (0.025)**
PoCapita	-1.514 (0.710)**			-1.281 (0.601)**
PoCapita2	3.111 (1.856)*			3.433 (1.917)*
PoArea		-2.699 (2.382)		
PoArea2		-0.101 (0.111)		
PoTown			-0.744 (0.873)	
PoTown2			-0.000 (0.000)	
Interact	0.347 (0.429)	3.003 (2.393)	0.756 (0.873)	
N	544	544	544	544
Adj. R^2	0.50	0.50	0.49	0.50

**-Significant at the 10% level*

***-Significant at the 5% level*

****-Significant at the 1% level*

Notes: The dependent variable is the absolute value of the difference between the log price of wheat in district headquarters and the mean log price across districts that year. RRPres is a dummy variable for whether a railroad was present at district headquarters that year; PoCapita is post offices per 1,000 persons in the district that year; PoArea is post offices per square mile in the district that year; PoTown is post offices per town in the district that year; a variable with a 2 at the end indicates that variable squared; Interact is RRPres x the post office density variable in that column. Not reported are district level fixed effects and yearly time dummies. Standard errors are in parentheses, clustered at the district level.

Table 4: Determinants of Absolute Log Price Difference from the Mean
Balanced Rice Sample

Variable	(1)	(2)	(3)	(4)
Constant	0.370 (0.037)***	0.342 (0.033)***	0.336 (0.030)***	0.347 (0.026)***
RRPres	-0.075 (0.040)*	-0.063 (0.040)	-0.062 (0.036)*	-0.052 (0.029)*
PoCapita	-1.403 (0.760)*			-0.653 (0.282)**
PoCapita2	0.771 (2.245)			
PoArea		-1.420 (1.736)		
PoArea2		0.068 (0.123)		
PoTown			-0.753 (1.013)	
Potown2			-0.000 (0.000)	
Interact	0.611 (0.532)	1.271 (1.752)	0.769 (1.013)	
N	652	652	652	652
Adj. R^2	0.54	0.53	0.53	0.54

**-Significant at the 10% level*
***-Significant at the 5% level*
****-Significant at the 1% level*
Notes: The dependent variable is the absolute value of the difference between the log price of rice in district headquarters and the mean log price across districts that year. RRPres is a dummy variable for whether a railroad was present at district headquarters that year; PoCapita is post offices per 1,000 persons in the district that year; PoArea is post offices per square mile in the district that year; PoTown is post offices per town in the district that year; a variable with a 2 at the end indicates that variable squared; Interact is RRPres x the post office density variable in that column. Not reported are district level fixed effects and yearly time dummies. Standard errors are in parentheses, clustered at the district level.

services a population that already had access to a post office. That seems to matter much more than establishing post offices in districts where the postal density per square mile or per town is low. So simply constructing new post offices in areas where they did not exist before need not significantly impact commodity prices.

It should be pointed out that after the setting up of new railway lines across the sub-continent, new post offices were often set up along the rail route, for convenient sorting and distribution. If there is a correlation between our rail and postal density variables then the specification might suffer from multicollinearity. This is not a concern, however, since the correlation between these two variables is quite low. The R^2 of a regression of post office density on whether a railway was present is only about two percent.

Post office placement

So far our analysis has treated the locations of post offices as exogenous. But they were not random, so depending on what did determine those locations, endogeneity could be a problem for our estimation. We have already discussed that there were commercial, political, and welfare reasons for the building of post offices. What else do we know about post office placement?

One way to begin to address that question is to do some simple regressions involving the number of post offices in each district. Intuitively, if the main purpose of post offices was to connect people, more people in a district would imply more post offices. More people would imply a greater demand for the services that post offices provide, including mailing and receiving letters and packages, money orders, parcel insurance, telegrams, and savings accounts (Hamilton 1910, Chapter XV). Holding the size of the population constant, a larger area would also probably spur the building of more post offices to make them easier to reach. Finally, controlling for both the population and the area of a district, more towns might also be expected to lead to the establishment of more post offices because the population would be more spread out.

Table 5 tests these hypotheses. Yearly dummies were added to allow for the growth in post offices over time. The results are strong, as all estimated coefficients are significant at the 1 percent level save the quadratic term on population density. A larger population definitely does increase the number of post offices in a district, to the tune of 6 extra post offices per 100,000 extra persons. Because the quadratic term is insignificant, there is no evidence of a declining effect from a larger population. A larger area also increases the number of post offices by up to 5 post offices per 1,000 square miles. The marginal effect diminishes with district size. The one perplexing result is that the number of towns reduces the number of post offices by more than 8 post offices per 1,000 towns, though again the effect shrinks as that number grows. Perhaps the increase in the number of towns indicates a higher number of small villages that are insufficiently large to warrant a post office. Overall, these results suggest a definite logic to the establishment of post offices. They also indicate that much of the variation in post office placement has already been controlled for in our regressions. In fact, simple fixed effect regressions with time dummies are capable of explaining 76 percent of the variance in the number of post offices in our sample.

Sen (1875, 128) informs us that after 1867 post offices were opened on a temporary basis for six months. A post office would be made into a permanent establishment only if during that time half of the money earned from postage covered the cost of the establishment. The other half was

Table 5: The Determinants of the Number of Post Offices in a District
Wheat Sample

Variable	Estimates
Constant	-22.811 (7.829)***
Population	0.063 (0.016)***
Population2	-0.00001 (0.00001)
Area	5.494 (1.862)***
Area2	-0.314 (0.133)***
NumberTowns	-8.642 (2.081)***
NumberTowns2	0.516 (0.145)***
1890 Dummy	14.831 (1.169)***
1899 Dummy	29.279 (2.081)***
1911 Dummy	51.029 (3.737)
N	544
R^2	0.47

**-Significant at the 10% level*
***-Significant at the 5% level*
****-Significant at the 1% level*
Notes: The dependent variable is the number of post offices in the district. Population is the population of the district in 1881 divided by 1000. Area is the area of the district in 1891 in square miles divided by 1000. NumberTowns is the number of towns and villages in the district in 1891 divided by 1000. A 2 at the end of a variable implies that the variable is squared. Standard errors are in parentheses, clustered at the district level.

meant to cover the costs incurred by other post offices that were sending letters to or receiving them from this one. It is not clear how the postal department decided where to set up temporary post offices. This revenue requirement encouraged post offices to open up in more populated and economically successful areas. But as noted earlier, revenue was not the only reason for setting up post offices. There were political, commercial and welfare motives too.

By the 1880's it was felt that the post had not yet reached enough remote villages, so extra-departmental post offices were introduced. The administration allowed any literate school teacher or merchant who was willing to operate a post office out of their home or work place to earn a small fee for the service. Since these were extremely cheap to open, the condition that half the postage should pay for the establishment cost (which was just the allowance paid to the post master) was satisfied easily. There was a marked increase in postal facilities following the adoption of this new rule in the 1880s in Bengal and the 1890s in Bombay province.

Based on this information we believe that that endogeneity is not a serious problem with our estimation. Since our regressions include district fixed effects, any missing time-invariant factors that might influence district price dispersion over our four waves are already controlled for. Military post office placement should not lead to reverse causation. And the expansion of postal establishments in rural areas after the 1880's runs counter to the possibility that new post offices were only constructed in booming districts prone to price convergence. We did attempt to test this by rerunning our regressions on districts with headquarters on military, rather than commercial, railroad lines. However, the tiny sample size (32 observations) produced too imprecise estimates to do any inference.

Conclusion

This paper uses new data on the location of post offices to address the question of the reasons behind price convergence in the rice and wheat markets in British India. With the limited data that are available to us, we estimate that the role of the post office is perhaps equal in magnitude to the role of the railways in reducing price dispersion. We find that a railway line passing through a district and the average number of district post offices per person both decrease price dispersion by about seven percent. The impact of postal density seems to be a little weaker in the rice market than in the wheat market.

While there is much research that demonstrates the importance of railways for market integration, the post is a decidedly understudied subject, in spite of its ubiquitous nature. The postal system was fine-tuned by the British government over the course of three centuries for at least three important reasons – political, commercial and welfare. Each of these motivations became important at different points in time, depending on the political and economic situation in British India. These represent the effects that the British government *intended* the post to have. This paper suggests that market integration can be added to the list of actual effects.

References

Administration Report on the Railways in India for Calendar Year 1910. London: His Majesty's Stationery Office, 1911.

Ahmed, Noor H. 1981. *India Post Through the Ages: A Saga of Communications*. Postal History Society of India, 11/63-G, Near Bus Stand, Alur (Kurnool) 518395.

Andrabi, Tahir and Kuehlwein, Michael. 2010. "Railways and Price Convergence in British India". *The Journal of Economic History*, 70: 351-377. Cambridge University Press.

Berry, Thomas. *Western Prices Before 1861.* Cambridge, MA: Harvard University Press, 1943.

Chattopadyay, Basudeb. 2004. *'A Jingle of Bells': A Short History of General Post Office*. Kolkata: K P Bagchi and Co.

Clarke, Geoffrey. 1921. *The Post Office of India and its Story*. London: John Lane.

Connell, Arthur. "Indian Railways and Indian Wheat". *Journal of the Statistical Society of London* 48, no. 2 (1885): 236-76.

Dobado, Rafael and Gustavo Marrero. "Corn Market Integration in Porfirian Mexico". *Journal of Economic History*. 65, no. 1 (2005): 103-28.

Donaldson, Dave. 2010. "Railroads of the Raj: Estimating the Impact of Transportation Infrastructure". *MIT Department of Economics, NBER and CIFAR*, (October).

Gazetteer of the Bombay Presidency Volume XVIII (Facsimile reproduction). 1992. Originally printed in 1885. The Government Photozincographic Press, Pune.

Hamilton, Ivie, G J. 1910. *An Outline of Postal History and Practice, with a History of the Post Office of India*. Calcutta: Thacker, Spink and Co.

House of Commons Parliamentary Papers. 1856.

Hurd, John II. "Railways and the Expansion of Markets in India, 1861-1921". *Explorations in Economic History* 12, no. 3 (1975): 263-88.

Majumdar, Mohinilal. 1995. *Early History and Growth of Postal System in India*. Calcutta: Rddhi-India.

___. 1990. *The Imperial Post Offices of British India, 1837 – 1914*. Phila Publications, Calcutta.

___. 1984. *The Postal History of Zemindari Dawk, 1707-1906*. Calcutta: Rddhi-India.

MacPherson, W.J. "Investment in Indian Railways, 1845-1875". The Economic History Review 8, no. 2 (1955): 177-86.

Metzer, Jacob. "Railroad Development and Market Integration: The Case of Tsarist Russia". *Journal of Economic History*. 34, no. 3 (1974): 529-50.

Mukherjee, Mukul. "Railways and Their Impact on Bengal's Economy, 1870-1920". *Indian Economic Social History Review* 17, no. 2 (1980): 191-209.

O'Rourke, Kevin and Jeffrey Williamson. *Globalization and History: The Evolution of a Nineteenth Century Atlantic Economy*. Cambridge, MA: MIT Press, 1999.

Report from the Commissioners for Post Office Enquiry. 1851. London.

Sams, H A Liert.-Col., (Ed.). 1922. *The Post Office of India in the Great War*. Bombay: The Times Press.

Sen, Ananda Gopal. 1875. *The Post Office of India*. Babooram Sarkar at the Roy Press, Calcutta. Reprinted by Manik Jain, Calcutta, 1996.

Shivanath. 2002. *An Approach to History of Post Offices in India and Other Essays*. Army Postal Service Association, New Delhi.

Slaughter, Matthew. “Does Trade Liberalization Converge Factor Prices? Evidence from the Antebellum Transportation Revolution”. *Journal of International Trade and Economic Development* 10, no. 3 (2001): 339-62.

Virk, D. S. 1991. *Indian Postal History, 1873-1923: Gleanings from Post Office Records*. New Delhi: Army Postal Service Association.