COMMUNICATION AND MANUFACTURING: EVIDENCE FROM THE EXPANSION OF POSTAL SERVICES

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ABSTRACT. In order to make a sale, a producer first has to find buyers and discover their willingness to pay. We argue that the analysis of this activity can help explain the process of structural transformation. If manufactured goods are more differentiated than agricultural commodities, then the price of those goods will increase relatively more after the introduction of communication technologies. Furthermore, cheaper communication leads to the geographic dispersion of production and consumption, an effect which is magnified by access to cheaper transportation. We test the model using a novel dataset on the roll-out of free postal delivery in rural communities in the US at the turn of the 20th century. We use newspaper subscriptions as a proxy first stage, and find that access to new post office services increased newspaper circulation. Investment in manufacturing significantly increased in counties with more new free delivery routes, particularly in regions with more access to railroads.

1. INTRODUCTION

Even after a good has been produced, its producer still needs to find someone willing to purchase it, ideally the person who will pay the most, net of transport costs. Even in a world with costless trade, if there are costs of communication, it may not be the case that the person who ends up purchasing the good is the one willing to pay the most. Communication costs will have a relatively larger effect on the expected price for products with a higher variance of demand. In places where it is more costly to contact potential buyers, therefore, producers will have relatively larger incentives to try to sell goods for whom information is less important. As a result, lowering communication frictions will not only lead to more production overall, for the same reasons as regular iceberg costs, but the increase will be relatively larger for more information-intensive goods. We use a natural experiment in roll-out of postal services in the late 1800s to demonstrate the differential impacts cheaper communication has for producers in isolated, rural areas. In particular, using an instrumental variables approach, we find a relatively larger increase in manufacturing relative to agriculture. This suggests that the ability to cheaply communicate is essential the process of development, because it encourages specialization and structural transformation.

In 1896, the United States Postal Service introduced a program of daily, free home delivery and pick-up of the mail, known as Rural Free Delivery (RFD), to rural towns and counties across the country. Before the introduction of RFD, areas of an average of 100 square miles shared one central post office with no direct

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home or business delivery services. The time costs of using the central post office had been sufficiently large that most farmers and other rural citizens did not check their mail more than once a week (Fuller 1959). Enough rural areas qualified for RFD that the roll-out, especially in the first decade, was reasonably arbitrary. Using a novel dataset on the spread of services, we show that there are no systematic differences in the pretreatment outcomes or covariates of counties with varying RFD implementation timing; nor is it possible to predict using census data or political information when a county would get RFD service. We find large reduced form impacts of cheaper communication on manufacturing investment at the county level. These large effects are not surprising; historian Wayne E. Fuller described the introduction of RFD to rural America as "as much a revolution in communication as the telegraph had been," (Fuller 1964, p. 294).

There have been several recent papers exploring the relationship between modern communication technologies and agricultural production. Jensen (2007), randomized experiments giving fishermen cell phones, Aker (2010) uses a natural experiment on access to cell services and grain markets, and Goyal (2010) implemented randomized experiment using internet kiosks to help run auctions for soy beans. These papers strongly suggest that price dispersion is not purely due to trade costs, the classical explanation, but also due to the difficulty and cost of communication between buyers and sellers spread over space.[1] Once cheaper communication methods are put in place, price dispersion across space shrinks (or vanishes entirely as in Jensen (2007) and Goyal (2010)). However, the reduction in communication costs and price dispersion should have longer term effects on the producers in these areas—agents should factor these new, lower costs into production decision. Indeed, Goyal (2010) suggests that another impact of her experiment is that more farmers choose to plant soybeans. We extend that logic across sectors and test it formally in the context of rural producers in the US in the 1890s.

The impacts of cheaper communication are similar in spirit (although to a much more aggregate level of data) to what would be predicted at an aggregate level by Melitz (2003) and Bernard, Eaton, Jensen, and Kortum (2003). While they examine in detail the intra-sectoral impacts of reducing trade barriers-exporters (the most productive firms) gain increased market shares and aggregate productivity increases as a consequence, we focus more broadly on more classical effects of sectoral choices. We also demonstrate complementarities between different types of reduced trade costs, as the impacts of cheaper communication are relatively larger in areas closer to railroads.

There are two natural experiments that have been used to examine phenomena most similar to ours in terms of how producers respond to changing trade costs. Trefler (2004) and Lileeva and Trefler (2010) use the introduction of the Canada-US free trade agreement to determine the impacts on firms on the economy.

[1]As first suggested by Heckscher (1916).

Trefler (2004) finds that industries with more tariff reductions saw a larger cut in employment in the short-run, but higher productivity gains in the long run. These long run gains were driven by favorable plant turnover and technological upgrading. Lileeva and Trefler (2010) find that this gain is concentrated among the firms who were induced to export by the lower tariff costs, as predicted by Melitz (2003). Bustos (2011) uses the reduction of tariffs from the introduction of Mercosur and finds similar effects. Sectors with larger tariff reductions had more firms start exporting and invest more.

Allen (2011) implicitly lays out a theory of why reductions in trade costs can have differential impacts across industries. His model describes the role information frictions pay in trade of homogenous goods, such a rice. He argues that they play a quantitatively large role in explaining trade flows and price dispersion, not only internationally but even internationally. Steinwender (2014) uses a natural experiment with the placement of the trans-Atlantic telegram to see how it changes the trade of cotton. She shows that in spite of the fact that cotton is a durable, price dispersion falls between London and New York, and trade flows increase. However, they do not consider the case how information frictions matter more for particular goods, which we explicitly model and find empirical support for. Furthermore, we look at the interaction of communication and trade costs.

Baldwin (2011) argues that railroads and steamships allowed production and consumption to be feasibly separated, leading to the industrial revolution (what he calls the first unbundling). He continues to argue that we are undergoing an information and communication technology (ICT) revolution, which in turn matters for the form of production, as headquarters and manufacturing can be separated (what he calls the second unbundling). An extension of our model, although without data to test empirically, suggests that an important part of the first unbundling was also access to cheaper communication, since it can decrease the relative cost of communicating over long distances, allowing producers and consumers to recognize the potential for benefits from trade.

The paper proceeds as follows. In Section 2, we describe the historical context of our study, detailing the rural economy of late nineteenth century America and the introduction and expansion of rural free delivery (RFD). Based on a close reading of the history of the RFD program and empirical analysis, we argue that the routes established between January 1898 and May 1900 were established in an arbitrary manner, at least among the towns applying to get RFD in this period. Section 3 presents a model of search and advertising. When search costs fall (as a result of the introduction of rural free delivery), firms will search more and advertize more. This will increase the expected price and expected revenue in the sector with more price dispersion and unknown good quality (manufacturing) relative to the sector with less price dispersion and commodity goods (agriculture). Thus, firms will transfer investment between sectors when search costs fall. Section 4 presents our data sources and our empirical method. Crucially, the 1900 census measures variables of interest to our model, like capital investment in both the agricultural and manufacturing sectors, as of April 1900. Thus, we observe counties with varying numbers and sizes of towns treated with between zero and 26 months of rural free delivery. We can exploit variation in both the timing and intensity of treatment to measure the effects of RFD. However, we rely on the arbitrary ordering of route establishment to identify the effects on investment of access to less expensive information (as provided by RFD). We also present a number of tests of balance that suggest both the towns and counties in our experiment are indeed ordered arbitrarily. In Section 5, we present our results. Relative to counties with treated with RFD later, we find that the early RFD counties investment in 1900 increases in manufacturing and decreases in agriculture, as predicted by our model. A placebo test of investment in earlier periods (1880 and 1890) strengthens our argument that the investment is caused by RFD. Preliminary results suggest, however, that there is no first-mover advantage, as we find no significant difference in manufacturing or agricultural output in 1920.[2] We also confirm the prediction that communication and transport costs are compliments in the decision to manufacture Section 6 presents empirical results about how RFD encouraged the spread of newspapers, which is in some sense the closest we get to a first stage. Section 7 concludes.

2. Historical Background

In 1863, Congressional action granted free city delivery to all towns requesting the service with population larger than 10,000. Within a year, 65 cities were served by the program, growing to 104 cities by 1880. However, for the majority of the American population living in rural areas, mail service continued as it had since the colonial era.[3] The postal service was responsible only for transporting mail between post offices. Individuals and firms could then travel to the closest central post office location to retrieve and send their mail. In many rural districts, the general store in town served as the post office. Contemporary reports suggest that much of the rural population, living more than three miles from a post office, picked up their mail once a week (Fuller 1955).

In 1890, a joint resolution passed Congress, authorizing the Postmaster General to experiment with "county free delivery:" the extension of the free-delivery system to small towns and villages. The service only provided home delivery and pick-up of letters, as parcel post would not be introduced for over 20 years. The post office experimented with 46 communities, with populations ranging from 300 to 5,000 people. The Postmaster General reported in 1891 that the experiment was successful. The post office made

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[2]This longer run analysis is complicated by two facts. First, the census of manufacturing is not available at the county level after 1900 until 1920. Second, the 1920 census of manufacturing is quite different from past censuses; it does not contain data on capital at the county level, nor is the definition of the manufacturing sector consistent with earlier years. Thus, any conclusions about the long term effects of cheaper communications or the first-mover advantage of establishing manufacturing in rural areas should be taken as preliminary.

[3]Fuller (1964) notes that in 1890 only 19 million of 76 million Americans received direct home or business mail delivery.

net proceeds of $3,600 on the $10,000 appropriated thanks to increased business. One community went so far as to arrange for the continuation of the service, whether or not it would be funded by the post office. Despite the initial popularity of the program, it was not expanded, due to concerns about cost.[4]

Upon the succession of William L. Wilson to Postmaster General in 1895, the post office began another rural free delivery experiment with a congressional appropriation of $40,000. A native of Jefferson County, West Virginia, Wilson chose to start the experiment on October 1, 1896 in three towns in that county: Charles Town, Halltown, and Uvilla. According to the Annual Report of 1897, "Congress desired rural free delivery to be thoroughly tested. The Department has endeavored to comply with this request."[5] RFD tests were expanded to 44 routes in 29 states by the end of 1897.

The post office reported to Congress that the trials were a tremendous success and highly popular. As the first assistant Postmaster wrote in 1897, "There has been nothing in the history of the postal service of the United States so remarkable as the growth of the rural free delivery system."[6] The program was expanded in 1898 to cover any town applying for a route. The applications required only 100 signatures to petition for service and the post office was quickly inundated with requests. As Fuller (1964, p 42) colorfully noted, "Congress could as easily have stopped an Oklahoma tornado as to have stemmed the demand for rural delivery." By 1899, 383 counties in 40 states had RFD. Figure 2.1 maps the expansion of rural free delivery through 1901. According to the 1901 Annual Report of the Postmaster General, 6,000 routes had been organized while more than 6,000 applications were still pending and awaiting action.[7]

Contemporary reports were particularly to bullish about the positive effects of RFD on the rural economy. According to the Annual Report of 1900, thanks to RFD, "[a] more accurate knowledge of ruling markets and varying prices is diffused, and the producer, with his quicker communication and larger information, is placed on a surer footing." An earlier report had suggested that "whenever the system has been judiciously inaugurated... it has been followed by these beneficial results... Enhancement of the value of farm lands... A moderate estimate is from $2 to $3 per acre... Better prices obtained for farm products..."[8]

A number of now famous firms emerged in the early years of rural free delivery, attributing their growth to the lower costs of communicating with customers. Vick's Chemical had been founded in Selma, North Carolina in 1890. The firm originally sent salesmen to neighboring counties to advertise and sell their products. In 1903, the first RFD route was established in Selma. Two years later, Vick's developed the "VapoRub" product and began manufacturing it on a large scale. At the same time, the firm used the RFD

[4]Congressman James O'Donnell of Michigan introduced "A Bill to Extend the Free Delivery System of Mails to Rural Communities" in 1892. However, due to the $6 million projected cost, it was rejected by the House Committee on Post Office and Post Roads.
[5]Annual Report of the Postmaster General 1897, p 105.
[6]Annual Report, 1899, p 196.
[7]Annual Report of the Postmaster General 1901, 25.
[8]Annual Report of the Postmaster General 1899, p 197.

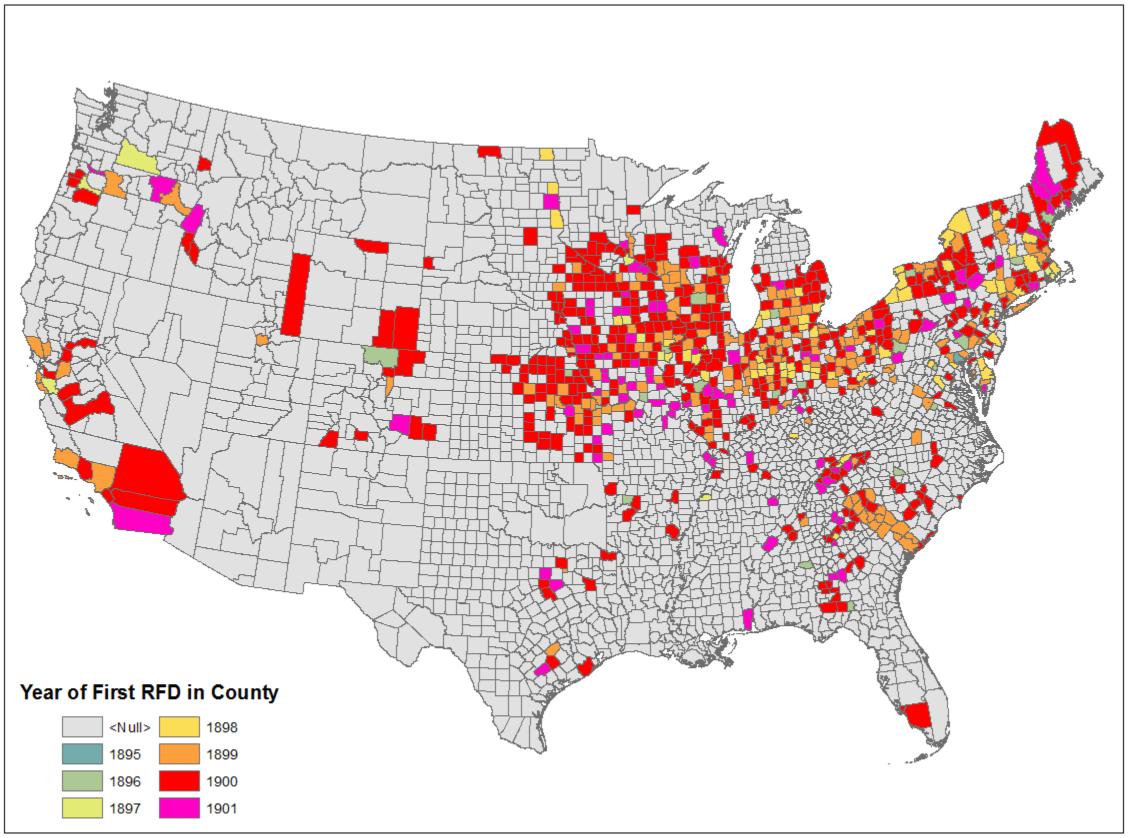

FIGURE 2.1. Year of First Rural Free Delivery Route by County

system to send mail to all nearby counties in order to cheaply access and advertise to potential customers. In fact, Vick's pioneered the use of sending advertisements to "box holder" rather than to named addressees. U.N. Roberts, a sawmill in Davenport, Iowa, introduced a mail-order catalog of millwork and building material sin 1900, the same year RFD was expanded to their county.

The expansion of RFD also fueled the growth of the giant mail-order catalog companies, Sears and Roebuck and Montgomery Ward in particular In 1897, for instance, Sears distributed around 360,000 catalogs in the US, which grew to over 3.6 million within 10 years, a growth caused in large part by the spread of rural free delivery. Furthermore, over the time period Sears added a color section, specialty catalogs, the guarantee "Your money back if you are not satisfied," and sample books for paints and wallpapers (Gordon 1990). While we focus on the short-term effects of RFD on production in affected areas, it is important to recognize that the most dramatic long-term effect of RFD was an increase in catalog sales. We plan to document and explore that fact more thoroughly in future work. For now, we will only consider the effects that short-run impacts communication could have on the geographic spread of production and consumption.

In order to qualify for rural free delivery, a potential route only needed to have at least 100 people along a route of 25 miles, with roads which were good enough to travel. While this is only a select group of rural counties at the time, there is some evidence that, especially at first, many qualified towns did not receive service due to a lack of funds and a lack of knowledge about the service (Annual Report of the Postmaster General, 1898).[9] The petitions for new routes filled several rooms at the Post Office Department and routes were "laid out through the countryside in a helter-skelter fashion" (Fuller 1964, p. 43-48). The Post Office Department spent a great deal of resources responding to citizen complaints, often delaying the establishment of services by weeks, months, or even years (Fuller 1964, p. 97). The service was requested by so many communities that in 1900, the Post Office ran out of funds to establish new routes in April 1900. The administration of the RFD application system was reorganized in in May 1900 and petitions required the endorsement of congressmen. From this point on, political considerations mattered greatly in the distribution of RFD routes (Kernell and McDonald 1999; Kernell 2001). Kernell and McDonald (1999) argue that freshman Republican Congressmen were more likely to receive postal routes than Democrats, as the Republicans had control of Congress, and therefore the post office budget. While this could be a concern for identification, our results include fixed effects for each congressional district.

3. Communication and Sector-Specific Investments

In this section, we lay out a partial equilibrium model of how producers make decisions in light of transport and information costs, in order to present micro-foundations which explain our empirical findings. We focus on producers, taking the structure of demand as given, abstracting from any competitive consequences of communication. The producers choose ex-ante the sector they want to be in (agriculture or manufacturing), and also how much to produce in that sector. As in (Allen 2011), once they have produced, they search for one buyer who buys all of their product, and who does not have decreasing marginal utility from goods (the notation would be almost identical if they searched for a buyer for each unit). We consider how the decision making changes, both on the intensive and extensive margins, as communication and transportation costs change. Furthermore, we account for the fact that lowered communication costs may be relevant not only for information acquisition, but also for advertising. While our data do not allow us to distinguish between the channels, they are potentially first order and there is no ex-ante reason to think that one effect is the dominant one in this setting.

3.1. **Setup.**

Each producer, indexed i, can produce in either sector, choosing an amount of agricultural output A_i or manufacturing output M_i. For simplicity, we assume that there is a common convex costs for

[9] There may have been unqualified towns receiving service as rural agents of the Post Office often granted routes with far fewer than 4 families per mile (Fuller 1964).

all producers in the agricultural sector, $F_A + \phi(A_i)$. We assume that agents know the price of agricultural goods, p_A, in advance. In the manufacturing sector, each producer faces the same fixed cost of entry and proportional variable costs, but the degree or proportionality is individual specific. That is to say, the convex costs of manufacturing for producer i is $F_M + \alpha_i \varphi(M_i)$, with $0 < \alpha_i < 1$.

In the agricultural sector, there are no costs to finding buyers or selling the product[10]. The price of agricultural goods is p_A. However, in the manufacturing sector, producers have to pay a cost $S > 0$ in order to contact each potential buyer (who are indexed k). Searching for a buyer serves two functions. First, it allows sellers to discover a buyer's willingness to pay, $p_{M_k} \sim g(p_M)$, which is distributed according to some distribution function which we are agnostic about other than $g'(p_m) < 0$. $E(p_M(M_i))$ is therefore the expected price for producing M_i units of manufactured goods, taking into account the endogenous change in effort as the amount produced changed. Second, it may be possible to shift the buyer's willingness to pay by $\eta(\sigma) \geq 1$. We call this channel advertising, where σ indexes the cost of advertising. We assume the advertising production function, η, satisfies Inada conditions.[11]

As in (Allen 2011), within each year, producers try to maximize expected earnings, without discounting the future of that year. However, producers do not take into account any consequences that one year's search behavior has on subsequent year's prices. At the start of each year producers make decisions both along the extensive (industry choice) and intensive (quantity produced) margins. This can be represented as a choice of

$$\arg\max_{A,M} \left\{ \begin{array}{c} \arg\max_{A_i} \left(p_A A_i - (F_A + \phi(A_i)) \right), \\ \arg\max_{M_i} \left(E(p_M) M_i \eta(\sigma) - (F_m + \sigma + \alpha_i \varphi(M_i)) \right) \end{array} \right\}. \tag{3.1}$$

Producers in the agricultural sector, whose profits are $p_A A_i - (F_A + \phi(A_i))$, therefore produce an amount A_i such that

$$\phi'(A_i) = p_A$$

whereas

Producers can solve this problem with backwards induction, first determining the production decisions and profits conditional on choosing a sector, and then picking the sector which offers relatively higher profits.

3.2. **Communication Costs.**

Theorem 1. *The expected profits from manufacturing are increasing as search costs decrease.*

[10]A potential motivation for this is that, in each community, there is costless entry to becoming a middleman for agricultural commodities

[11]That is, $\eta'(0) \to \infty$ and $\eta'(\infty) \to 0$

Proof. Before engaging in search, a manufacturing wants to maximize expected profits

$$E(p_M)M_i\eta(\sigma) - (F_m + \sigma + \alpha_i\varphi(M_i))$$

so the amount they produce will equalize the marginal gains and costs

$$\left(\frac{\partial E(p_M)}{\partial M_i}M_i + E(p_M)\right)\eta(\sigma) + \frac{\partial \eta(\sigma)}{\partial M_i}E(p_M)M_i = \alpha_i\frac{\partial \varphi(M_i)}{\partial M_i}. \tag{3.2}$$

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A producer who has produced M_i, has put forth a level of advertising intensity σ, and whose highest price seen so far is $\hat{p}_m(M_i)$, has the value function

$$V_i(\hat{p}_m) = \max\{\hat{p}_m(M_i)M_i\eta(\sigma), E(V_i) - S\}$$

This is a stationary problem and so there will exist a critical stopping price $p^*_m(M_i)$ and level of advertising $\overline{\sigma}$, which solve

$$\eta(\overline{\sigma})\ \underbrace{p_m(M_i)M_i}_{\text{Revenue if stop}} = \underbrace{-(S+\overline{\sigma})}_{\text{search+advertising}} + \underbrace{\int_{p_m(M_i)}^{p^*_m(M_i)} \eta(\overline{\sigma})p^*_m(M_i)M_i dG(p_m)}_{\text{Expected revenue if continue next period}}$$

$$+ \underbrace{\int_{p^*_m(M_i)}^{\infty} \eta(\overline{\sigma})p_m(M_i)M_i dG(p_m)}_{\text{Revenue if sell next period}} \tag{3.3}$$

The producer is indifferent to stopping when the benefits to search are equal to the costs

$$S = \eta(\overline{\sigma})\int_{p^*_m(M_i)}^{\infty} \left(p_m(M_i) - p^*_m(M_i)\right) M_i dG(p_m), \tag{3.4}$$

which implicitly defines the stopping values. We can therefore determine comparative statics:

$$\begin{aligned}
&\frac{\partial p^*_m(M_i)}{\partial(-S)} > 0, \qquad \frac{\partial\overline{\sigma}}{\partial(-S)} > 0 \Rightarrow \frac{\partial ER(M_i)}{\partial(-S)} > 0\\
&\frac{\partial p^*_m(M_i)}{\partial(M_i)} > 0, \qquad \frac{\partial\overline{\sigma}}{\partial(M_i)} > 0 \Rightarrow \frac{\partial ER(M_i)}{\partial(M_i)} > 0\\
&\frac{\partial^2 p^*_m(M_i)}{\partial M_i\partial(-S)} > 0, \frac{\partial^2\overline{\sigma}}{\partial M_i\partial(-S)} > 0 \Rightarrow \frac{\partial ER(M_i)}{\partial M_i\partial(-S)} > 0
\end{aligned} \tag{3.5}$$

which imply when search costs go down, the expected revenue from each amount of production are increasing. The producer, when choosing where to invest, anticipates this. As a result, for producers who were already manufacturing M_i manufactured goods

$$\frac{\partial\left(\left(\frac{\partial E(p_M)}{\partial M_i}M_i + E(p_M)\right)\eta(\sigma) + \frac{\partial\eta(\sigma)}{\partial M_i}E(p_M)M_i\right)}{\partial(-S)} > 0.$$

Given 3.2, the the ex-ante production choice

$$\frac{\varphi'(M_j)}{\partial(-S)} > 0$$

implying that

$$\Longrightarrow \frac{\partial M_j}{\partial(-S)} > 0 \tag{3.6}$$

□

Together, these equations imply that lowering search costs will cause manufacturers to produce more and wait for a higher price, both of which cause higher profits. Define $\Delta ER_i(S, S')$ as the change in net revenue from manufacturing as the search cost changes from S to S'.

Lemma 2. *The total amount of manufacturing will increase as search costs decrease*

Proof. Equation 3.6 shows that there will be movement along the intensive margins - those who were already producing manufactured goods will produce more as search costs decrease. Furthermore, there are some producers for whom

$$\begin{aligned}\Delta ER_i \quad \geq \quad & \arg\max_{A_i}\left(p_A A_i - (F_A + \phi(A_i)\right) \\ & - \arg\max_{M_i}\left(E(p_M)M_i - (F_m + \alpha_i\varphi(M_i))\right).\end{aligned}$$

These producers will switch products as search costs decrease. As a result, lowering search costs unambiguously increases the extent of manufactured products in a region. □

The impact of communication also matters differentially in areas with different trade costs. We model trade costs as affecting the density of willingness to pay for goods. This will shift distribution of demanded prices is shifted to the right, which in turn will increase the relative benefit to manufacturing.

3.3. **Transportation and Communication Costs.** In addition to finding buyers, there may also be a cost to actually shipping goods to consumers. As a result, we can think of the willingness to pay of consumer k from the perspective of the producer, $p_{M_k} \sim g(p_M)$, as coming from two sources: one the deterministic trade cost to ship the good to consumer k, $\theta\tau(d_k)$, and the other an idiosyncratic distribution $\hat{g}(p_m)$, such that $p_{M_k} \sim \hat{g}(p_m) - \theta\tau(d_k)$. We define decreasing the trade cost as doing so proportionally with respect to the fixed component, that is to say different transportation regimes will correspond with different θs.

Lemma 3. *Decreasing transport costs increase the return to manufactured (differentiated) products*

Proof. Define $G(p_m)$ as the CDF of willingness-to-pay before transportation costs are lowered, and $\overline{G}(p_m)$ as the CDF after. Note that, $\forall p_m$, $\overline{G}(p_m) < G(p_m)$, since lower the transport costs increase the price the producer is able to receive from each consumer. As shown in equation 3.4, the expected price before transportation costs are lowered is defined implicitly by the price $p_m^*(M_i)$ where

$$S = \eta(\overline{\sigma}) \int_{p_m^*(M_i)}^{\infty} \left(p_m(M_i) - p_m^*(M_i)\right) M_i dG(p_m).$$

whereas after the costs are lowered the expected price satisfies $\overline{p}_m^*(M_i)$, where

$$S = \eta(\overline{\sigma}) \int_{\overline{p}_m^*(M_i)}^{\infty} \left(p_m(M_i) - \overline{p}_m^*(M_i)\right) M_i d\overline{G}(p_m).$$

Since $d\overline{G}(p_m) < G(p_m)$, for any p_m^*,

$$\int_{p_m^*(M_i)}^{\infty} dG(p_m) < \int_{p_m^*(M_i)}^{\infty} d\tilde{G}(p_m).$$

Therefore, it must be the case that $\overline{p}_m^*(M_i) > p_m^*(M_i)$. As shown above, this is also the expected effective price net of total search costs, implying that the return to manufacturing, and differentiated goods, increases relatively more in areas with cheaper transport costs. □

Theorem 4. *The increase in manufacturing due to the introduction of cheaper communication technologies will be relatively larger in places which have lower transportation costs.*

Proof. Extending the comparative statics of equation 3.5 yields

$$\frac{\partial p_m^*(M_i)}{\partial(-\theta)} > 0, \qquad \frac{\partial \overline{\sigma}}{\partial(-\theta)} > 0 \Rightarrow \qquad \frac{\partial ER(M_i)}{\partial(-\theta)} > 0 \tag{3.7}$$
$$\frac{\partial^2 p_m^*(M_i)}{\partial(-\theta)\partial(-S)} > 0, \frac{\partial^2 \overline{\sigma}}{\partial(-\theta)\partial(-S)} > 0 \Rightarrow \frac{\partial ER(M_i)}{\partial(-\theta)\partial(-S)} > 0.$$

Extending the logic of the proof of Theorem 1 gives

$$\frac{\partial M_j}{\partial(-\theta)\partial(-S)} > 0,$$

which means that both on the intensive and extensive margins, producers will be more sensitive to lowering communication costs in places with relatively lower transportation costs. □

4. Data and Empirical Strategy

We draw data from two primary sources. First, to identify the towns and counties with rural free delivery, we have digitized the roll out schedules as presented in the Annual Reports of the Postmaster General, from 1900 and 1901. From these records, we are able to record the location of each RFD route, the earliest establishment date of each route, the length of the route, the population and area served, and the number of carriers assigned.[12] The Annual Reports also include the volume of mail delivered on each route and applications for money orders, which we hope to make use of in future analysis.[13] Figure 4.1 presents a sample page of our raw historical data.

Second, we draw our main outcomes of interest and control variables from the United States Census records, including the Census of Population, the Census of Agriculture, and the Census of Manufacturing, for the years 1870 through 1920 (Haines 2010). Census data is available at the county level. Though county boundaries are relatively stable over this time period for most of the eastern and Midwestern states, we adjust our data to account for county boundary changes.[14] Again, it is vital to our empirical strategy that the 1900 census measures capital investment in the agricultural and manufacturing sectors, as well other outcomes and controls, as of April 1900. Thus, we observe counties with varying numbers and sizes of towns treated with between zero and 26 months of rural free delivery. We rely on the arbitrary ordering of route establishment to identify the effects on investment of access to less expensive information (as provided by RFD), exploiting variation in both the timing and intensity of treatment. However, it is clear that getting access to RFD is not exogenous, since only certain places were even eligible.

Our identifying assumption is that, conditional on getting an RFD route relatively quickly, a town getting the route early or later is arbitrary, determined by the idiosyncratic timing application review in the office of the Postmaster General. By only comparing communities who got RFD, we overcome many of the fundamental selection problems. However, we still have to account for the fact that the establishment of rural free delivery routes occurred at the town level, while both our outcome and control variables were measured at the more aggregate county level.[15] This presents another challenges to identification in our empirical work, due to the selection into eligibility. Even if applications were literally approved with a lottery, treatment intensity at the county level may be directly correlated with outcomes, since counties with more applications are different than those with fewer, and in expectation will also have more routes.

[12] We use a variety of sources, including other postal service records and GIS software, to match each route to its county.

[13] Unfortunately, we are unable to directly test the effects of cheaper communication on communication itself as we do not have data on mail before the roll out of RFD. However, given the large, discrete reduction in communication costs, in money, time, and effort, it seems unlikely that the mechanism driving effects of RFD on firms is anything other than cheaper communication.

[14] Specifically, we follow Hornbeck (2010) and use historical county boundary maps, intersecting the boundaries in our base year, 1900, with earlier and later boundaries.

[15] Technically, our treatment is at the post office or route level, but it is not a semantic distinction which changes the underlying econometrics.

Post-office.	County.	State.	When established.	Population served.	Area, square miles.	Number of carriers.	Length of routes.	Pieces of mail delivered and collected during fiscal year 1898–99.
Abbeville[1]	Abbeville	S. C.	May 1, 1899	2, 000	57	1	46	4, 089
Ada	Hardin	Ohio	May 1, 1899	1, 000	42	2	42	19, 423
Aiken[1]	Aiken	S. C.	May 15, 1899	1, 300	55	1	48	1, 357
Albany	Delaware	Ind	Nov. 8, 1897	500	10	1	20	28, 217
Allensville[2]	Todd	Ky	Jan. 11, 1897	220	24	3	45	21, 752
Anderson[1]	Anderson	S. C.	May 1, 1899	800	60	1	50	3, 936
Antwerp	Jefferson	N. Y.	May 2, 1898	500	50	1	25	24, 247
Archbold	Fulton	Ohio	May 1, 1899	1, 500	50	2	44	7, 818
Athens	Clarke	Ga.	Feb. 1, 1899	800	45	1	27	10, 893
Athol	Worcester	Mass	Aug. 1, 1898	500	12	2	18	24, 955
Atoka	Tipton	Tenn	Jan. 11, 1897	300	10	1	20	17, 866
Auburn	Sangamon	Ill	Nov. 23, 1896	1, 000	47	3	39	76, 995
Baldwinsville	Onondaga	N. Y.	July 5, 1898	2, 500	45	4	80	153, 024
Baltimore	Baltimore	Md						
Powhatan station	do	do	Feb. 20, 1899	600	5	1	20	13, 170
St. Denis station	do	do	May 15, 1899	1, 600	23	1	20	3, 381
Bamberg[1]	Bamberg	S. C.	Apr. 3, 1899	3, 000	82	1	51	5, 674
Barker	Niagara	N. Y.	Oct. 3, 1898	1, 000	30	1	20	29, 568
Belton	Anderson	S. C.	May 1, 1899	1, 000	21	1	23	2, 842
Benson	Douglas	Nebr	June 1, 1899	800	8½	1	20½	2, 571
Benton Harbor	Berrien	Mich	Oct. 15, 1898	2, 100	55	2	44	106, 545
Bernardston	Franklin	Mass	Nov. 2, 1896	450	17	1	17	38, 344
Berryessa	Santa Clara	Cal	Sept. 20, 1898	600	9	1	24	28, 539
Bonner Springs	Wyandotte	Kans	Oct. 26, 1896	700	36	3	64	81, 569
Bowling Green	Wood	Ohio	Oct. 3, 1898	2, 000	56	2	44	66, 458
Bradfordsville	Marion	Ky	Jan. 1, 1898	1, 200	20	2	48	26, 273
Branford	New Haven	Conn	June 1, 1898	1, 200	3	1	10	52, 576
Brattleboro	Windham	Vt.	Mar. 2, 1898	400	20	1	16	23, 405
Brooklyn	Poweshiek	Iowa	Dec. 16, 1897	700	60	2	39	145, 792
Extension	do	do	Aug. 15, 1898	325	22	1	22	
Brunswick	Cumberland	Me	Dec. 7, 1896	250	16	1	13	42, 133
Extension	do	do	May 1, 1899	1, 700	45	3	85	
Burlington	Des Moines	Iowa	Aug. 1, 1898	500	18	1	24	254, 197
Extension	do	do	Sept. 1, 1898	1, 500	80	5	130	
Burlington	Chittenden	Vt.	July 20, 1898	1, 300	20	2	42	93, 484
Cairo	Randolph	Mo	Oct. 15, 1896	1, 000	36	3	54	50, 923
Campbell	Santa Clara	Cal	Feb. 1, 1897	1, 600	22	3	75	205, 080
Canton	Stark	Ohio	Jan. 3, 1899	3, 900	93	4	80	65, 278
Chardon	Geauga	do	Apr. 3, 1899	2, 500	46	2	44	32, 053
Charlestown	Jefferson	W. Va.	Oct. 1, 1896	600	36	3	54	54, 589
Chatham	Morris	N. J	Nov. 1, 1898	1, 375	21	1	21	13, 709
Chillicothe	Livingston	Mo	May 15, 1899	715	18	1	24½	3, 640
China Grove	Rowan	N. C	Oct. 23, 1896	500	40	1	25	19, 653
Circleville	Pickaway	Ohio	Oct. 24, 1898	700	15	1	26	29, 825

FIGURE 4.1. Data on RFD Roll Out from the Annual Report of the Postmaster General, 1900

In order to overcome this issue, we use measures of treatment intensity within the treated group as an instrument for total treatment intensity.

We consider two different instrumental variables approaches, which empirically suggest similar impacts. The simplest one splits the sample into three groups: early (getting RFD before a certain date), late (getting RFD after a certain date), and never (not getting RFD in our sample). With this approach, counties, indexed j, have characteristics X_j and outcomes Y_j. Let t_j be the number of people in the county who got an RFD service early, c_j be the number who got it late, and z_j be the number who are not in the experiment at all. Define $n_j \equiv t_j + c_j + z_j$ as the total number of people in the county. The share of the population treated is

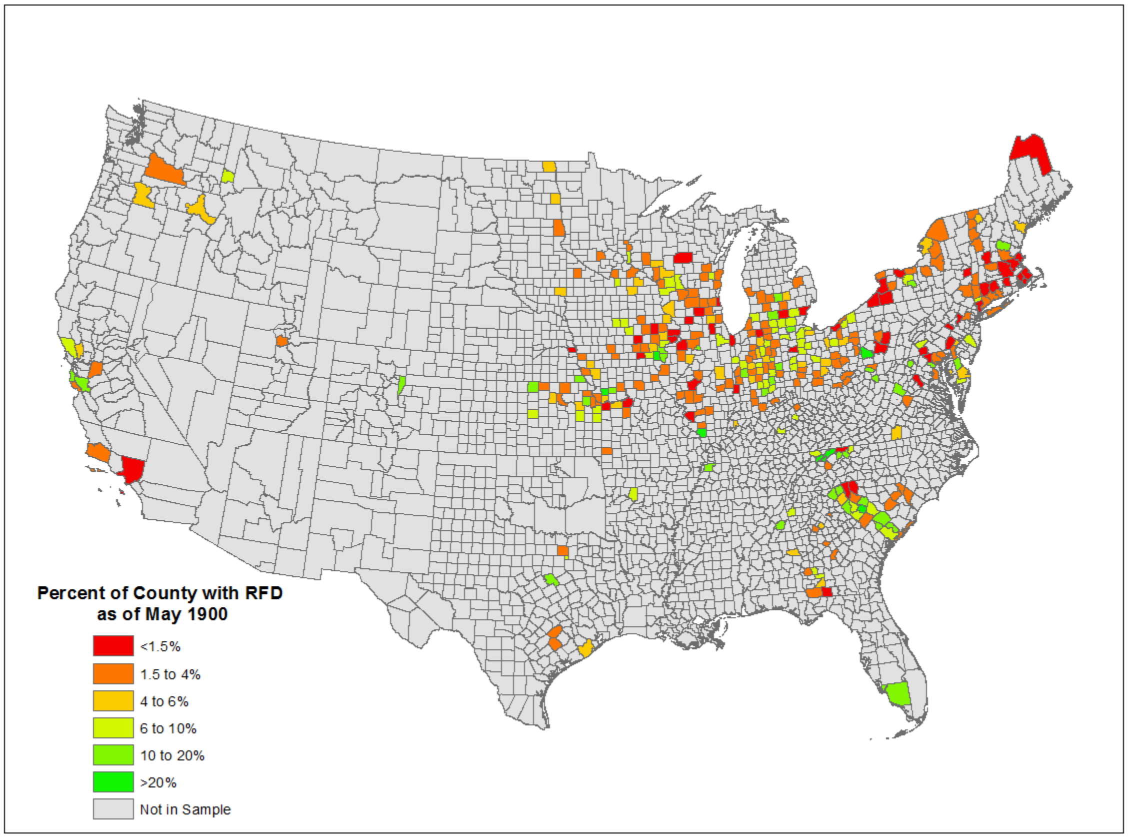

FIGURE 4.2. Year of First Rural Free Delivery Route by County

$\frac{t_j}{n_j}$, and the share eligible for treatment is $\frac{t_j+c_j}{n_j}$. In Figure 4.2, we present a map of the treatment intensity with in a county, $\frac{t_j+c_j}{n_j}$.

The *potential* outcomes for town j given different levels of treatment can therefore be written as $y_j\left(\frac{t_j}{n_j}\right)$. As a result, the theoretical marginal effect of increased RFD is

$$\frac{\partial E\left(y\left(\frac{t}{n}\right)\right)}{\partial\left(\frac{t}{n}\right)}.$$

However, in the data, towns with more RFD are different not just because they happened to get more towns treated, but potentially also because there were more towns eligible. As a result, the gradient observed in the data is a function of both the theoretical effect of interest as well as a selection effect, since counties with fewer z_j towns are likely to also be on a different growth path. Denoting $\tilde{E}$ as the mean in the data,

$$\frac{\partial \tilde{E}\left(y\right)}{\partial\left(\frac{t}{n}\right)}=\underbrace{\frac{\partial E\left(y|\frac{t+c}{n}\right)}{\partial\left(\frac{t}{n}\right)}}_{\text{Effect of RFD}}+\underbrace{\frac{\partial E\left(y\left(\frac{t}{n}\right)\right)}{\partial\left(\frac{t+c}{n}\right)}\frac{\partial\left(\frac{t+c}{n}\right)}{\partial\left(\frac{t}{n}\right)}}_{\text{Selection Bias}}, \tag{4.1}$$

In order to how this selection bias shows up in our data, we perform the following test. For three of the outcomes we look at for the paper (share of a county's capital in manufacturing, log manufacturing wages per capita, and share of output in manufacturing), we predict the 1900 levels using the lagged outcomes from 1890, 1880, and 1870 (for all of the outcomes in the paper[16]), as well as political vote shares. We then regress the share of a country treated $\left(\frac{t}{n}\right)$and the share of a county eligible for treatment $\left(\frac{t+c}{n}\right)$ on these predicted outcomes, following (Card, Chetty, and Weber 2007).

TABLE 1. Effect of Percent Treated on Predicted Manufacturing Outcomes in 1900

	Mfg Capital Share		Mfg Wages per Capita		Mfg Output Share	
	(1)	(2)	(3)	(4)	(5)	(6)
t+c/n	-1.002***		-87.49***		-1.057***	
	(0.235)		(21.49)		(0.280)	
t/n		-0.240		-39.29*		-0.0747
		(0.204)		(21.83)		(0.284)
Observations	326	326	326	326	326	326
R^2	0.056	0.002	0.056	0.007	0.050	0.000

Standard Errors clustered at the Congressional District.

The results are presented in table 1. Places which were relatively more eligible for treatment (the first row) are correlated with significantly smaller predicted manufacturing sectors, which leads to places which were relatively more treated (the second row) also being correlated with smaller predicted manufacturing sectors. As a result, we need an empirical strategy which can account for this selection effect.

Our identifying assumption is that conditional on the percent of the county treated, the potential outcomes are not a function of the actual percent treated, drawing on the fact that the placement of routes was "helter-skelter." Formally, our assumption is

$$E\left(\left((Y(\frac{t}{n})|\frac{t}{n}=a\right)|\frac{t+c}{n}\right)=E\left(\left((Y(\frac{t}{n})|\frac{t}{n}=b\right)|\frac{t+c}{n}\right),\ \forall a,b.$$

Since $\frac{\partial E\left(y\left(\frac{t}{n}\right)|\frac{t+c}{n}\right)}{\partial\left(\frac{t+c}{n}\right)}=0$, conditioning equation 4.1 gives

$$\frac{\partial \tilde{E}\left(y\left(\frac{t}{n}\right)|\frac{t+c}{n}\right)}{\partial\left(\frac{t}{n}\right)}=\underbrace{\frac{\partial E\left(y\left(\frac{t}{n}\right)\right)}{\partial\left(\frac{t}{n}\right)}}_{\text{Effect of RFD}}. \tag{4.2}$$

Our identification strategy relies on the claim that, given a town applied for rural free delivery, the establishment date is arbitrary. Earlier, we presented historical evidence on how the Postmaster General and his staff handled applications. To buttress this claim, we present empirical evidence on the (lack of)

[16]Which involve output, wages, and capital, both overall and manufacturing's share.

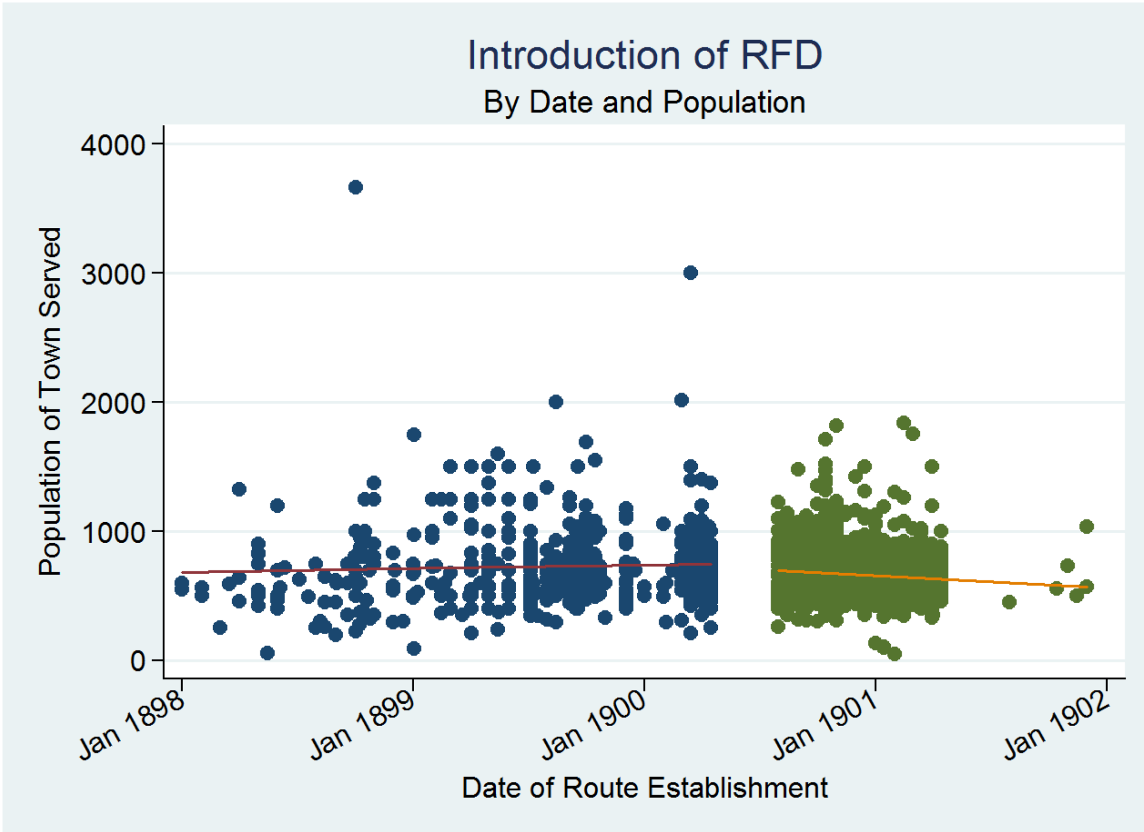

FIGURE 4.3. Introduction of RFD

differences between towns and counties with earlier or later RFD routes. Figure 4.3 graphs the population of towns served by routes against the date RFD routes were established. As is apparent in the figure, the initially there is no relationship between town size and the date of establishment. However, following April 1900, where we see the break in route establishment after the post office ran out of funds, larger towns tended to get routes earlier. Roughly, this trend break coincides with the politicization of the RFD application process. After April 1900, towns needed the support of their local congressmen to be granted an RFD route.[17] The towns and counties treated with RFD routes before the break, before April 1900, will be our t_j and c_j groups. In these results, we choose July 1899 as the cut off between the t_j and c_j populations. Our qualitative results are not sensitive to shifting this cut-off by a month in either direction. In a web appendix, we employ a more continuous measure of treatment, using the total number of person-days with access to rural free delivery in a county.

There were not enough RFD routes for us to be able run regressions which have fixed effects for the percent of a county getting RFD, as would be suggested by equation 4.2. We employ two strategies in order to deal with this issue. The first strategy is to instead control for a cubic polynomial in $\frac{t}{t+c}$, in order to

[17]A similar trend break appears in measure of area served.

approximate the appropriate controls. However, we present these results more for their suggestive nature, as they are unable to fully control for selection effects. Our preferred strategy is an instrumental variables approach, taking advantage of the fact that the percent of the eligible group who ends up actually receiving a route is orthogonal to the potential outcomes given the identification assumption. More formally,

$$E\left(Y(\frac{t}{n})|\frac{t}{t+c}=a\right)=E\left(Y(\frac{t}{n})|\frac{t}{t+c}=b\right)\ \ \forall a,b.$$

As a result, $\frac{t_j}{t_j+c_j}$ can be used as an instrument for $\frac{t_j}{n_j}$. In order to give one test of the exclusion restriction, we show that this measure is not correlated with observables using the same (Card, Chetty, and Weber 2007) test as before. The results are presented in table 2. As can be seen in both in the IV specification and the OLS specification of table with appropriate controls, there is a small and insignificant correlation between the observables and the shock which is orthogonal to $\frac{t+c}{n}$.

TABLE 2. IV Percent Treated on Predicted Outcomes in 1900

	Mfg Capital Share		Mfg Wages per Capita		Mfg Output Share	
	(1) Fitted values	(2) Fitted values	(3) Fitted values	(4) Fitted values	(5) Fitted values	(6) Fitted values
t/n	0.560* (0.310)		22.95 (25.24)		0.863** (0.389)	
t/t+c		0.0465 (0.0301)		2.303 (2.538)		0.0565 (0.0347)
Controls for (t+c)/n	Yes	No	Yes	No	Yes	No
Observations	326	323	326	323	326	323

Standard Errors clustered at the Congressional District.

For the IV specification, we run a first stage regression of the form

$$\frac{t_j}{n_j}' = \beta_0 + \beta_1 \frac{t_j}{t_j+c_j} + \lambda X_j + \epsilon_j'.$$

which we present in Table 3.Standard errors are clustered at the congressional district level. Clearly, the percent of the experiment treated, $\frac{t_j}{t_j+c_j}$ is a very strong predictor of the percent of the county treated, $\frac{t_j}{n_j}$. Importantly for the first stage of an IV regression, the F-statistics are over 10, suggesting than any bias from a weak instrument is likely to be extremely small.

4.1. **Newspapers.** In the various Annual Reports of the Postmaster General, comments from RFD patrons and beneficiaries are included, perhaps in an attempt to elicit support from members of Congress for further expansion of RFD efforts. We find one such comment, submitted by Nathan Nicholson of Newcastle, IN in

TABLE 3. IV First Stage

	Percent County Treated
	(1)
t/t+c	0.0640***
	(0.00655)
Observations	323
R^2	0.531
F	12.42

Standard Errors clustered at the Congressional District.
Controls for lagged outcomes in 1890, 1880, and 1870, for all of the variables of interest in the paper

1898, to be particularly revealing. Of the the personal benefits of RFD that Nicholson had experienced, he wrote (emphasis added):

> You want to know about the free delivery of mail. I do not know of anything that the United States could do for that small amount of money that is doing as much good as the free delivery. Nearly everybody is taking more mail than they did before the free delivery started, so it must be about self-supporting. ***I am taking two daily papers now and took none before.*** I send and get more letters since this has started. We can keep better posted on the war, markets, weather, politics, etc. It has got me spoiled. I would rather it had not started if it is going to stop now. ***If I was going to buy a farm I would give more per acre on a free-delivery route than I would where there was not any.*** Let it come. My neighbors and I are willing to pay our part.[18]

We turn towards Nicholson's contention that one first-order effect of RFD should be to increase newspaper delivery. While it would be ideal to have an "economic" first stage in which we show the relationship between the introduction of rural free delivery and usage of the mail, newspapers provide a reasonable proxy for this. Given that the model in this paper suggests that easier communication led to changing the structure of the economy in affected regions, before showing the results on the economy it seems prudent to show that RFD also changed communication patterns. We test this using data from Gentzkow, Shapiro, and Sinkinson (Forthcoming). Drawing on data from published advertisers catalogs of newspapers, the data from Gentzkow, Shapiro, and Sinkinson (Forthcoming) reports both the number of daily papers and the circulation of those papers in each county.[19] As presented in Table 4, the IV estimates suggest that giving everyone in a rural community RFD for a year would double the total newspaper circulation, consistent

[18] Annual Report of the Postmaster General, 1898 p 240

[19] As the original emphasis in Gentzkow, Shapiro, and Sinkinson (Forthcoming) is on the effects of newspapers on elections, they collect data every four years, coinciding with the Presidential election years. Thus, we use data from 1892, 1896, and 1900.

with the anecdotal evidence. Conversely, the results also suggest that the expansion of RFD does not significantly change the number of daily newspapers in a given county. With the high fixed costs of newspaper printing in this era, it is not unreasonable that the response to RFD would be on printing and circulating more papers rather than founding new papers. It is also theoretically unclear if decreased communication costs would allow for higher-quality papers to dominate the market, a theoretical question well beyond the scope of the current paper.

TABLE 4. Effect of Rural Free Delivery on Newspapers in 1900

	Published Newspapers		Circulation	
	(1) IV	(2) OLS	(3) IV	(4) OLS
t/n	-2.308	-1.389	6274.8*	3160.3
	(2.416)	(1.921)	(3559.4)	(3948.8)
Observations	332	335	332	335
R^2	0.881	0.883	0.948	0.949

Standard Errors clustered at the Congressional District.
The number of published newspapers and the circulation are measured per 10,000 elibigle voters.
Controls for outcomes in 1896 and 1892, as well as population and political vote shares.

5. Results

Our main specification is the effect of RFD, measured as a treatment intensity at the county level, on investment. From the census, we measure both manufacturing capital per capita and farm capital per acre.[20] The models take the form of an IV specification:

$$Y_{j,1900} = \beta_0 + \beta_1 \frac{t_j}{n_j}' + \sum \gamma_{jt} controls_{jt} + \epsilon_j$$

and an OLS specification:

$$Y_{j,1900} = \beta_0 + \beta_1 \frac{t_j}{n_j}' + \sum_{k=1}^{3} \theta_k \left(\frac{t_j + c_j}{n_j} \right)^k + \sum \gamma_{jt} controls_{jt} + \epsilon_j$$

where we include controls for all of the (lagged) variables of interest in the paper, as well as fixed-effects for each congressional district, and the first stage is as described in the previous section. For outcomes involving how important manufacturing is to the local economy, our model suggests that $\beta_1 > 0$.

Our main results are presented in table 5. The coefficient in column 1 suggests that going from no access to full RFD access would triple the share of manufacturing capital in a county, from about 25% to 75%, an increase which is significant at the 5% level. The coefficient on wages, in column 2, is insignificant,

[20] Measuring the farm capital per acre is a more natural number than farm capita per capita, but results are not sensitive to this definition.

TABLE 5. Effect of Rural Free Delivery on Manufacturing

	Mfg Capital Share		Mfg Wages per Capita		Mfg Output Share	
	(1) IV	(2) OLS	(3) IV	(4) OLS	(5) IV	(6) OLS
t/n	0.582**	0.298	18.24	8.979	0.643**	0.366
	(0.277)	(0.220)	(22.13)	(19.42)	(0.306)	(0.286)
Controls for (t+c)/n	No	Yes	No	Yes	No	Yes
Observations	323	326	323	326	323	326
R^2	0.615	0.627	0.554	0.559	0.582	0.592

Standard Errors clustered at the Congressional District.

Controls for lagged outcomes in 1890, 1880, and 1870, for all of the variables of interest in the paper, as well as their 1880-1890 growth rates

although the point estimate is in line with that of capital, with about a doubling of manufacturing wages. The coefficient on output in column 3, also significant at the 5% level, is somewhat difficult to take literally, as it would suggest that the share of manufacturing output would double from just over 50% to just over 100% of total output. As that is impossible, we take these results more for the comparative-static use, demonstrating a economically and statistically significant relationship between RFD and manufacturing in a county.

5.1. **Railroads.** Counties and towns with more railroad access should better be able to take advantage of increased access to consumers who want shipped goods. Fogel (1964) argues that, although railroads are associated with large economic benefits, transportation by rivers and canals was only slightly more expensive. We find results in line with Donaldson and Hornbeck (2012), suggesting that access to local markets has a differentially important role when communication to those markets is easier, confirming the predictions of our model.

We use data from Atack, Bateman, Haines, and Margo (2010) on railroad access in counties. In the analysis that follows, we expand the sample to include all counties in a congressional district with at least one RFD route as of April 1900. We measure railroad density as a continuous variable, as in Donaldson and Hornbeck (2012), but results are not sensitive to more discrete measures of access.

However, as shown in Table **??**, the effects of RFD were concentrated in places with railroads. In the first column, without an interaction term, it appears that both RFD and railroads lead to more manufacturing capital in 1900. Including the interaction term, however, changes the interpretation dramatically. As in Table 5, there are positive and significant effect of the *interaction* of RFD access and more railroads within a given county on manufacturing capital and output, suggesting that transportation is crucial for communication to be helpful.

TABLE 6. Complimentarity of Rural Free Delivery and the Transportation Network railroads

	Share Mfg Capital		Mfg Wages per Capita		Share Mfg Output	
	(1) IV	(2) OLS	(3) IV	(4) OLS	(5) IV	(6) OLS
t/n	1.053**	0.247	34.13	-2.823	1.032**	0.479
	(0.422)	(0.263)	(35.73)	(24.49)	(0.408)	(0.303)
Railroad Track Length (Z-Score) × t/n	1.054**	-0.141	33.37	-26.65	0.776*	-0.0361
	(0.513)	(0.209)	(43.31)	(21.24)	(0.462)	(0.245)
Railroad Track Length (Z-Score)	-0.00429	0.0107	0.167	0.852	-0.0134	-0.00681
	(0.0119)	(0.00984)	(1.226)	(0.945)	(0.0115)	(0.0101)
Controls for (t+c)/n	No	Yes	No	Yes	No	Yes
Observations	320	323	320	323	320	323
R^2	0.592	0.627	0.544	0.557	0.572	0.594

Standard Errors clustered at the Congressional District.
Controls for lagged outcomes in 1890, 1880, and 1870, for all of the variables of interest in the paper, as well as their 1880-1890 growth rates

5.2. **Placebo Tests.** Another concern might be that RFD was given to regions which would have grown regardless, and our identification strategy is unable to account for this. One test of this is to use a placebo test using 1890 outcomes. As a result, we can run the same specification as in Table 5, only using the outcomes in 1890 (before RFD) on the left hand side, and using controls from 1880 and 1890. The coefficients in Table 7 are consistently small and insignificant, and often of the opposite sign as in the main results, suggesting that our measure of RFD access is not merely capturing pre-existing growth trends.

TABLE 7. 1890 Placebo Effect of Rural Free Delivery on Manufacturing

	Mfg Capital Share		Mfg Wages per Capita		Mfg Output Share	
	(1) IV	(2) OLS	(3) IV	(4) OLS	(5) IV	(6) OLS
t/n	-0.0700	-0.0370	-29.45	-5.902	-0.654	-0.270
	(0.210)	(0.205)	(37.85)	(33.82)	(0.516)	(0.514)
Controls for (t+c)/n	No	Yes	No	Yes	No	Yes
Observations	333	336	333	336	333	336
R^2	0.956	0.960	0.922	0.927	0.938	0.944

Standard Errors clustered at the Congressional District.
Controls for lagged outcomes in 1880 and 1870, for all of the variables of interest in the paper, as well as their 1870-1880 growth rates

6. DISCUSSION AND CONCLUSION

Before the introduction of postal delivery, it is reasonable to think that search costs were convex with distance, since while it was relatively easy to send someone door-to-door within a small geographic area, it would be difficult to send someone further away. However, the price of postage was independent of the distance. As a result, the introduction of RFD led to a relative decrease in search costs far away. In the simplest possible view of this, suppose that a producer can sell in two areas, *close* and *far*, which have identical willingness to pay distributions, but searching in *far* is more costly (even though, in light of the results of the previous section, the costs to ship goods is the same in each area). It's obvious that this will lead to the producer only searching in *close*. However, if the search costs in *far* decrease to equal those of *close*, the producer will be indifferent to searching in each area. As a result, it is reasonable to expect that there will be a larger geographic spread of production and consumption as search costs decrease, even when there are no transport costs. This suggests that postal and telegraph services were important to the spread of intranational trade. This suggests an explanation for the stylized fact that the growth of catalog sales came not after the spread of railroads in the early 19th century, but after the spread of Rural Free Delivery in the early 20th century.

We demonstrate that the impacts of cheaper communication are nuanced, but extremely large. The benefits from reduced communication costs are concentrated in sectors where the willingness to pay across individuals is more spread out and are complimentary to reduced transportation costs. As a result, the introduction of postal delivery services caused a substantial shift from production agricultural commodities to manufactured differentiated goods, particularly in areas with railroads.

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