

Does improving market access help de-industrialize lagging regions? 'Leaking by linking' in Ghana¹

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ABSTRACT

One of the main insights of the New Economic Geography is that as inter-regional transport costs fall, agglomeration economies and interregional migration will lead to higher concentration of firms and workers in economically dense locations. In other words, improving inter-regional accessibility can increase spatial differences in production between lagging and leading regions. In this paper, we examine the importance of infrastructure connectivity, local human capital and other regional endowments in the location decisions of manufacturing firms in Ghana. We find that agglomeration economies and local education levels have a positive effect on location decisions and productivity of Ghanaian manufacturing. Proximity to markets also matters: longer travel time to the nearest city of 100,000 or more reduces the attractiveness of a location. Further, improvements in market access increases economic density in the leading Southern region, where as the North loses manufacturing activity with better connectivity to markets. We also find that the placement of transport links involves spatial efficiency-equity tradeoffs -- improving connectivity in the North reduces national productivity by 0.15 percent; in contrast improving connectivity in the South increases manufacturing productivity by 3.1 percent nationally. While economically integrating lagging regions is an important policy priority in Ghana, the government may want identify instruments that are better suited to directly improve welfare of local residents. Lessons from the WDR2009 "Reshaping Economic Geography" calling for investments in health and education in lagging areas are likely to be more useful.

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1. Introduction

Consider these facts: In Ghana's leading region, the Greater Accra region, 82 percent of households are within 30 minutes of a health clinic or hospital; in the country's poorest one, the Northern region, 35 percent are. In the Greater Accra region 64 percent of the poor are able to use a motorized vehicle to get to the hospital; in the Northern region only 17 percent can. In the Greater Accra region 26 percent of the urban poor have access to piped water in their home; in the Northern region only 4 percent do.²

The debate over spatial inequality in Ghana generally revolves around the broad divide between the North – mostly in the arid Savannah zone, bordering on Burkina Faso and comprised of the three administrative regions of Upper East, Upper West and Northern – and the coastal South, which encompasses the main export crop-growing areas and the three largest metropolitan areas.

The North is both poorer and more sparsely populated than the country at large, with an economy that is highly dependent on basic staple crops. Based on the 1999 Ghana Living Standards Survey the headcount poverty rate was 62.9% in Northern Region, 83.9% in Upper East and 88.2% in Upper West, compared to 39.5% for the national average. While the North occupies 41% of the national land area, it comprises less than 20% of the population, 80% of whom are in rural areas (Sowa 2006).

How can public investments be prioritized to improve living conditions in the country's lagging regions? The World Bank's World Development Report 2009 (WDR 2009) – Reshaping Economic Geography (World Bank 2008) provides a framework for territorial development, arguing that policies should focus on integrating lagging and leading regions – and not be exclusively concerned with stimulating growth in lagging regions. The WDR2009 highlights that enabling geographic mobility of labor and improving

² These statistics are calculated from the 2003 CWIQ data produced by the Ghana Statistical Service. The poor are defined as the bottom 20 percent of the income distribution.

economic connectivity between lagging and leading regions are key ingredients for countries to gain from the geographic concentration of economic activities along with convergence in living standards. Which policies can help?

Policies that are “spatially blind” in design can have the spatially sharpest effects. These include progressive income tax policies, achieving national minimum standards in basic health and education indicators, and removal of barriers to labor mobility. In addition, “spatially connective” policies such as transport and communication improvements physically link lagging and leading regions. “Spatially targeted” incentives should be policy instruments of last resort, only to be used when factor mobility is weak due to internal divisions from ethnic and linguistic fractionalization. In these cases, incentives may be considered, but only after investing in information to identify sources of comparative advantage, and to amplify the benefits from spatially blind and connective policies.

However in many countries, policymakers prefer to rely on spatially targeted incentives for improving economic conditions in areas not favored by market forces. But most local economic development policies are not based on systematic evaluations of economic potential. And when these policies are aimed at relocating activities that benefit from spatial concentration to less dense, remote regions, they run the risk of slowing aggregate economic growth. Thus spatially targeted policies that try to equalize economic mass across territories may involve a tradeoff with national growth priorities.

While historical policies to prop up Northern Ghana have focused on provision of social services, targeted incentives for economic development are becoming more pronounced since the country’s economic liberalization and subsequent democratization. As Jebuni (2006, p. 3) states,

“Even though the overall development strategy of Ghana had changed to a private-sector export-led growth strategy, the approach to development in the North reverted to welfarism.”

Jebuni's diagnosis reflects a growing consensus among policy analysts that the development strategy for the North, as for the South, must be led by private sector development. There remains an ongoing debate, however, over whether policy should aim to deliver jobs to the poor, or bring people to where the jobs are. This debate has both a geographic dimension – over the policy stance toward out-migration – and a sectoral dimension – over the primacy of agricultural investment in poverty reduction.

A recent donor-sponsored report on the prospects for development in the North frames the policy options in terms of two alternative hypotheses: (a) “there is growth potential in the Northern Ghana”, and (b) “the best hope for Northern Ghana is ‘better’ out-migration, and growth through remittances” (Shepherd et al, 2006). While the authors of that report embrace the first hypothesis – and within it, an agricultural-led development strategy – they acknowledge that current growth prospects in the North are not encouraging.

Focusing on the role of agriculture, Al-Hassan and Diao (2007) simulate alternative growth patterns and their implications for poverty reduction in the North through 2015. Based on the current trend of poverty reduction driven by output growth in export crops, they find that Ghana is on track to achieve the first Millennium Development Goal of halving income-poverty by 2015, but that regional inequality is projected to worsen. Without allowing for large-scale migration or structural transformation, they find that even a sharp acceleration in productivity growth in groundnuts and other Northern staples is insufficient to bring the North up to par with the South in the medium term.

Looking beyond agriculture, there is little sign that the current trajectory of industrial investment will rectify this divide either. Of the 1,160 investment projects registered with the Ghana Investment Promotion Council in 2000, just 14 were located in the three Northern regions; by 2005 this number rose only slightly to 23 out of 1,779 projects (Shepherd et al 2006).

In this paper, we focus on understanding the potential for spatially connective policies to link the North with large domestic markets and improve local economic conditions. In

particular, we are interested in identifying the factors that Ghanaian entrepreneurs value when they decide where to set up industrial activities. We find that agglomeration economies and local education levels have a positive effect on location decisions and productivity of Ghanaian manufacturing. Proximity to markets also matters: longer travel time to the nearest city of 100,000 or more reduces the attractiveness of a location. These results show that most manufacturing firms would pay a premium to be located in a region that offers good access to markets and skilled labor and that already has a concentration of other firms in the same line of business. However the impacts of market access vary considerably between the South and the North. We find that as districts in the South are better connected to markets, they attract more firms – thereby increasing economic density. However, district in the North will lose firms when they are better connected to markets in leading regions. Clearly, there is evidence of ‘leaking by linking.

Using the estimates from the model of location choice, we simulate the implications of transport improvements that reduce travel time to markets. We find that the placement of transport links clearly involves spatial efficiency-equity tradeoffs. Improving connectivity in the North would increase the region’s manufacturing productivity by 4.53 percent—but reduce national productivity by 0.15 percent. By contrast, improving connectivity in the South by the same degree would increase manufacturing productivity by 3.2 percent in the South and by 3.1 percent nationally.

Given the limited economic density in the North and preference for manufacturing to locate in proximity to markets and existing concentrations of economic activity, it is unlikely that industrial development is likely to be a viable solution for development of the lagging region. On the other hand, investments in basic services such as water supply and sanitation, and improving education and health outcomes are likely to be sharper instruments to improve living standards of people in the Northern region.

The paper proceeds as follows. In Section 2, we provide stylized facts highlighting the extent of regional differences in industrial development. The empirical framework for

assessing the importance of regional endowments and access to markets in location decisions of manufacturing establishments is discussed in Section 3. This section also discusses the results from estimating the model. Section 4 concludes by providing results of a simulation exercise that improves infrastructure conditions in specific regions.

2. Ghana's industrial geography

In this section, we discuss the evolution of industrial development in Ghana and provide stylized facts on the spatial distribution of industrial activities in the country.

2.1 Industrial development – recent history

Killick (1978) divides the role of the Ghanaian state during first two decades of independence into two parts: the state as entrepreneur (managing almost all large scale economic activity in the country) and the state as controller (regulating most economic activity through fixed prices, a complex system of import licenses and a monopoly on foreign exchange). The first stage of the liberalization launched in 1983 rolled back the 'state as controller', i.e., to abolish the trade, exchange and price controls regulating almost all economic activity in Ghana at the time. Exchange rate devaluation was perhaps the most significant and politically challenging of these reforms, as the government's urban base depended on cheap food imports. Nevertheless, through a complex system of multiple exchange rates and sequential reforms, the government moved from a 700% black market premium in 1982 to full legalization of foreign exchange bureaus and a floating currency by 1988.

Efforts to dismantle the 'state as entrepreneur' by privatizing state-owned enterprises began only after the initial reforms were well established. The privatization program began in 1987, just at the start of the period spanned by the industrial census data examined in this paper. Across all sectors, a total of 335 – or approximately 70% of Ghana's state enterprises – were sold between 1987 and 1999, including some of the

largest and highest profile firms such as Ashanti Goldfields (Divestiture Implementation Committee 2006). Of the total divested firms, Appiah-Kubi (2001) reports that in 53% of cases assets were sold outright; 15% involved sale of shares, 10% formation of a joint public-private venture; 3% lease of assets; and 20% simple liquidation. He also notes that the choice between divestiture methods appears to be highly endogenous to the viability of the enterprise, with sale of shares on the Ghanaian Stock Exchange, for instance, being reserved for only the most profitable and attractive investment opportunities, such as Barclays Bank, Twifo Oil Plantation and Ghana Bauxite Company.

Since liberalization, the dominant trend in Ghana's manufacturing sector has been the expansion of the small-scale, domestically oriented, labor-intensive, informal sector. Sandefur (2007) documents the collapse of the firm size distribution in the sector, which fell from an average firm size of 19 employees in 1987 to just 9 employees in 2003. This trend can be explained – at a somewhat superficial level – by the differing 'life cycles' of large and small firms in Ghana. New entry into the large scale sector has virtually ceased, while the formation of new microenterprises has accelerated. These new microenterprises exit rapidly however, with effectively zero firms surviving long enough (or growing fast enough) to reach the larger size classes.

Large and small firms in Ghana use different factor intensities, have different propensities to export, pay different prices for both capital and labor, and face different regulatory environments. These systematic differences provide hints about both the causes and consequences of the shift in favor of small, informal firms serving a localized niche market. First, with regards to the labor market, there is strong evidence that large firms pay higher wages. Furthermore, a large part of this wage differential is not explained by human capital differences between small- and large-firm workers. Soderbom and Teal (2007) find that a firm of 100 employees will pay roughly double that of a firm of 10 employees, after controlling for unobserved employee characteristics. Second, with regards to the credit market, Bigsten et al (1999) confirm that smaller firms face rationed access to capital. This is reflected in the higher profitability threshold required for small firms to access credit: by their estimates for a group of nine African

countries, small manufacturing firms require 200% profitability to have a 20% chance of acquiring credit, while medium-sized firms require only 56% profitability to stand the same chance.

These patterns highlight the need to understand the underlying determinants of firm survival and growth.³ Soderbom and Teal (2004) draw on detailed survey data on a panel of Ghanaian manufacturing to estimate the distribution of total-factor productivity (TFP) and its determinants. They consistently fail to reject constant returns to scale, implying no underlying TFP advantage for larger firms. Using this same data, Soderbom and Teal (2006) and Frazer (2006) investigate the link between TFP and firm survival – the central prediction of models of industrial evolution based on ‘evolutionary’ selection. Both studies confirm a link for larger enterprises; however, Soderbom and Teal show that this relationship is not detectable when examining smaller firms in isolation.

Finally, perhaps the most important fact related to the economic geography of Ghana’s manufacturing sector relates to international trade – and, more precisely, the failure of Ghanaian firms to overcome geographic isolation and compete in global markets. This failure is important for two reasons. First, given the limited size of the domestic market, penetrating global markets is seen as a necessary part of industrial expansion. Second, it has been widely hypothesized that the pressure to compete in international markets was a major driving force behind the industrial growth of the East Asian NICs. One of the major findings from the analysis of the RPED surveys has been the confirmation of this pattern in Africa, including Ghana (Bigsten et al 2004, Van Biesebroeck 2005). In both studies, entering export markets has a strong, positive, causal impact on firm-level TFP.

³ See Bigsten and Soderbom (2007) for a review of research on manufacturing enterprise performance in Africa using panel data collected under the World Bank’s Regional Program on Enterprise Development (RPED). For much of the analysis cited here, the Ghana data is pooled with other RPED surveys. However, the Ghana panel was extended beyond the lifespan of the other RPED surveys by the Centre for the Study of African Economies, Oxford, allowing for more credible, country-specific analysis of growth and survival patterns.

2.2 Stylized Facts

We now discuss stylized facts on geographic distribution of industry in Ghana, drawing on firm level data from the 1987 and 2003 National Industrial Censuses. The industrial census provides detailed profiles on the location of firms overlaid with various firm-specific characteristics, such as the year of establishment, firm size (the number of employees), industrial classification, registration status, and the nationality of owners. The following distinct features emerge:

First, the regional share of manufacturing firms during the period 1987 - 2003 shows deconcentration of manufacturing firms in the leading regions, such as Ashanti (31% → 27%) and Greater Accra (35% → 25%), or from the South (95% → 91%) to other regions (table 1). As a result, the share of manufacturing firms in the North increased from 5% to 9%. However, manufacturing firms are still highly concentrated in the South.

Table 1: Spatial distribution of manufacturing firms

Region	Number of manuf firms in 1987, nat. share, % (a)	Number of manuf firms in 2003, nat. share, % (b)	(b-a)	Number of new firms in 2002-03, nat. share, %	Number of new firms / number of all firms, %
Ashanti	30.7	27.3	-3.4	24.5	18.3
Brong Ahafo	3.6	6.5	2.9	5.4	17.0
Central	3.0	9.2	6.2	10.5	23.2
Eastern	12.0	11.0	-1.0	10.8	20.0
Greater Accra	34.9	24.8	-10.1	31.5	25.9
Northern	2.5	4.6	2.0	3.5	15.5
Upper East /Upper West	2.3	4.6	2.3	3.6	16.0
Volta	2.2	4.8	2.6	3.6	15.2
Western	8.8	7.1	-1.6	6.7	19.3
South	95.2	90.8	-4.4	92.9	20.9
North	4.8	9.2	4.4	7.1	15.8
Total	100.0	100.0	0.0	100.0	20.4

* source: The 1987 and 2003 National Industrial Censuses

Second, firm births, measured by the number of new firms established between 2002 and 2003, is strongly correlated with the mass of existing firms. This can reflect local

spillovers or agglomeration economies. The shares of new firms in the South versus the North are 93:7. Third, the firm birth rate, the ratio of new firms over the total firms, measures how many new firms can spin off from existing ones, and therefore serves as a proxy of regional entrepreneurial environment. We observe higher turn-out ratios in coastal regions such as Greater Accra (26%) and Central (23%), called the first tier group. Interestingly, the second tier corresponds to inland regions physically adjacent to the first tier group, such as Eastern (20%), Western (19%), and Ashanti (18%). As expected, the North and Volta show the lowest rates.

Table 2: Number of top five manufacturing firms at ISIC 2-digit level in 2003

Region	Number of clothes manuf firms (ISIC-18), nat. share, %	Number of furniture manuf firms (ISIC-36), nat. share, %	Number of food manuf firms (ISIC-15), nat. share, %	Number of metal manuf firms (ISIC-28), nat. share, %	Number of wood manuf firms (ISIC-20), nat. share, %
Ashanti	21.2	33.2	22.0	34.7	43.2
Brong Ahafo	6.7	7.6	6.0	6.2	9.0
Central	8.9	11.2	12.2	5.4	6.0
Eastern	13.0	10.5	11.4	5.3	16.7
Greater Accra	32.5	16.9	12.4	31.1	11.9
Northern	4.0	3.1	10.0	4.9	1.5
Upper East /Upper West	3.9	2.0	12.6	2.8	1.1
Volta	3.5	5.2	7.0	4.0	3.8
Western	6.3	10.3	6.4	5.5	6.8
South	92.1	94.9	77.3	92.3	97.4
North	7.9	5.1	22.7	7.7	2.6
Total	100.0	100.0	100.0	100.0	100.0

1. ISIC-18: Manufacture of wearing apparel, dressing and dyeing of fur
 ISIC-36: Manufacture of furniture, manufacturing n.e.c.
 ISIC-15: Manufacture of food products and beverages including bakery
 ISIC-28: Manufacture of fabricated metal products, except machinery and equipment
 ISIC-20: Manufacture of wood and of products of wood and cork except furniture, manufacture of articles of straw and plaiting materials.
2. source: The 2003 National Industrial Census

Ghana's top five manufacturing industries at the ISIC 2-digit level are apparel, furniture, food (bakery), metal, and wood manufactures. The North is relatively more concentrated in constant returns activities such as food products, of which its national firm share is 23% (table 2). In addition, the Northern and Volta regions have relatively high shares of

large firms -- 25% and 21% respectively, compared to national average of 15% (table 6).

There is a higher share of informal/ unregistered firms in the North – 88% compared with 70% in the South. Non-Ghanaian ownership is more prevalent in the North, mainly due to the border region of Upper East/Upper West (table 3). The share of foreign owners is 64% in the North compared to the national average of 43%. While public sector ownership is relatively small in Ghanaian economy -- 1.2%, the North has twice the share of public firms (2.3%) compared to the South (1.1%).

Table 3: Within-region manufacturing firm composition in different categories in 2003

Region	Large firms, regional share, %	Informal firms, regional share, % ¹⁾	Non-Ghanaian firms, regional share, % ¹⁾	Private firms, regional share, % ¹⁾
Ashanti	16.3	80.3	38.4	99.1
Brong Ahafo	14.1	83.7	41.5	98.5
Central	12.1	85.4	48.3	99.6
Eastern	11.3	77.7	48.1	99.0
Greater Accra	14.1	46.1	45.2	98.4
Northern	25.4	87.5	44.7	98.3
Upper East /Upper West	14.4	87.9	64.3	97.0
Volta	20.8	81.6	35.2	100.0
Western	14.5	73.4	42.1	98.8
South	14.6	70.3	42.4	98.9
North	19.9	87.7	55.1	97.6
Total	15.1	71.6	43.4	98.8

1. from a smaller sample of 12% of the 2003 National Industrial Census data

2. source: The 2003 National Industrial Census

3. Modeling location choice

3.1 Location Choice Model

For examining location decisions of firms, we specify a profit function where a firm will locate in a particular region if the profits from being located in that region are higher than profits in any other region of the country. Based on the New Economic Geography and urban economics (specifically systems of cities) perspectives, a firm's profits in a region depend on agglomeration economies, inter-regional market accessibility of the region, the supply and demand of local labor market in particular spatial competition with neighboring regions, and other local attributes. This model is an adaptation of the Bayer and Timmins (2007) equilibrium model of location choice to the question of industrial development.

Suppose profits π earned by firm i , in industry k , which chooses to locate in region j are:

$$\pi_{i,j,k} = f(\sigma_{j,k}, \text{transport}_j, H_j, W_j, X_j, \eta_{i,j,k}; \bar{\beta}_k)$$

Agglomeration effects that provide production externalities are represented by $\sigma_{j,k}$ (localization economies), measured as the own industry concentration of industry i in region j ; transport_j represents the quality and availability of inter-regional transport infrastructure; H_j represents the stock of local human capital, W_j represents local labor market conditions, and X_j includes other local attributes which may influence a firm's profits in region j .

We choose the following functional form for this profit function:

$$\pi_{i,j,k} = \beta_{\sigma,k} \sigma_{j,k} + \beta_{tr,k} \ln(\text{transport}_j) + \beta_{H,k} \ln(H_j) + \beta_{W,k} \ln(W_j) + \beta_{X,k} \ln(X_j) + \eta_{i,j,k}$$

The i th firm will choose region j if $\pi_j^i \geq \pi_l^i$ for all l , where l indexes all the possible city choices to i th firm. For estimation we will assume that $\eta_{i,j,k}$ is additively separable from the rest of the utility function, and has a Weibull distribution. The result is that we can write the probability that any firm will choose to locate in city j (McFadden, 1973):

$$P(\pi_{i,j} \geq \pi_{i,l} \quad \forall l \neq j) = \frac{e^{\beta_{\sigma,k} \sigma_{j,k} + \beta_{tr,k} \ln(\text{transport}_j) + \beta_{H,k} \ln(H_j) + \beta_{W,k} \ln(W_j) + \beta_{X,k} \ln(X_j)}}{\sum_{m=1}^J e^{\beta_{\sigma,k} \sigma_{m,k} + \beta_{tr,k} \ln(\text{transport}_m) + \beta_{H,k} \ln(H_m) + \beta_{W,k} \ln(W_m) + \beta_{X,k} \ln(X_m)}}$$

In our estimation of the conditional logit model, we are assuming that each firm takes attributes associated with each region as given and make rational location choice decisions. For the purpose of estimation this assumption translates into a condition where the idiosyncratic error term is independent of the regional characteristics.

The location choice model provides us with estimates of the importance that agglomeration economies and inter-regional transport costs have in determining location of private industrial activity and provides region specific estimates of improving regional endowments on the probability of firm location decisions. These estimates can be interpreted as rates of return in terms of new private investment in response to improvements in various infrastructure types. These rates of returns can be viewed as one way to rank order investment priorities as they reflect the sensitivity of industrial location (or private investment in general) to region specific improvements, and identifies where such investments can produce the highest payoffs. Public investment criteria that follow the rate of return rankings would be efficient in terms of stimulating private investment. On the other hand, if public investments were targeted to regions with low expected rates of return (on grounds of spatial equity or needs), these could have considerable costs for national economic efficiency.

3.2 Variable Construction

We estimate location decision of new firms, established between 2002-2003 in Ghana, given the location of firms before 2001 and other local attributes. The 2003 National Industrial Census reports 27,126 manufacturing firms as of 2003, and of which 5,543 firms (20%) were newly established between 2002 and 2003. We disaggregate Ghana into 110 districts and produce district-level aggregates as explanatory variables in the estimation. These are described below.

Variables representing agglomeration economies, or local spillovers, are measured by the national share of all existing manufacturing firms at the end of 2001. As we measure local spillover effects from information available at the end of 2001 and estimate its impacts on new firms' location choice after 2002, we control for a standard simultaneity issue. The quality and availability of inter-regional transport infrastructure are measured by the travel time to the nearest city of more than 100,000 people. We experiment with different measures of travel time, such as proximity to different city sizes (of 20,000; 250,000; 500,000 population) and travel times to ports and airports. District-level (average) travel time measures are geo-processed from the World Bank internal datasets.

Local human capital level is measured by the share of middle school or higher graduates in the local population over 15 years old (see table 4). In fact there are stark disparities between the North and the South. The share of graduates in the North is merely 12.2% in 2003, compared to 36.3% in the South. And there is no significant mean reversion or a strong increase in education levels in the North between 1997 and 2003.

Table 4: human capital accumulation: education level

Region	Share of middle school and higher graduates over 15 years old in 1997, %, (a)	Share of middle school and higher graduates over 15 years old in 2003, %, (b)	(b-a)
Ashanti	35.5	37.3	1.8
Brong Ahafo	28.1	25.3	-2.7
Central	26.7	29.7	3.0
Eastern	35.8	33.1	-2.7
Greater Accra	54.7	54.5	-0.2
Northern	9.1	12.1	3.0
Upper East /Upper West	11.4	12.4	1.0
Volta	33.4	26.9	-6.5
Western	34.6	33.1	-1.4
South	36.4	36.3	-0.1
North	10.1	12.2	2.1
Total	31.9	32.3	0.5

* source: The 1997 and 2003 Core Welfare Indicators (CWIQ)

This variable reflects demand side condition of the local labor market. Concentration of skilled workers, measured by education level, attracts more firms. The supply side

condition of the local labor market in a spatial competition context is measured by the urban and rural labor quality in neighboring districts in the same region. We group the 110 districts into 9 larger regions, based on their historical and geographical similarities. High skilled urban workers in neighboring districts, again measured by the ratio of middle school graduates or higher, are potential labor suppliers to the district. A higher urban education level in neighboring districts will drive down local wages, and therefore attract more firms into the district. However, the rural education level in neighboring districts will work in the opposite direction. A higher rural education level in neighboring districts is likely to attract more jobs in the rural sector and induces less demand for urban workers in neighboring districts. As the potential urban labor supply from neighboring districts is limited, it will drive up local wages in the district and discourage firm investment. Local education data are from the 2003 CWIQ.

We measure the size of district economy using two variables. First, we use district population in 2003. Table 5 highlights large differences in population distribution between the North and the South, and this disparity has increased between 1997 and 2003. Densely populated regions, such as Ashanti and Greater Accra, show a strong increase in their national population shares (+4.0%p and +2.1%p), while all other regions show declining national population shares during the period. As the annual population growth of the North (4.2%) is lower than the South (5.1%), the national population share of the North declined from 18.1% in 1997 to 17.4% in 2003 (-0.7%p).

Table 5: regional distribution of population

Region	Population in 1997, nat. share, % (a)	Population in 2003 nat. share, % (b)	(b-a)	Annual population growth rate, %
Ashanti	15.0	19.1	4.0	8.9
Brong Ahafo	10.8	9.1	-1.7	2.1
Central	9.0	9.0	0.0	4.9
Eastern	13.9	11.6	-2.3	1.9
Greater Accra	11.9	14.1	2.1	7.7
Northern	10.3	10.2	-0.1	4.8
Upper East /Upper West	7.8	7.2	-0.7	3.4
Volta	10.2	9.6	-0.6	3.9
Western	10.9	10.1	-0.8	3.6

South	81.9	82.6	0.7	5.1
North	18.1	17.4	-0.7	4.2
Total	100.0	100.0	0.0	4.9

* source: The 1997 and 2003 Core Welfare Indicators (CWIQ)

Second, the crop production estimates from the IFPRI's Spatial Allocation Model are used to measure overall economic size of the district.⁴ The district-level crop production estimates are geo-processed from the global distribution of 20 crops in different production systems during the period of 1999-2001.

3.3 Main Findings

Table 6 provides the main results from estimating the conditional logit model. Column 1 covers all manufacturing firms in Ghana. We assume that each new firm considers each of the 110 districts as a candidate location and chooses the district which is expected to generate the highest profits. All parameter estimates are significant and have expected signs. First, agglomeration economies (national share of manufacturing firms in 2001), or local spillovers, have a strong positive effect on firm location decisions. The travel time to the nearest city of 100,000 population, as a measure of inter-regional transport costs, has a negative effect on the investment attractiveness of a location. The longer time it takes from a district to an external market, the less likely that the district attracts manufacturing firms.

Second, the local education level has a strong and positive effect on firm location decisions. And as we discussed, urban and rural education levels in neighboring districts have opposing impacts: a higher level of urban education in neighboring districts increases the attractiveness of a district, presumably by increasing local labor supply of skilled workers; but a higher rural education level in neighboring districts has a negative effect by lowering labor supply for industrial activities.

Finally, local economic size, measured by district population and crop production estimates, also has positive and statistically significant impacts on firm location decision.

⁴ The International Food Policy Research Institute.

Table 6: Estimation results: basic model

	(1)	(2)	(3)	(4)	(5)
Dependent variable	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03
Estimation	conditional logit	conditional logit	conditional logit	conditional logit	conditional logit
Firms	all manuf firms	all manuf firms	all manuf firms	large manuf firms	small manuf firms
Location choices	national	south	North	national	national
Number of manuf firms at the end of 2001, national share	7.455*** (0.863)	8.079*** (0.947)	271.745*** (48.316)	14.622*** (3.237)	6.948*** (0.894)
ln(travel time to 100K city)	-0.288*** (0.039)	-0.276*** (0.046)	1.392*** (0.458)	-0.148 (0.133)	-0.297*** (0.041)
Middle school grads or higher, pop ratio over 15 years old	3.908*** (0.211)	3.728*** (0.248)	0.385 (2.117)	2.695*** (0.867)	4.016*** (0.218)
Urban middle school grads or higher in neighboring districts, pop ratio over 15 years old	1.332*** (0.279)	1.653*** (0.402)	6.085 (4.441)	2.522** (1.073)	1.149*** (0.289)
Rural middle school grads or higher in neighboring districts, pop ratio over 15 years old	-1.419*** (0.404)	-1.755** (0.880)	-16.096 (17.793)	-4.950*** (1.373)	-0.970** (0.426)
ln(district population)	0.342*** (0.044)	0.322*** (0.048)	0.076 (0.142)	0.107 (0.153)	0.358*** (0.046)
ln(total crop proudciton)	0.068*** (0.014)	0.061*** (0.015)	0.205** (0.084)	0.041 (0.054)	0.071*** (0.015)
Observations	609,730	442,900	9,432	40,150	569,580

1. Robust standard errors are in parentheses.

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

'Leaking by linking': The New Economic Geography's core-periphery hypothesis

Columns 2 and 3 test one of the main insights of the New Economic Geography (NEG). Puga (1999) argues that as inter-regional transport costs fall, agglomeration economies and interregional migration will create a tendency for firms and workers to agglomerate into the core region. In other words, improving inter-regional accessibility

can increase spatial differences in production between the core and periphery by inducing firms and workers to relocate to the core region.

For a cross-sectional interpretation of the NEG hypothesis, we subsample 110 Ghana districts into (i) the periphery/hinterland region -- the North, which include “Northern” and “Upper East/Upper West” regions, and (ii) the core region, the South, which covers the remaining 7 regions. The conditional logit specification is that a firm in the South (the core region) chooses an optimal district among 86 districts in the South, and that a firm in the North (the periphery region) chooses among 24 districts in the North. If the NEG hypothesis is valid, we should expect that inter-regional transport costs (travel time) have a negative coefficient estimate in the South and a positive estimate in the North. The results in Columns 2 and 3 are exactly what the NEG predicts: they show shorter inter-regional travel times increase firm location in the South, but reduce firm location in the North. As a district in the South is better connected to markets, it attracts more firms – thereby increasing economic density. However, a district in the North will lose firms as it is better connected to other (possibly core) regions. The coefficient estimates for travel time in both regions are statistically significant at 1% level. All other regressors also have expected signs, even though some parameters in the North equation are not significant.

These findings are consistent with experience in developed countries. In Italy reducing transport costs between the north and south in the 1950s deprived *Mezzogiorno* firms of their previous protection and accelerated their deindustrialization in Italy (Faini 1983). And in France, where transport costs within the country fell by 38 percent between 1978 and 1993, the geographic concentration of employment increased (Combes and Lafourcade (2001).

Firm Size

Large and small firms may respond differently to industrial clustering or other local endowments of a location. We examine this possibility by grouping firms into (i)

large firms (more than 10 employees), and (ii) small firms of less than 10 employees. Columns 4 and 5 in Table 6 show the results for large firms and small firms, respectively. Large firms' location choice is more sensitive to (i) existing industrial clustering of a location, and (ii) broader labor market conditions including those in neighboring districts. It is consistent with the industrial clustering patterns seen in countries such as the United States, showing that large manufacturing firms tend to cluster more as more production processes are out-sourced or depend on sophisticated input-output linkages (Holmes 2004). However, small firms are more responsive to local conditions such as inter-regional travel time, local education level, and local economic size (population and crop production).

Industry sector

As product markets and production technologies vary across industrial sectors, we expect to see variations in how different sectors will respond to local characteristics. We examine industry-specific firm location choice models. Table 7 shows the conditional logit estimation results for 5 major manufacturing industries in Ghana: manufacturing of apparel/ garments (ISIC 18; 10,688 firms), furniture (ISIC 36; 5,508 firms), food (ISIC 15; 4,502), metal (ISIC 28; 1,828 firms), and wood (ISIC 20; 1,155 firms). A couple of distinct features emerge:

First, the estimation results for garments manufacturing are very similar to those of all manufacturing firms in Table 6. This is because a large majority of firms (40%) in Ghana belong to garments manufacturing industry. Second, resource-based industries, such as furniture, metal, and wood products, respond in similar magnitudes to local spillovers, inter-regional travel times, and local education levels. The coefficient estimates for those regressors are similar to other industries or manufacturing firms in general. However, resource-based industries are less sensitive to local labor market conditions measured by urban and rural education levels in neighboring districts. We attribute this difference to the dominance of resource accessibility over labor market conditions when resource-based industry firms choose production locations.

Table 7: Estimation results—by industry sector

	(1)	(2)	(3)	(4)	(5)
Dependent variable	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03
Estimation	conditional logit	conditional logit	conditional logit	conditional logit	conditional logit
Firms	Clothes (ISIC 18)	Furniture (ISIC 36)	Food (ISIC 15)	Metal (ISIC 28)	Wood (ISIC 20)
Location choices	national	national	national	national	national
Number of clothes manuf firms at the end of 2001, nat. share	6.241*** (1.224)				
Number of furniture manuf firms at the end of 2001, nat. share		6.728*** (1.358)			
Number of food manuf firms at the end of 2001, nat. share			51.343*** (3.252)		
Number of metal manuf firms at the end of 2001, nat. share				3.768* (2.193)	
Number of wood manuf firms at the end of 2001, nat. share					11.274*** (2.624)
ln(travel time to 100K city)	-0.516*** (0.059)	-0.172** (0.078)	0.059 (0.081)	-0.907*** (0.218)	-0.345** (0.164)
Middle school grads or higher, pop ratio over 15 years old	3.735*** (0.323)	4.452*** (0.467)	0.043 (0.619)	5.384*** (0.879)	4.652*** (1.097)
Urban middle school grads or higher in neighboring districts, pop ratio over 15 years old	1.529*** (0.546)	-0.133 (0.812)	0.924 (0.777)	0.794 (1.020)	-0.715 (1.916)
Rural middle school grads or higher in neighboring districts, pop ratio over 15 years old	-1.585** (0.668)	1.187 (0.968)	-0.004 (0.906)	-1.705 (1.617)	1.759 (1.993)
ln(district population)	0.263*** (0.065)	0.343*** (0.087)	-0.206** (0.105)	0.366* (0.187)	0.025 (0.208)
ln(total crop proudciton)	0.132*** (0.028)	0.088*** (0.030)	-0.026 (0.027)	0.370*** (0.085)	0.272*** (0.080)
Observations	266,750	119,350	75,130	41,030	21,450

1. Robust standard errors are in parentheses.

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

Alternate measures of market access

In the main estimations discussed above, we use travel times to the nearest city of 100,000 or more people as a measure of market access. However, market access can be measured in different dimensions, such as travel time to cities of different sizes or travel time to ports or airports. The latter group can be a measure of accessibility to international markets.

Table 8 shows estimation results with alternate measures of accessibility. We observe that the parameter estimates of different travel time measures are statistically significant and of similar magnitudes with expected signs. Parameter estimates of other regressors are also statistically significant and of similar magnitudes across all specifications. Thus we confirm a stable and robust relationship between firm creation and market access.

Table 8: Estimation results: different inter-regional travel time

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03	manuf firm birth in 2002-03
Estimation	conditional logit	conditional logit	conditional logit	conditional logit	conditional logit	conditional logit
Firms	all manuf firms	all manuf firms	all manuf firms	all manuf firms	all manuf firms	all manuf firms
Location choices	national	national	national	national	national	national
Number of manuf firms at the end of 2001, national share	7.293*** (0.989)	7.455*** (0.863)	6.865*** (1.021)	7.149*** (1.126)	11.743*** (0.844)	7.189*** (0.963)
ln(travel time to 20K city)	-0.239*** (0.049)					
ln(travel time to 100K city)		-0.288*** (0.039)				
ln(travel time to 250K city)			-0.204*** (0.039)			
ln(travel time to 500K city)				-0.168*** (0.043)		
ln(travel time to ports)					-0.149*** (0.032)	
ln(travel time to airports)						-0.227***

						(0.043)
Middle school grads or higher, pop ratio over 15 years old	3.991*** (0.231)	3.908*** (0.211)	4.582*** (0.187)	4.591*** (0.188)	4.135*** (0.213)	4.276*** (0.200)
Urban middle school grads or higher in neighboring districts, pop ratio over 15 years old	1.700*** (0.287)	1.332*** (0.279)	1.034*** (0.295)	1.136*** (0.292)	0.413 (0.356)	1.517*** (0.282)
Rural middle school grads or higher in neighboring districts, pop ratio over 15 years old	-1.486*** (0.406)	-1.419*** (0.404)	-1.422*** (0.407)	-1.895*** (0.420)	-1.370*** (0.417)	-1.486*** (0.407)
ln(district population)	0.369*** (0.044)	0.342*** (0.044)	0.355*** (0.044)	0.389*** (0.044)	0.352*** (0.046)	0.337*** (0.045)
ln(total crop production)	0.050*** (0.014)	0.068*** (0.014)	0.027** (0.012)	0.026** (0.012)	0.077*** (0.017)	0.036*** (0.012)
Observations	609,730	609,730	609,730	609,730	609,730	609,730

1. Robust standard errors are in parentheses.

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

4. Implications for industrial policy?

The empirical analysis highlights that agglomeration economies and local education levels have a positive effect on location decisions and productivity of Ghanaian manufacturing. Proximity to markets also matters: longer travel time to the nearest city of 100,000 or more reduces the attractiveness of a location. These results show that most manufacturing firms would pay a premium to be located in a region that offers good access to markets and skilled labor and that already has a concentration of other firms in the same line of business. The only exception is food and beverage firms, which tend to cluster in small centers producing for local markets.

What do our estimates imply for regional industrial policy? Policy interventions can affect regional and national manufacturing activities through two channels. First, they influence production and profits for existing firms by changing production costs and market conditions. For example, lowering inter-regional transport costs will enable easier access to products and intermediate input markets. Second, these interventions can alter

location decisions of firms. The second channel emphasizes spatial interdependence of policy interventions. New firms will be created or existing firms will move to more profitable locations, where policy interventions provide more incentives to do business.

Our conditional logit estimation results enable us to examine the spatially heterogeneous impacts of public interventions. First, we compute the change in imputed profits to a representative ‘local’ firm driven by a hypothetical policy intervention, which in this case is reducing inter-regional travel time to markets. The imputed profits are measured by linear predictions from the logit estimation results. Assuming homogeneity of degree one in production inputs, the imputed profit growth is the same as manufacturing output growth. In this way, we can measure the effects of the first channel.

Changing the spatial distribution of infrastructure, in particular the road network alters firm location decisions. In principle, firms will locate in production in a place that generates the highest returns or profits. In this way, policy interventions influence local economies not only through benefits accrued to existing local firms but also by changing the density of firms in a region. This second channel is measured by calculating changes in imputed probabilities of the conditional logit results before and after hypothetical interventions.

A firm’s response to local conditions will vary across industry groups. In this regard, we group Ghana’s manufacturing firms into 6 groups. We select 5 major industries at ISIC 2 digit level, and combine all other firms into a separate group. The total number of firms in the 5 major industries is 24,635 as of 2003, or 87% of all Ghanaian manufacturing firms. The conditional logit estimations are reported in table 7. Market access is measured by travel time to the nearest city of 100,000 or more people. The results show that metal and clothes manufacturing firms are more responsive to inter-regional travel time. However, food and other industries are not sensitive to inter-regional travel time. Not only is it not statistically significant, but also it has positive coefficients.

Table 9 shows the simulation results of combining the impacts of two channels we discuss above. First, we report baseline information. The first column is the total

number of manufacturing firms (as of 2003) in each category. In the last row, we report the national aggregate of each item. For example, 27,126 manufacturing firms in Ghana as of 2003 are disaggregated into various categories in upper rows. The second column is imputed probabilities of new firm location, calculated from the results of table 7.

Table 9: Simulating impacts of reducing inter-regional travel time in different regions

	Total number of firms in 2003	Imputed probability of new firm location, %				Imputed growth of manufacturing industry, %		
		Baseline	case 1: reducing travel time by 10% in South	case 2: reducing travel time by 10% in North	case 3: reducing travel time by 5% nationally	case 1: reducing travel time by 10% in South	case 2: reducing travel time by 10% in North	case 3: reducing travel time by 5% nationally
Clothes manuf: ISIC-18								
South	9,842	93.7	94.0	93.4	93.7	5.63	-0.33	2.61
North	846	6.3	6.0	6.6	6.3	-4.73	10.50	2.61
National	10,688	100.0	100.0	100.0	100.0	5.60	-0.30	2.61
Furniture manuf: ISIC-36								
South	5,228	94.7	94.8	94.6	94.7	1.83	-0.09	0.87
North	280	5.3	5.2	5.4	5.3	-1.62	3.41	0.87
National	5,508	100.0	100.0	100.0	100.0	1.82	-0.08	0.87
Food manuf: ISIC-15								
South	3,482	81.8	81.7	81.9	81.8	-0.69	0.11	-0.29
North	1,020	18.2	18.3	18.1	18.2	0.48	-1.06	-0.29
National	4,502	100.0	100.0	100.0	100.0	-0.61	0.03	-0.29
Metal manuf: ISIC-28								
South	1,687	95.8	96.1	95.4	95.8	9.89	-0.40	4.64
North	141	4.2	3.9	4.6	4.2	-8.33	19.40	4.64
national	1,828	100.0	100.0	100.0	100.0	9.83	-0.33	4.64
Wood manuf: ISIC-20								
South	1,125	95.6	95.7	95.4	95.6	3.67	-0.15	1.74
North	30	4.4	4.3	4.6	4.4	-3.25	6.99	1.74
National	1,155	100.0	100.0	100.0	100.0	3.66	-0.14	1.74
Other manuf;								
South	3,271	95.3	95.2	95.3	95.3	-1.26	0.06	-0.60
North	174	4.7	4.8	4.7	4.7	1.16	-2.33	-0.60
National	3,445	100.0	100.0	100.0	100.0	-1.25	0.05	-0.60
All manuf								
South	24,635	92.7	92.8	92.5	92.7	3.22	-0.16	1.50
North	2,491	10.8	10.7	10.9	10.8	-2.02	4.53	1.11

National	27,126	100.0	100.0	100.0	100.0	3.13	-0.15	1.47
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1. Inter-regional travel time is measured by travel time (minutes) to the nearest city of 100,000 or more population.

Columns 3 to 5 calculate the imputed probabilities of new firm location in three scenarios: (i) reducing travel time in the South by 10%, (ii) reducing travel time in the North by 10%, and (iii) reducing travel nationally by 5%. As expected, the changes in new firm location probabilities in these three scenario differ by industry. In summary, reducing travel time in a region increases the probability of new firm location. However, there are no significant changes in probability between the baseline and those after policy interventions.

Columns of 6 to 8 provide the main insights from this exercise. We compute the combined impacts of reducing travel time through (i) improving profitability of existing local firms and (ii) changing location choice decision of new entrants. As local conditions, such as agglomeration economies, skilled workers, and local market size, are beneficial for manufacturing activities, we expect that policy interventions favoring the South will generate greater returns at the national level.

The results confirm our priors. Reducing travel time in the South reinforces manufacturing activity in the South and de-industrializes the North, as favoring the South encourages firm migration from the North to the South or discourages firm creation in the North. In summary, the South will show a higher growth of manufacturing activity (+3.2%), but the North suffers (-2.0%). And nationally, manufacturing industry grows by 3.1%. Reducing travel time in the North generates the opposite effect. The North will show higher manufacturing growth (+4.5%) at the cost of the South (-0.2%). As large mass of manufacturing firms are located in the South and they do not benefit from transport improvements, and more importantly some manufacturing firms in the South will migrate to the less productive North, the overall national impact of this North-favoring intervention is negative (-0.2%).

Finally, equitable and equal improvement of transport network across the North and South, produces moderate impacts in both North and South regions as well as

nationally. However, the national gains are lower than those by prioritizing investments towards the South. The main conclusion from this exercise is that (i) due to spatial interdependence any regional policy intervention will eventually produce “spatial externalities” which affect other regions, and therefore (ii) the overall impacts at the national level can be quite different from those expected at a regional level.

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