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Barriers to Growth-Enhancing Structural Transformation: The Role of Subnational Differences in Intersectoral Productivity Gaps

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ABSTRACT

Barriers to Growth-Enhancing Structural Transformation: The Role of Subnational Differences in Intersectoral Productivity Gaps*

The movement of workers from the farm sector to a more productive nonfarm sector has failed to generate significant gains in labor productivity in recent decades in many developing countries. This paper offers a new perspective into the barriers to growth-enhancing structural transformation, combining structural modeling with enterprise census data from Ghana. We argue that subnational differences in the intersectoral productivity gap between the nonfarm informal and formal sectors constrain the productivity gain from structural transformation. In Ghana, intersectoral productivity gaps among the richer regions are on average three times larger than among the poorer regions. We model the disparity in regional intersectoral productivity gaps as reflecting the disparity in the regional misallocation of labor between the informal and formal sectors and identify misallocation as the output wedge between the informal and formal sectors. Simulations suggest that a more productive nonfarm informal sector reduces the disparity in regional intersectoral productivity gaps and, in turn, increases national productivity and the contribution of structural transformation to national productivity. For example, a 90-percent reduction in the disparity in regional intersectoral productivity gaps raises Ghana's national aggregate productivity by 11.9 percent and the contribution of structural transformation to productivity by 19.7 percent.

JEL Classification: D24, F15, F43, N10, O11, O14, O47

Keywords: structural transformation, misallocation of resources, labor productivity, nonfarm enterprises, subnational regions, informal and formal sectors, Ghana

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I. Introduction

Despite much higher average labor productivity in the nonfarm sector than in the farm sector, structural transformation—the movement of workers from the farm to the nonfarm sector—has largely failed to generate significant economic growth in many developing countries (de Vries et al. 2015; McMillan et al. 2014). This paper provides a new perspective into the barriers to growth-enhancing structural transformation, arising from subnational differences in intersectoral productivity gaps.

Within each subnational area, the flow of workers across sectors can be stylized as consisting of three main subflows: (1) from the farm to the nonfarm informal sector, (2) from the farm to the nonfarm formal sector, and (3) from the nonfarm informal to the nonfarm formal sector. The contribution of each of these subflows to national aggregate productivity then depends on the size of the corresponding intersectoral productivity gap and its distribution across subnational areas. For example, the gain in national productivity from structural transformation can be dampened if subnational areas with productivity gaps smaller than the national productivity gap undergo rapid structural transformation, or if workers primarily shift from the farm sector to a nonfarm informal sector characterized by low-productivity activities.¹ A large productivity gap between the farm and the nonfarm sectors at the national level, which has mainly been used in the literature to assess the effect of structural transformation on productivity (Gollin et al. 2014), may conceal such uneven distributions of intersectoral productivity gaps across subnational areas.

We argue that subnational differences in the intersectoral productivity gap between the nonfarm informal and formal sectors can undermine the productivity gain from structural transformation. We model the mechanisms underlying the disparity in subnational intersectoral productivity gaps in terms of the disparity in subnational productivity losses from the misallocation of labor between the informal and formal sectors.² The model assumes that labor is efficiently allocated when sectoral employment shares in a region equal the ratio of sectoral and regional labor productivities. Identifying the misallocation of labor as the output wedge between the informal sector and the formal sector, we show that an efficient allocation of labor through a more productive informal sector lowers the disparity in subnational intersectoral productivity gaps.

¹ There has been a steady increase in nonfarm employment in Sub-Saharan Africa since the early 2000s (Diao et al. 2019), with an expansion of employment in nonfarm informal activities (Diao et al. 2021).

² A large body of literature shows productivity gains from the reallocation of resources from informal to formal activities (Banerjee and Duflo 2007; Gollin 2008; La Porta and Shleifer 2014; McCraig and Pavcnik 2015).

To understand the link between the disparity in subnational intersectoral productivity gaps and the level of national productivity, consider the following shift-share framework at the subnational level which decomposes the change in national labor productivity (value-added per worker):

$$\Delta LP = \sum_r \phi_r \Delta LP_r^N \theta_r^N + \sum_r \phi_r \Delta LP_r^A (1 - \theta_r^N) + \sum_r \phi_r (LP_r^N - LP_r^A) \Delta \theta_r^N, \quad (1)$$

where LP , LP_r^N , and LP_r^A denote national, subnational farm, and subnational nonfarm productivity levels, respectively. The nonfarm employment share in subnational area r is denoted by θ_r^N , and $\Delta \theta_r^N = -\Delta \theta_r^A$ since $\theta_r^N = 1 - \theta_r^A$. The subnational area's share of value-added is denoted by ϕ_r . The contribution of structural transformation to national aggregate labor productivity is given by the last term on the R.H.S. of Equation 1. This last term can be expressed as the sum of the productivity gain from workers moving from the farm sector to the nonfarm informal sector and the productivity gain from workers moving from the nonfarm informal sector to the nonfarm formal sector, as follows:

$$\sum_r \phi_r (LP_r^N - LP_r^A) \Delta \theta_r^N = \sum_r \phi_r \delta_r^{NF} (LP_r^{NF} - LP_r^{NI}) \Delta \theta_r^N + \sum_r \phi_r (LP_r^{NI} - LP_r^A) \Delta \theta_r^N, \quad (2)$$

where LP_r^{NF} , LP_r^{NI} and δ_r^{NF} denote nonfarm formal productivity, nonfarm informal productivity, and nonfarm formal employment share in subnational area r , respectively. Subnational nonfarm labor productivity, given by the second term on the R.H.S. of Equation 2, is a weighted average of productivity levels in the nonfarm informal and formal sectors.

On the one hand, a more productive informal sector narrows the intersectoral productivity gap between the nonfarm informal and formal sectors, which leads to a lower productivity gain (the first term on the R.H.S. of Equation 2). On the other hand, it increases the productivity gap between the nonfarm informal and farm sectors, which leads to a greater productivity gain (the last term on the R.H.S. of Equation 2). Since only a small fraction of the nonfarm employment share is formal (as documented in several studies for developing countries), i.e., $\delta_r^{NF} < 1$, a more productive informal sector results in a greater *net* productivity gain from structural transformation. Through this mechanism, a lower disparity in subnational intersectoral productivity gaps (following a more productive nonfarm informal sector and a lower level of misallocation) increases national labor productivity as workers shift from the

farm sector to the nonfarm informal sector. Equally importantly, this process does not restrict productivity gains as workers move from the farm sector to the nonfarm formal sector.

Equation 2 includes another channel through which structural transformation can increase national productivity. Regions that see a rapid pace of structural transformation (i.e., a higher $\Delta\theta_r^N$ than the national average) and a higher productivity gap between the farm sector and the nonfarm informal sector ($LP_r^{NI} - LP_r^A$) can experience a large gain in labor productivity. This channel may appear counterintuitive to the first channel, which relies on a lower disparity in subnational intersectoral productivity gaps through a more productive informal sector. In countries where the pace of structural transformation varies substantially across subnational areas, regional equality in intersectoral productivity gaps can increase the productivity gain from structural transformation only through the first channel. However, both channels coincide if the pace of structural transformation across subnational areas is constant. Our analysis assumes a constant pace of structural transformation across subnational areas to isolate the effects of a more equal distribution of subnational intersectoral productivity gaps on the gain in national productivity from structural transformation.

The contribution of this study relates to three strands of literature. First, the underlying mechanism connecting subnational differences in intersectoral productivity gaps to national productivity growth relates to studies on structural transformation and convergence in subnational productivity (Imbs and Wacziarg 2003; Caselli and Tenreyro 2005; Hnatkovska and Lahiri 2012). Second, our argument for a more productive informal sector to minimize subnational intersectoral productivity gaps hinges on productivity gains from the reallocation of resources between the informal and formal sectors as documented by an extensive literature (Banerjee and Duflo 2007; La Porta and Shleifer 2014; McCraig and Pavcnik 2015). Finally, by offering a new perspective on the barriers to growth-enhancing structural transformation, this study fits into the emerging class of studies that aims to understand why structural transformation has failed to produce significant productivity growth in many developing countries (Caselli and Tenreyro 2005; Restuccia et al. 2008; McMillan et al. 2014).

We use data from Ghana to examine the role of subnational intersectoral productivity gaps. Ghana is a representative case among developing countries of marked structural transformation in recent decades accompanied by limited national aggregate productivity growth. The country also has the needed spatially disaggregated data for our analysis.

Using nonfarm enterprise census data for the country collected between 2014 and 2016, we find that average productivity in the informal sector is lower than in the formal sector in all

of the country's administrative regions (10 regions in total, at the time that the enterprise census was conducted). The productivity gap averaged across the five richest regions is three times larger than that for the five poorest regions. Greater Accra, the country's richest region, has the largest productivity gap, more than four times larger than the productivity gap averaged across the other nine regions. Greater Accra's large productivity gap is due mainly to the substantially higher average productivity in its formal sector compared to the formal sectors in other regions.

Simulated model predictions suggest a strong negative relationship between the disparity in regional intersectoral productivity gaps and both the level of national labor productivity and the contribution of structural transformation to national labor productivity. Reducing the standard deviation of regional intersectoral productivity gaps by 50 percent raises national nonfarm labor productivity, national aggregate (nonfarm and farm) labor productivity, and the contribution of structural transformation to national aggregate labor productivity by a little less than 3 percent each. Reducing the standard deviation of regional intersectoral productivity gaps by 90 percent raises national nonfarm labor productivity by 13.8 percent, national aggregate labor productivity by 11.9 percent, and the contribution of structural transformation to national aggregate labor productivity by 19.7 percent.

Our argument that the variation in regional intersectoral productivity gaps acts as a barrier to growth-enhancing structural transformation weakens if differences in the pace of structural transformation across regions naturally equalizes regional intersectoral productivity gaps over time. Using short-term net employment creation rates in informal and formal enterprises in services and industry across regions as a proxy for the differing pace of structural transformation across regions, we examine the extent to which structural transformation contributes to the change in regional intersectoral productivity gaps. We find that the differing pace of structural transformation across regions in fact has the opposite effect, increasing the disparity in regional intersectoral productivity gaps.

The rest of the paper is organized as follows. Section II provides an overview of national and regional patterns and trends in incomes, structural transformation, and informal nonfarm employment. Section III describes the enterprise data we use in our analysis and provides estimates of regional intersectoral productivity gaps. Section IV presents the model for deriving regional productivity losses from intersectoral misallocation of labor and compares these regional losses to regional intersectoral productivity gaps. Section V discusses the simulation results of the effects of hypothetical adjustments to the disparity in regional intersectoral productivity gaps on the level of national labor productivity and on the contribution of structural transformation to national labor productivity. It also discusses the robustness of the

simulation results to the case of a differing pace of structural transformation to differ across regions. Section VI explores the change in the distribution of regional intersectoral productivity gaps, in conjunction with recent patterns of structural transformation in Ghana. Section VII concludes.

II. Background

A. *Regional incomes*

Regional GDP estimates are unavailable for Ghana. Consequently, to obtain a picture of trends in income across regions, we use trends in average consumption (per adult equivalent) as a proxy. Figure 1 plots average consumption for nine of the country's 10 regions benchmarked to Greater Accra (the richest region) in 2005/06 and in 2016/17, based on data from Ghana Living Standard Survey (GLSS) rounds. The GLSS are multi-topic, national household sample surveys administered by the Ghana Statistical Service (GSS) with data representative at the region level.³ The regions are organized from the poorest (Upper West) to the second richest (Ashanti).

Regions have generally observed a growing gap in average consumption relative to Greater Accra. In addition, this growing gap is generally larger (in percent terms) for poorer regions than for richer regions. The pattern in trends suggests that poorer regions are falling behind Greater Accra at a faster rate than richer regions.

B. *National and regional sectoral employment shares*

Figure 2a plots trends in employment shares by sector (agriculture, industry, and services) at the national level between 1960 and 2018 (almost a 60-year period). Ghana did not exhibit any strong signs of structural transformation during the subperiod from 1960 to 2000 (during the first 40 years of the full period); sectoral employment shares showed some fluctuation during this subperiod but no sustained upward or downward trends. Across this subperiod, agriculture accounted for, on average, about 55 percent of overall employment, followed by services (about 30 percent) and industry (about 15 percent).

Since the early 2000s, the employment share in agriculture began to decline noticeably, with the trend accelerating from 2005 after Ghana opened its economy to global trade

³ See GSS (2008) and GSS (2019) for survey design and implementation details for the 2005/06 and 2016/17 GLSS rounds, respectively.

(Wacziarg and Welch 2008). Between 2000 and 2018, the employment share in agriculture declined from 55 percent to 33 percent (or by 22 percentage points), while the employment share in services increased from 28 percent to 47 percent (19 percentage points). After a long period of stagnation, the employment share in industry rose slightly after 2013, from 17 percent in that year to 20 percent in 2018 (3 percentage points).

Figure 2b plots trends in average labor productivity per worker by sector between 1990 and 2018. Agriculture and industry have seen steady gains in average labor productivity over this subperiod. Starting from the early 2000s, average labor productivity in services declined slightly (from about 18,300 cedis per worker in 2000 to about 17,600 cedis per worker in 2018). Between 1990 and 2000, when the country exhibited little structural transformation, a basic decomposition of annual average labor productivity growth shows that virtually all of the gain in average labor productivity is attributable to within-sector productivity gains.⁴ Between 2000 and 2018, when structural transformation was much stronger in the country, roughly 46 percent of the gain in average labor productivity is attributable to between-sector gains (that is, the movement of workers between sectors, or structural transformation) while the remaining percentage is attributable to within-sector gains.

Turning to the picture across regions within Ghana, Figure 3 plots trends in employment shares in agriculture, industry, and services by region, based on data from the 2005/06, 2012/13, and 2016/17 GLSS rounds.⁵ These rounds of data are also used for other results presented in the remainder of this section.

Based on the figure, we note three general patterns across the regions. First, the employment share in agriculture has declined. Second, employment has mainly shifted from agriculture to services. Third, in richer regions, services have replaced agriculture as the dominant sector in terms of employment.

The shift to nonfarm employment across regions can be more clearly seen in Figure 4, which plots trends in nonfarm employment shares by region between 2005/06 and 2016/17. There is some indication that the shift to nonfarm employment has been generally stronger among poorer than richer regions.

C. Regional informal shares of nonfarm employment

⁴ See de Vries et al. (2015) for a description of the decomposition approach.

⁵ See GSS (2014) for survey design and implementation details for the 2012/13 GLSS.

Figure 5 plots the trends in informal shares of nonfarm employment by region between 2005/06 and 2016/17. We define informal employment as self-employment (including as a contributing family worker) or wage-employment without a written contract. Given this definition, the resulting informal shares should be treated as upper-bound estimates, as some (presumably small) percentage of the self-employed are likely to be formal and misclassified under our definition.

As the figure shows, most regions have observed a decline in the informal share of nonfarm employment. Whether a region shows a decline in informal share and to what extent does not appear to be related to whether the region is comparatively poor or rich.

III. Regional intersectoral productivity gaps

A. Data, sample, and key variables

Our main empirical analysis is based on data from Ghana's Integrated Business Establishment Survey (IBES) 2014, administered by the GSS. The IBES 2014 is the latest census of nonhousehold establishments across all economic sectors.⁶ In the survey, the GSS defines an establishment as "a unit of production or service engaged in a single economic activity under a single ownership at a single fixed location," and defines nonhousehold establishment as one that "has a fixed location and operates from a structure not predominantly used for domestic activities."

The IBES was conducted in two phases, phase I and phase II. Fielded beginning in September 2014, phase I surveyed 638,480 business establishments. Data collected under phase I included location, form of organization, type of ownership, year of establishment, registration status, sector, principal and secondary activities, workforce size, skill distribution of the workforce, and type of financial accounting records maintained. The reference date for the data was August 31, 2014.

Fielded between November 2015 and April 2016, phase II surveyed 24,400 establishments (out of an original intended sample of 31,152 establishments drawn from the set of establishments surveyed under phase I).⁷ Data collected under phase II included workforce, wages and salaries, stocks, value of fixed assets, quantity and cost of inputs

⁶ Ghana's statistical authorities have administered four previous business establishment censuses focused exclusively on industrial establishments.

⁷ With establishments surveyed under phase I serving as the frame, the intended phase-II sample is comprised of all establishments with workforces of 50 or more workers and a representative sample of establishments with workforces of fewer than 50 workers.

purchased, other operating costs, and sales and other income. The reference period for the data was the 2013 calendar year. See GSS (2015) and GSS (2016a) for further information on the design and implementation of the IBES.

We measure labor productivity at the enterprise level, as the enterprise's value-added per worker (in thousand cedis). In the IBES, the GSS defines a formal enterprise as one that is registered with the Registrar-General's Department (RGD) and professionally maintains its financial accounting records (GSS 2015). We adopt the same definition in this study.

Our main analysis focuses on nonfarm establishments, toward examining the effects of the regional disparity in intersectoral misallocation on national nonfarm productivity. For some ancillary results that connect the regional disparity in intersectoral misallocation to national aggregate productivity, we estimate productivity based on the small sample of farm enterprises available in the IBES.⁸ From here on in, we refer to nonfarm establishments as enterprises unless otherwise specified; in addition, we frequently refer to labor productivity as simply productivity, and employment in enterprises as simply employment.

B. Informal and formal enterprises and employment by region and sector

Figure 6 plots the distribution of enterprises by formality status and region. The number of informal enterprises exceeds that of formal enterprises in each region.⁹ Richer regions have more informal and formal enterprises than poorer regions.¹⁰ Figure 7 plots the distribution of employment by formality status and region. Except in Greater Accra, the number of informal workers exceeds that of formal workers in each region.¹¹ Richer regions have greater numbers of informal and formal workers than poorer regions. As the information in Figures 6 and 7 collectively show, while Greater Accra dominates other regions in terms of the numbers of enterprises and workers (both informal and formal), its dominance is stronger with respect to workers than enterprises.

C. Estimates of regional intersectoral productivity gaps

Figure 8 plots average productivity per worker by formality status and by region (panel a) and the gap in average productivity per worker between the informal and formal sectors by region

⁸ Phases I and II of the IBES surveyed 2,831 and 572 farm establishments, respectively (or 0.4 percent or 2.4 percent of all establishments surveyed under those phases, respectively).

⁹ See Figure A1 for the share of enterprises that is informal in each region and at the national level.

¹⁰ The pattern also holds on a per capita basis when we account for regional population numbers based on the 2010 Ghana Population and Household Census (GSS 2012).

¹¹ See Figure A1 for the share of informal employment in each region and at the national level.

(panel b), referred to as the regional intersectoral productivity gap. These gaps are all negative, which means that average productivity is lower in the informal sector than in the formal sector in every region. However, the productivity gap is statistically significant at the 5 percent level in five regions (Upper East, Northern, Eastern, Western, and Greater Accra). The intersectoral productivity gap averaged across the five richest regions (154.9 thousand cedis per worker) is three times larger than that for the five poorest regions (51.1 thousand cedis per worker).

Greater Accra has the largest productivity gap (at 177 thousand cedis per worker). It is more than four times larger than the productivity gap averaged across the other nine regions (which comes to 42 thousand cedis per worker). Greater Accra's large productivity gap is due mainly to the substantially higher average productivity in its formal sector compared to the formal sectors in other regions.

The ratio of average productivity between the informal and formal sectors ranges between 0.08 and 0.83 across regions. The average ratio across all regions, weighted by the regional shares of total value-added, is 0.26. These numbers are in the ballpark of informal-formal productivity gaps estimated by other studies using microdata. For example, Busso et al. (2012) estimate a ratio of 0.38 using data for Mexico for the period 1998–2008.

As a sensitivity check, we also estimate regional intersectoral productivity gaps controlling for characteristics other than the formality status of the enterprise that potentially influence enterprise productivity. See Table A1 for average values for these characteristics by the formality status of the enterprise (including differences in average values in these characteristics between informal and formal enterprises). And see Table A2 for results from region-specific, enterprise-level OLS regressions of log labor productivity on formality status, controlling for these other characteristics. These regressions provide estimates of regional log conditional intersectoral productivity gaps.

The conditional intersectoral productivity gap is statistically significant at the 5 percent level in six regions (Upper West, Upper East, Northern, Eastern, Ashanti, and Western) and at the 10 percent level in Greater Accra. Figure 9 plots the conditional productivity gap alongside the unconditional productivity gap for each region. The regional pattern in productivity gaps is qualitatively similar across the two types of gaps.

IV. Regional productivity losses from intersectoral misallocation

A. Model

We develop a model to derive productivity losses from the misallocation of labor between the informal and formal sectors. The model is adapted from the framework developed by Brandt et al. (2013), which extends the Hsieh and Klenow (2009) firm-by-sector level model, to examine factor misallocation and its effect on total factor productivity at a more aggregate level, between sectors, provinces, and China’s nonfarm economy. Under Hsieh and Klenow’s model, maximum allocation efficiency is achieved when the marginal revenue products of enterprises within a sector become equal.¹²

Consider a static allocation problem in an economy consisting of two sectors (s), formal (f) and informal (i), and n regions (r), $r = 1, 2 \dots n$. Employment in a year is given. We model the allocation of labor across sectors within a region. We however do not model allocation of labor across regions. Supporting this decision, based on GLSS 2016/17, we find that internal migration (across regions) by workers is limited in Ghana. Only 8.2 percent of workers have moved from their birth region to another region due to self-reported employment-related reasons.¹³ More importantly, the distribution of workers between the informal and formal sectors in regions is unchanged by the extent of migration.

We assume a linear production technology at the sector level with labor as the only input. Outputs produced in both sectors are gross substitutes with some degree of product differentiation. Average productivity equals marginal productivity in a linear production function. As a result, the condition for allocative efficiency in our model can be expressed in terms of average labor productivities.

The production function in sector s and region r exhibits constant returns to scale (CRS):

$$Y_{rs} = A_{rs}L_{rs}, \quad (3)$$

where Y_{rs} and L_{rs} are output and employment in sector s and region r , respectively, and A_{rs} is labor productivity in sector s and region r , i.e., $A_{rs} = \frac{Y_{rs}}{L_{rs}}$. Total output in region r (Y_r) is a constant elasticity of substitution (CES) aggregate of sectoral outputs:

¹² A large body of literature adopts the model by Hsieh and Klenow to estimate misallocation across enterprises (for example, see Daude and Fernández-Arias 2010, Busso et al. 2013, Crespi et al. 2014, Nguyen et al. 2016, Chuah et al. 2018, Bastidas and Acosta 2019, and Cirera et al. 2020).

¹³ Self-reported employment-related reasons comprise seeking employment or establishing a business; they also include job relocation or job transfers. If we relax the restriction on the reason for movement, the share of workers who have moved from their birth region to another region increases to 25.6 percent.

$$Y_r = \left[Y_{rf} \frac{\sigma-1}{\sigma} + Y_{ri} \frac{\sigma-1}{\sigma} \right]^{\frac{\sigma}{\sigma-1}}, \quad (4)$$

where σ is the elasticity of substitution between the formal and informal sector outputs.¹⁴

For any type of labor allocation across sectors, labor productivity in sector s and region r can be written as

$$A_r = \frac{\left[Y_{rf} \frac{\sigma-1}{\sigma} + Y_{ri} \frac{\sigma-1}{\sigma} \right]^{\frac{\sigma}{\sigma-1}}}{L_r}. \quad (5)$$

The expression for regional labor productivity, after some algebraic steps, becomes

$$A_r = \left[(A_{rf} L_{f|r})^{\frac{\sigma-1}{\sigma}} + (A_{ri} L_{i|r})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \text{ where } L_{s|r} = \frac{L_{rs}}{L_r}.$$

The gross output at the national level or the GDP is a weighted sum of the regional outputs,

$$Y = \sum_r^n \delta_r Y_r,$$

where δ_r represents region r 's share of national GDP.

Consider output maximization at the sector and region level. Sector s in region r maximizes profit $\pi_{rs} = P_{rs} A_{rs} L_{rs} - w L_{rs}$, where P_{rs} is the output price in sector s and region r . From the first order conditions for profit maximization at the sector level, we derive Equation 6 in which the sectoral price ratio equals the inverse of the sectoral labor productivity ratio:

$$\frac{P_{rf}}{P_{ri}} = \frac{A_{ri}}{A_{rf}}. \quad (6)$$

Region r maximizes profit, $\pi_r = P_r Y_r - P_{rf} Y_{rf} - P_{ri} Y_{ri}$. Using Equation 4, the profit maximization problem of region r can be rewritten as

$$\pi_r = P_r \left[Y_{rf} \frac{\sigma-1}{\sigma} + Y_{ri} \frac{\sigma-1}{\sigma} \right]^{\frac{\sigma}{\sigma-1}} - P_{rf} Y_{rf} - P_{ri} Y_{ri}.$$

¹⁴ We assume that the structuralist school of thought on informality (Moser 1978, Castells and Portes 1989) holds, and view the formal and informal sectors to be economically integrated and interdependent.

From the first order conditions for profit maximization at the region level, we obtain

$$\frac{P_{rs}}{P_r} = \left(\frac{Y_r}{Y_{rs}} \right)^{\frac{1}{\sigma}}. \quad (7)$$

In Equation 7, the ratio of sectoral and regional prices is inversely related to the ratio of sectoral and regional outputs. Substituting the expressions for Y_r and Y_{rs} from Equations 3 and 4 in Equation 7, we derive an expression for the ratio of prices at the sector and region level as a function of regional productivity, sectoral productivity, and sectoral employment share in a region, as follows:

$$\frac{P_{rs}}{P_r} = \left(\frac{A_r}{A_{rs}} \right)^{\frac{1}{\sigma}} \left(\frac{1}{L_{s|r}} \right)^{\frac{1}{\sigma}}, \text{ where } L_{s|r} = \frac{L_{rs}}{L_r}. \quad (8)$$

From Equation 8, we can derive $L_{s|r} = \left(\frac{P_r}{P_{rs}} \right)^{\sigma} \frac{A_r}{A_{rs}}$. Substituting this expression for $L_{s|r}$ in Equation 5 for $s = f, i$, the ratio of prices at the sector and the region level ($\frac{P_{rs}}{P_r}$) becomes

$$\frac{P_{rs}}{P_r} = \frac{\phi_r}{A_{rs}}, \text{ where } \phi_r = \left(A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1} \right)^{\frac{1}{\sigma-1}}. \quad (9)$$

Combining Equations 8 and 9, we obtain

$$L_{s|r} = A_r \phi_r^{-\sigma} A_{rs}^{\sigma-1}. \quad (10)$$

Now, $L_{f|r} + L_{i|r} = 1$ by definition. Applying this condition to Equation 10, we can write $A_r \phi_r^{-\sigma} A_{rf}^{\sigma-1} + A_r \phi_r^{-\sigma} A_{ri}^{\sigma-1} = 1$. After some algebraic steps, it is possible to derive the following expression for labor productivity in region r under an efficient allocation of labor (A_r^*):

$$A_r^* = \frac{\phi_r^{\sigma}}{A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1}} = \left(A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1} \right)^{\frac{1}{\sigma-1}}. \quad (11)$$

Combining Equations 10 and 11, the efficient allocation condition is

$$L_{s|r} = \frac{A_{rs}^{\sigma-1}}{A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1}} = \left(\frac{A_{rs}}{A_r^*}\right)^{\sigma-1} \text{ for } s = f, i. \quad (12)$$

Equation 12 implies that an efficient allocation of labor is achieved when the ratio of sectoral and regional labor productivities is proportional to the ratio of sectoral and regional employment shares. This condition ties the intersectoral productivity gap to the productivity loss from the intersectoral misallocation of labor. Under an efficient allocation of labor across sectors, national labor productivity is given by the weighted average of the regional productivities with regional shares of total value-added serving as the weights, $A^* = \sum_r^n \delta_r A_r^*$. The productivity loss from the intersectoral misallocation of labor in region r (\aleph_r) is given by calculated as $\aleph_r = A_r - A_r^*$. Likewise, the productivity loss from the intersectoral misallocation of labor at the national level (\aleph) is given by $\aleph = A - A^*$.

If mis-specified, our modeling assumptions of CES and CRS technology can produce biased estimates of misallocation (Hopenhayn 2014; Blackwood et al. 2021). However, if the bias across regions is in equal proportion, then the regional disparity in the intersectoral misallocation of labor remains largely unaffected.

B. Calculation of regional productivity losses from intersectoral misallocation

Based on Equation 11, we calculate the efficient level of productivity in each region. We set a low value for the elasticity of substitution (σ) between the formal and informal sectors, at 1.5. In their sector-region framework, Brandt et al. (2013) use 1.5 as the elasticity of substitution between the state and non-state sectors to examine the misallocation of factor inputs across regions in China.¹⁵

Figure 10 plots the actual and efficient levels of productivity by region (panel a) and the productivity loss from the intersectoral misallocation of labor by region (panel b). The loss is defined as the difference between the actual and the efficient productivity level. Greater Accra suffers the largest productivity loss, at 292 thousand cedis per worker, compared to a

¹⁵ As points of reference for our selected elasticity, the survey article by Ruhl (2008) documents elasticities between 1 and 3 in the macro literature on business cycles. In the macro literature on trade, elasticities tend to be set higher, above 4. In the macro literature on the informal sector, the elasticity of substitution between informal and formal consumption is often set greater than 8 (for example, see Restrepo-Echavarria 2014). This is because formal and informal consumption goods are considered to be close substitutes. Finally, in the labor economics literature, the elasticity of substitution between skilled and unskilled labor is often set between 0.6 to 0.9 (for example, see Havranek et al. 2020).

productivity loss of 47 thousand cedis per worker averaged across the other nine regions. Relative to the actual productivity level in each region, the productivity loss ranges from 7 percent in Central to 116 percent in Upper West and Greater Accra, with a productivity loss of 63 percent averaged (unweighted) across all 10 regions.

As a comparison of Figures 8 and 10 shows, the regional pattern of intersectoral productivity gaps is similar to the regional pattern of productivity losses from intersectoral misallocation. The correlation coefficient between the two measures is .93 and statistically significant at the 1 percent level. Excluding Greater Accra, the correlation coefficient becomes .72, but remains significant at the 5 percent level.

Our results differ from the findings of Herrendorf and Schoellman (2015), who suggest that the intersectoral labor productivity gap does not reflect the productivity loss from the intersectoral misallocation of labor. As Herrendorf and Schoellman (2015) and Gollin et al. (2014) argue, measurement errors in labor productivity in the farm sector might explain the difference. The restriction of our analysis to the nonfarm sector could explain why we find a strong association between productivity gaps and productivity losses from misallocation. We are however unable to provide direct evidence in support of our claim due to data limitations.

V. Effects of adjustments in the distribution of regional intersectoral productivity gaps on national labor productivity

A. Extension to the model

To examine the effect of the disparity in regional intersectoral productivity gaps on national labor productivity, we would need to identify a potential source of intersectoral misallocation. Adopting an indirect approach, we rely on a factor that creates a wedge in the profit maximization of an economic entity (Restuccia and Rogerson 2008; Hsieh and Klenow 2009).

We extend our model presented in Section IV.A to incorporate market distortions through the informal sector, informed by a large body of literature that provides evidence of such distortions (for example, see Busso et al. 2013, Levy and López-Calva 2016, and Bastidas and Acosta 2019).¹⁶ Specifically, we consider market distortions as the output wedge (τ_r) between the informal sector and the formal sector in region r . In a similar vein, Brandt et al.

¹⁶ While market wedges at the enterprise or sector level have been used to identify and estimate productivity losses from misallocation, these are likely to also capture any misspecification in the production function. In addition, our output wedge estimates may be subject to bias from measurement error. For example, Bils et al. (2020) show that correcting for measurement error lowers the potential gains from reallocation by 60 percent in U.S. manufacturing plants between 1978 and 2013 and by 20 percent in Indian manufacturing plants between 1985 and 2013.

(2013) investigate output wedges between provinces and between state and nonstate sectors to account for productivity losses of nonfarm total factor productivity in China. Note, however, that we consider output wedges between the formal and informal sectors within a region, not output wedges between regions.

A decrease in the size of the output wedge in region r implies that the informal sector in region r becomes more productive. To quantify the effect of hypothetical barriers to the efficient allocation of labor between sectors on productivity and isolate regional differences in misallocation arising from the sector level, we assume that institutional constraints distort market output and affect productivity only at the sector level based on a joint distribution of sector-specific wedges and sectoral productivity.

The profit maximization problem for region r can now be written as $\pi_r = P_r Y_r - P_{rf} Y_{rf} - P_{ri} \tau_r Y_{ri}$. The allocation of labor between sectors is efficient when $\tau_r = 1$. If $\tau_r > 1$, then in region r , the productivity loss from misallocation occurs because the level of productivity in the informal sector is lower than that in the formal sector. We expect τ_r to be greater than unity based on the estimates of intersectoral productivity gaps presented in Section III.C.

Using Equation 4, the new profit maximization condition for region r can be rewritten as $\pi_r = P_r \left[Y_{rf}^{\frac{\sigma-1}{\sigma}} + Y_{ri}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} - P_{rf} Y_{rf} - P_{ri} \tau_r Y_{ri}$. Using the first order conditions for profit maximization, we derive

$$\frac{P_{rf}}{P_r} = \left(\frac{Y_r}{Y_{rf}} \right)^{\frac{1}{\sigma}} \text{ and } \frac{P_{ri}}{P_r} = \frac{1}{\tau_r} \left(\frac{Y_r}{Y_{ri}} \right)^{\frac{1}{\sigma}}. \quad (13)$$

Substituting the expressions for Y_r and Y_{rs} from Equations 3 and 4 in Equation 13, we obtain an expression for the sectoral employment share in a region as a function of labor productivities and prices at the sector and region level, and the output wedge:

$$L_{f|r} = \left(\frac{P_r}{P_{rf}} \right)^{\sigma} \frac{A_r}{A_{rf}} \text{ and } L_{i|r} = \left(\frac{P_r}{P_{ri} \tau_r} \right)^{\sigma} \frac{A_r}{A_{ri}}. \quad (14)$$

Substituting the expressions for $L_{f|r}$ and $L_{i|r}$ from Equation 5 in Equation 14, we can rewrite the price ratios as

$$\frac{P_{rs}}{P_r} = \frac{\theta_r}{A_{rs}}, \text{ where } \theta_r = \left[(A_{rf})^{\sigma-1} + A_{ri}^{\sigma-1} \tau_r^{1-\sigma} \right]^{\frac{1}{\sigma-1}}.$$

Then, the expressions for the sectoral employment shares in region r become

$$L_{f|r} = A_r \theta_r^{-\sigma} A_{rf}^{\sigma-1} \text{ and } L_{i|r} = A_r \theta_r^{-\sigma} A_{ri}^{\sigma-1} \tau_r^{-\sigma}. \quad (15)$$

Since $L_{f|r} + L_{i|r} = 1$, using Equation 15, the optimal labor productivity in region r can now be written as

$$A_r = \frac{\theta_r^\sigma}{A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1} \tau_r^{-\sigma}} = \frac{[A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1} \tau_r^{1-\sigma}]^{\frac{\sigma}{\sigma-1}}}{A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1} \tau_r^{-\sigma}}. \quad (16)$$

Combining Equations 15 and 16, the optimal allocation conditions with distortion becomes

$$L_{s|r} = \frac{A_{rs}^{\sigma-1}}{A_{rf}^{\sigma-1} + A_{ri}^{\sigma-1} \tau_r^{-\sigma}}, \text{ for } s = f, i. \quad (17)$$

We can identify the output wedges for any given allocation of sectoral productivities and sectoral shares of employment using the following expression derived from Equations 15 and 17:

$$\tau_r = \left[\frac{\left(\frac{A_r A_{rf}^{\sigma-1}}{L_{f|r}} \right)^{\frac{\sigma-1}{\sigma}} - A_{rf}^{\sigma-1}}{A_{ri}^{\sigma-1}} \right]^{\frac{1}{1-\sigma}}. \quad (18)$$

Using Equation 18, we can calculate the actual output wedge in a region using the parameter value, the regional sectoral share of employment, and sectoral labor productivities. By construction, the distribution of regional output wedges is linked to the distribution of regional productivity losses from intersectoral misallocation. And, as we had shown in Section IV.B, regional intersectoral productivity gaps and regional productivity losses from intersectoral misallocation are strongly correlated.

Adjusting the distribution of regional output wedges offers a way to evaluate the hypothetical effects of changes in the distribution of regional intersectoral productivity gaps on national labor productivity. Note however that our model independently maximizes output in each region. Thus, the model does not itself provide a unique mechanism to adjust the distribution of regional output wedges. The same level of disparity in regional intersectoral productivity gaps and the consequent level of national labor productivity can arise from different distributions of regional output wedge sizes. Moreover, equalizing regional output wedges at different wedge sizes can produce different levels of national labor productivity.

B. Effect of the disparity in regional output wedges on national labor productivity

We calculate regional output wedges using Equation 18. Actual regional output wedges are calibrated based on sectoral labor productivities and labor allocation in a region, and the base model parameter values.

Using the calculated values of regional output wedges, the ratio of the productivity level in the informal sector relative to that in the formal sector, averaged across the regions, is 0.19.¹⁷ This figure is smaller than the corresponding average of 0.26 estimated solely using the IBES. The correlation between the actual ratio and that obtained from applying the calculated values of regional output wedges is .92. Additionally, the correlation between regional output wedges and regional intersectoral productivity gaps is .81, and the correlation between regional output wedges and regional productivity losses due to the intersectoral misallocation of labor is .93. All the correlations are statistically significant at the 1 percent level. These patterns provide support for the use of regional output wedges as a proxy for regional intersectoral productivity gaps to assess the effect of hypothetical adjustments in the disparity of regional intersectoral productivity gaps on national productivity.

To assess the effect of the distribution of regional output wedges on national labor productivity, we perform a series of simulations. Table 1 presents the results regarding the effects on national nonfarm labor productivity from three types of simulations: uniform percentage changes in actual regional output wedges in all regions (panel a), in the five poorest regions (panel b), and in the five richest regions (panel c). The incremental adjustments we examine lie in the range from 10 percent to 75 percent of actual regional output wedges. Under the actual distribution of regional output wedges, we obtain a national nonfarm productivity level of 211.9 thousand cedis per worker. The standard deviation of regional output wedges

¹⁷ The average is weighted, with regional shares of total value-added serving as the weights.

and the standard deviation of regional nonfarm productivity levels are 398.5 thousand and 69.3 thousand cedis per worker, respectively. Moving from the actual to the efficient allocation of labor across sectors (that is, to where regional output wedges are eliminated) increases national nonfarm productivity to 448.5 thousand cedis per worker (a 111.6 percent increase from the level of national nonfarm productivity under the actual distribution of regional output wedges); in addition, it increases the standard deviation in regional nonfarm productivity levels to 169.3 thousand cedis per worker.

Table 2 presents analogous results regarding the effects on national aggregate labor productivity from the three types of simulations. National aggregate labor productivity is a weighted average of farm and nonfarm labor productivities. To obtain the effects on national aggregate labor productivity, apart from the simulation results on the effects on nonfarm productivity (presented in table 1), we use data from Phase II of the IBES to estimate productivity in farm enterprises, as well as GGDC data to estimate the farm employment share, the change in the nonfarm employment share, and the change in farm labor productivity.¹⁸

As the table shows, under the actual distribution of regional output wedges, we obtain a national aggregate productivity of 164.4 thousand cedis per worker. Moving from the actual to the efficient allocation of labor across sectors increases national aggregate productivity to 316.7 thousand per worker (an increase of 92.6 percent from the level of national aggregate productivity under the actual distribution of regional output wedges).

As both Tables 1 and 2 show, the simulation results from adjusting regional output wedges in all regions or in the five richest regions suggest a strong negative association between the extent of disparity in regional output wedges and the level of national labor productivity. In addition, the results from adjusting output wedges in the five poorest regions suggest little or no association between the extent of variation in regional output wedges and the level of national labor productivity. These results suggest that the negative association is effectively driven by the five richest regions.

In addition, the effect of reductions in regional output wedges on the level of national nonfarm or aggregate labor productivity are nonlinear. Reducing output wedges in all regions by 50 percent increases nonfarm productivity to 217.9 thousand cedis per worker (an increase

¹⁸ Based on GGDC data, we obtain a farm employment share of 36 percent averaged across 2013 and 2014, an annual rate of increase in the nonfarm employment share of slightly over 1 percentage point, averaged over the period from 2000 to 2018, and an annual farm productivity growth rate of 3 percent, averaged over the period from 2013 to 2015. Farm productivity is estimated based on 567 farm enterprises (2.3 percent of the total surveyed sample of 24,400 enterprises) in Phase II of the IBES.

of 2.8 percent relative to national nonfarm productivity under the actual distribution of regional output wedges) and national aggregate productivity to 169.1 thousand cedis per worker (an increase of 2.9 percent relative to national aggregate productivity under the actual distribution of regional output wedges). Whereas, reducing regional output wedges by 90 percent increases national nonfarm productivity to 241.2 thousand cedis per worker (an increase of 13.8 percent) and national aggregate productivity to 184 thousand cedis per worker (an increase of 11.9 percent).

C. Effect of the disparity in regional output wedges on the contribution of structural transformation to national aggregate labor productivity

Based on Equation 1, we calculate the contribution of a constant pace of subnational structural transformation to national aggregate productivity, $\sum_r \phi_r (LP_r^N - LP_r^A) \Delta \theta_r^N$. For the regional pace of structural transformation ($\Delta \theta_r^N$), we uniformly apply the national average rate of increase in the nonfarm employment share of 1 percentage point, obtained from GGDC data.

Table 3 reports the simulated effects of the disparity in regional output wedges on the contribution of structural transformation to national aggregate productivity. Under the actual distribution of regional output wedges, the contribution of structural transformation to national aggregate productivity is 1.38 thousand cedis per worker. Moving from the actual to the efficient allocation of labor across sectors increases the contribution of structural transformation to national aggregate productivity to 3.74 thousand cedis per worker (a 172.1 percent increase from the level of contribution of structural transformation to national aggregate productivity under the actual distribution of regional output wedges).

The results presented in Table 3 are broadly in line with those presented in Tables 1 and 2. They suggest a strong negative association between the disparity in regional output wedges and the contribution of structural transformation to national aggregate productivity. Reducing output wedges in all regions by 50 percent increases the contribution of structural transformation to national aggregate productivity to 1.41 thousand cedis per worker (or an increase of 2.7 percent relative to the contribution of structural transformation to national aggregate productivity under the actual distribution of regional output wedges), while reducing regional output wedges by 90 percent increases the contribution of structural transformation to national aggregate productivity to 1.65 thousand cedis per worker (an increase of 19.7 percent).

D. Sensitivity test: Contribution of structural transformation to the change in regional intersectoral productivity gaps when the pace of structural transformation differs across regions

In deriving our results, we have assumed a constant pace of structural transformation across regions. If structural transformation reduces the disparity in regional intersectoral productivity gaps, it weakens our argument that the disparity in these gaps undermines national productivity. It becomes important then to examine how the disparity in regional intersectoral productivity gaps relates to the differing pace of structural transformation across regions.

We cannot directly observe the long-term pattern or pace of structural transformation at the region level using the IBES since it is a single cross-section. However, the IBES collected retrospective employment data going back a year. Specifically, the IBES gathered information on total persons engaged in an enterprise for four different dates: November 30, 2013; February 28, 2014; May 31, 2014; and August 31, 2014. We use these data to estimate short-term net nonfarm employment creation between November 2013 and August 2014, adopting the calculation method used by GSS (2016b).¹⁹

Across regions in general, net employment creation has been dominated by services, and within services, by the informal sector (Figure 11a). At the national level, 70 percent of net nonfarm employment creation between 2013 and 2014 was in informal services. We view these patterns as being part of the long-term process of structural transformation occurring in Ghana, although we recognize that these patterns may be due to unrelated short-term labor market adjustments. The patterns of nonfarm employment creation, combined with the patterns in sectoral employment trends presented in Section II, indicate that the largest flow of workers has been from agriculture to informal services.

At the national level, net employment creation (as a percentage of the employment level in 2013) in formal and informal enterprises in industry were 3.3 and 7.1 percent, respectively (Figure 11b). Net employment creation in formal and informal enterprises in services was slightly higher, at 3.8 and 10.3 percent, respectively.²⁰ Assuming that net employment creation in these sectors continued at the same rate in the following year (from 2014 to 2015), we can

¹⁹ Net employment creation between November 30, 2013 and August 31, 2014 is estimated as a sum of (1) change in total persons engaged between November 30, 2013 and February 28, 2014; (2) change in total persons engaged between February 28, 2014 and May 31, 2014; and (3) change in total persons engaged between May 31, 2014 and August 31, 2014.

²⁰ In Section II, we show that the informal employment share fell in Ghana. Here, we show that net employment creation was strongest in informal enterprises. The informal employment share includes informal self-employment while net employment creation in informal enterprises only comprises wage-employment. Over time, there has been shift from self-employment to wage-employment in Ghana.

calculate the contribution of structural transformation (as proxied by the rate of net employment creation) to the change in the intersectoral productivity gap between 2014 and 2015 based on the following equation:

$$\Delta PG_r^{ST} = \sum LP_{rIND}^I \Delta \phi_{rIND}^I + \sum LP_{rSER}^I \Delta \phi_{rSER}^I - \sum LP_{rIND}^F \Delta \phi_{rIND}^F - \sum LP_{rSER}^F \Delta \phi_{rSER}^F, \quad (19)$$

where ΔPG_r^{ST} = contribution of structural transformation to the change in the intersectoral labor productivity gap in region r , LP_{rj}^k = labor productivity of k -type enterprises in sector j in region r , ϕ_{rj}^k = employment share of k -type enterprises in sector j in region r , k = informal or formal, j = industry (IND) or services (SER), and $\Delta = 2014 - 2015$.

It is not feasible to measure the change in labor productivity at the enterprise level. Given this, Equation 19 provides a partial picture of the total change in the intersectoral productivity gap over time (using a standard shift-share decomposition framework). Assuming own-sector productivities remain constant, that is, $\Delta LP_{IND}^I = \Delta LP_{IND}^I = \Delta LP_{IND}^F = \Delta LP_{IND}^F = 0$, Equation 19 approximates the contribution of structural transformation to the change in the regional intersectoral productivity gap. We calculate $\Delta \phi_{IND}^I$, $\Delta \phi_{SER}^I$, $\Delta \phi_{SER}^F$, and $\Delta \phi_{SER}^F$ and labor productivities based on IBES data.

Figure 12 compares the actual intersectoral productivity gap and the predicted intersectoral productivity gap calculated as the sum of the actual intersectoral productivity gap and the contribution of structural transformation to the predicted change in the intersectoral productivity gap in each region. At the national level, the contribution of structural transformation to the change in the intersectoral productivity gap is positive, increasing the gap from 111.8 thousand cedis per worker to 158.3 thousand cedis per worker. For most regions, the contribution of structural transformation to the change in the regional intersectoral productivity gap is positive. As a result, accounting for the contribution of structural transformation, the disparity in regional intersectoral productivity gaps increases. Measured in standard deviation terms, the disparity in regional intersectoral productivity gaps increases from 55.0 thousand cedis per worker to 75.6 thousand cedis per worker.

The disparity in regional intersectoral productivity gaps could be smaller if the negative own-sector effect were to outweigh the positive contribution of structural transformation. For this reason, our results here should only be taken as suggestive evidence that the disparity in regional intersectoral productivity gaps is not lowered by the differing pace of structural transformation across regions.

VI. Channels of change in the distribution of regional intersectoral productivity gaps

To further identify potential channels behind the distribution of regional intersectoral productivity gaps, we examine the change in this distribution and the relationship between the change and the pattern of structural transformation in Ghana since the early 2000s. The analysis here examines the intersectoral (informal-formal) productivity gap in industry and in services.

As discussed in Section III.C, the intersectoral productivity gap averaged across the five richest regions is three times larger than that for the five poorest regions. Refining further, the intersectoral productivity gap in industry averaged across the five richest regions (180.8 thousand cedis per worker) is also roughly three times larger than that for the five poorest regions (66.8 thousand cedis per worker) (Figure A2). On the other hand, the intersectoral productivity gap in services averaged across the five richest regions (55 thousand cedis per worker) is about 1.6 times larger than that for the five poorest regions (32.8 thousand cedis per worker). These numbers suggest that the difference in the intersectoral productivity gap between the richest and the poorest regions of Ghana is driven by the corresponding difference in industry.

We cannot examine the change in the distribution of regional intersectoral productivity gaps over time in industry and services because the previous rounds of establishment censuses in Ghana only surveyed industrial establishments. As a second-best option, we examine the change in the distribution of regional intersectoral productivity gaps only in industry, by comparing statistics from the National Industrial Census (NIC) 2003 to those from IBES 2014, a period of roughly a decade.²¹ In doing so, we can only obtain a partial picture of the change in the distribution of regional intersectoral productivity gaps in the nonfarm sector. To allow for a comparison of statistics between 2003 and 2014, we redefine some key variables. Specifically, an informal enterprise is redefined as an enterprise that is not registered with RGD, labor productivity is redefined as revenue per worker (given the absence of value-added data for enterprises in the NIC 2003 data), and the intersectoral productivity gap is redefined as the log of the ratio in labor productivity between the informal and formal sectors (given the absence of sector- and enterprise- specific price deflators over time).

We do not see any clear pattern in the change in the distribution of intersectoral productivity gaps between the richest and the poorest regions (Figure 13). Except in Northern,

²¹ See GSS (2006) for further information on the design and implementation of the National Industrial Census 2003.

the intersectoral productivity gap fell in the five poorest regions. Among the five richest regions, the intersectoral productivity gap increased in Central and Greater Accra but declined somewhat in Ashanti, Eastern, and Western. Overall, the ratio of intersectoral productivity gaps in industry between the five richest and the five poorest regions roughly doubled from 0.61 in 2003 to 1.3 in 2014.

How closely does this change in the distribution of regional intersectoral productivity gaps relate to recent trends in structural transformation in the country? Between 2003 and 2014, the industrial share of employment and value-added per worker increased, which coincided with the major discovery of oilfields in 2010 (World Bank 2021). Consequently, Ghana's exports of fuels increased nearly 3.5 times in trade value from 2010 to 2019 (World Bank 2021). More than 76 percent of industrial employment in 2014 is in the four richest regions of Ashanti, Central, Greater Accra, and Western (Figure A3). Given this, the growing importance of extractive sectors is likely to be correlated with the increasing wedge in the intersectoral productivity gap in industry between the five richest and five poorest regions (Figure 13).

VII. Conclusion

The movement of workers from the farm sector to a more productive nonfarm sector has failed to generate a significant gain in labor productivity in recent decades in many developing countries, including in Ghana. We offer a new perspective on the barriers to growth-enhancing structural transformation, by combining structural modeling with recent enterprise census data from Ghana. Specifically, we argue that differences across Ghana's regions in terms of the productivity gaps between the nonfarm informal and formal sectors impair national productivity gains from structural transformation in the country.

We interpret the disparity in regional intersectoral productivity gaps as reflecting the disparity in regional productivity losses in the intersectoral misallocation of labor, and identify intersectoral misallocation as the output wedge between the informal and formal sectors. Through a series of simulations, we show that a more productive nonfarm informal sector reduces the disparity in regional intersectoral productivity gaps and, in turn, generates higher levels of national nonfarm and aggregate labor productivity as well as a larger level of contribution of structural transformation to national aggregate labor productivity.

Policies that aim to increase labor productivity tend to focus on the reallocation of resources from the informal to the formal sectors. However, limited potential to transition from the informal to the formal sector (de Mel et al. 2010) and high mobility costs (Caselli and Coleman 2001), among other factors, cast doubt on the efficacy of such policies. In contrast,

our findings highlight the importance of a more productive nonfarm informal sector and a lesser role for resource mobilization between the nonfarm informal and formal sectors in raising aggregate labor productivity. The findings also point to the value of implementing sector or enterprise development initiatives that are region-sensitive, and that are coherent and well-coordinated with regional development initiatives.

Limited by our data, we model regional productivity losses from the intersectoral misallocation of labor based on a static framework, assuming a constant pace of structural transformation across regions. This assumption can be relaxed within a dynamic framework, accompanied by multiple rounds of comparable cross-sections or panel data on workers, enterprises, and productivity levels, and at the appropriate level of spatial representativeness. Applying such a framework can deepen understanding of the constraints to productivity growth from structural transformation emanating from the subnational level.

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Table 1. Simulated Effects of Adjustments in the Distribution of Regional Output Wedges (τ_r) on National Nonfarm Labor Productivity

| | | National nonfarm productivity | | Regional differences | |
|---|------------------------|-------------------------------|---------------------|------------------------------------|--|
| | | Level (thousand cedis) | Change (percent) | SD of τ_r (thousand cedis) | SD of regional productivity (thousand cedis) |
| | | (1) | (2) | (3) | (4) |
| Actual τ_r | | 211.9 | 0.0 | 398.5 | 69.3 |
| Efficient τ_r (i.e., $\tau_r = 1$) | | 448.5 | 111.6 | 0.0 | 169.3 |
| a. Uniform percentage changes in actual regional output wedges, all regions | | | | | |
| Case 1 | 10% of actual τ_r | 241.2 | 13.8 | 39.8 | 67.4 |
| Case 2 | 25% of actual τ_r | 226.1 | 6.7 | 99.6 | 66.5 |
| Case 3 | 50% of actual τ_r | 217.9 | 2.8 | 199.2 | 67.7 |
| Case 4 | 75% of actual τ_r | 214.2 | 1.1 | 298.8 | 68.7 |
| b. Uniform percentage changes in actual regional output wedges, five poorest regions only | | | | | |
| Case 5 | 10% of actual τ_r | 213.9 | 0.9 | 401.5 | 66.0 |
| Case 6 | 25% of actual τ_r | 213.3 | 0.7 | 401.0 | 66.8 |
| Case 7 | 50% of actual τ_r | 212.6 | 0.3 | 400.1 | 68.0 |
| Case 8 | 75% of actual τ_r | 212.2 | 0.1 | 399.3 | 68.7 |
| c. Uniform percentage changes in actual regional output wedges, five richest regions only | | | | | |
| Case 9 | 10% of actual τ_r | 239.3 | 12.9 | 37.3 | 71.5 |
| Case 10 | 25% of actual τ_r | 224.7 | 6.0 | 97.2 | 69.3 |
| Case 11 | 50% of actual τ_r | 217.2 | 2.5 | 197.6 | 69.1 |
| Case 12 | 75% of actual τ_r | 213.9 | 0.9 | 298.0 | 69.2 |

Source: Authors' estimates based on data from Phase II of the IBES.

Note: SD = standard deviation. Productivity = value-added per worker (in thousand cedis). In column 2, the change in national nonfarm productivity is calculated as the percentage change relative to the national nonfarm productivity level associated with the actual distribution of regional output wedges (first row, column 1).

Table 2. Simulated Effects of Adjustments in the Distribution of Regional Output Wedges (τ_r) on National Aggregate Labor Productivity

| | | National aggregate productivity | |
|---|------------------------|---------------------------------|-----------|
| | | Level | Change |
| | | (thousand cedis) | (percent) |
| | | (1) | (2) |
| Actual τ_r | | 164.4 | 0.0 |
| Efficient τ_r (i.e., $\tau_r = 1$) | | 316.7 | 92.6 |
| a. Uniform percentage changes in actual regional output wedges, all regions | | | |
| Case 1 | 10% of actual τ_r | 184.0 | 11.9 |
| Case 2 | 25% of actual τ_r | 174.3 | 6.0 |
| Case 3 | 50% of actual τ_r | 169.1 | 2.9 |
| Case 4 | 75% of actual τ_r | 166.7 | 1.4 |
| b. Uniform percentage changes in actual regional output wedges, five poorest regions only | | | |
| Case 5 | 10% of actual τ_r | 166.5 | 1.3 |
| Case 6 | 25% of actual τ_r | 166.1 | 1.1 |
| Case 7 | 50% of actual τ_r | 165.7 | 0.8 |
| Case 8 | 75% of actual τ_r | 165.4 | 0.6 |
| c. Uniform percentage changes in actual regional output wedges, five richest regions only | | | |
| Case 9 | 10% of actual τ_r | 182.7 | 11.2 |
| Case 10 | 25% of actual τ_r | 173.4 | 5.5 |
| Case 11 | 50% of actual τ_r | 168.6 | 2.6 |
| Case 12 | 75% of actual τ_r | 166.5 | 1.3 |

Source: Authors' estimates based on data from Phase II of the IBES.

Note: Aggregate = farm and nonfarm. Productivity = value-added per worker (in thousand cedis). In column 2, the change in national aggregate productivity is calculated as the percentage change relative to the national aggregate productivity level associated with the actual distribution of regional output wedges (first row, column 1).

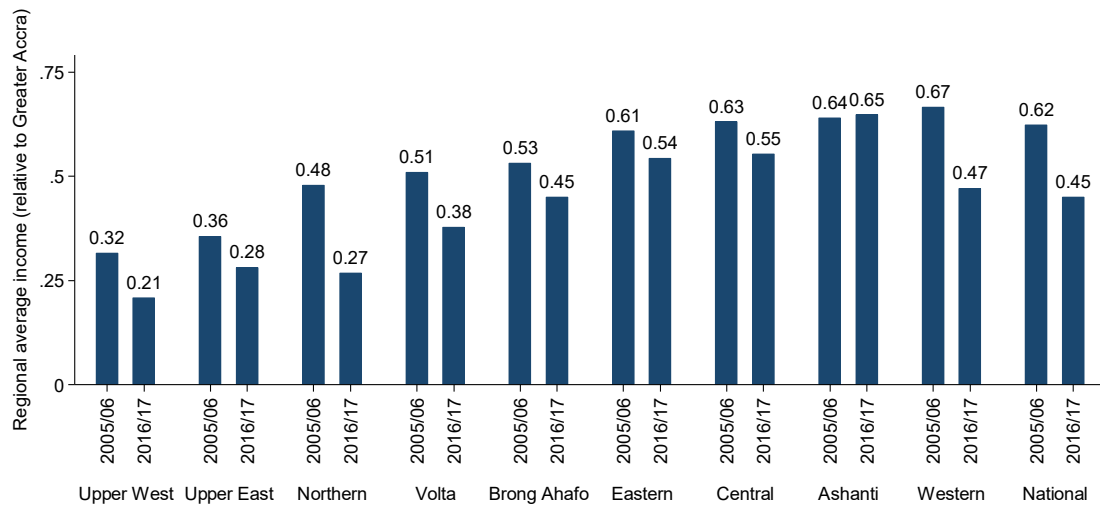
Table 3. Simulated Effects of Adjustments in the Distribution of Regional Output Wedges (τ_r) on the Contribution of Structural Transformation to National Aggregate Labor Productivity

| | Contribution of structural transformation to national aggregate productivity | |
|---|--|------------------|
| | Level | Change |
| | (thousand cedis) (1) | (percent) (2) |
| Actual τ_r | 1.38 | 0.0 |
| Efficient τ_r (i.e., $\tau_r = 1$) | 3.74 | 172.1 |
| a. Uniform percentage changes in actual regional output wedges, all regions | | |
| Case 1 | 10% of actual τ_r | 19.7 |
| Case 2 | 25% of actual τ_r | 8.7 |
| Case 3 | 50% of actual τ_r | 2.7 |
| Case 4 | 75% of actual τ_r | 0.0 |
| b. Uniform percentage changes in actual regional output wedges, five poorest regions only | | |
| Case 5 | 10% of actual τ_r | -0.2 |
| Case 6 | 25% of actual τ_r | -0.6 |
| Case 7 | 50% of actual τ_r | -1.1 |
| Case 8 | 75% of actual τ_r | -1.4 |
| c. Uniform percentage changes in actual regional output wedges, five richest regions only | | |
| Case 9 | 10% of actual τ_r | 18.3 |
| Case 10 | 25% of actual τ_r | 7.7 |
| Case 11 | 50% of actual τ_r | 2.2 |
| Case 12 | 75% of actual τ_r | -0.2 |

Source: Authors' estimates based on data from Phase II of the IBES.

Note: Productivity = value-added per worker (in thousand cedis). In column 2, the change in the contribution of structural transformation to national aggregate productivity is calculated as the percentage change relative to the contribution of structural transformation to national aggregate productivity associated with the actual distribution of regional output wedges (first row, column 1).

Figure 1. Regional Income Differences Benchmarked to Greater Accra

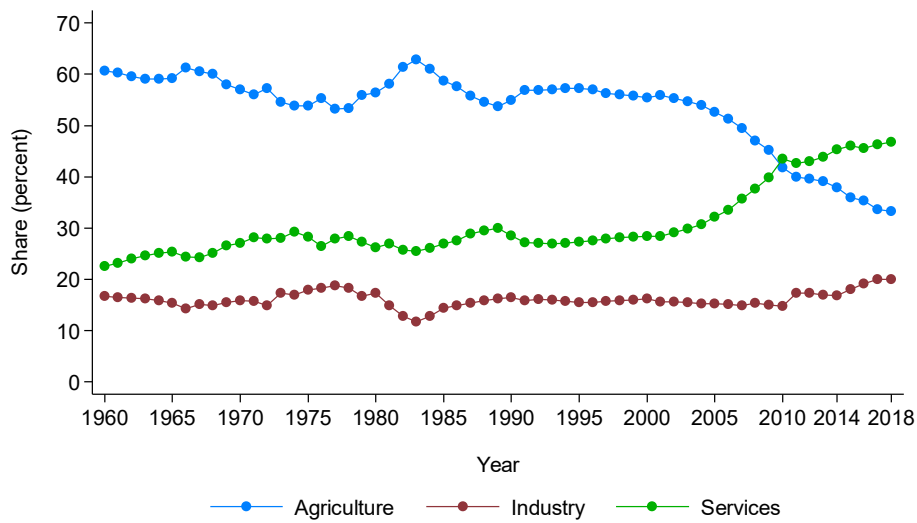


Source: Authors' estimates based on data from the 2005/06 and 2016/17 rounds of the GLSS.

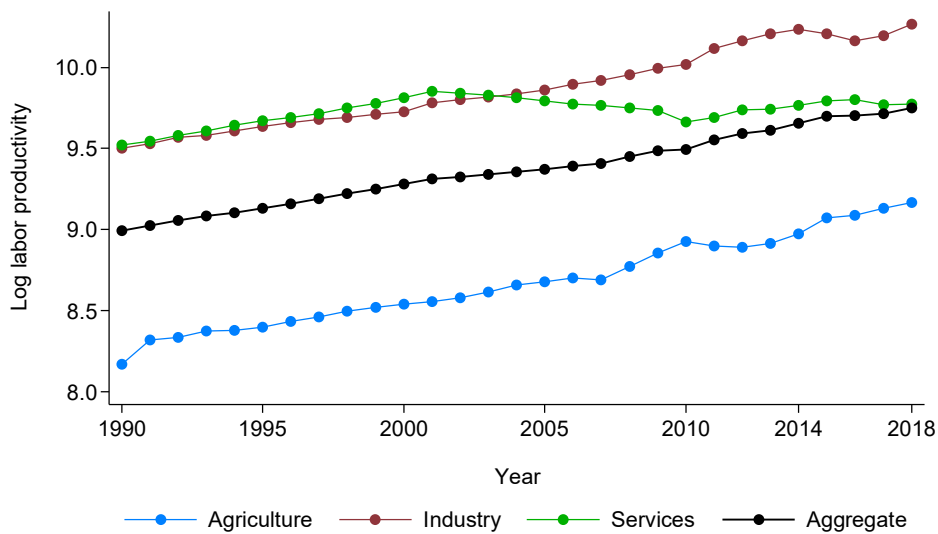
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regional average income is proxied by regional average household consumption per adult equivalent. Regions are ordered according to regional average household consumption per adult equivalent in 2005/06, from lowest to highest (left to right).

Figure 2. Trends in Sectoral Employment Shares and Labor Productivity

a. Sectoral employment shares, 1960–2018



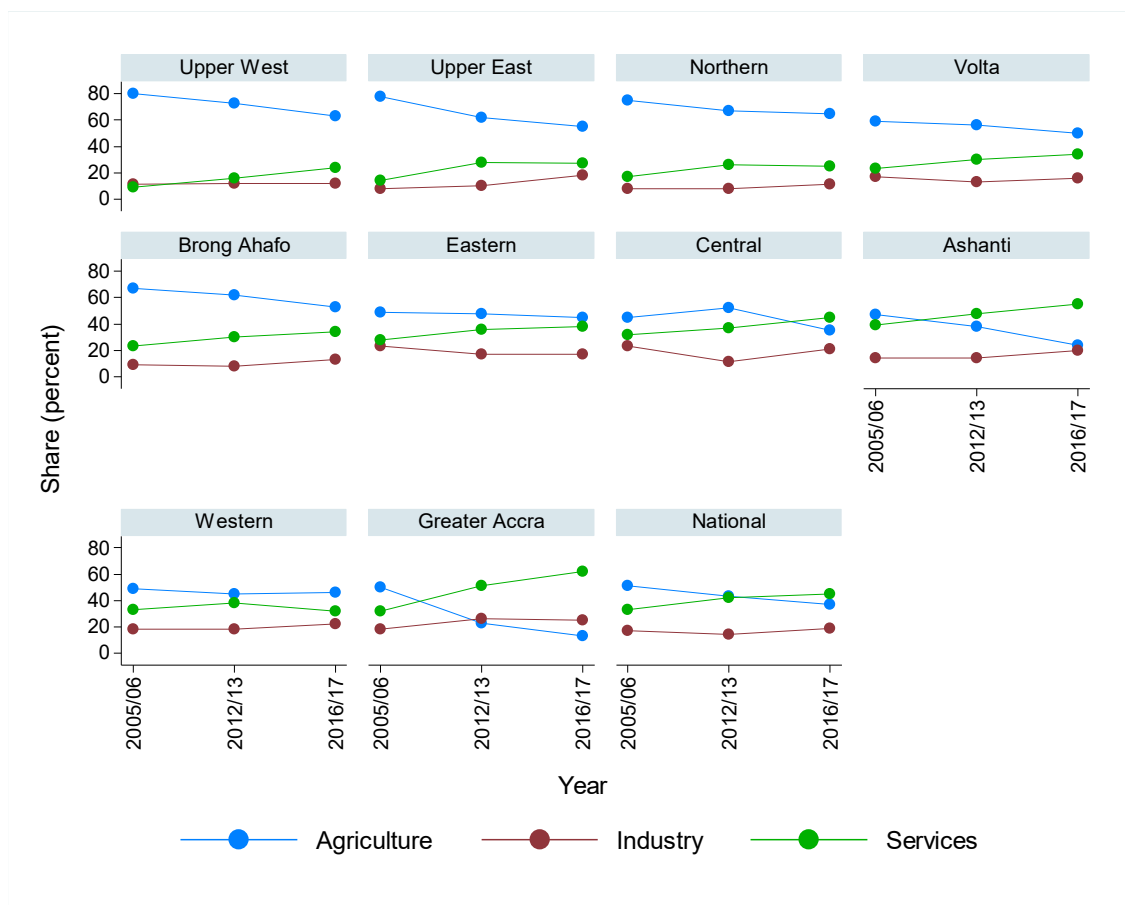
b. Labor productivity, 1990–2018



Source: Authors' estimates based on GGDC (Economic Transformation database) data.

Note: Agriculture includes forestry and fisheries; industry includes mining, manufacturing, public utility, and construction; and services include wholesale and retail trade, transportation and storage, financial and real estate activities, government services, and other services. Nonagriculture includes industry and services. Labor productivity = value-added per worker at constant 2015 prices (in thousand cedis).

Figure 3. Trends in Sectoral Employment Shares, by Region, 2005/06–2016/17

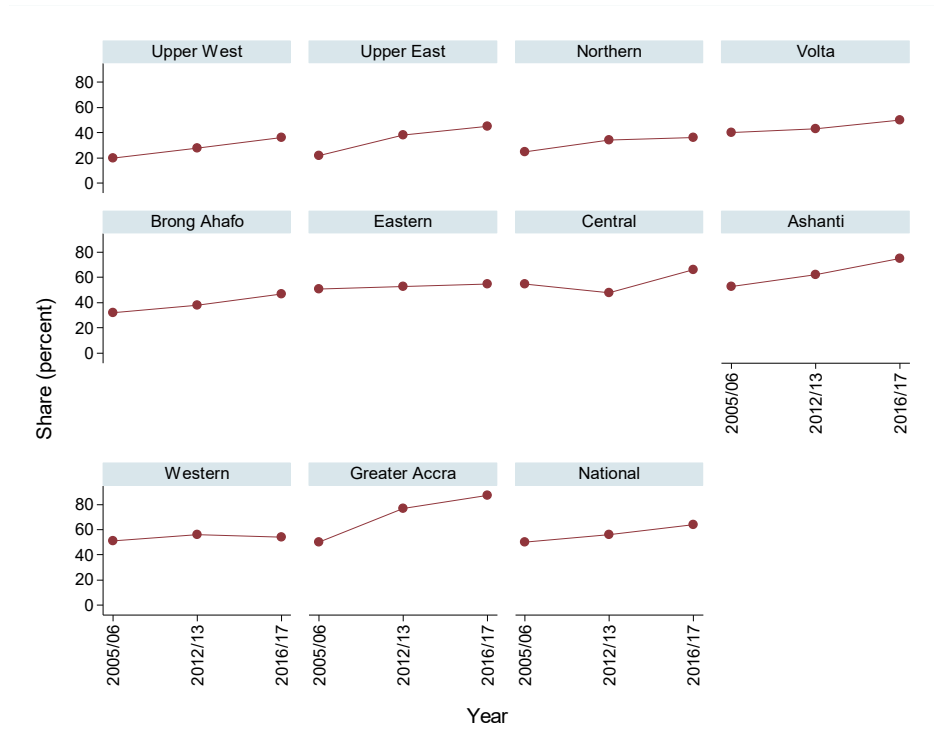


Source: Authors' estimates based on data from the 2005/06, 2012/13, and 2016/17 rounds of the Ghana Living Standard Surveys (GLSS).

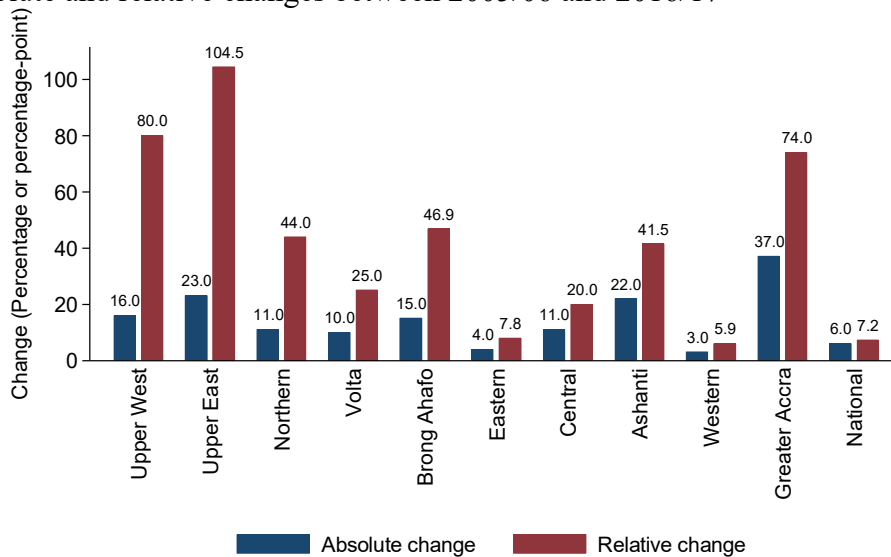
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are ordered according to average household consumption per adult equivalent in 2005/06, from lowest (top left) to highest (bottom right). The sample is restricted to employed workers between ages 15–64 years. Agriculture includes forestry and fisheries. Industry includes construction, utilities, mining, and manufacturing. Services include wholesale and retail trade; transportation and storage; accommodation and food services activities; information and communications; financial and insurance activities; real estate activities; professional, scientific and technical activities; administrative and support services activities; public administration and defense; education; health; arts, entertainment, and recreation; and other service activities.

Figure 4. Trends in Nonfarm Employment Shares, by Region, 2005/06–2016/17

a. Trends in nonfarm employment shares



b. Absolute and relative changes between 2005/06 and 2016/17

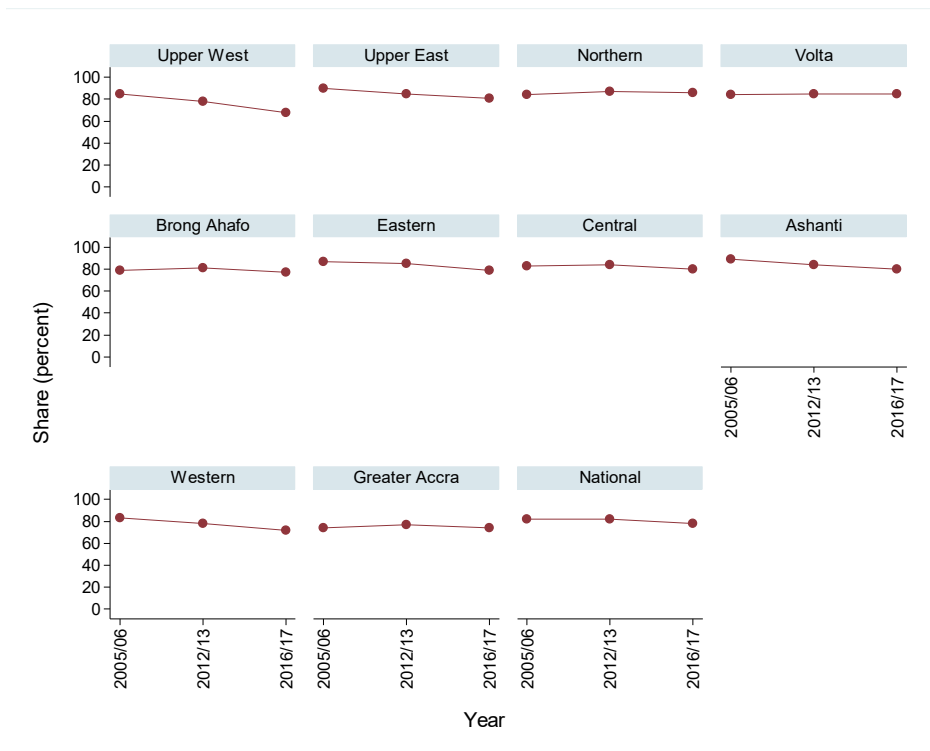


Source: Authors' estimates based on data from the 2005/06, 2012/13, and 2016/17 rounds of the GLSS.

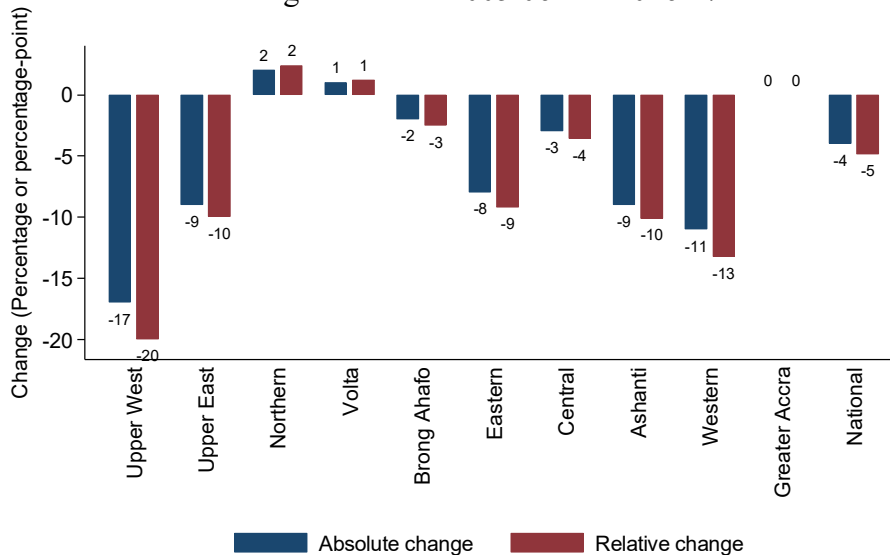
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are ordered according to average household consumption per adult equivalent in 2005/06, from lowest to highest (in panel a, from top left to bottom right; in panel b, from left to right). The sample is restricted to employed workers between ages 15–64 years. Nonfarm = services or industry.

Figure 5. Trends in Informal Shares of Nonfarm Employment, by Region, 2005/06–2016/17

a. Trends in informal shares of nonfarm employment



b. Absolute and relative changes between 2005/06 and 2016/17

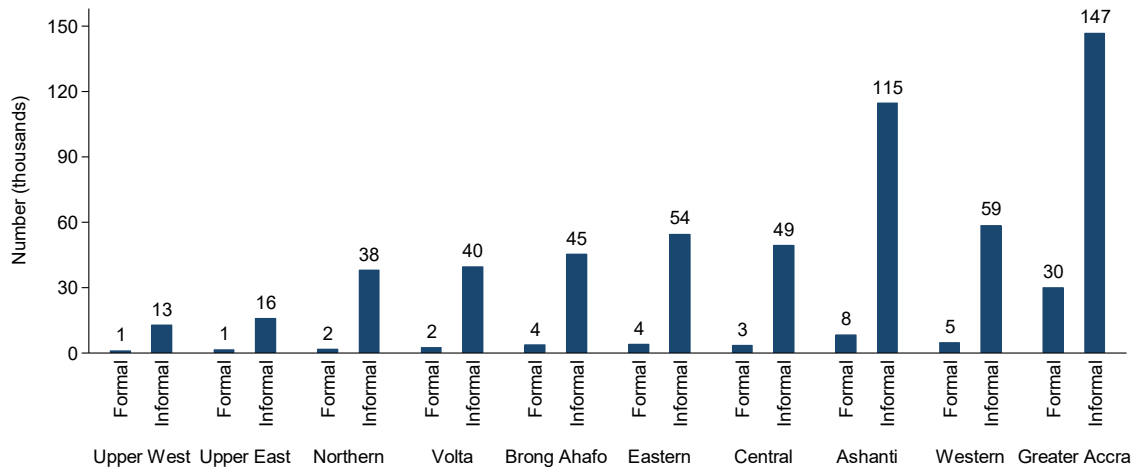


Source: Authors' estimates based on data from the 2005/06, 2012/13, and 2016/17 rounds of the GLSS.

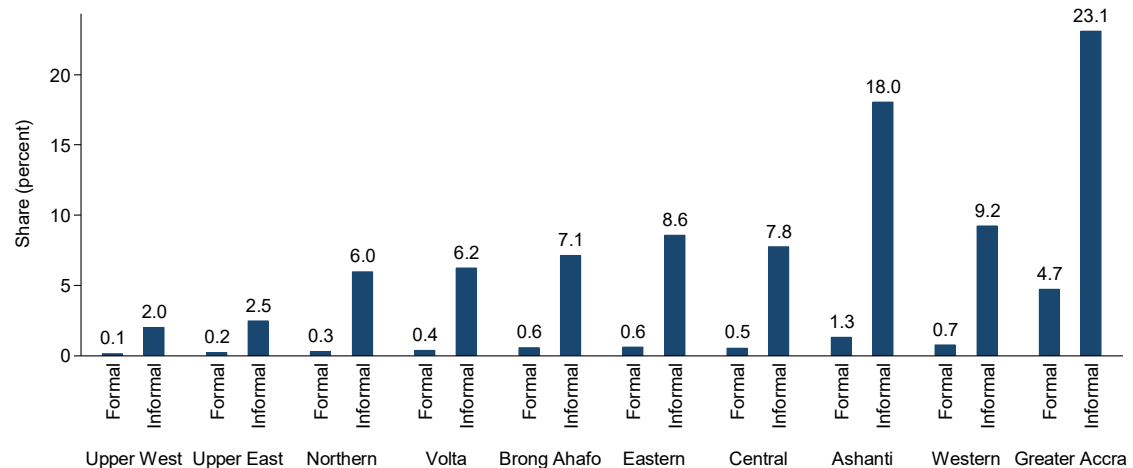
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are ordered according to average household consumption per adult equivalent in 2005/06, from lowest to highest (in panel a, from top left to bottom right; in panel b, from left to right). The sample is restricted to employed workers in nonfarm economic activities between ages 15–64 years. Informal worker = self-employed worker, contributing family worker, or wage-employed worker without a written contract.

Figure 6. Distribution of Nonfarm Enterprises, by Formality Status and Region

a. Enterprises (number, in thousands)



b. Enterprises (in percent)

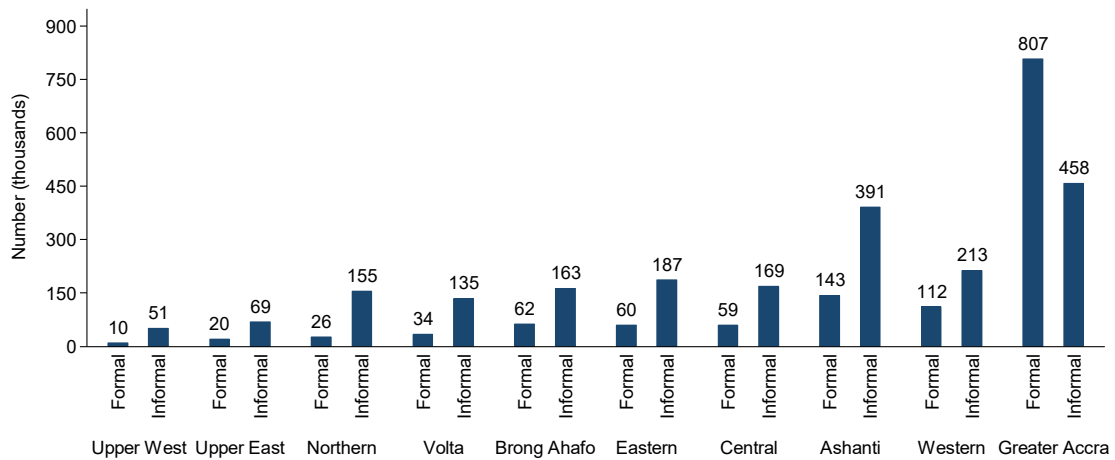


Source: Authors' estimates based on data from Phase I of the IBES.

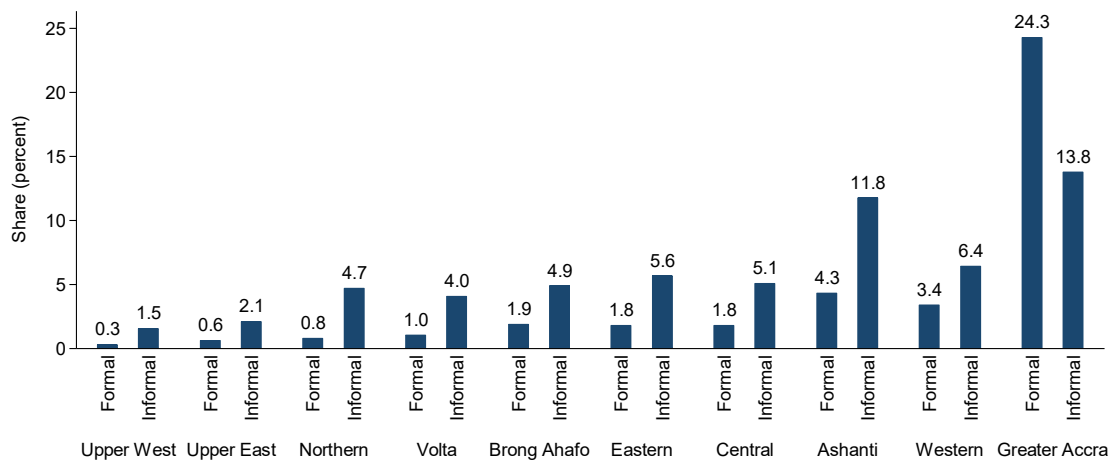
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (left to right). The sample is restricted to nonfarm enterprises. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. In panel b, the distribution of enterprises across informal/formal statuses and regions sum to 100 percent (rounding error notwithstanding).

Figure 7. Distribution of Employment in Nonfarm Enterprises, by Formality Status and Region

a. Employment (workers, in thousands)



b. Employment (in percent)

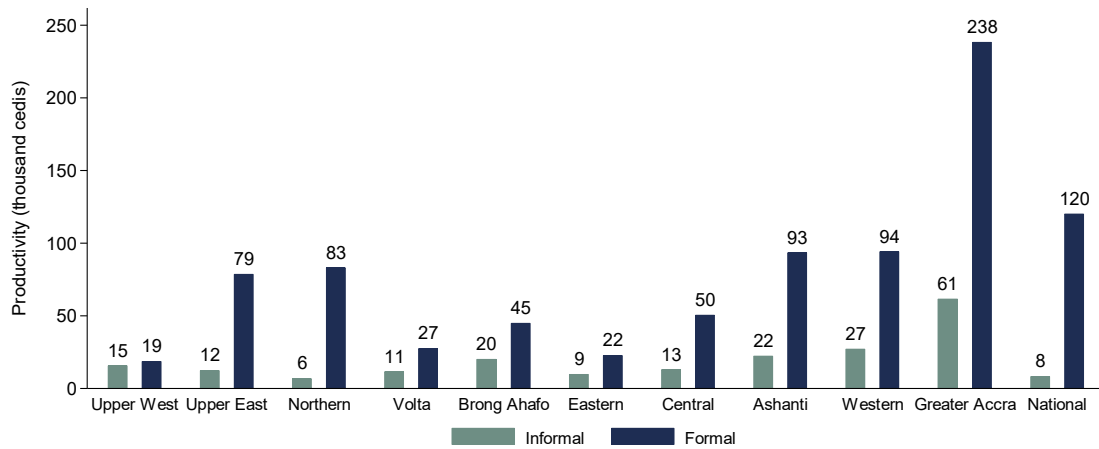


Source: Authors' estimates based on data from Phase I of the IBES.

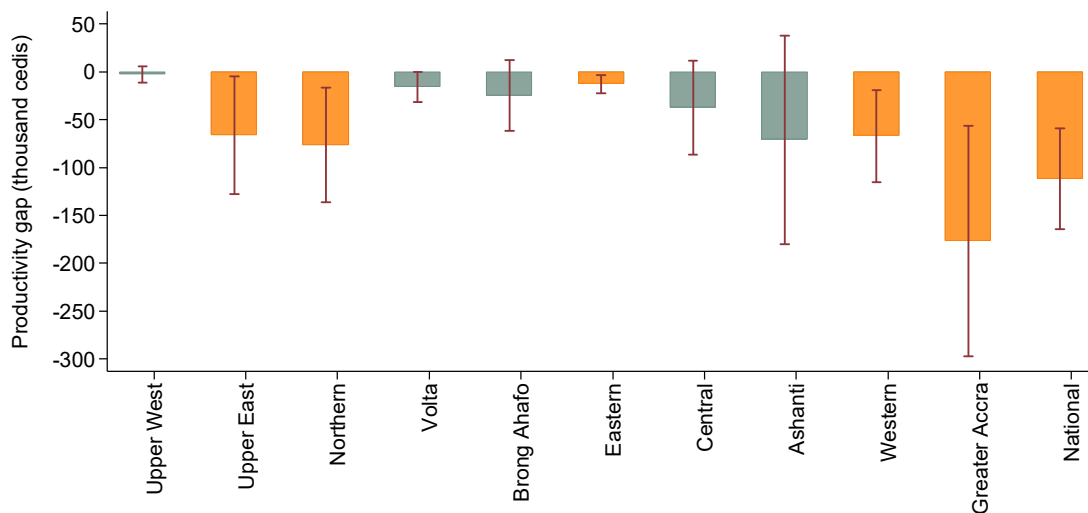
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (left to right). The sample is restricted to nonfarm enterprises. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. In panel b, the distribution of employment across informal/formal statuses and regions sum to 100 percent (rounding error notwithstanding).

Figure 8. Intersectoral Productivity Gaps, by Region

a. Average productivity levels



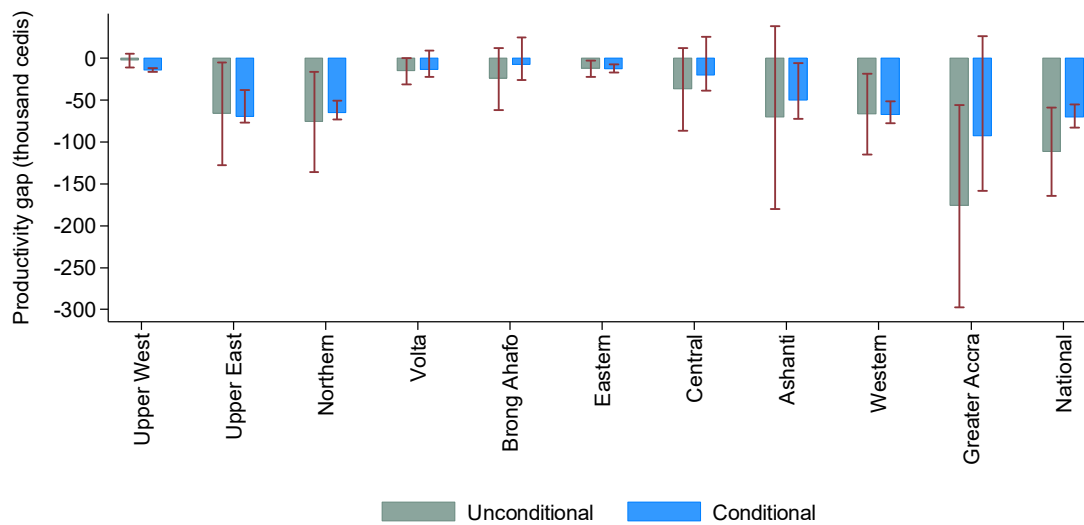
b. Intersectoral productivity gaps



Source: Authors' estimates based on data from Phase II of the IBES.

Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (left to right). The sample is restricted to nonfarm enterprises, and sampling weights are used to obtain regionally representative estimates. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. Productivity = value-added per worker (in thousand cedis). Intersectoral productivity gap = the difference between the informal and formal sectors in average value-added per worker. The intersectoral productivity gap is statistically different from zero (at the 5 percent level) for Upper East, Northern, Eastern, Western, and Greater Accra (denoted by orange shading). In panel b, red error bars denote the 95 percent confidence interval.

Figure 9. Unconditional and Conditional Intersectoral Productivity Gaps, by Region

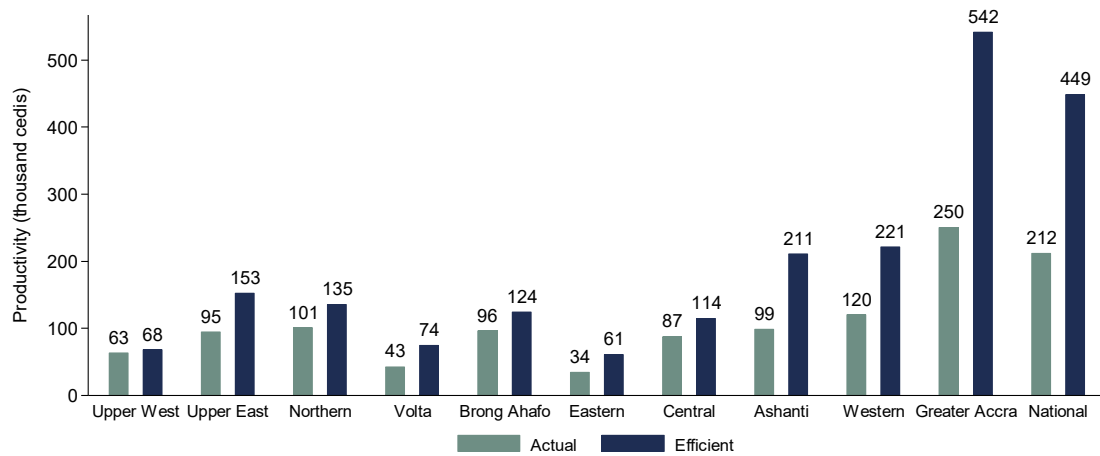


Source: Authors' estimates based on data from Phase II of the IBES.

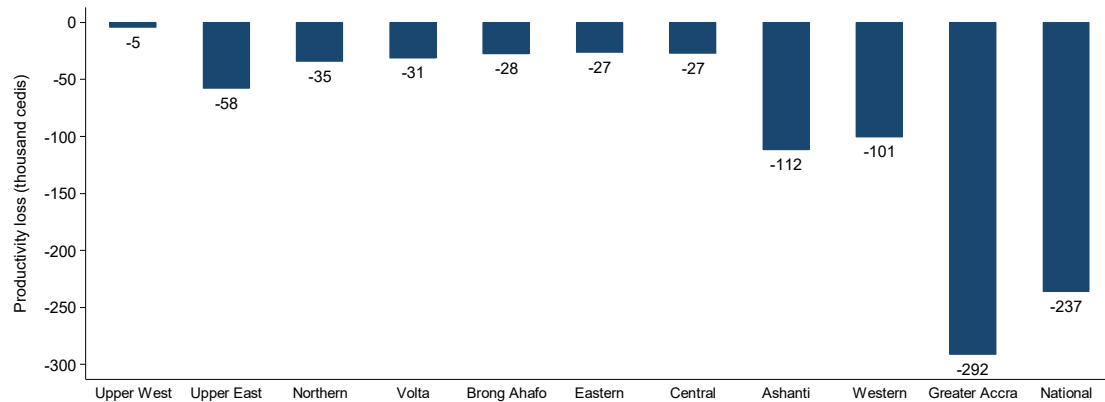
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (left to right). The sample is restricted to nonfarm enterprises. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. Productivity gap = difference between the informal and formal sectors in average value-added per worker (in thousand cedis). Conditional gaps are exponentiated coefficients of an informal indicator variable estimated in a regression model with log productivity as the dependent variable, controlling for selected other characteristics (see table A2 for full regression results). Red error bars denote the 95 percent confidence interval.

Figure 10. Productivity Losses due to the Intersectoral Misallocation of Labor, by Region

a. Actual and efficient productivity levels



b. Productivity losses

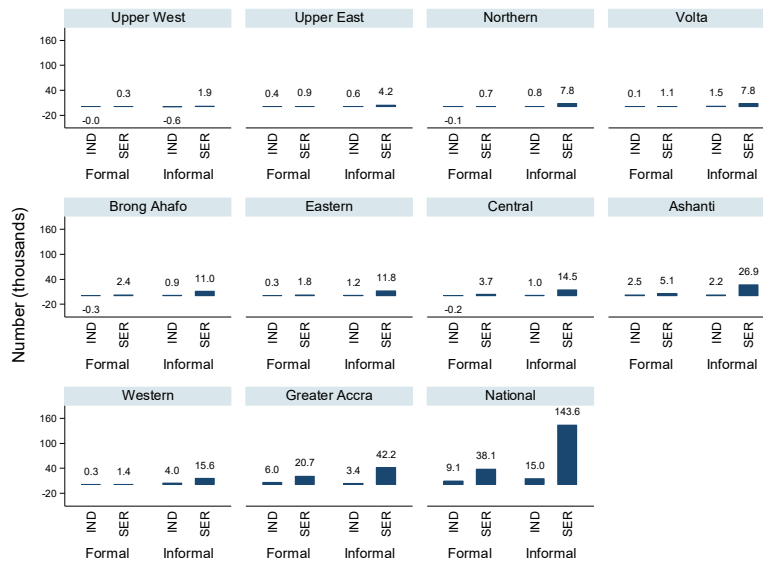


Source: Authors' estimates based on data from Phase II of the IBES.

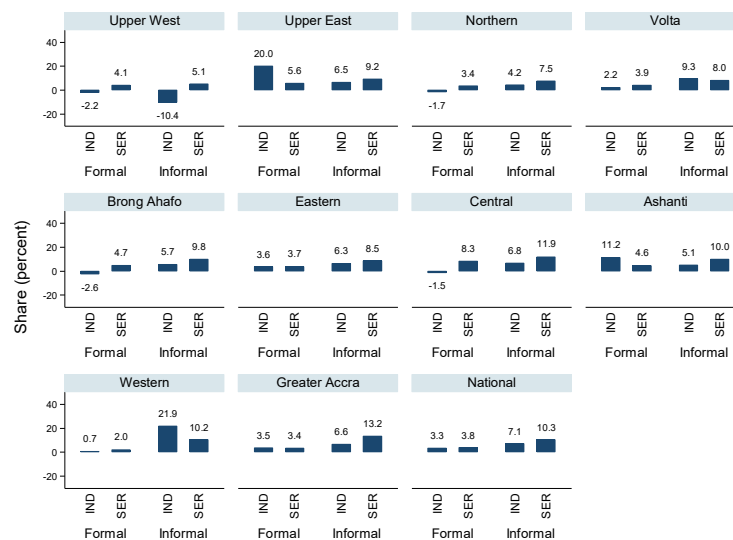
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (left to right). The sample is restricted to nonfarm enterprises, and sampling weights are used to obtain regionally representative estimates. Productivity = value-added per worker (in thousand cedis). Productivity loss = difference between the actual and the efficient level of labor productivity (in thousand cedis).

Figure 11. Net Employment Creation between 2013 and 2014, by Formality Status, Sector, and Region

a. Net employment creation (number, in thousands)



b. Net employment creation (in percent, with 2013 as the base year)

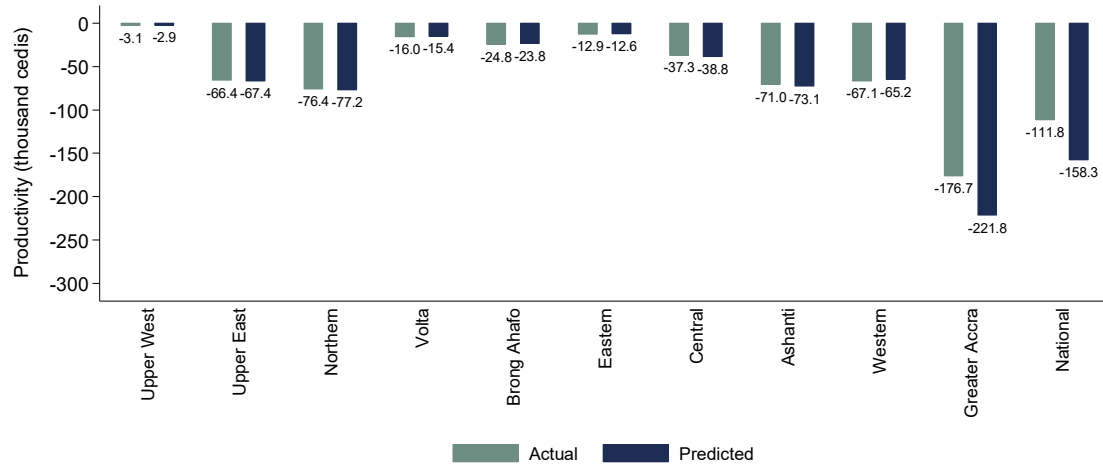


Source: Authors' estimates based on data from Phase I of the IBES.

Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (top left to bottom right). The sample is restricted to nonfarm enterprises. IND = industry sector, SER = services sector. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. In panel b, the base year for the calculation of net employment creation in percent terms is 2013 (specifically, November 30, 2013).

Figure 12. Contribution of Structural Transformation to the Change in Regional Intersectoral Productivity Gaps

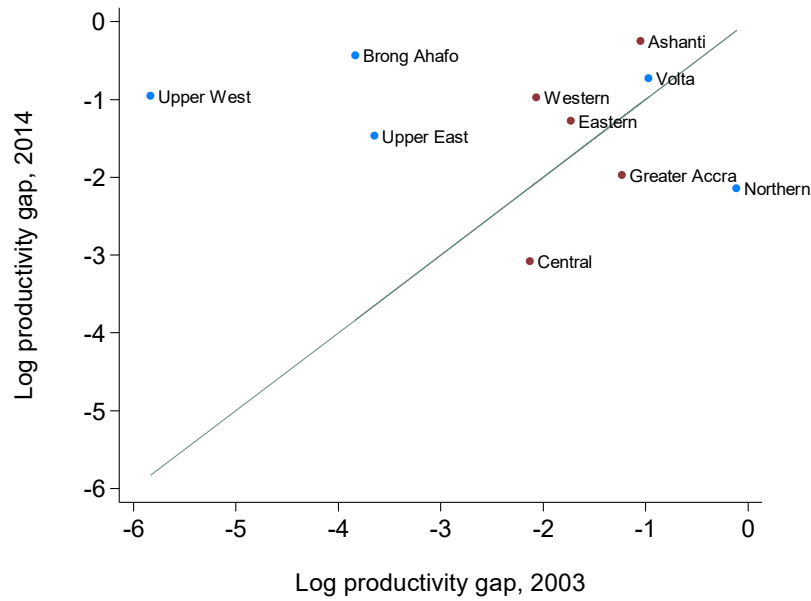
Actual versus predicted intersectoral productivity gaps, by region



Source: Authors' estimates based on data from Phase I and II of the IBES.

Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (left to right). The sample is restricted to nonfarm enterprises, and sampling weights are used to obtain regionally representative estimates. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. Productivity = value-added per worker (in thousand cedis). Actual intersectoral productivity gap = the difference between the informal and formal sectors in average value-added per worker. Predicted intersectoral productivity gap = actual intersectoral productivity gap + contribution of structural transformation to the predicted change in the intersectoral productivity gap.

Figure 13. Regional Log Intersectoral Productivity Gaps, Industry, 2003 versus 2014



Source: Authors' estimates based on data from Phase II of the National Industrial Census 2003 and Phase II of the IBES 2014.

Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. The sample is restricted to nonfarm enterprises in industry. Sampling weights are used to obtain regionally representative estimates. Informal enterprise = an enterprise that is not registered with the Registrar General's Department. Productivity = revenue per worker (in thousand cedis). Log productivity gap = log of the ratio of the average revenue per worker between the informal and formal sectors. Maroon dot denotes a region among the five richest regions, and a blue dot denotes a region among the five poorest regions. The productivity gap has widened (narrowed) between 2003 and 2014 for regions located to the right (left) of the 45-degree line.

Appendix

Table A1: Average Characteristics of Informal and Formal Nonfarm Enterprises

| Characteristic | Formal | | Informal | | Formal- informal |
|----------------------------|---------|------|----------|------|---------------------|
| | Average | SD | Average | SD | |
| | (1) | (2) | (3) | (4) | |
| Log of workforce size | 3.00 | 1.41 | 1.09 | 1.22 | 1.91*** |
| Log of age | 2.19 | 1.00 | 1.86 | 1.03 | 0.32*** |
| Industry | 0.23 | 0.42 | 0.30 | 0.46 | -0.07*** |
| Wholesale and retail trade | 0.15 | 0.36 | 0.27 | 0.44 | -0.12*** |
| Single establishment | 0.30 | 0.46 | 0.86 | 0.34 | -0.56*** |

Source: Authors' estimates based on data from Phase II of the IBES.

Note: *** = statistically significant at the 1 percent level. SD = standard deviation. The sample is restricted to nonfarm enterprises, and sampling weights are used to obtain regionally representative estimates. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. "Industry" and "wholesale and retail trade" are indicator variables. "Single establishment" is also an indicator variable, denoting that the enterprise is a single establishment, as opposed to an enterprise with multiple establishments.

Table A2. Conditional Intersectoral Productivity Gaps, by Region, Full Regression Results

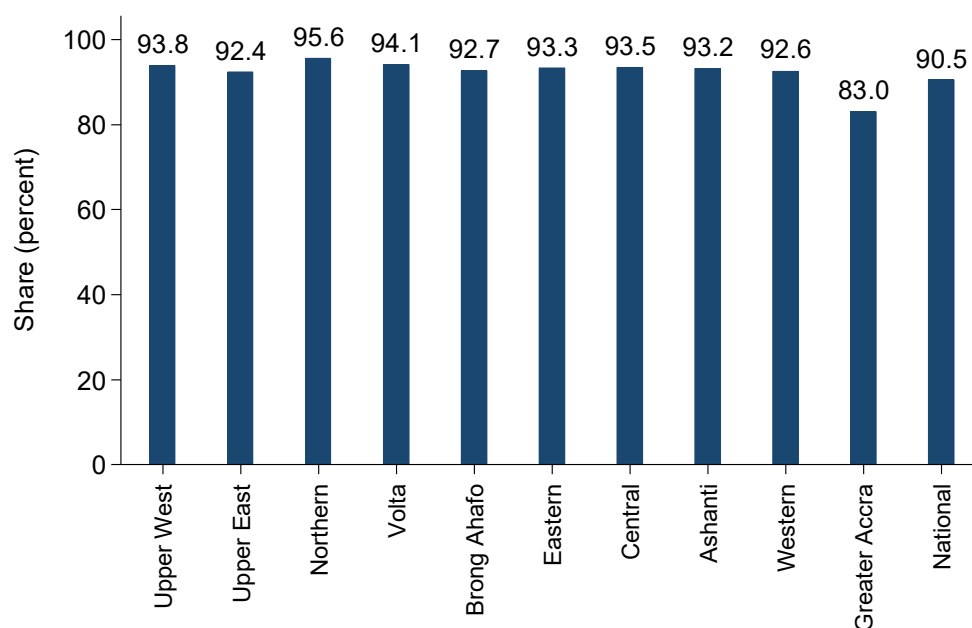
| | Upper West | Upper East | Northern | Volta | Brong Ahafo | Eastern | Central | Ashanti | Western | Greater Accra | National |
|---|----------------------|----------------------|----------------------|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------|---------------------|----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| <i>Dependent variable: Log value-added per worker</i> | | | | | | | | | | | |
| Informal | -1.569*** (0.254) | -2.279*** (0.743) | -1.568*** (0.299) | -0.754 (0.498) | -0.213 (0.315) | -0.932*** (0.243) | -0.544 (0.454) | -0.791** (0.355) | -1.288*** (0.234) | -0.497* (0.282) | -0.896*** (0.139) |
| Log of workforce size | -0.085 (0.182) | -0.287 (0.163) | -0.125 (0.098) | 0.175 (0.152) | 0.196 (0.127) | 0.154* (0.087) | -0.024 (0.074) | -0.003 (0.073) | -0.208*** (0.069) | 0.214*** (0.060) | 0.055 (0.045) |
| Log of age | 0.084 (0.109) | -0.083 (0.140) | -0.210** (0.096) | 0.050 (0.066) | -0.110 (0.085) | -0.029 (0.093) | 0.110 (0.103) | -0.148* (0.081) | 0.006 (0.138) | 0.017 (0.067) | -0.045 (0.035) |
| Industry | 0.062 (0.170) | 0.329 (0.322) | 1.620*** (0.411) | 0.521** (0.220) | 0.554** (0.237) | 0.285 (0.290) | 0.543*** (0.177) | 0.457** (0.217) | 0.569* (0.285) | 0.354 (0.226) | 0.531*** (0.085) |
| WRT | 1.117*** (0.221) | 1.287*** (0.251) | 2.117*** (0.335) | 1.278*** (0.202) | 1.138*** (0.229) | 1.020*** (0.250) | 1.010*** (0.298) | 1.159*** (0.165) | 1.223*** (0.183) | 0.744*** (0.142) | 1.119*** (0.075) |
| Single establishment | 0.941** (0.372) | 0.639 (0.837) | -0.510 (0.322) | 0.711* (0.365) | -0.038 (0.273) | 0.661* (0.362) | 0.012 (0.432) | 0.002 (0.321) | -0.234 (0.284) | -0.322 (0.209) | 0.010 (0.126) |
| Constant | 0.576 (0.538) | 1.828*** (0.321) | 1.150*** (0.246) | -0.090 (0.548) | 0.612** (0.258) | 0.379 (0.384) | 0.347 (0.441) | 1.542*** (0.216) | 2.081*** (0.470) | 1.509*** (0.255) | 1.213*** (0.126) |
| <i>N</i> | 1,472 | 1,411 | 1,884 | 1,802 | 1,872 | 1,875 | 1,861 | 2,736 | 2,824 | 4,934 | 22,671 |
| <i>R</i> -squared statistic | 0.101 | 0.145 | 0.302 | 0.178 | 0.122 | 0.190 | 0.114 | 0.127 | 0.156 | 0.073 | 0.144 |

Source: Authors' estimates based on data from Phase II of the IBES.

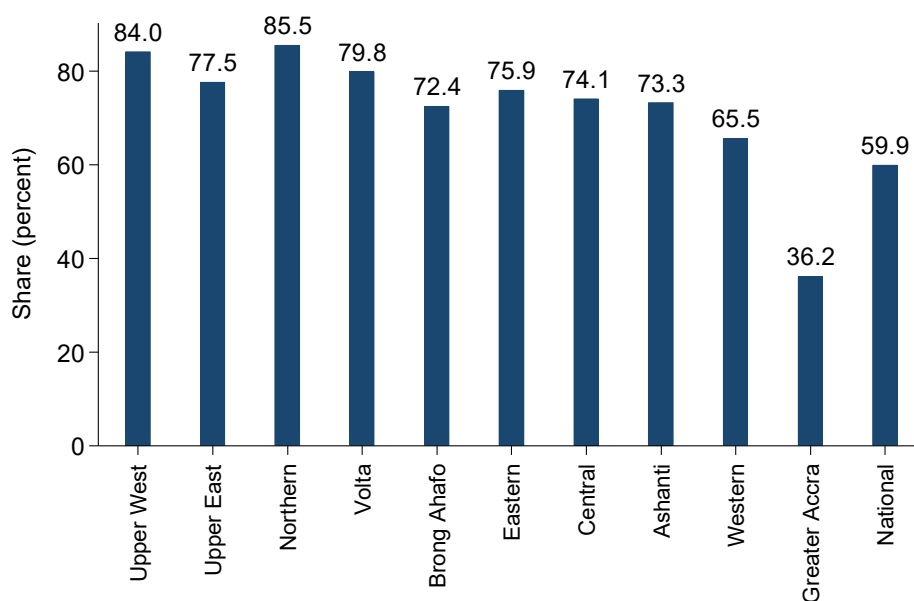
Note: The 10 regions of Ghana are as defined prior to the expansion to 16 regions in 2019 and in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (left to right). Standard errors reported in parentheses. Regressions control for the enterprise's district. Estimates are adjusted for sampling weights. WRT = wholesale and retail trade. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. *** denotes statistically significant at the 1 percent level; ** at the 5 percent level; and * at the 10 percent level.

Figure A1. Shares of Enterprises and Workforces That Are Informal, by Region

a. Shares of enterprises that are informal



b. Shares of workforce that are informal

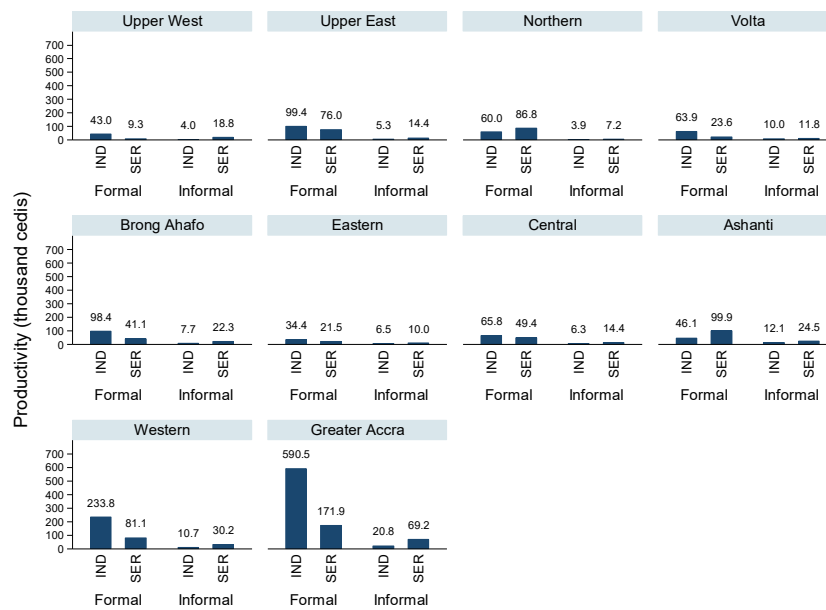


Source: Authors' estimates based on data from Phase I of the IBES.

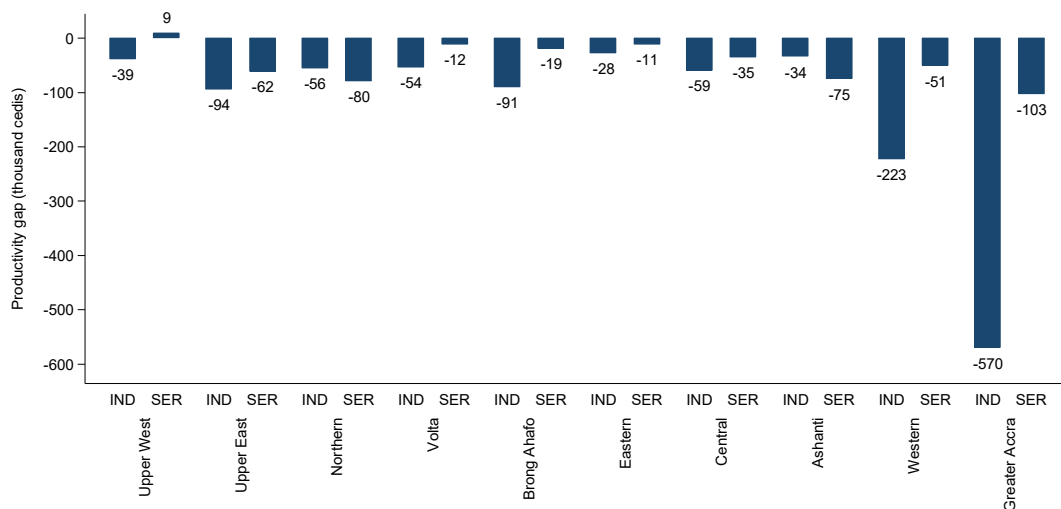
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. The regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2015/16 GLSS data), from the lowest to the highest (left to right). The sample is restricted to nonfarm enterprises. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. Informal workforce = workers in an enterprise classified as informal.

Figure A2. Intersectoral Productivity Gaps, by Industry versus Services and Region

a. Average productivity levels



b. Intersectoral productivity gaps

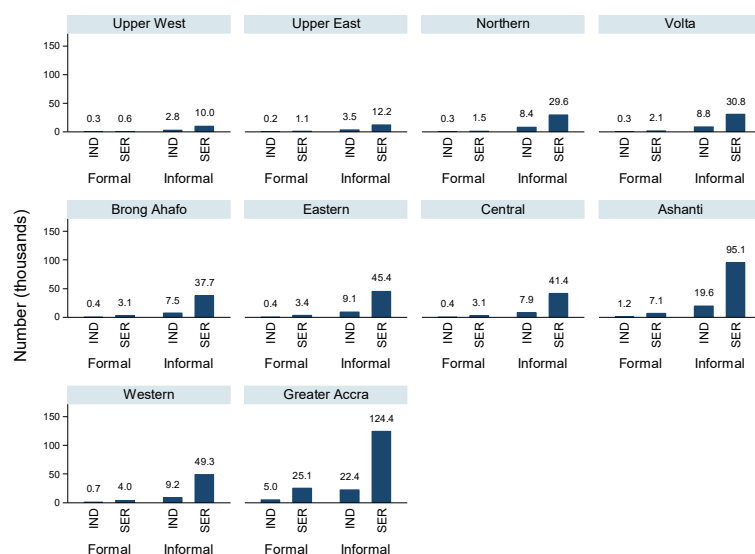


Source: Authors' estimates based on data from Phase II of the IBES.

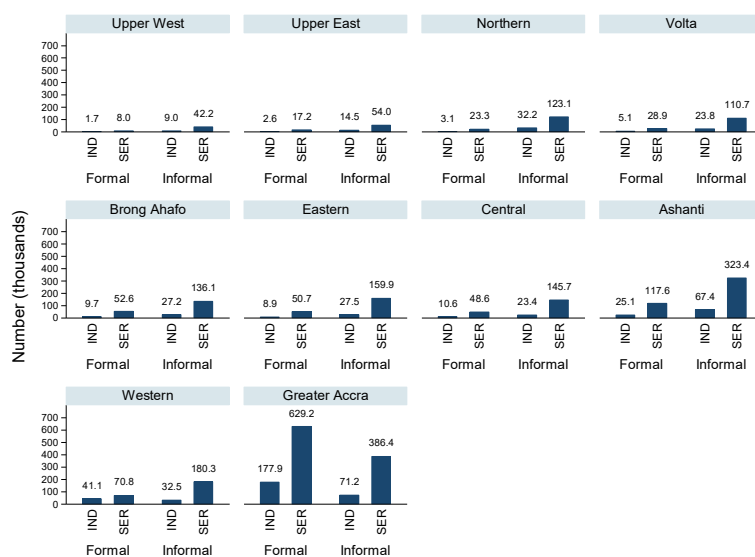
Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (top left to bottom right in panel a, and from left to right in panel b). IND = industry sector, SER = services sector. The sample is restricted to nonfarm enterprises. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records. Productivity = value-added per worker (in thousand cedis).

Figure A3. Distribution of Nonfarm Enterprises and Employment, by Formality Status, Sector, and Region

a. Enterprises (number, in thousands)



b. Employment (number, in thousands)



Source: Authors' estimates based on data from Phase I of the IBES.

Note: The 10 regions of Ghana are as defined prior to the 2019 expansion to the 16 regions that are in effect today. Regions are arranged according to regional average household consumption per adult equivalent in 2005/06 (based on 2005/06 GLSS data), from the lowest to the highest (top left to bottom right). IND = industry sector, SER = services sector. The sample is restricted to nonfarm enterprises. Informal enterprise = an enterprise that is not registered with the Registrar General's Department (RGD) and does not professionally maintain financial accounting records.

