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Windfalls, structural transformation and specialization ☆

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ABSTRACT

Macro cross-country data and micro US county data indicate that resource-rich regions have *small but relatively productive manufacturing* sectors and *large but relatively unproductive non-manufacturing* sectors. We suggest a process of specialization to explain these facts. Windfall revenue induces labor to move from the (traded) manufacturing to the (non-traded) non-manufacturing sector. A self-selection of workers takes place. Only those most skilled in manufacturing sector work remain in manufacturing. Workers that move to non-manufacturing however, will be less skilled at non-manufacturing sector work than those who were already employed there. Resource-induced structural transformation thus results in higher productivity in manufacturing and lower productivity in non-manufacturing. We construct and calibrate a two-sector, open economy model of self-selection and show that exogenous cross-country variation in natural resource endowments is large enough to explain the direction and magnitude of sectoral employment and productivity differences between resource-rich and resource-poor regions. The model implies that low aggregate productivity found in some resource-rich countries is *not caused* by a resource-induced decline of a relatively productive manufacturing sector. Rather, the higher manufacturing productivity in those countries is a *consequence* of manufacturing's smaller size.

1. Introduction

This paper investigates the impact of structural transformation in open economies on sectoral productivity through a process of specialization. Structural transformation is a reallocation of labor across sectors. Whilst there are potentially many sources of structural transformation,[1] we focus on labor reallocation induced by a windfall of revenue. Furthermore, we concentrate only on windfall revenue arising from the export of natural resources (fuels, ores and metals), although our entire analysis is applicable to other types of windfalls such as – for example – foreign aid, remittances, EU structural funds or war reparations.

In the paper we do two things. First, we use a panel of macro cross-country data and a cross-section of micro US county-level data to show that resource-rich regions tend to have a) *small* but *relatively productive* manufacturing sectors and b) *large* but *relatively unproductive* non-manufacturing sectors. Whilst the difference in sectoral size is well known and in line with theoretical predictions,[2] the productivity facts are novel and we show that standard models are ill-equipped to replicate them. Second, we construct and calibrate a small, open economy model with two sectors in which observed differences in sectoral productivity emerge endogenously as a consequence of windfall-induced labor reallocation and subsequent worker specialization.

In the model, we assume manufacturing goods are traded whilst non-manufacturing goods are non-traded and that agents have heterogeneous skills at performing different tasks in each sector. A region with higher windfall revenues will demand more of both types of goods

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[1] Gollin et al. (2002), Duarte and Restuccia (2010), Rogerson (2008), Dekle and Vandenbroucke (2011) and Yi and Zhang (2010), for instance, focus on labor reallocation induced by non-homotheticities in agriculture.

[2] See for instance, Corden and Neary (1982), Matsuyama (1992) or Michaels (2011) for theoretical and empirical treatments of this so-called Dutch Disease.

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than a region without windfalls. Whilst the region's higher demand for manufacturing goods can be satiated by imports from abroad, more workers need to be employed in non-manufacturing to meet the higher demand for locally produced non-manufacturing goods. This generates a reallocation of labor from manufacturing to non-manufacturing and results in a process of self-selection. Workers who choose to remain in manufacturing despite a windfall are those who are most skilled at manufacturing sector tasks, which leads to a more specialized and hence a more productive manufacturing sector. Workers who re-allocate to non-manufacturing do so only in response to the higher demand generated by the windfall and will be less skilled at non-manufacturing sector tasks than workers already employed in that sector. This leads to a more de-specialized and hence less productive non-manufacturing sector. Windfalls thus induce labor reallocation which in turn generates asymmetric changes in sectoral productivity.

We calibrate the model and show that the exogenous variation in endowments of natural resources does remarkably well in explaining the differences in sectoral employment structure and the large, asymmetric differences in sectoral productivity observed across countries. The model also does well in explaining differences in non-manufacturing prices in the data. Finally, we take advantage of the fact that there exist systematic and exogenous differences in brawn endowments between men and women to provide micro-level evidence of our mechanism.

Our model has important implications for understanding the role of economic structure as a driver of aggregate productivity differences between resource-rich and resource-poor regions. We perform a hypothetical growth-accounting exercise and show that if the biggest resource exporters had manufacturing employment shares as large as those of the typical resource-poor country but kept their own high levels of manufacturing productivity, the aggregate productivity of the resource-rich countries could rise by as much as 20%. In contrast to this naive growth-accounting exercise, the model suggests that low aggregate productivity found in many resource-rich economies is *not* driven by a windfall-induced decline of a relatively productive manufacturing sector — but rather that the higher manufacturing productivity in those countries is a direct consequence of the smaller size of their manufacturing sector.

This observation provides guidance to economists trying to explain low aggregate productivity found in some resource-rich economies. In our model there is no first-order effect of windfall-induced sectoral labor reallocation on aggregate productivity since sectoral productivity is endogenous and depends on sectoral size. Our theory thus supports the arguments of Robinson et al. (2006), van der Ploeg (2010) and others who argue that explanations of the so-called "resource curse" should be sought outside economic structure, perhaps – as they suggest – in areas such as political economy, weak institutions and property rights or volatile resource prices. The model also suggests that policy makers in resource-rich countries hoping to increase aggregate productivity by encouraging workers to move towards more productive manufacturing sectors will not be successful. Through the lens of our model such policies would be self-defeating. New manufacturing sector workers will be less talented at manufacturing sector work than those who are already employed in that sector, causing manufacturing productivity to fall whilst leaving aggregate productivity unchanged. Economists and policy makers should note however, that other sectoral factors that are beyond the scope of our model (such as sector-specific learning-by-doing externalities) could still influence aggregate productivity. Our argument should thus be seen as providing supporting evidence – rather than conclusive proof – against a structural explanation of the resource curse.

Our work is in the spirit of Lagakos and Waugh (2013), Roy (1951) and Lucas (1978) and is closely linked to a similar discussion in the development literature. Poorer countries tend to have a larger fraction of their labor force employed in agriculture, due to subsistence requirements. Caselli (2005) and Restuccia et al. (2008) also show that productivity differences in agriculture between rich and poor countries are significantly greater than aggregate productivity differences. Lagakos and Waugh (2013) argue that this fact stems from the specialization that takes place in the smaller agricultural sectors in rich countries. They formalize and test their idea in the framework of a Roy (1951) model of self-selection. Due to subsistence requirements in agriculture (modeled as non-homothetic preferences), poorer countries employ more workers in agriculture. As aggregate productivity increases, subsistence needs can be met with a smaller fraction of the labor force which results in a shift of labor towards non-agriculture. This leads to productivity increasing in the agricultural sector by more than it does at the aggregate level, since only those workers that are most skilled (and hence most productive) in agriculture, self-select to remain in that sector.

Whilst superficially the mechanism of our model closely parallels Lagakos and Waugh (2013), conceptually the two models are quite different. The similarity between the two papers lies in that they both generate a reallocation of workers across sectors which translate to an endogenous change in sectoral productivity. The difference between the two papers concerns the source of this labor reallocation. Lagakos and Waugh (2013) rely on non-homothetic preferences and an exogenous variation in aggregate productivity to generate a shift of workers towards agriculture. Our model has homothetic preferences and instead emphasizes the role of exogenous resource windfalls and the existence of a non-traded sector as the channel driving labor reallocation. Our approach thus avoids what Lagakos and Waugh (2013) call the "key challenge" of their setup which is the requirement of large, exogenous productivity differences to drive workers across sectors.

Section 2 introduces the macro and micro data used in this study and establishes the productivity and employment facts. Section 3 then introduces a general version of our model, whilst Sections 4 and 5 consider the role of heterogeneity in our framework. Sections 6 and 7 present our calibration and results, whilst Sections 8 and 9 present direct and indirect evidence in support of our mechanism. Finally, we conclude in Section 10.

2. Data and facts

In our analysis we divide economies into mining and utilities (MU), manufacturing (M) and non-resource non-manufacturing (NM) sectors[3]:

$$\text{Total Economy} = \overbrace{\underbrace{A}_{\text{Non Res.}} + \underbrace{C+S}_{\text{Non-Mfg.}} + \underbrace{M}_{\text{Mfg.}}}^{\text{Non-Resource Economy}} + \underbrace{MU}_{\text{Mining and Utilities}}. \quad (1)$$

Furthermore, we focus only on the productivity and employment structure of the non-resource economy.[4] In the following two subsections we construct measures of employment shares and productivity in manufacturing and non-resource non-manufacturing and show how they vary with measures of resource wealth. In particular, we use a panel of cross-country macro data as well as a cross-section of US county-level data to establish that resource-rich regions have small and relatively productive manufacturing sectors and large and relatively unproductive non-manufacturing sectors. Using the macro data, we also show how these facts could have important consequences for aggregate productivity of resource-rich countries.

2.1. Macro data and facts

2.1.1. Data

We construct three residual measures of productivity, A_s, B_s and D_s, from the following production functions:

$$Y_s = A_s L_s \quad (2)$$

[3] The lowest level of aggregation available for all data is the one sector ISIC classification. NM here is defined as the sum of agriculture (A), construction (C) and services (S).

[4] Thus, when we refer to aggregate productivity or sectoral employment share, we always mean aggregate productivity of the *non-resource* economy or sectoral employment relative to *non-resource* employment.