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Linking Economic Complexity, Institutions, and Income Inequality

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Summary. — A country's mix of products predicts its subsequent pattern of diversification and economic growth. But does this product mix also predict income inequality? Here we combine methods from econometrics, network science, and economic complexity to show that countries exporting complex products—as measured by the Economic Complexity Index—have lower levels of income inequality than countries exporting simpler products. Using multivariate regression analysis, we show that economic complexity is a significant and negative predictor of income inequality and that this relationship is robust to controlling for aggregate measures of income, institutions, export concentration, and human capital. Moreover, we introduce a measure that associates a product to a level of income inequality equal to the average GINI of the countries exporting that product (weighted by the share the product represents in that country's export basket). We use this measure together with the network of related products—or product space—to illustrate how the development of new products is associated with changes in income inequality. These findings show that economic complexity captures information about an economy's level of development that is relevant to the ways an economy generates and distributes its income. Moreover, these findings suggest that a country's productive structure may limit its range of income inequality. Finally, we make our results available through an online resource that allows for its users to visualize the structural transformation of over 150 countries and their associated changes in income inequality during 1963–2008.

Key words — income inequality, economic complexity, product space, institutions, economic development

1. INTRODUCTION

Is a country's ability to both generate and distribute income determined by its productive structure? Economic development pioneers, like Paul Rosenstein-Rodan, Hans Singer, and Albert Hirschman, would have said yes, since they argued in favor of a connection between a country's productive structure, and its ability to generate and distribute income. These pioneers emphasized the economic role of "structural transformations"—the process by which economies diversify from agriculture and extractive industries to more sophisticated forms of services and manufacturing (Hirschman, 1958; Rosenstein-Rodan, 1943; Singer, 1950).

But testing the intuition of these development pioneers has not been easy due to the complexity of measuring a country's productive structure. During the twentieth century, scholars did not go beyond simple quantitative approaches, such as (a) measuring the fraction of an economy employed in agriculture, manufacturing, or services; (b) using aggregate measures of diversity and concentration (Herfindahl, 1950; Hirschman, 1945; Imbs & Wacziarg, 2003); or (c) looking at diversification into related and unrelated varieties—that is, diversification into similar or different products (Boschma & Iammarino, 2009; Frenken, Oort, & Verburg, 2007; Saviotti & Frenken, 2008; Teece, Rumelt, Dosi, & Winter, 1994). These measures of a country's productive structure, however, fail to take the sophistication of the products into account, or capture differences in industrial structures in a manner that is too coarse (i.e., by defining broad categories such as agriculture, manufacturing, and services).

Recently, though, the introduction of measures of "economic complexity"—which we define and explain in the data and methods section below—has expanded our ability to quantify a country's productive structure and has revived interest in the macroeconomic role of structural transformations (Abdon & Felipe, 2011; Bustos, Gomez, Hausmann, & Hidalgo, 2012; Caldarelli *et al.*, 2012; Cristelli, Gabrielli, Tacchella, Caldarelli, & Pietronero, 2013; Cristelli, Tacchella, & Pietronero, 2015; Felipe, 2009; Hausmann, Hwang, & Rodrik, 2006; Hausmann *et al.*, 2014; Hidalgo & Hausmann, 2009; Hidalgo, Klinger, Barabási, & Hausmann, 2007; Rodrik, 2006; Tacchella *et al.*, 2012). These measures of economic complexity have received wide attention because they are highly predictive of future economic growth. This also makes these measures of economic complexity relevant for social welfare, since economic growth and average income are correlated with country's absolute levels of poverty and social welfare (Bourguignon, 2004; Ravallion, 2004).

However, there are also multiple reasons why the productive structures of countries could be associated not only with economic growth, but also with a country's average level of income inequality.

First, the mix of products that an economy makes constrains the occupational choices, learning opportunities, and bargaining power of its workers and unions. Notably, in several emerging economies, technological catch-up and industrialization have provided new jobs and learning opportunities for workers, contributing to the rise of a new middle class (Milanovic, 2012). Conversely in several "industrialized" economies, de-industrialization, de-unionization, and rising global competition for the export of industrial goods have

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contributed to higher levels of income inequality. In the industrialized economies many industrial workers have become unemployed or were forced to work at low-paying jobs, and the ability of unions to compress wage inequality has decreased (Acemoglu, Aghion, & Violante, 2001; Gustafsson & Johansson, 1999).

Second, recent work on productive structures has highlighted that the complexity and diversity of products a country exports are a good proxy of the knowledge and knowhow available in an economy that is not captured by aggregate measures of human capital (Hidalgo, 2015)—such as the years of schooling or the percentage of the population with tertiary education. Moreover, productive structures can also be understood as a proxy of an economy's level of social capital and the health of its institutions, since the ability of a country to produce sophisticated products also critically depends on the ability of people to form social and professional networks (Fukuyama, 1996; Hidalgo, 2015). For this reason, complex industrial products also tend to require a large degree of tacit knowledge and more distributed knowledge than found with simple products that are mainly based on resource richness or low labor costs. More distributed knowledge and a large degree of tacit knowledge can enhance the incentives to unionize and increase the effectiveness in negotiating high wages and therefore compress wage inequality.

Third, in a world in which economic power begets political power, non-diverse economies—such as countries with incomes largely based on few natural resources—are more susceptible to suffer from both economic and political capture (Collier, 2007; Engerman & Sokoloff, 1997; Hartmann, 2014).

Here, we contribute to the literature on economic complexity, income inequality, and structural transformations, by documenting a strong, robust, and stable correlation between a country's level of economic complexity (as proxied by the Economic Complexity Index) and its level of income inequality during 1963–2008. We find this correlation is robust to controlling for a variety of factors that are expected to explain cross-country variations in income inequality, such as a country's level of education, institutions, and export concentration. Moreover we find that, over time, countries that experience increases in economic complexity are more likely to experience decreases in their level of income inequality. We develop a product-level index to estimate the changes in the level of income inequality that we would expect if a country were to modify its product mix by adding or removing a product. Our results suggest that a country's level of income inequality may be conditioned by its productive structure.

The remainder of the paper is structured as follows. Section 2 reviews the literature on economic development, institutions, and income inequality. Section 3 presents the data and methods used in this paper. Section 4 compares the correlations between Gini and a variety of measures of productive structures, including the Economic Complexity Index (Hidalgo & Hausmann, 2009), the Herfindahl–Hirschman Index (Herfindahl, 1950; Hirschman, 1945), Entropy (Shannon, 1948), and the Fitness Index (Tacchella *et al.*, 2012). This section then uses multivariate regressions and panel regressions to estimate the correlation between economic complexity and income inequality that is not explained by the correlation between income inequality and average income, population, human capital (measured by average years of schooling), export concentration, and formal institutions. Finally, Section 5 introduces an estimator of the level of income inequality expected for the exporters of 775 different products in the Standard Industrial Trade Classification at the four-digit level (SITC-4 Rev.2). We use this estimator to illustrate how changes in a country's productive structure are associated with changes in income inequality. Section 6 provides concluding remarks.

2. CONNECTING INCOME INEQUALITY AND ECONOMIC DEVELOPMENT

Decades ago Simon Kuznets (1955) proposed an inverted-u-shaped relationship describing the connection between a country's average level of income and its level of income inequality. *Kuznets' curve* suggested that as an economy develops, market forces would first increase and then decrease income inequality. Yet, Kuznets' curve has been difficult to verify. The inverted-u-shaped relationship predicted by Kuznets fails to hold if several Latin American countries are removed from the sample (Deininger & Squire, 1998), and in recent decades, the upward side of Kuznets' curve has vanished as inequality in many low-income countries has increased (Palma, 2011). Moreover, several East-Asian economies have grown from low to middle incomes while reducing income inequality (Stiglitz, 1996). Together, these findings undermine the empirical robustness of Kuznets' curve, and reaffirm that GDP per capita is an insufficient measure of economic development in terms of explaining variations in income inequality (Kuznets, 1934, 1973; Leontief, 1951; Stiglitz, Sen, & Fitoussi, 2009).

The empirical failure of Kuznets' curve resonates with recent work arguing that inequality is not only dependent on a country's rate or stage of growth, but also on its type of growth and institutions (Acemoglu & Robinson, 2012; Beinhocker, 2006; Bourguignon, 2004; Collier, 2007; Engerman & Sokoloff, 1997; Fields; 2002; Hartmann, 2014; Ravallion, 2004; Sachs, 2005; Stiglitz *et al.*, 2009). We should expect, then, that more nuanced measures of economic development (such as those focused on the sophistication of the products that a country exports) should provide information on the connection between economic development and income inequality that exceeds the limitations of aggregate output measures like GDP.

Understanding the determinants of income inequality is not simple since income inequality depends on a variety of factors, from an economy's factor endowments, geography, institutions, and social capital, to its historical trajectories, changes in technology, and returns to capital (Acemoglu *et al.*, 2001; Acemoglu & Robinson, 2012; Autor, 2014; Beinhocker, 2006; Brynjolfsson & McAfee, 2012; Collier, 2007; Davis, 2009; Engerman & Sokoloff, 1997; Fields, 2002; Frey & Osborne, 2013; Gustafsson & Johansson, 1999; Hartmann, 2014; Piketty, 2014; Stiglitz, 2013).

Measuring these factors directly is difficult, but we can create indirect measures of them by leveraging the fact that the presence of these factors is expressed in a country's mix of products (Cristelli *et al.*, 2013; Engerman & Sokoloff, 1997; Felipe, Kumar, Abdon, & Bacate, 2012; Hausmann & Rodrik, 2003; Hausmann *et al.*, 2006, 2014; Hidalgo, 2015; Hidalgo & Hausmann, 2009; Hidalgo *et al.*, 2007; Innis, 1970; Rodrik, 2006; Tacchella *et al.*, 2012;). For example, post-colonial economies specializing in a limited number of agricultural or mineral products, like sugar, gold, and coffee, tend to have more unequal distributions of political power, human capital, and wealth (Acemoglu & Robinson, 2012; Engerman & Sokoloff, 1997; Innis, 1970), and hence, their productive structures provide us with indirect information about their geographies, human capital, and institutions. Conversely, sophisticated products, like medical imaging devices or electronic components, are typically produced in diversified

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