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Economic geography and wages in Brazil: Evidence from micro-data

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ABSTRACT

This paper estimates the impact of market and supplier access on wage disparities across Brazilian states, incorporating the control for individual characteristics into the new economic geography methodology. We estimate market and supplier access disaggregated by industry, and we compute access to local, national and international markets separately. We find a strong correlation between market access and wage differentials, even after controlling for individual characteristics, market access level (international, national or local), and using instrumental variables.

1. Introduction

Brazil, the world's fifth largest country in surface area, also has one of the highest levels of inequality. Its inequality is reflected not only at the individual level, but also in its geographic distribution. Lall et al. (2004) report that per capita income in São Paulo, the wealthiest Brazilian state, is 7.2 times higher than in Piauí, the poorest north-eastern state. In addition, population density and market size vary substantially across regions. Most of the population lives in the coastal areas of the north-east and south-east. While the average density in the south-east of Brazil is over 150 inhabitants per square kilometer, this number drops below 4 for the states in the north.

New economic geography (NEG) models focus on the impact of market proximity on economic outcomes, hence providing an interesting framework to study regional wage inequalities in Brazil. An important relationship put forward by NEG models is the impact of trade costs on firm profits. Trade costs are captured by two structural terms referred to in the literature as “market access” and “supplier access”. The first term measures access to potential consumers, while the latter refers to access to intermediate inputs. Since market and supplier access have a positive impact on profits, the maximum wages that firms can afford to pay are positively related to these variables.

This paper estimates a structural NEG model in order to study wage disparities across states and industries in Brazil. We use estimates of market and supplier access to explain regional wages, as in Redding and Venables (2004), and Head and Mayer (2006). We draw on industry-level trade data across states and control for individuals' characteristics in our estimations. Thereby, we are able to isolate the impact of location on wage inequality from other sources of wage inequality such as differences in the composition of the labor force or the local diversity of industries.

In two seminal works, Hanson (2005) and Redding and Venables (2004) test structural models of the new economic geography. The first is applied to US counties and the second to a sampling of countries. Both find a significant impact of trade costs on wages. Inspired by this approach, intranational studies have looked at European NUTS regions (Head and Mayer, 2006), US states (Knaap, 2006) and Chinese provinces (Hering and Poncet, forthcoming).[1]

Our empirical framework makes two noteworthy methodological contributions. First, we control for individual characteristics. The spatial distribution of individuals could be such that their characteristics are correlated with structural NEG variables, thus leading to

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[1] All these papers use the methodology proposed by Redding and Venables (2004), performing a structural estimation of NEG models. Other empirical studies use alternative frameworks, such as Mion and Naticchioni (2005) for Italy, Combes et al. (2008) for France, and Lederman et al. (2004) and Da Mata et al. (2007) for Brazil.

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spurious results in the estimation of the NEG wage equation.[2] Such controls are particularly important in the case of Brazil, since individual diversity is vast and it is an important determinant of wage inequalities in the country. For instance, Barros et al. (2000) show that the distribution of education and its return account for about half of the wage inequality from observed sources in Brazil. In addition, we observe large differences in human capital distribution across regions: workers from southern regions are on average more educated than those from northern regions. Ferreira et al. (2006) show that over 55% of the difference in the return to labor between the north-eastern and the south-eastern regions are due to differences in educational attainment. This substantial difference in the workforce's level of education across regions may be explained by sorting (Combes et al., 2008) or endogenous differences in returns to schooling (Redding and Schott, 2003). In any case, by controlling for education we correct for the bias induced by the differences in workforce composition across regions.

The second methodological contribution is an estimation of market and supplier access using trade flows at industry level. Other studies use aggregate trade flows.[3] This procedure alleviates the colinearity problem found in the literature when attempts are made to estimate these two variables simultaneously. While it is true that supply and demand should be naturally correlated at aggregate level, since workers are also consumers, it is less likely to be true at industry level. A firm may rely intensively on inputs from a particular industry, while selling its product to consumers at large. Supplier access will then be higher for regions specialized in that particular industry. Hence, by adopting this procedure we are better equipped to disentangle the effects of market and supplier access. As a matter of fact, in the case of Brazil, the distribution of economic activity across regions varies a great deal across industries. Chemicals, for example, are mainly produced in Bahia, whereas transportation industries are mostly located in São Paulo.

With data on intranational and international trade flows, all disaggregated at industry level, we are also able to isolate local, national and international market and supplier access. Consequently, we are able to establish which kinds of trade (intranational or international) have the greatest impact on wages using a NEG mechanism.

Our empirical strategy uses a three-step procedure. Firstly, wages are regressed on worker characteristics, controlling for state–industry fixed effects. Secondly, we estimate gravity equations by industry in order to calculate market and supplier access for each industry in each state. We can also compute access to international, national and local markets separately. Lastly, market access and supplier access derived in the second step are used as explanatory variables for the wage disparities captured by the state–industry fixed effects in the first step.

We find a positive and significant effect of market and supplier access on the state–industry wage premium, with the impact of market access being stronger than the effect of supplier access. International market access turns out to have a greater impact than national or local market access. The positive impact of market access on wages is robust after controlling for several variables, such as firm productivity, taxes, regulation, endowments, and after using instrumental variables. The results are also unchanged in regressions at municipal level, where we are able to further control for local amenities and endowments.

The paper is organized as follows. Section 2 describes the methodology, with a brief summary of the theoretical background and a description of the empirical strategy used. The data are described in Section 3, while Sections 4 and 5 discuss the results and the main robustness checks. Section 6 concludes.

2. Methodology

2.1. Theoretical framework

In economic geography models, transport costs make the geographic distribution of demand an important determinant of profits. We follow in the footsteps of Head and Mayer (2006) and Redding and Venables (2004) and derive profits and market and supplier access from Dixit–Stiglitz preferences. We present a brief description of the main hypothesis and results, rather than a full-fledged model, since such models are now standard in the literature.

As in the standard version of the Dixit–Stiglitz–Krugman model of trade, we assume preferences have a constant elasticity of substitution across product varieties. Each variety is produced by a single firm under monopolistic competition. Producers and consumers are spread over different regions, and we assume *ad valorem* trade costs, τ_{rsi}, between any two regions r and s.

Given these assumptions, in a symmetric equilibrium with n_{ri} firms in region r and industry i, the value of total sales from region r to region s, in industry i, X_{rsi}, can be shown to be:

$$X_{rsi} \equiv n_{ri} p_{ri} x_{rsi} = \frac{n_{ri}(p_{ri}\tau_{rsi})^{1-\sigma}}{P_{si}^{1-\sigma}} E_{si}, \tag{1}$$

where x_{rsi} represents sales of a firm in region r to region s, in industry i, p_{ri} is the price received by the firm, so that $p_{ri}\tau_{rsi}$ is the price paid by a consumer in region s for a good from region r in industry i, σ is the elasticity of substitution between product varieties, and E_{si} is the total region s spending on industry i. P_{si} is the price index for industry i in region s, defined as:

$$P_{si} \equiv \left[\sum_r n_{ri}(p_{ri}\tau_{rsi})^{1-\sigma}\right]^{1/1-\sigma}. \tag{2}$$

As for production costs, we assume that firms use labor and intermediate goods as inputs, and incur a fixed cost. More precisely, in industry i, intermediate inputs consist in a composite of goods from all industries where ϖ_{ji} is the share of expenditure on inputs from industry j, and, for each industry i, $\sum_j \varpi = 1$. The total price index of intermediate inputs is equal to $\prod_j P_{rj}^{\varpi_{ji}}$.[4] 'Supplier access' for a firm in region r and sector i, SA_{ri}, is defined as the price index of intermediate inputs, raised to the power $1-\sigma$, as in:

$$SA_{ri} \equiv \prod_j \left(P_{rj}^{1-\sigma}\right)^{\varpi_{ji}} \tag{3}$$

It is worth noting that, in this paper, we adopt a more precise definition of supplier access than the NEG literature, by computing supplier access separately for each industry, and taking into account inter-industry linkages. This procedure helps to disentangle supplier access from market access. Given the definition of supplier access, total costs of a firm in region r and industry i may be represented by $SA_{ri}^{\alpha/(1-\sigma)} w_{ri}^{\beta}\left(f_i + \sum_s x_{rsi}\right)$, where α and β are parameters, f_i indicates the fixed cost in industry i, and w_{ri} is the wage in region r and industry i.[5] Supplier access is a measure of the firm's access to intermediate inputs, and it is negatively related to trade costs. The greater the supplier access, the lower the cost of intermediate inputs.

[2] To our knowledge, only Hering and Poncet (forthcoming) control for worker characteristics in a NEG framework, and no other study has introduced firm productivity. Mion and Naticchioni (2005) also control for individual characteristics, but in a different framework.

[3] Head and Mayer (2006) also use industry-level data, but they compute market access only.

[4] This specification of the price index of intermediate inputs may be derived from a Cobb–Douglas production function, using input from all other industries.

[5] We assume that labor migration across regions is not high enough to arbitrage away all regional wage disparities.