Health, Technological Interdependence and Economic Growth in Brazil

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Motivation

- Improving health is an important social objective, which has obvious direct payoffs in terms of longer and better lives for millions. There is also a growing consensus that improving health can have large indirect payoffs through accelerating economic growth. (Aghion, Howitt & Murtin, 2010; Lorentzen, McMillan & Wacziarg, 2008; Bloom & Canning, 2005)

Motivation

- Economists have identified a number of channels through which health improvements may affect the **level of production** of a country. First, there seems to be a direct effect on the productivity of individuals, ie, healthy people tend to work more and better. (Schultz, 2002; Behrman & Rozenweig, 2004)

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2. Healthy students miss fewer classes and have more accurate cognitive functions (Miguel & Kremer, 2004);
3. Reductions in mortality rates can cause people to increase their savings for retirement, raising the level of investment and the level of capital per worker. (Ashraf, Lester & Weil, 2008)

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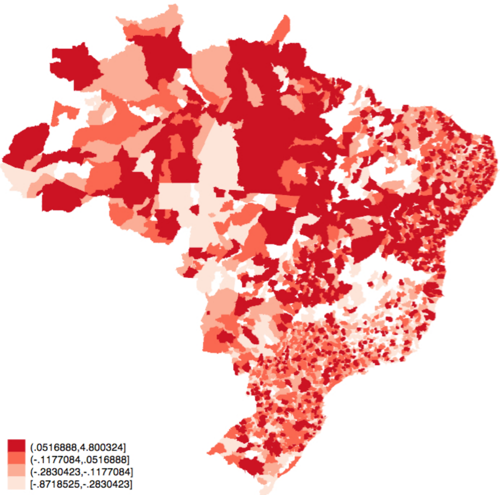
- In recent years, Brazil has seen a dramatic fall of 77% in infant mortality rates. In 1990, 62 out 1,000 infants would die before reaching 1 year old. In 2012, this rate was 14 out 1,000. (UN, 2013)

Motivation

Figure 1 - Decline of infant mortality rates in Brazilian municipalities



Motivation

- Since health affect productivity, we are also concerned about the effect of this influence on a context of productivity spillovers. Arrow's (1962) and Romer's (1986) treatment of knowledge spillover is now well know in the growth literature. In broad lines, external effects of knowledge in one region extends across its borders but does so with diminished intensity because of friction generated by socio-economic and institutional dissimilarities captured by exogenous geographic distance or border effects, for instance.

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Motivation

- Question: What is the influence of health to the economic growth process under productivity spillovers?
- We follow Acemoglu & Johson (2007) and Erthur & Koch (2007) to develop a model in which the effects of health improvements in the total factor productivity of one region are also carried across borders through productivity spillovers.
- We use the specification implied by the model to estimate the influence of health to the growth process using data from Brazilian municipalities between the years of 1996 and 2010.

Assumptions

The economy i has a production function with constant returns to scale:

$$Y_{it} = (A_{it}H_{it})^{\alpha} K_{it}^{\beta} L_{it}^{1-\alpha-\beta}, \quad \alpha + \beta \leq 1 \tag{1}$$

- K_{it} = stock of capital
- L_{it} = land suply
- H_{it} = effective labor units

where $H_{it} = h_{it}N_{it}$, N_{it} is total population and h_{it} is human capital per capita. We normalize $L_{it} = L_i = 1$ for all i and t.

Assumptions

We first assume that health improvements lead to a greater population:

$$N_{it} = \bar{N}_i X_{it}^{\lambda} \tag{2}$$

- X_{it} = health conditions
- $\bar{N}_i$ = baseline population difference across units

We also assume that health conditions may increase output through an effect on human capital accumulation:

$$h_{it} = \bar{h}_i X_{it}^{\eta} \tag{3}$$

- $\bar{h}_i$ = baseline human capital difference across units

Assumptions

We incorporate knowledge spillovers so that total factor productivity evolves acording to

$$A_{it} = \bar{A}_t X_{it}^{\gamma} \prod_{j \neq i}^{N} A_{jt}^{\rho w_{ij}}, \quad 0 \leq \gamma < 1, 0 \leq \rho < 1 \tag{4}$$

- $\bar{A}_t$ = exogenous technological growth
- A_{jt} = level of technology of neighboring areas

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In addition to previous channels, in our model health conditions affect outuput by (i) a direct effect on total factor productivity (TFP) and (ii) an indirect effect related to "feedback" that higher TFP in unit *i* causes in TFP in neighboring areas and back.

Equilibrium

If the total capital stock remains fixes at $\bar{K}_{it_0}$while health conditions change, from equations (1) to (4) we can obtain the folowing equilibrium relationship:

$$\begin{aligned} y_{it} =& \beta \log \bar{K}_{it_0} + \alpha \log \bar{A}_i + \alpha \log \bar{h}_i - (1-\alpha)\bar{N}_i \\ & + \rho \sum_{j\neq i}^{N} w_{ij}(\alpha \log \bar{h}_j + \beta \log \bar{K}_{jt_0} - (1-\alpha) \log \bar{N}_j) \\ & + [\alpha(\gamma+\eta) - (1-\alpha)\lambda]x_{it} + \rho[\alpha\eta - (1-\alpha)\lambda] \sum_{j\neq i}^{N} w_{ij} x_{jt} \\ & + \rho \sum_{j\neq i}^{N} w_{ij} y_{jt} \end{aligned} \tag{5}$$

where $x_{it} \equiv \log X_{it}$ and $y_{it} \equiv \log(Y_{it}/N_{it})$.

Estimating Framework

The equation to be estimated in our econometric exercise follows from equation (5):

$$y_{it} = \alpha_i + \mu_t + \beta x_{it} + \theta W x_{jt} + \rho W y_{jt} + \varepsilon_{it} \tag{6}$$

where α_i's denote a set of fixed effects that are functions of the parameters $\bar{A}_i$, $\bar{h}_i$, $\bar{N}_i$ and $\bar{K}_i$ in equation (4) and μ_t's incorporate time-varying factors common across units. In the spatial econometrics literature, this specification is referred to as spatial Durbin model (SDM).

Estimating Framework

Since we do not expect yearly changes in health conditions to have their full effect on the economic variables we will estimates equation (6) in long differences, that is

$$\Delta y_i = \Delta\mu + \Delta\beta x_i + \Delta\theta W x_j + \Delta\rho W y_j + \Delta\varepsilon_i \tag{7}$$

Data

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2. Per capita GDP
   - Municipalities' GDP - IBGE
   - Population Census - IBGE

Results

- Spatial Hausman test comparing OLS and spatial error model (SEM) rejects null hypothesis of both estimates being consistent in favor of alternative hypothesis that OLS is baised because of spatially omitted variable.

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- Spatial Hausman test comparing OLS and spatial error model (SEM) rejects null hypothesis of both estimates being consistent in favor of alternative hypothesis that OLS is baised because of spatially omitted variable.
- The use of the SDM model in the presence of ommited variables shrinks the bias relative to OLS estimates, which provides aditional econometric motivation for the use of the SDM model in applied work.

Results

Table 1: Regression Results

	OLS	SEM	SDM
dlntxmortinf	0.022	0.015	0.015
	(0.000)	(0.000)	(0.000)
lag.dlntxmortinf			0.043
			(0.000)
rho			0.286
			(0.000)

Obs: P-value in parentheses.

Results

Table 2: Direct, Indirect and Total Effects of changes in Infant Mortality Rates

SDM		
Direct	Indirect	Total
0.016	0.065	0.081
(0.000)	(0.000)	(0.000)

Obs: P-value in parentheses based on 10,000 extractions from the MCMC sample procedure.

Conclusion

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- First econometric exercise showed that smaller declines on infant mortality were related to higher income per capita growth, for the period being analyzed.
- Incorporating productivity spillovers tend to exacerbate this effect, as noticed in indirect and total effects.
- This result sugests that increased population in fact counterbalanced the potential influence of health on the level of production and it highlights the importance of human capital formation.
- The capacity of productively including the surplus population may be the key to achieve a positive effect of health on economic growth.

Thank you!

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