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Gains from trade and measured total factor productivity ☆

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ABSTRACT

We develop and calibrate a model where differences in factor endowments lead countries to trade different goods, so that the existence of international trade changes the sectorial composition of output from one country to another. Gains from trade reflect in total factor productivity. We perform a development decomposition, to assess the impact of trade — and barriers to trade — on measured TFP. In our sample, the median size of that effect is about 6.5% of output, with a mean of 17% and a maximum of 89%. Also, the model predicts that changes in the terms of trade cause a change of productivity, and that effect has an average elasticity of 0.73.

1. Introduction

A large literature (e.g., Mankiw et al., 1992; Prescott, 1998; Klenow and Rodriguez-Clare, 1997; Caselli, 2005 among many) has studied the cross-country differences in total factor productivity, that is, those differences in output per-capita that cannot be explained by corresponding differences in available inputs. In these exercises, it is assumed that the technology that transforms inputs into output is the same across countries, except for a single TFP coefficient that changes the effectiveness of the overall production process, but does not change the way different inputs interact with each other. The functional forms used in these analyses are chosen assuming that countries do not trade with each other, and are calibrated using parameters that give a good fit to the data of developed nations.

In this paper, we quantify the impact of international trade on Total Factor Productivity (TFP). Trade leads to a more efficient allocation of resources across sectors, and thus may affect aggregate productivity even if sectorial productivities are not allowed to differ across countries. Since barriers to trade do vary significantly, the degree to which gains from trade are exploited may be a relevant component in explaining cross-country TFP differences.

Here, we use a one-period version of the model developed in Ferreira and Trejos (2006), with the adjustments made necessary by the cross-country data analysis that follows. The equilibrium of that model under autarky is homeomorphic

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to the standard model used in most development accounting exercises, so comparison is convenient. The simplest way of formulating this model is to interpret the traded goods as inputs in the production function of a final non-tradeable good, but it is not the fact that these are intermediate goods that matters, but rather that there is a sectorial allocation problem that trade barriers may distort. By construction, this model predicts that trade will be of little importance for rich countries, but for a poor country the model predicts that trade induces a sizeable gain in TFP, which increases with trade liberalization and with the terms of trade.[1]

We calibrate this model and apply it to a large sample of developing countries, to assess the quantitative importance of the effects mentioned above. Because countries reap at least some of these benefits from trade, the TFP differences between rich and poor countries that are estimated with our model are larger than those emerging from more conventional output decompositions, which are performed assuming a closed economy. For the country in our database with the lowest capital endowment per worker, Uganda, our calibrated model estimates that free trade could increase output by 89.8% compared to autarky; in other words, the raw productivity difference relative to the US is much larger than conventional measurements (which would impute those gains from trade as productivity) would deliver. The assessed gains from trade for other African nations (Congo, Mozambique and Rwanda, among others) range between 50% and 62% of productivity; for several Asian countries, around 15%. Of course, many countries waste a good part of these gains through protectionism. We estimate that in 1985 Bangladesh and India, who should have enjoyed gains from trade to the tune of 1/3 of GDP due to their capital scarcity, wasted most or all those gains with average tariffs at prohibitive levels over 90%.

Because countries can pick very different trade policies, the model adds another dimension that can explain the behavior of TFP residuals. We do not have comparable cross-country data for transportation costs, non-tariff barriers, and other phenomena that reduce the incentives to international exchange. But looking at data on tariffs we find that for some poor nations, those barriers alone are large enough to account for large differences in productivity. Due to the nature of the trade problem, the same tariffs would have a different cost in different countries, because both the potential gains from trade and the distortionary effect of policy vary with the capital–labor ratio. For instance, in 1985 Brazil and Benin had similar nominal tariff rates, under which poorer Benin realized almost all its (large) potential gains from trade, while the wealthier Brazil lost most of its (proportionally smaller) benefits.

Other authors have pursued to quantify the relationship between trade and productivity, although emphasizing different transmission mechanisms. For instance, Eaton and Kortum (2002) develop a model where TFP is specific to each country and industry, so trade allows countries to allocate more resources to the industries that have drawn high productivities. Using a similar model, Alvarez and Lucas (2007) estimated that a country with 1% of world GDP would gain from openness to trade up to 41% in productivity. Using a similar model, Rodriguez-Clare (2007) obtains similar estimates, which become much higher if openness involves not only the possibility to exchange goods, but also fosters the diffusion of ideas. Echevarria (2008) looks at how exogenous TFP differences can affect the sectoral composition and the pattern of trade, so that her model predicts that poorer countries specialize in primary goods.

An open economy with barriers to trade is one of the simplest examples of resource misallocation in a sectorial problem, and thus the mechanism described here is related to a recent literature that emphasizes inefficiencies in the composition of output as a means to explain differences in TFP. For instance, Restuccia and Rogerson (2008) show that policies that distort prices faced by individual producers can lead to 50 percent decreases in measured TFP. Likewise, Hsieh and Klenow (2007) use a standard model of monopolistic competition with heterogeneous firms to measure the impact on productivity of the resource misallocation caused by distortions across firms. They find that the removal of these distortions could boost TFP in India by as much as 60%.

Another issue that our model can address is the effect of changes in the terms of trade. Here, a change in the relative price of exported to imported goods alters the allocation of resources and degree of specialization among different sectors, in a way that affects not only welfare but also output and TFP. There is a literature (e.g., Easterly et al., 2001) that describes an empirical link of this sort. Kehoe and Ruhl (2008) show that one can explain this empirical link with a standard macro model only under very limited specifications both of the theory and of the measurement, and thus pose that this strong empirical relationship is a puzzle. Our model can help explain this puzzle, since it predicts — in a manner that is quite natural within a Hecksher–Ohlin framework — that an improvement in terms of trade simply allows a better sectorial composition, that yields more final output out of the same inputs. Under our calibration, for a very capital-poor country a 10% gain in the terms of trade yields a 5.7% gain in TFP, and these effects can be larger depending on factor endowments and trade policies.[2]

In Section 2 we describe and solve the model, and in Section 3 we describe the data and calibration. In Section 4, we present the results and Section 5 concludes.

[1] We use essentially the same model here as in Ferreira and Trejos (2006), but to address very different questions with it. In the first case, the objective is to characterize the dynamic properties of this model, showing that under trade there may be multiple steady states, and the model is calibrated for the purpose of comparing quantitatively the income level at the lower steady state (that is, the development trap) with the one at the higher steady state. It is mentioned in the paper that in the model trade amounts to a productivity gain, and the implications are quantified within the model, but this productivity gain is not taken to data, nor analyzed more fully. In this second paper, we ignore the dynamic issues, and take the problem to the cross-country data, to assess the potential and actual effects of trade on output, and how the estimates of productivity residuals are affected by taking into account the extent to which different countries tap on the gains from trade.

[2] Other possible explanations are financial market frictions (Mendoza, 2006), labor hoarding and changes in capital utilization (Meza and Quintin, 2007) and costs in shifting resources across sectors (Kehoe and Ruhl, 2009).