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Neighbors and the evolution of the comparative advantage of nations: Evidence of international knowledge diffusion?

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ABSTRACT

The literature on knowledge diffusion shows that knowledge decays strongly with distance. In this paper we document that the probability that a product is added to a country's export basket is, on average, 65% larger if a neighboring country is a successful exporter of that same product. For existing products, growth of exports in a country is 1.5% higher per annum if it has a neighbor with comparative advantage in these products. While these results could be driven by a common third factor that escapes our controls, they align with our expectations of the localized character of knowledge diffusion.

1. Introduction

Knowledge has become central to modern theories of growth. Knowledge is embodied in goods that are then shipped around at a cost. When these goods are imported, they accelerate productivity growth in the recipient country (e.g. Rivera-Batiz and Romer, 1990; Coe and Helpman, 1995; Coe et al., 2009). However, significant parts of knowledge are disembodied or tacit (Polanyi, 1962) and its diffusion requires more direct forms of human interaction, which inevitably limits its scope to more localized or idiosyncratic settings (Arrow, 1969).

Previous research has documented the rapid decay of knowledge diffusion with geographic distance. This literature looked at the impact of distance on the patterns of patent citation (e.g. Jaffe et al., 1993), of R&D and patent output (e.g. Branstetter, 2001; Bottazzi and Peri, 2003), of R&D and productivity (Keller, 2002), and on the sales of subsidiaries of multinational corporations (Keller and Yeaple, 2013). Keller (2002, 2004) has shown that foreign sources of technology account for up to 90% of domestic productivity growth and that the impact is highly localized.

What are the implications of rapid geographic decay of knowledge diffusion for the patterns of comparative advantage of countries? Ricardian models of trade argue that trade patterns are the reflection of productivity differences: countries export the goods in which they are relatively more productive—i.e. goods in which they exhibit comparative advantage. In this framework, countries become exporters of new goods or increase their market share in existing goods because they become more productive in them. If knowledge drives productivity and diffuses at short distances, then telltale signs should be observable in the geographic patterns of comparative advantage both statically and dynamically. In particular, neighboring countries should share more knowledge and hence have more similar static patterns of comparative advantage, in which case they should exhibit a geographically correlated pattern of product adoption and export growth.

In this paper, we use a novel setting to explore the diffusion of industry-specific productivity increases: the export baskets of countries. The key assumption is that, controlling for product-specific shifts in global demand, firms in a country will be able to incorporate a new good into their export basket only after they have become productive enough to

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compete in global markets. Additionally, in order to increase their market share, firms will also need to become more productive. If knowledge diffusion decays strongly with distance, countries with the relevant knowledge should induce shifts in productivity in their neighbors—we explore this in both a static and a dynamic setting. We study both the intensive and the extensive margins of exports, exploring whether neighbors matter in affecting the ability of a country to gain market share or to become productive enough to export a product for the first time. As has been shown, the extensive margin accounts for a significant fraction of the growth of global trade in the last decades (Zahler, 2007; Kehoe and Ruhl, 2013). We therefore also explore the intensive margin, looking at the impact of neighbors in the evolution of a country's market share.

From a static perspective, we find that the export baskets of neighbors are remarkably similar, even after controlling for similarity in size, level of development, culture, institutional setting and factor endowments, among other controls: sharing a border and a region makes countries two standard deviations more similar than the average. From a dynamic perspective, we find that—after controlling for all time-varying sources of aggregate similarity between pairs of countries, for time varying product characteristics and for a country's own predisposition to adopt a product—countries are 65% more likely to start exporting a product which was being exported with comparative advantage by one of its geographic neighbors at the beginning of the period.

This result is not obvious. After all, gravity models have shown that, ceteris paribus, trade is more intense at short distances (Tinbergen, 1963; Bergstrand, 1985; Leamer and Levinshohn, 1995; Frankel, 1997). Hence, we should expect neighbors to specialize in different industries in order to exploit their comparative advantage and benefit from the gains of trade. The higher intensity of trade at short distances should force specialization and differentiation, whether—as pointed out by Feenstra, Markusen and Rose (2001)—the differences causing specialization arise as a result of an Armington structure of demand (e.g. Anderson, 1979; Bergstrand, 1985; Deardorff, 1998), economies of scale (e.g. Helpman and Krugman, 1985; Bergstrand, 1989), technological differences across countries (e.g. Davis, 1995; Eaton and Kortum, 1997), differences in factor endowments (e.g. Deardorff, 1998); or whether they arise from reciprocal dumping in models of homogeneous goods, imperfect competition and segmented markets (e.g. Brander, 1981; Brander and Krugman, 1983; Venables, 1985).

We can understand our results in the context of an endogenous Ricardian framework, where comparative advantage evolves with the progressive acquisition of knowledge or technologies which diffuse geographically.[1] However, under such a Ricardian framework, a reasonable question to ask is, what aspects of technology have limited tradability so that geography could be a defining factor in its diffusion pattern? Clearly, the technology that is embodied in machines and tradable goods and services should diffuse more broadly: after all, cellphones are available everywhere. However, tacit knowledge (Polanyi, 1962)—knowledge that is disembodied and hard to codify and teach because it cannot be captured by blueprints or instruction manuals—should diffuse with more difficulty. How does tacit knowledge diffuse? As mentioned above, Kenneth Arrow argued that knowledge diffusion requires more direct forms of human interaction, which limits its scope to more localized or idiosyncratic settings (Arrow, 1969). Furthermore, the emerging consensus in the literature of knowledge diffusion is that diffusion occurs predominantly within a fairly short range (e.g. Jaffe et al., 1993; Branstetter, 2001; Keller, 2002; Bottazzi and Peri, 2003), an observation that is attributed to the characteristics of tacit knowledge. Hence, if indeed knowledge diffusion translates into productivity shifts that can shape the export basket of countries, then, in a world in which knowledge diffuses preferentially at short ranges, a country's export basket—as well as its evolution—will be shaped by the knowledge available in its neighborhood.

The localized nature of knowledge diffusion should generate the observables that we document in this paper. In particular, if knowledge has been homogenized preferentially at shorter distances, a snapshot view of the export basket of countries (a realization of their comparative advantage) should resemble that of their neighbors. Dynamically, we should also observe a geographically correlated pattern of adoption of new export goods and of changes in market shares. In this interpretation, there is a causal link between the presence of productive knowledge in a country and its diffusion to a neighbor. However, there is always the possibility that these correlated events may be caused by a third factor that is common to neighboring countries and that explains both the static similarity and the time-lapsed pattern of adoption without there being a causal link between the two. We will try to control, as best we can, for these alternative channels but we do not claim to have ruled them out completely. We discuss this more in detail in the body of the paper.

Until now, the burgeoning literature on international knowledge diffusion has relied on three main indicators to measure knowledge acquisition: patent citations (e.g. Jaffe et al., 1993), patent output (e.g. Bottazzi and Peri, 2003; Branstetter, 2006) and changes in total factor productivity (e.g. Coe and Helpman, 1995; Keller, 2002; Keller and Yeaple, 2009). One contribution of this paper consists in bringing to the literature a more tangible measure of knowledge acquisition: the ability of a country to achieve or improve its comparative advantage in the export of goods.

This paper is organized as follows. In the next section we discuss our sample and present a set of stylized facts based on the static export similarity between countries. In Section 3 we study the dynamics of this process. Section 4 discusses the results and Section 5 presents concluding remarks.

2. Data and stylized facts

2.1. Data

Data on exports in the period 1962–2000 comes from the World Trade Flows (WTF) Dataset (Feenstra et al., 2005) and was extended until 2008 using data from the UN COMTRADE website by Hausmann et al. (2011). This data contains the total export value for 1005 products using the SITC 4-digit (rev. 2) classification.

We exclude countries with less than 1.2 million citizens and with total trade below USD $1 billion in 2008. Also excluded are countries with poor data on exports such as Iraq, Chad and Macau. This cut of the data accounts for 99% of World trade, 97% of World total GDP and 95% of World population (Hausmann et al., 2011). We use time varying national variables from the World Development Indicators (World Bank, 2010). In addition, we use data on conventionally measured factors of production (stock of physical capital, human capital and land) from UNCTAD (Shirotori et al., 2010). Bilateral data, such as distance between the most populated cities, common continent or region, territorial contiguity, common colonizer and colonizer–colony relationship, are from CEPII's GeoDist dataset (Mayer and Zignago, 2011).

In the static analysis, for which we use a cross-country data of the year 2000,[2] the base sample consists of 123 countries (7503 country pairs).[3] For the dynamic analysis, the list of countries is reduced to 100, given the exclusion of countries with no geographic neighbors from the sample and those that belonged to the Former Soviet Union

[1] Alvarez et al. (2012) provides a useful framework to think about this. In their model, technology diffuses through the interaction of domestic and foreign business partners and competitors. Although they do not discuss the geographic implications of this assumption, one could expect this effect to be stronger at short distances as suggested by Keller and Yeaple (2013) in the context of multinational corporations and their foreign subsidiaries.

[2] We limit the analysis to one period (year 2000) in order to avoid artificially low standard errors given that most variables that will be used in the static analysis are fixed in time.

[3] When we include data on factor endowments in our analysis, the dataset is limited to 105 countries.