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Domestic productivity and variety gains from trade

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ABSTRACT

We show theoretically and confirm empirically that domestic productivity has a significant impact on the demand for foreign varieties under the assumption that domestic and foreign varieties are imperfect substitutes. In particular, the demand for imported varieties is more elastic for countries with comparative advantage. For an average good facing a median trade barrier, doubling the importer–exporter relative export performance decreases the number of imported varieties by 17%. Our findings suggest that the variety gains estimates could be significantly biased if we ignore the substitutability between imported and domestic varieties.

1. Introduction

The importance of gains from new imported varieties has been recognized since Krugman (1979), yet the empirical literature on evaluating the variety gains from trade is still emerging. Major challenges that hinder the researchers' ability to estimate the variety gains are data availability and model tractability. While trade data at a highly disaggregated commodity level have become available for many countries, disaggregated data on domestic production are still scarce. Consequently, when evaluating the variety gains from trade, one is forced to restrict the interaction between foreign and domestic varieties and often to downplay the importance of the domestic sector.

This paper highlights the importance of domestic productivity in evaluating the variety gains from trade. We show theoretically and confirm empirically that domestic productivity has a significant impact on the demand for foreign varieties. While subject to the same data constraints as other studies in the literature, we shed light on the importance of comparative advantage in calculating welfare gains from trade. The magnitude of the variety gains estimate varies depending on the underlying assumptions and data employed. In a calibrated model, Romer (1994) shows that the GDP losses associated with the exit of foreign varieties can reach up to 20% as a result of only a 10% tariff. Using Costa-Rican data, Klenow and Rodriguez-Clare (1997) confirm Romer's qualitative predictions, but find the size of the effect to be an order of magnitude lower. More recently, Broda and Weinstein (2006) estimate that varieties imported into United States have quadrupled between 1972 and 2001, which has increased the U.S. welfare by 2.6% of GDP.

These papers, however, impose restrictive assumptions on the competition between foreign and domestic product varieties. In the model of Romer (1994) the importer is a small open economy incapable of producing its own varieties. Klenow and Rodriguez-Clare (1997) relax this assumption by allowing only one domestic variety in each sector. While allowing for multiple domestic varieties, Broda and Weinstein (2006) assume that the number of domestic varieties is unaffected by the new foreign varieties.[2]

We claim that domestic productivity is a key factor in evaluating the variety gains from trade when foreign and domestic varieties are substitutes. In our model we show that countries with stronger domestic industries import fewer varieties. Consequently they suffer smaller welfare losses from trade barriers.[3]

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[2] They relax this assumption in the robustness check section, but the substitutability between foreign and domestic varieties is allowed only at aggregate (rather than sector-specific) level with the common elasticity of substitution applied to all varieties.
[3] While stemming from a different modeling framework, our qualitative predictions are similar to those of Feenstra (2009) who uses the translog expenditure function to measure the variety gains from trade while allowing for the changing set of domestic varieties.

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Empirically, we provide indirect evidence that supports the effect of comparative advantage on variety gains from trade since the available data restrict our ability to structurally estimate the direct effect. In particular, we explore the impact of comparative advantage on the demand for imported varieties. Consistent with the previous literature, trade barriers have a negative effect on the number of imported varieties. However, in our model this effect is magnified by the relative importer–exporter productivity: the higher the relative productivity, the more foreign varieties exit the importer's market because of a trade barrier. To test this hypothesis, we estimate the demand for imported varieties and show that the elasticity of the number of imported varieties with respect to trade barriers co-varies positively with the importer–exporter relative productivity in that sector. Alternatively, if domestic and foreign varieties are not substitutes, the elasticity is independent of the comparative advantage.

Our dataset consists of a panel of bilateral trade data disaggregated at 6-digit Harmonized System commodity level from UN's COMTRADE data that covers many country pairs spanning the years 1995–2003. We measure the number of imported varieties as the extensive margin, which represents the cross-section equivalent of the variety growth measure derived by Feenstra (1994), and the bilateral productivity ratio by the corresponding ratio of Relative Export Performances (henceforth, REP). Since transport costs and tariffs data are sparse for a large number of countries, we proxy trade costs with bilateral distance.

The results are consistent with the predictions of our model. As expected, the distance decreases the number of foreign varieties. More importantly, the magnitude of this effect increases in the importer's comparative advantage measured by the bilateral (importer–exporter) REP. In the pooled regression, doubling the bilateral REP yields a 17% decrease in the number of imported varieties for a median trade barrier. The data reveal substantial variation when we estimate the effect for each sector. In Electronics, Miscellaneous, and Machinery & Transportation doubling REP lowers the number of imported varieties by 44%, 35%, and 31%, respectively, while in Agriculture & Food Products and Mining & Basic Metals — only by 9%. Other sectors show a percentage decrease similar to the estimate in the pooled regression. In accordance with our theoretical predictions, we show that the larger effects arise when the substitutability between varieties depends less on the country of origin of these varieties. The results are robust to employing various model specifications, datasets, and measures of trade barriers.

Next, we apply the methodology of Broda and Weinstein (2006) to calculate how variety gains estimates change if the number of domestic varieties responds to changes in the number of imported varieties. We employ the U.S. trade and production data for 1991–2001 and find that ignoring domestic varieties generates bias in the calculation of the variety gains from trade. The bias varies significantly across sectors. For example, variety gains from trade for Machinery & Transportation are overestimated by 41% and for Electronics they are underestimated by 93%.[4] The weighted average bias is 8% with the weighted standard deviation of 40%, where the weights are ideal log-change weights. However, if we apply the same elasticity of substitution to all varieties, regardless of country of origin and sector, the aggregate bias reaches 66%.

This paper relates, and contributes, to several lines of research. First, we contribute to a rapidly growing literature on evaluating the variety gains from trade by focusing on the interaction between domestic and imported differentiated products. We show that ignoring the substitutability between foreign and domestic varieties may bias the estimation of the welfare gains from trade. This result is in line with the theoretical literature emphasizing the importance of the domestic market conditions for evaluating the variety gains from trade (see e.g., Melitz and Ottaviano, 2008; Feenstra 2009). However, due to the limited availability of the disaggregated production data, the empirical studies which incorporate the domestic sector characteristics are scarce. One exception is Blonigen and Soderbery (2009) who use the highly disaggregated data on production and import of automobiles in the U.S. The data allow them to define varieties at a more detailed level than it is possible under the Harmonized Classification System, to distinguish between domestic and foreign automobiles produced in the U.S., and to observe changes over time in the number of both domestic and foreign varieties. They show that ignoring any of the above factors would result in a significant bias when estimating the welfare gains from foreign varieties of automobiles.

Second, we identify an additional factor – comparative advantage – as determining the demand for foreign varieties. Previously the number of imported varieties was shown to co-vary positively with the market size and GDP per capita (Hummels and Klenow 2005) and negatively with trade barriers (Klenow and Rodriguez-Clare 1997; Feenstra and Kee 2007, 2008). We show that the number of imported varieties is smaller in sectors in which a country has comparative advantage. More importantly, the demand for imported varieties is more responsive to variation in trade barriers, when the importer has higher relative productivity. The latter is consistent with the empirical evidence provided by Kehoe and Ruhl (2002) who show that the untraded or least-traded goods experience the highest trade growth after trade liberalization.

The rest of the paper is structured as follows: section 2 presents the model and solves for the equilibrium; section 3 takes the predictions of the model to the data; section 4 checks the robustness of our estimates; section 5 examines the variety gains bias using the U.S. trade and production data; and section 6 concludes.

2. Theoretical framework

In this section, we explore how relative productivity affects the variety gains from trade when domestic and imported varieties are substitutes. For this purpose, we develop a two-country general equilibrium model of trade. In our model the world consists of two countries, Home and Foreign, indexed by *h* and *f*. Consumers' preferences in each country are defined over many differentiated varieties produced by $s=1, 2,\ldots, S$ differentiated sectors and a homogeneous good (indexed by 0). Within each sector, domestic and imported varieties are substitutes, and varieties produced in the same country are closer substitutes. We implement this idea by combining the preferences of Armington (1969) and Dixit and Stiglitz (1977): each differentiated sector is modeled as an index of country-specific differentiated *goods*, where each good is a CES composite of many *varieties*.

On the production side, a crucial assumption is the fixed cost of entering the market. As a result, each variety has just one destination. The two-way trade exists not due to the original "increasing returns to scale" Helpman and Krugman (1985) style motivation, but due to the fact that consumers have preferences over varieties from different sources, as in Armington model. The standard increasing returns to scale framework is employed within a country-specific *good*, which allows us to endogenize the number of imported varieties on relative productivity and trade barriers. By allowing the productivity to vary across sectors, we are able to pinpoint the effect of the comparative advantage and trade barriers on the number of imported varieties.

2.1. Preferences

The preferences are symmetric in Home and Foreign. For brevity, we set up the model only from Home's perspective. Home's representative consumer has a Cobb–Douglas utility function across sectors:

$$U_h = q_{h0}^{\mu_0} \prod_{s=1}^{S} C_{hs}^{\mu_s} \quad \sum_{s=0}^{S} \mu_s = 1, \tag{1}$$

[4] The U.S. experienced an increase in relative productivity in "Electronics" between 1991 and 2001.