

Is Buying on Amazon like Trading with a Digital Atlantis?

Maria Polugodina, Lennart Jansen

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Markets across the world are being reshaped by the new, online-based, business models, such as that of the online retail giant Amazon. At the same time, small firms use online shops to sell their goods and services, and so compete for customers without having to maintain an expensive infrastructure, e.g. of physical shops. E-commerce is on a continuous growth path along several dimensions and is growing faster than overall retail and eventually at the expense of the traditional retail channels. At this scale of growth, traditional firms, wage earners, consumers and policy-makers are often overwhelmed by the impacts and the disruption caused by e-commerce. And, while there is much literature in business administration and managerial science about firm- and consumer-level impacts of e-commerce, economics research still lags behind in providing a solid theoretical basis for the macro-effects we observe. Nor are the macroeconomic effects of e-commerce well-researched empirically.

This paper works towards closing this gap. We formulate a theoretical model of e-commerce within the Melitz framework of trade theory. By that, we add to the research on the role of heterogenous firms in new markets (Bernard et al., 2011; Helpman et al., 2003; Melitz, 2003). We also add to the literature modelling e-commerce, which has so far been limited to buyer-seller matching (Freund & Weinhold, 2004; Goldmanis et al., 2009). Furthermore, we contribute to the recent literature on non-linearities in the models of heterogenous firms (Helpman et al., 2017; Helpman & Redding, 2010). We then investigate empirically the implications of our model with a rich dataset on the countries of the European Union and the EU accession candidates. We, therefore, offer new insights into the empirics of macroeconomic effects of e-commerce (Anvari & Norouzi, 2016; Couture et al., 2018; Dolfen et al., 2019; Duch-Brown et al., 2017; Falk & Hagsten, 2015; Terzi, 2011; Visser, 2019).

As an intuitive basis for our theoretical approach, we start by presenting several new stylized facts about e-commerce. First, there is much heterogeneity across firms in the adoption of e-commerce. Second, there is also heterogeneity across sectors in consumers' preference to buy online. At the same time, while e-commerce has shown tremendous growth in the last decades, large online-based firms also increasingly engage in offline sales.

Our theoretical model is based on the Melitz (2003) model of heterogenous firms and monopolistic competition. We use the costly trade equilibrium of Melitz (2003) to compare how an introduction of e-commerce will influence the respective sectors. Our focus here is on productivity, sectoral demand and sectoral price index. The advantage of our approach is that the traditional markets – which are equivalent to the benchmark model – will co-exist with the e-commerce markets, and the complete mechanics of the original model are still in place.

We call our approach the “twin varieties option” (TVO), as technically we model introduction of e-commerce as an emergence of a new variety in the sector, which is an imperfect substitute for the traditional varieties. The existence of these two options means, on the firm side, that it will have an option to offer a maximum of two varieties, instead of one in the benchmark model. The traditional and e-commerce varieties are the result of the same R&D process, meaning they will share the same productivity. The e-commerce variety, however, comes with a different fixed and marginal cost, the latter captured as an iceberg factor τ_{nij}^{ec} . Importantly, the quantities in the Melitz model are quality-adjusted, meaning that τ_{nij}^{ec} captures both potential cost differences to the traditional variety and the preference of consumers towards or against buying online. Thus, unlike the trade iceberg cost $\tau_{nij} \geq 1$, τ_{nij}^{ec} can be larger than, equal to or less than one.

Our simplifying assumption is that the elasticity of substitution is the same between e-commerce and traditional varieties as it is between any two varieties within the e-commerce or traditional parts of the sector. The argument in support of this simplifying assumption is that there is no reason to assume that, within any sector, the technology of distribution would define a variety's uniqueness any less than the uniqueness properties defined in the R&D process. While some customers want a specific book and will compare the options of buying it online or in a traditional store, others will have a preference to go to some specific store (online or traditional) "to buy a present for their mother" and then rather randomly choose between any book presented in that store. At the same time, this assumption allows us to work with the CES utility function, as in Melitz (2003). Moreover, this implies that the sector aggregates (demand B and price index P) will be the same for e-commerce varieties, though their values will change relative to the benchmark model.

Calculating variety prices, firm revenues and profits exactly the same way as in Melitz (2003), except that now there are two of each for any firm, allows to compare the zero-profit and market-entry conditions. We show that a). introduction of e-commerce will increase productivity in the traditional sector, relative to the benchmark, and b). introduction of e-commerce will lower the price index. In this sense, *introduction of e-commerce has similar effects as trade liberalization*. The channel for increased competition is that large, productive firms will now have additional markets to compete in, so they will use *multichannel marketing*.

There is, however, a second mechanism, that can play out differently than in trade liberalization. If e-commerce comes with a *comparative advantage*, i.e. the costs of e-commerce are lower than those of traditional channels, small and medium firms will switch to it to survive in the market or even enter markets where they would otherwise be uncompetitive. Technically, this is possible because, unlike for trade costs, we cannot *ex ante* put any parametrical restrictions on the fixed and marginal costs of e-commerce except that they are nonnegative. Thus, theoretically, any hierarchy of productivity cut-offs is possible in this extension. We, therefore, identify three potential scenarios from which we derive our empirical hypotheses:

Scenario I: E-commerce comes with comparative disadvantage. Productivity cut-off is highest for e-commerce, followed by the new traditional cut-off and the benchmark cut-off. Only the most productive firms will adopt the second channel and expand because of their access to additional markets. On the lower tail of productivity distribution, some firms that are no longer productive enough will have to exit the market. In the middle, firms will only sell traditionally. A good example here is the sales of groceries. Our hypothesis is, therefore:

Hypothesis 1: *Markets with very high e-commerce costs are characterized by higher concentration and very large size of companies trading online.*

Scenario II: E-commerce comes with minor comparative advantage. Productivity cut-off is highest for the new traditional market, followed by the e-commerce cut-off and the benchmark cut-off. The most productive firms will again use both channels to reach most markets. On the lower tail of productivity distribution, some firms that are no longer productive enough will have to exit the market. However, in the middle, some firms will be able to survive by switching from traditional sales to e-commerce. Any further decrease in e-commerce costs will allow some less productive firms to stay in the market. Our hypothesis is, therefore:

Hypothesis 2: *Decreasing e-commerce costs lead to lower average productivity in ecommerce, thus, to smaller average firm size.*

Scenario III: E-commerce comes with large comparative advantage. Productivity cut-off is highest for the new traditional market, followed by the benchmark cut-off and the e-commerce cut-off. No firms exit the market, all firms will be using e-commerce. All those, who were present in the market before e-

commerce introduction, will use both technologies. On the lower tail of productivity distribution, however, a number of even smaller and less productive firms will be able to use e-commerce to enter the market. There will be a “wave of start-ups”. Our hypothesis is, therefore:

Hypothesis 3: *Markets with very low e-commerce costs are characterized by a large number of online-only firms and overall lower market concentration.*

We use a panel dataset on different sectors in 35 EU countries and EU accession candidates between 2005 and 2017 to explore these hypotheses. Due to data limitations, we perform our analysis in three steps. In the first step, we use our first, smaller dataset, which includes data on e-commerce adoption, and a large set of potential e-commerce cost proxies to single out those that can best explain the adoption of e-commerce. We then relate e-commerce adoption to market concentration as an intermediary “safety check”. The reason is, e-commerce adoption is the channel through which e-commerce costs affect market structure. For this second step, we use both the robust fixed effects model and an IV approach, where e-commerce adoption is instrumented by e-commerce costs. If data support hypotheses 1 and 3, we expect to find a hump-shaped relationship between e-commerce adoption and market concentration. Indeed, the data point to such relationship.

In the final step, we relate e-commerce costs directly to market concentration, as postulated in hypotheses 1 and 3. Here, again, we expect to find a hump-shaped relationship. For this step, we also utilize a larger dataset, which is very detailed in the sectoral classification. Also in this step, for the main cost drivers of e-commerce, we find a hump-shaped relationship. This effect, however, varies a lot by sector. It is very pronounced for manufacturing and real estate services, but barely present in mining and wholesale / retail trade. The latter is an interesting case, as trade can be considered both a sector on its own, where shops can decide to adopt e-commerce, but also an intermediary for the producers of the manufacturing sectors. In the latter case, they would stand in competition with the producers’ direct online sales and might in fact put more efforts into the traditional infrastructure. Another interesting observation is that, if only sectors with high e-commerce costs are considered, the relationship between costs and market concentration becomes linear, with falling costs leading to higher concentration, as in hypothesis 1. The evidence for low-cost sectors is more mixed, possibly owing to the lack of plausibility in the selection of sectors corresponding to scenario III.

To conclude, our paper presents novel theoretical results on the effects of e-commerce on the market structure. On the one hand, e-commerce has similar effects as those of trade liberalization. E-commerce will increase competition, as it will allow some firms to compete for more market shares via (additional) e-commerce channels. Traditional business models, or channels, will, as a result, inevitably lose market shares and profits. Therefore, only some firms will benefit from the new opportunity of e-commerce. This pattern is quite similar to the one caused by trade liberalization, where export opportunities for some firms go hand in hand with import competition for all firms.

On the other hand, e-commerce also has non-linear effects, which are different from those of trade liberalization. The twin-varieties extension proposed here provides a more complex insight into the effects of e-commerce, as it reflects that firms can *optionally* apply e-commerce, *either as a additional channel or an alternative technology*. As a result, depending on parameter constellations, there are up to three types of firms applying e-commerce. Whenever e-commerce is comparatively unattractive for costumers and/or associated with higher costs, only the biggest firms will establish e-commerce as additional channels (multichannel marketing). Whenever e-commerce is comparatively more attractive and/or less costly, medium-sized firms will switch from traditional business concepts to e-commerce business concepts, additionally to the large multi-channel firms. If the comparative advantage of the e-commerce technology is large, additional small e-commerce firms will enter the market on top of the multi-channel firms and the switching firms. The findings on the first and third scenario are also supported by the data at hand.

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