Rev World Econ
https://doi.org/10.1007/s10290-017-0303-3

ORIGINAL PAPER

Competitive effects of trade: theory and measurement

Marc J. Melitz[1]

Abstract In this paper, I develop a simple model of heterogeneous exporters to a single destination. This model highlights how the response of producer markups to market-level changes in that destination are intrinsically tied to the induced reallocation of export sales to that destination. I discuss how additional assumptions on the shape of demand (originally advocated by Alfred Marshall as his second law of demand) generate specific predictions for the response of those markups and induced product reallocations to increases in market size and competition in a destination: markups fall and market shares are reallocated towards better performing products. Recent evidence on French multi-product exporters strongly confirms this prediction for market share reallocations. The predictions for the markup responses are also consistent with the findings of the large empirical literature on pricing to market and incomplete pass-through.

Keywords Heterogeneous Firm · Globalization · Variable Markups

JEL Classification F12 · L11

1 Introduction

There is an extensive empirical literature documenting the response of firm and product-level markups to market-wide changes in an export destination—often referred to as "pricing to market". When these market-wide changes affect the

✉ Marc J. Melitz
mmelitz@harvard.edu

[1] Harvard University, Cambridge, MA, USA

Published online: 24 November 2017

delivered cost of exported goods, the evidence overwhelmingly confirms the phenomenon of incomplete pass-through: Those cost changes are passed on less than one-for-one into the imported prices paid by consumers.[1] More recently, empirical work has also documented that the extent of this incomplete pass-through consistently varies with a producer's performance (at the firm or firm-product level): Better performing producers absorb a greater proportion of a cost shock into their markups (their pass-through rate is more incomplete than for worse performing producers).[2]

In this paper, I sketch a very simple model of monopolistic competition with heterogeneous exporters that captures these markup responses to market-wide changes. Endogenous markups are driven by variable elasticities of substitution on the demand side. This model highlights how increases in the market-size of a destination induce increases in competition that are tied to decreases in markups for each exported product. The model is used to connect these predictions for markups to predictions on the reallocation effects of increased market size and competition in export markets. These reallocations include both extensive margin trade responses—changes to the set of products exported to the destination—as well as an intensive margin trade response—changes to the relative market shares of exported products. More specifically, increases in competition (and lower markups) are tied to a reallocation of market shares towards better performing exported products. The paper reviews some recent evidence that strongly confirms this type of intensive margin reallocation.

A substantial portion of the theoretical trade literature analyzing the response of heterogeneous exporters assumes constant markups.[3] These models do a good job of capturing the extensive margin of trade: the selection effects that determine which products are sold where. However, those models cannot capture the intensive margin reallocations I just mentioned. The model described in this paper captures *both* the extensive margin responses (which are very closely aligned with the predictions of models with exogenous markups) as well as the empirically documented intensive margin reallocations. In addition, this model replicates the main findings of the empirical literature on "pricing to market" and incomplete pass-through that was previously mentioned.

2 Model

This model is a stripped-down version of the one developed in Mayer et al. (2016).[4] In this paper, I focus on a short-run scenario for French firms selling in a given export destination market D. I abstract from the longer-run feedback forces from

[1] See the evidence reviewed in De Loecker and Goldberg (2014), Burstein and Gopinath (2014), and Yilmazkuday (2015).

[2] See Berman et al. (2012) for France, Amiti et al. (2014) for Belgium, Chatterjee et al. (2013) for Brazil, and Li et al. (2015) for China.

[3] See Melitz and Redding (2014) for a survey.

[4] There is an active literature analyzing the properties of monopolistic competition with endogenous markups generated by variable elasticities of substitution on the demand side. See, for example, Zhelobodko et al. (2012), Bertoletti and Epifani (2014), and Mrázová and Neary (2013).

changes in the destination market to the entry of French firms (which eliminates a free-entry condition at the firm-level). In the short-run, all firm optimization for their sales to D occurs at the product level. I can thus also abstract from the explicit modeling of multi-product firms—and relate the theoretical results for firms in the model to products sold by multi-product firms in the data. I consider an exogenous set N of all potential French exporters to D. These exporters face a constant marginal cost c (including both production, trade, and distribution costs) along with a fixed cost F for their sales into D. The distribution of those marginal costs c across the N firms is characterized by the cumulative distribution $\Gamma(c)$.

The market size of destination D is given by the number of consumers L in that destination. I assume that these consumers spend a share η_F of their income on French goods. One can think of an increase in foreign (non-French) competitors selling to D as a decrease in this French share η_F. Similarly a positive response of entry on the French market can be modeled via an increase in the set N of potential exporters.

2.1 Consumer optimization

There is a continuum of differentiated varieties indexed by $i \in [0, I]$, where I is the measure of products available. The demand for differentiated varieties q_i in destination D is generated by the L consumers who solve:

$$\max_{q_i \geq 0} \int_0^I u(q_i)di \quad \text{s.t.} \quad \int_0^I p_i q_i di = 1.$$

I normalize consumer expenditures on the differentiated varieties to 1. So long as

$$(\mathbf{A1})\ u(q_i) \geq 0; \mathrm{u}(0) = 0; u'(q_i) > 0; \quad \text{and} \quad u''(q_i) < 0 \quad \text{for} \quad q_i \geq 0$$

this leads to a downward sloping inverse demand function (per consumer)

$$p(q_i, \lambda) = \frac{u'(q_i)}{\lambda}, \quad \text{where} \quad \lambda = \int_0^I u'(q_i) q_i di > 0 \tag{1}$$

is the marginal utility of income (spent on differentiated varieties). Given the assumption of separable preferences, this marginal utility of income λ is the unique endogenous aggregate demand shifter: Higher λ shifts all residual demand curves *inward*; I refer to this as an increase in competition for a given level of market demand L.

Strict concavity of $u(q_i)$ ensures that the chosen consumption level from (1) also satisfies the second order condition for the consumer's problem. This residual demand curve (1) is associated with a marginal revenue curve

$$\phi(q_i) = \frac{u'(q_i) + u''(q_i) q_i}{\lambda}. \tag{2}$$

Let $\varepsilon_p(q_i) \equiv -p'(q_i) q_i / p(q_i)$ and $\varepsilon_\phi(q_i) \equiv -\phi'(q_i) q_i / \phi(q_i)$ denote the elasticities of inverse demand and marginal revenue (expressed in absolute values). Thus

$\varepsilon_p(q_i) \geq 0$ is the inverse price elasticity of demand (less than 1 for elastic demand), capturing the sensitivity of price to changes in quantities. $\varepsilon_\phi(q_i) \geq 0$ captures the sensitivity of marginal revenue to changes in quantities, which combines both the response of the price of the marginal unit as well as the impact on revenue from the change in price on infra-marginal units.

Although the demand and marginal revenue curves are residual (they depend on λ), their elasticities are nonetheless independent of λ. These preferences nest the case of C.E.S. preferences where the elasticities $\varepsilon_p(q_i)$ and $\varepsilon_\phi(q_i)$ are constant.[5]

2.2 Firm optimization

The optimal operating profit (gross of the fixed cost F) and output (per consumer) for a firm with cost c facing market competition λ in D solves

$$\pi(c,\lambda) = \max_{q_i}[p(q_i,\lambda)q_i - cq_i],$$
$$q(c,\lambda) = \arg\max_{q_i}[p(q_i,\lambda)q_i - cq_i].$$

The first order condition for this optimization problem is the well known equalization of marginal revenue with marginal cost:

$$\phi(q(v,\lambda)) = c. \tag{3}$$

In order to ensure that the solution to this problem exists (for at least some $c > 0$) and is unique, I further restrict the choice of preferences to satisfy:

$$(\mathbf{A2})\ \varepsilon_p(0) < 1 \quad \text{and} \quad (\mathbf{A3})\ \varepsilon_\phi(q_i) > 0 \quad \text{for} \quad q_i \geq 0.$$

These assumptions ensure that marginal revenue is decreasing for all output levels (A3) and positive (elastic demand) for at least some output levels (A2).

One can also measure a firm's output using their generated revenues (per consumer):

$$r(c,\lambda) = q(c,\lambda)p(q(c,\lambda),\lambda).$$

Note that all these performance measure (operating profit, output, sales) are decreasing in both firm level cost c and in the endogenous competition level λ: More productive firms (with lower cost c) are larger and earn higher profits than their less productive counterparts; and an increase in competition λ lowers production levels and profits for all firms.

2.3 Endogenous determination of selection and competition

Firms with operating profits $L\pi(c,\lambda)$ below the operating cost F cannot profitably sell to destination D and will therefore choose not to do so. This leads to a cutoff cost $\hat{c}$ for selection into exports to D:

[5] In the case of C.E.S. preferences, the marginal utility of income λ is an inverse monotone function of the C.E.S. price index.

$$L\pi(\hat{c}, \lambda) = F. \tag{4}$$

Only French firms with cost $c \leq \hat{c}$ export to D. In equilibrium, the aggregate export sales by these $N\Gamma(\hat{c})$ firms must equal the consumers' expenditures on French goods:

$$N \int_0^{\hat{c}} r(\hat{c}, \lambda) d\Gamma(c) = \eta_F. \tag{5}$$

Together, the above two equations (cutoff profit and budget constraint) jointly determine the toughness of competition λ in D and the cost cutoff $\hat{c}$.

2.4 Market size and competition

I now consider the effects of an increase in market size L in destination D. Given a level of competition λ, the direct effect of such an increase is to proportionally increase firm output, sales, and operating profits; with no change in firm level prices and markups (all of the per-consumer measures of firm performance remain unchanged). However, the level of competition λ is endogenous; along with selection (the endogenous cutoff), these variables respond to changes in market size: The increased market size allows additional firms to profitably sell in D (increase in the cutoff $\hat{c}$), and the increased number of sellers in-turn leads to an increase in competition λ.[6]

The short-run analysis stops here; but one can also infer what would happen in the longer run allowing for a response of entry. This response would be positive, given the increase in exporting profits generated by the larger market size. This can be investigated within the context of the model by examining the effects of an increase in the number N of potential exporters. On its own, such an increase would also lead to an increase in competition λ, but would have an opposite effect on selection (tougher selection).[7] Thus, the response of entry in the longer-run would re-enforce the prediction for tougher competition λ in destination D, though predictions for the impact on selection of exporters into D would then become ambiguous.

One can also use this model to examine another dimension of competition generated by foreign firms. This would be captured by a decrease in the share η_F of expenditures devoted to French goods. Inspection of the budget constraint (5) reveals that decreases in this expenditure share have identical effects to the previously considered increase in the number of potential exporters N—thus resulting in an increase in the toughness of competition λ in D, along with tougher selection. In the following section, I will impose some further restriction on

[6] This can be shown by contradiction: Assume that competition λ were to *decrease* following an increase in market size L. Then, from (4), the export cutoff $\hat{c}$ must increase. This would then violate the budget constraint (5) as spending must then rise [higher cutoff $\hat{c}$ and higher sales $r(c, \lambda)$ for all firms due to decrease in competition λ].

[7] Consider a similar proof by contradiction: assume that competition λ were to *decrease* following a increase in N. Then, from (4), the export cutoff $\hat{c}$ must increase, which would then violate the budget constraint (5) as spending must then rise.

preferences (affecting the shape/curvature of demand) and show how these restrictions shape the intensive margin reallocations across firms. Before doing so, I underscore that all of the effects of competition on selection and the extensive margin of exports to D that were just discussed do not depend on any such further restrictions (and thus also hold for the case of C.E.S. preferences).

3 Curvature of demand

Up to now, I have placed very few restrictions on the shape of (residual) demand that the firms face, other than the conditions (A1)–(A3) needed to ensure a unique monopolistic competition equilibrium. The shape of demand determines how tougher competition λ (an inward shift of residual demand) impacts firm prices and markups. At their chosen production level $q(c,\lambda)$, firms set a markup $\mu(q_i)$ (the ratio of price to marginal cost) that is tied down (inversely) by the price elasticity of demand: $\mu(q_i) = 1/\big(1-\varepsilon_p(q_i)\big)$. Thus, the response of markups is tied to changes in the price elasticity of demand (along the residual demand curve). If, moving up residual demand, demand becomes more elastic, $\varepsilon_p'(q_i) > 0$, then tougher competition λ leads to a lower markup (and hence price) for any given firm with cost c.[8] And conversely, if demand becomes more inelastic (again, moving up the demand curve), then tougher competition leads to higher markups and prices. Although theoretically possible, this latter case seems counter-intuitive. Indeed, this case was excluded by Marshall (1890) in his original exposition defining demand curves; it is often referred to as "Marshall's Second Law of Demand" (MSLD)[9]—that elasticity of demand increases with price along a demand curve, or alternatively that the demand curve is log-concave in log-price.[10] This is also the main demand assumption made "without apology" by Krugman (1979) (in order to yield "reasonable results") in his seminal paper on trade with economies of scale.

Violations of MSLD would also directly contradict the evidence on markups and pass-through that were mentioned in the introduction. Within a monopolistic competition framework (required for a well-defined residual demand curve), MSLD is equivalent to the property that more productive firms (or alternatively lower cost) set higher markups. It is also equivalent to the property of incomplete pass-through: that a change to marginal cost c is passed-on less than one-for-one into prices—with the remaining variation absorbed into the markup: $\partial \ln p(q(c,\lambda))/\partial \ln c < 1$.[11] Under

[8] Recall that firm output per consumer $q(c,\lambda)$ is decreasing in competition λ.

[9] Marshall's First Law of Demand is that it is downward sloping; this too can be violated with rational utility maximizing consumers.

[10] Several other terms have been used to describe MSLD demand in the literature on monopolistic competition with endogenous markups. Zhelobodko et al. (2012) describe those preferences as exhibiting increasing "relative love of variety" (RLV); Mrázová and Neary (2013) describe this as the case of "sub-convex" demand; and Bertoletti and Epifani (2014) use the term "decreasing elasticity of substitution".

[11] This property of incomplete pass-through also applies to exchange rate changes. In this case however, the change in delivered cost impacts the entire set of firms with a common currency selling into a given destination. This induces a change in competition λ which amplifies the price response. Nevertheless, the pass-through rate remains incomplete.

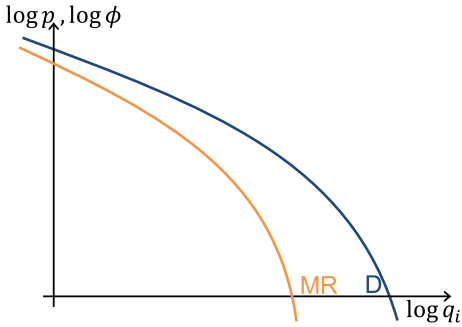

Fig. 1 Graphical representation of demand assumptions

C.E.S. preferences, markups are constant, both across firms and with respect to changes in competition λ. Changes to marginal costs are passed on one-for-one into prices, and pass-through is therefore complete. Lastly, the endogenous markups generated by MSLD demand also induce a pattern of endogenous trade elasticities that are broadly consistent with the empirical evidence.[12]

Whereas the shape of the demand curve governs the relationship between output levels and markups, the shape of the marginal revenue curve governs the relationship between *changes* in output levels and *changes* in markups. Since marginal revenue is entirely determined by demand, it is clear that the shapes of these two curves are linked. In particular, the marginal revenue curve is always below and steeper than the demand curve. Under MSLD, demand becomes more inelastic as output increases; this implies that, on average, marginal revenue must also become more inelastic as output increases: $\varepsilon_\phi(q_i) > \varepsilon_p(q_i)$. A slightly stronger assumption than MSLD is that marginal revenue smoothly becomes more inelastic as output increases: $\varepsilon'_\phi(q_i) > 0$. I refer to this assumption as MSLD', which implies MSLD. Figure 1 depicts a log–log graph of the inverse demand and marginal revenue curves satisfying these restrictions. On its own, MSLD is equivalent to the concavity of the demand curve in log–log space. MSLD' is equivalent to the concavity of the marginal revenue curve in that space (relative to MSLD, it eliminates the possibility of inflection points in the marginal revenue curve).[13]

Just like MSLD is associated with an empirical property of markup differences across firms, MSLD' is associated with an empirical property regarding *changes* in markups across firms: In response to a given cost shock (a given percentage change in cost), a low-cost/high-productivity firm adjusts its markups by more than a high-cost/low-productivity firm. In other words, better performing firms exhibit lower pass-through rates (though the pass-through rates are incomplete—lower than one—for all firms). As I previously discussed, this prediction for heterogeneous pass-through rates has been strongly confirmed in recent empirical work in many different countries at both the firm and product level.

[12] It is the key characteristic of the demand systems analyzed by Spearot (2013), Novy (2013), and Arkolakis et al. (2015) in order to explain the empirical variations in the trade elasticity (at the intensive product margin).

[13] $u(q_i)$ quadratic, leading to linear demand $p(q_i)$ is a simple functional form satisfying MSLD' (and hence MSLD).

4 MSLD and intensive margin reallocations

In the previous section, I discussed how an additional restriction on the shape of demand (MSLD') was needed in order for the simple theoretical model to match established patterns of markup differences and changes across firms and products. I now discuss how this same demand restriction is also needed in order to explain relatively newer evidence on intensive margin reallocations. This demand restriction is important because—although relatively broad—it excludes one of the most widely used demand parametrization in models of international trade: C.E.S. preferences, which along with monopolistic competition implies exogenously fixed markups. Of course, it is well understood that this parametrization is made for analytical tractability and imposes a counterfactual prediction for the (non) response of markups to demand conditions. My main point is that this parametrization also precludes intensive margin reallocations from trade, whereas these reallocations are empirically important and generate an important channel for the propagation of trade shocks—over and above the effects generated by the extensive margin of trade (which are captured by monopolistic competition models with C.E.S preferences; but also as well by our current model with MSLD demand).

In this section, I discuss how the demand restrictions of MSLD' (and hence MSLD) are tied to intensive margin reallocations—and contrast this to the case of C.E.S. demand. I return to the comparative static for an increase in market size L in the destination market D—potentially compounded by an increase in entry N and/or an increase in foreign supply to D (lower French share η_F). Without imposing any additional demand restrictions, I discussed how such changes would induce an increase in the endogenous competition level λ in the destination market. Restrictions on the shape of demand then govern how this increase in competition translates into changes in markups: MSLD and MSLD' ensure that markups decrease with increases in competition λ. I now describe how such an increase in market size and competition impacts the relative performance (operating profits, sales, and output) of different firms selling into D, both before and after the market-size change. I thus abstract from the extensive margin consequences of this change for the set of products sold in D.

The impact of these demand restrictions on the relative performance measures is depicted in Fig. 2. Both panels show the shape of any of those three performance measures (operating profits, sales, and output) as a function of cost on a log–log scale—and how they change when market size and competition increases. (The direction for log cost on the horizontal axis is inverted so that more productive firms are to the right of less productive ones.) The left-hand side depicts the case of MSLD' demand; this stands in contrast to the right-hand side panel depicting the case of C.E.S. preferences. Under C.E.S. preferences, a 1% productivity increase always translates into an exogenously given percent increase in operating profit, sales, and output (determined by the constant elasticity of substitution from the preferences). Under MSLD' the percent increase in all three performance measures from a 1% increase in productivity decreases with productivity: a 1% increase in productivity leads to a bigger (proportional) expansion for smaller, less productive producers. On the other side of the scale, larger more productive respond to a 1% increase in productivity by increasing their markup relatively more, leading to smaller expansions.

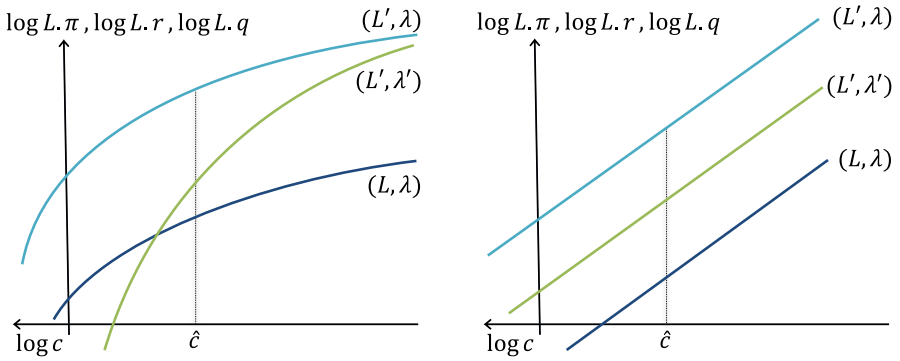

Fig. 2 Performance measures: MSLD versus C.E.S.

The three curves in each panel breaks down the impact of the increase in market size, starting from the initial equilibrium associated with market size L and competition λ. Absent any change in competition, a market size increase to $L' > L$ would generate a proportional increase in all three performance measures (for any given firm)—represented by a vertical shift of the curve for environment (L, λ) to (L', λ). This holds in both panels under both MSLD' and C.E.S. preferences. The third curve shows the transition incorporating the endogenous increase in competition to $\lambda' > \lambda$. Under MSLD', this increase in competition translates into an increase in the elasticity of all three performance measures in response to a 1% productivity change (steeper curve in the left-hand panel). When competition toughens, a 1% increase in productivity becomes more valuable to all firms, and leads to proportionately bigger expansions in output and sales. This also implies that tougher competition leads to bigger proportional gains (in terms of profits, sales, and output) for relatively more productive firms.[14] In other words, tougher competition reallocates profits, sales, and output towards more productive firms. This intensive margin reallocation stands in contrast to the C.E.S. case in the right-hand panel. In that case, the elasticity of the performance measures with respect to productivity is fixed. So there is no scope for changes in competition to affect this elasticity. Thus, the change in competition to λ' does not affect the slope of the curves: the ratio of profits, sales, and output for any two firms remains constant; there are no reallocations at the intensive margin.

5 Connecting back to empirical measures of producer reallocations

Market size and competition also affect the extensive margin of trade: the set of producers with cost $c \leq \hat{c}$ who find it profitable to sell to D given a market size L and

[14] Take two firms with costs c_1 and c_2 in the graph. The proportional change for any performance measure from the increase in competition λ is indexed by the difference in the vertical intercept for these two firms. This difference must increase as the curve with tougher competition $\lambda' > \lambda$ is steeper everywhere.

competition λ.[15] But this response of the extensive margin is much less sensitive to the shape of demand, which critically affects the intensive margin response (as discussed above). The two panels in Fig. 2 also show how the increase in market size L (and induced increase in competition λ) affect the cost cutoff $\hat{c}$—assuming no further changes to the number of producers N and foreign competition η_F. In this case, the operating profits of all exporters to D increase, and exporting then becomes more profitable for some higher cost producers who did not previously export: the cost cutoff $\hat{c}$ thus increases. This prediction for the extensive margin does not rely on our previous assumption for the shape of demand: it holds both for the case of MSLD' demand as well as for C.E.S. demand where markups are exogenous.

If the increase in market size to L' is associated with an increase in either domestic competition (an increase in the number of producers N) or foreign competition (a decrease in the expenditure share of French firms η_F), then the equilibrium increase in competition λ' is magnified. This would result in a downward shift in the performance curve associated with the new equilibrium (L', λ') in both panels. If the increase in competition to λ' is large enough, then the predictions for the extensive margin will be reversed, and the cutoff will increase: Some high cost producers who previously exported to D drop out of that market. Although there are some parameter configurations that could induce opposite responses for the cutoff in the two panels (depending on the shape of demand), the cutoff will generally move in the same direction, implying a qualitatively similar response for the extensive margin: lower cost cutoff (tougher selection) for large increases in competition induced by significant increases in either domestic or foreign competition; and higher cost cutoff (weaker selection) for small or no increases in domestic and foreign competition.

In contrast, the direction of the intensive margin response will be entirely determined by the shape of demand: under endogenous markups with MSLD' demand, the *relative* performance measures for better performing firms increases with market size and competition—regardless of the direction of the extensive margin response (the level change in operating profits for the cutoff firm). If the increase in competition is substantial enough to toughen selection, then this divergence in relative performance measures also implies a divergence in the direction of the performance measure change: the same shock leads to an increase in operating profits and scale for better performing producers (with lower cost) while at the same time leading to a decrease in profits and scale for the worse performing producers (with higher costs near the cutoff $\hat{c}$). Thus, producers can respond to the same shock in divergent ways.[16] This kind of divergence cannot be explained under C.E.S. preferences and exogenous markups (a given shock in a market D will make producers selling in that market either *all* better off or *all* worse off).

This divergence prediction for the intensive margin reallocations induced by market size and competition can be tested directly for the performance measure in

[15] See the cutoff equation (4).

[16] Aghion et al. (2017) show that this divergence has important consequences for the firms' innovation response to demand shocks in their export markets; consequences with strong empirical support: better performing firms respond to a positive demand shock by increasing innovation, whereas worse performers respond to the same shock by decreasing innovation.

terms of sales: tougher competition is associated with higher *relative* sales for better performing producers; where tougher competition is induced by market size, and more generally by a larger set of producers competing in a market. This prediction can be evaluated across markets (with different size or number of competing producers) as well as for the same market over time (given a demand shock that affects market size). Empirically, one can isolate the intensive margin response by using customs-level data which breaks down exports by firm, product, destination, and time: the relative export sales of the same products by the same firm in the same destination in the same year. This sweeps away the extensive margin effect, which induces firms to sell a different set of products to different destinations at different points in time. Mayer et al. (2014, 2016) use this type of customs data for French exporters and strongly confirm this divergence prediction for the intensive margin reallocations: French multi-product exporters sell relatively more of their better performing products (1) in bigger markets (measured by destination GDP in a given year), (2) in markets where more firms compete (measured by the geography of the destination in a given year), and (3) in the same market following a positive demand shock). Mayer et al. (2016) also show that the connection between MSLD demand (in monopolistic competition models of trade) and intensive margin reallocations run in both directions. Thus, this evidence for the intensive margin reallocations of French exporters represents a violation of the predictions of a monopolistic competition model of trade that did not impose MSLD (and in particular a model of trade with exogenous markups and C.E.S. preferences). It therefore provides strong confirmation for the predictions of endogenous markups and incomplete pass-through highlighted in the introduction. This evidence is an important complement to the evidence from this literature as it does not require the estimation of firm or product-level markups, which in-turn relies on additional data for firm-product prices or quantities (which are typically very noisy) and the recovery/estimation of marginal cost shocks based on functional form assumptions for demand and/or production.[17]

6 Conclusion

In this paper, I have developed a simple model of heterogeneous exporters to a single destination. This model highlights how the response of producer markups to changes in that destination are intrinsically tied to the induced reallocation of export sales to that destination. I have discussed how additional assumptions on the shape of demand (originally advocated by Alfred Marshall as his second law of demand) generate specific predictions for the response of those markups and induced product reallocations to increases in market size and competition in a destination: market shares are reallocated towards better performing products. Recent evidence on French multi-product exporters strongly confirms this prediction. The prediction for the response of markups cannot be tested directly as it first involves an estimation framework to recover product level markups. However, those predictions are

[17] See De Loecker and Goldberg (2014) for a discussion of these data and functional form requirements.

consistent with the findings of the large empirical literature on pricing to market and incomplete pass-through, which undertakes this additional estimation procedure, and measures the response of markups to aggregates changes affecting a destination.

A substantial portion of the theoretical trade literature analyzing the response of heterogeneous exporters assumes constant markups—rationalized by assumptions of monopolistic competition and C.E.S. preferences. These models do a good job of capturing the extensive margin of trade: the selection effects that determine which products are sold where. However, those models cannot capture the intensive margin reallocations that were just described (conditional on the set of products sold in a destination). The additional assumptions on the shape of demand that I have introduced allow the model to capture *both* the extensive margin responses (which are very closely aligned with the predictions of models with exogenous markups) as well as the empirically documented intensive margin responses.

It is important for models of trade to capture both of these margins. The reallocations driven by the intensive margin are important not only because they point to changes in markups that can better explain the response of prices to changes competition in a destination; they are also important because they directly affect productivity and welfare—over and above the channels operating through the extensive margin of trade: The reallocation of market shares towards better performing products in response to tougher competition is also associated with a more efficient allocation of production resources across those products. This intensive margin reallocation generates both a productivity and welfare gain (separate from the selection effects induced at the extensive margin).[18] A portion of those productivity changes occur within multi-product exporters. Mayer et al. (2016) show that there is indeed a strong empirical link from demand shocks in export markets to the productivity of multi-product firms exporting to those markets. In the aggregate for French manufacturing between 1995–2005, the authors calculate that the growth in world trade generated a 1% average increase per year in French manufacturing productivity.

Acknowledgements Based on the Bernhard Harms Prize Lecture delivered at the Kiel Institute of World Economics on December 7, 2016. I thank and acknowledge my co-authors Thierry Mayer and Gianmarco Ottaviano with whom I have collaborated to produce the research described in this lecture.

References

Aghion, P., Bergeaud, A., Lequien, M., & Melitz, M. (2017). *The impact of exports on innovation: Theory and evidence* (Technical Report, Working Paper).

Amiti, M., Itskhoki, O., & Konings, J. (2014). Importers, exporters, and exchange rate disconnect. *American Economic Review*, *104*(7), 1942–1978.

Arkolakis, C., Costinot, A., Donaldson, D., & Rodríguez-Clare, A. (2015). *The elusive pro-competitive effects of trade* (Working Paper 21370, National Bureau of Economic Research).

Berman, N., Martin, P., & Mayer, T. (2012). How do different exporters react to exchange rate changes? *The Quarterly Journal of Economics*, *127*(1), 437–492.

[18] See Dhingra and Morrow (2018) for a normative analysis of monopolistic competition with endogenous markups.

Bertoletti, P., & Epifani, P. (2014). Monopolistic competition: CES redux? *Journal of International Economics*, *93*(2), 227–238.

Burstein, A., & Gopinath, G. (2014). International prices and exchange rates. In G. Gopinath, E. Helpman, & K. Rogoff (Eds.), *Handbook of international economics* (Vol. 4, pp. 391–451). Amsterdam: Elsevier.

Chatterjee, A., Dix-Carneiro, R., & Vichyanond, J. (2013). Multi-product firms and exchange rate fluctuations. *American Economic Journal: Economic Policy*, *5*(2), 77–110.

De Loecker, J., & Goldberg, P. K. (2014). Firm performance in a global market. *Annual Review of Economics*, *6*(1), 201–227.

Dhingra, S., & Morrow, J. (2018). Monopolistic competition and optimum product diversity under firm heterogeneity. *Journal of Political Economy* **(forthcoming)**.

Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade. *Journal of International Economics*, *9*(4), 469–479.

Li, H., Ma, H., & Xu, Y. (2015). How do exchange rate movements affect Chinese exports? A firm-level investigation. *Journal of International Economics*, *97*(1), 148–161.

Marshall, A. (1890). *The principles of economics*, 1st edn. London: Macmillan

Mayer, T., Melitz, M. J., & Ottaviano, G. I. P. (2014). Market size, competition, and the product mix of exporters. *American Economic Review*, *104*(2), 495–536.

Mayer, T., Melitz, M. J., & Ottaviano, G. I. P. (2016). Product mix and firm productivity responses to trade competition (Working Paper 22433, National Bureau of Economic Research). https://doi.org/10.3386/w22433.

Melitz, M. J., & Redding, S. J. (2014). Heterogeneous firms and trade. In E. Helpman, K. Rogoff, & G. Gopinath (Eds.), *Handbook of international economics* (Vol. 4, pp. 1–54). Amsterdam: Elsevier.

Mrázová, M., & Neary, J. P. (2013). Not so demanding: Preference structure, firm behavior, and welfare. *Mimeo*. **(forthcoming)**.

Novy, D. (2013). International trade without CES: Estimating translog gravity. *Journal of International Economics*, *89*(2), 271–282.

Spearot, A. C. (2013). Variable demand elasticities and tariff liberalization. *Journal of International Economics*, *89*(1), 26–41.

Yilmazkuday, H. (2015). Pass-through of trade costs to U.S. import prices. *Review of World Economics*, *151*(4), 609–633.

Zhelobodko, E., Kokovin, S., Parenti, M., & Thisse, J.-F. (2012). Monopolistic competition: Beyond the constant elasticity of substitution. *Econometrica*, *80*(6), 2765–2784.