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Allocative efficiency, mark-ups, and the welfare gains from trade☆

Thomas J. Holmes [a,d,e,*], Wen-Tai Hsu [b], Sanghoon Lee [c]

[a] Department of Economics, the University of Minnesota, United States
[b] School of Economics, Singapore Management University, Singapore
[c] Sauder School of Business, the University of British Columbia, Canada
[d] Federal Reserve Bank of Minneapolis, United States
[e] The National Bureau of Economic Research, United States

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ABSTRACT

This paper develops an index of allocative efficiency that depends upon the distribution of mark-ups across goods and is separable from an index of standard Ricardian gains from trade. It determines how changes in trade frictions affect allocative efficiency in an oligopoly model of international trade, decomposing the effect into the *cost-change channel* and the *price-change* channel. Formulas are derived shedding light on the signs and magnitudes of the two channels. In symmetric country models, trade tends to increase allocative efficiency through the cost-change channel, yielding a welfare benefit beyond productive efficiency gains. In contrast, the price-change channel has ambiguous effects on allocative efficiency.

1. Introduction

When mark-ups are the same across all goods, first-best allocative efficiency is attained. The condition that the price ratio equals the marginal cost ratio, for any pair of goods, holds because the constant mark-ups in prices cancel out. In this paper, we develop an index W^A of allocative efficiency that can be calculated when mark-ups *differ* across goods, and the first-best *is not* attained. We focus on how international trade influences W^A. In particular, we distinguish effects on allocative efficiency from standard Ricardian gains from trade, which we account for through how trade affects an index of productive efficiency W^{Prod}. Our key result is a decomposition of the effect on allocative efficiency W^A into what we define as the *cost-change channel* and the *price-change channel*. The decomposition is useful because each channel has an intuitive formula that makes it possible to discuss conditions determining sign and magnitude of the trade elasticity of W^A. In important limiting cases, both terms are zero, and effects of international trade on W^A can be safely ignored. In general, however, the two terms are not zero, and the effect on allocative efficiency can be a significant component of the overall welfare analysis of trade.

Consider how W^A changes when a friction τ impeding trade between countries is *reduced*. To determine the cost-change channel, we evaluate the effect of lower τ on mark-ups, taking into account effects on costs, but leaving prices fixed. Only costs of imported goods are affected by lower τ. Thus, holding prices fixed, lower τ raises mark-ups on imported goods. To determine how this change affects allocative efficiency W^A, the formula for the cost-change channel compares mark-ups for imported goods, with the average mark-up (foreign and domestic goods combined). Suppose, for example, that mark-ups on foreign goods are initially less than average. If τ is lowered, then holding prices fixed, mark-ups on foreign goods will increase closer to the average mark-up through the cost-change channel, attenuating the initial distortion.

In the limiting case where the friction is small and countries are symmetric, the cost-change channel for the effect on W^A goes to zero, because mark-ups on imports and domestic goods are identical in the limit. The cost-change channel is also approximately zero in another limiting case where competing firms draw their productivities from a Pareto distribution, as is commonly assumed in the trade literature.[1] Holding fixed productivity draws, foreign firms incur trade costs that domestic firms do not, and everything else the same, this tends to lower mark-ups for foreign firms compared to domestic. However, foreign firms face a tougher selection process over productivity (since foreign firms must surmount the trade cost barrier), and everything else the same, higher productivity for the market leader raises mark-ups. Under the Pareto, these two offsetting forces cancel out, and

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* Corresponding author at: Department of Economics, 4-101 Hanson Hall, 1925 Fourth Street South University of Minnesota Minneapolis, MN 55455.

[1] A similar limiting case is when firms draw productivities from a fat-tailed distribution and the number of firms goes to infinity.

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mark-ups for imports are the same as overall, zeroing out the cost-change channel. The outcome is a consequence of the "fat-tailed" nature of the Pareto, which gives the selection effect great force.[2] If instead we use a distribution with less of a fat tail, like the log-normal, the selection effect no longer "keeps up" as an offsetting force. Everything else the same (e.g. a symmetric setup where foreign firms draw from the same productivity distribution as domestic firms), foreign firms tend to have lower mark-ups than domestic because of the friction, and the cost-change channel for the effect of a reduction in τ on W^A is strictly positive.

To understand the price-change channel, consider the effect of lower τ on allocative efficiency W^A, when we take into account how prices change but hold costs fixed. It turns out that in the two limiting cases just mentioned, the case of symmetry and negligible frictions, and the case where productivity draws are Pareto, the price-change channel is zero like the cost-change channel, and the overall effect of lower τ on W^A is zero. More generally the price-change channel is non-zero, and its sign and magnitude depend upon how mark-ups on goods whose prices decrease, when τ goes down, compare with mark-ups on goods whose prices remain the same. In symmetric cases, when demand tends to be inelastic, the price-change channel tends to be positive, and thereby reinforces the positive effect of lower τ that comes through the cost-change channel. In our numerical analysis, the combined effects of the two channels can be large, and the effect of τ on W^A can be of the same order of magnitude to the effect on W^{Prod}. In contrast, when demand is elastic, the price-change channel tends to be negative, and in some cases can more than offset the positive effect from the cost-change channel. In these cases, allocative efficiency actually falls as trade frictions decline, as firms are less able to harmonize their mark-ups around the simple monopoly mark-up.

Our motivation for decomposing the effect on W^A into cost and price channels is analogous to the motivation for the textbook decomposition of the price effect of demand into income and substitution effects. In our case, as in the textbook case, the decomposition sheds light on the fundamental economic forces at work. Furthermore, we obtain results concerning when the two effects work in the same direction, and when they work in different directions. These results can help sign the overall effect, much the same way a discussion of the income and substitution effects can be employed to sign the overall effect of price on demand. Finally, as noted earlier, in important special cases we can use the formulas to zero out both terms.

Our paper builds on long understood ideas about allocative efficiency. In particular, Robinson (Ch 27, 1934) showed that if there is a constant mark-up across all goods, first-best efficiency is achieved. The literature on the theory of the second best (e.g. Lipsey and Lancaster (1956–1957)) made the point that making one sector more competitive potentially reduces welfare if there already exists monopoly distortions elsewhere in the economy. Based on the insights of this old literature, it is clear that while increased trade might have "pro-competitive" effects of reducing mark-ups, the effect of trade on allocative efficiency will not necessarily be positive. Epifani and Gancia (2011) is a recent paper highlighting this point.

Our analysis is conducted in an oligopoly model of international trade where firms compete "head-to-head" in a Bertrand fashion, as in Bernard et al. (2003) (hereafter BEJK), and Atkeson and Burstein (2008).[3] Our model is the same as BEJK, with BEJK making a particular functional form assumption for the productivity distribution. BEJK show in their setup that the mark-up distribution is the same for imports as it is for domestic goods, and that changes in trade frictions do not affect the distribution of mark-ups. The BEJK productivity distribution has a fat-tailed shape, and the cost-change and price-change channels are both zero, for how τ affects W^A, following our discussion above. Atkeson and Burstein (2008) and de Blas and Russ (2012) start with the BEJK model and show that with alternative assumptions on the distribution of productivity, foreign goods can have different mark-ups than domestic goods, and changes in trade frictions can affect the overall distribution of mark-ups. Our work is different from these papers, in our focus on allocative efficiency.

Recently, Edmond et al. (2012) consider a similar model and examine gains from trade achieved through the "pro-competitive" effect of how trade changes the distribution of mark-ups. The paper provides a quantitative analysis, with model parameters pinned down with Taiwanese manufacturing data. Epifani and Gancia (2011) also consider a similar model, and present a formula for allocative efficiency in the special case where the mark-up distribution is log-normal. The key differences between both of these papers and our paper are (i) our general definition of allocative efficiency, (ii) how we decompose the effects of trade on allocative efficiency into the cost-change and price-change components, and (iii) how we use the decomposition to shed light on the potential signs and magnitudes of the pro-competitive effect.

In a recent paper, Arkolakis et al. (2012a) hereafter ACR, derive a condition summarizing the welfare gains from trade that is applicable in a variety of models, including BEJK. The condition depends upon the volume of observed trade. For example, in the ACR framework, a necessary condition for trade to have welfare effects is that there be positive trade flows. By focusing on the fat-tailed productivity draws included in the BEJK setup, for which the mark-up distribution is invariant to trade, the ACR approach shuts down any possibility of welfare effects through allocative efficiency. All welfare effects go through a *productive efficiency index* W^{Prod}. If instead we consider productivity distributions without a fat tail, then in general trade will affect both productive efficiency W^{Prod} and allocative efficiency W^A. In the end, if observed trade volume is zero, the ACR formula will determine that trade leads to no gains in W^{Prod}. However, even if there are no observed trade flows, the possibility of trade can affect the mark-up distribution, and hence overall welfare through W^A.[4]

There are now several models of monopolistic competition where trade affects mark-ups, including Melitz and Ottaviano (2008) and Behrens and Murata (2012).[5] Arkolakis et al. (2012b) is particularly relevant as it generalizes the monopolistic competition version of the ACR framework to capture what they refer to as "the elusive pro-competitive effects of trade." The economics of the pro-competitive effect is very different in a monopolistic competition model than it is in the oligopoly model we consider. In monopolistic competition, a change in the trade friction only affects a domestic firm through general equilibrium effects that might shift or rotate the firm's demand curve. Depending on assumptions about the shape of the utility function, monopoly demand can become more or less elastic, and domestic mark-ups can go down or up. In contrast, in a Bertrand environment, the pro-competitive force of trade operates at the level of the particular good, not through general equilibrium. If trade frictions are lowered, a domestic firm limit pricing on a foreign rival will directly have to lower price (and mark-up) to meet competition.

Using the techniques to estimate mark-ups recently developed by De Loecker and Warzynski (2012), one can apply the formula provided in this paper to micro data to decompose welfare into productive and allocative efficiency indices. For example, Goldberg et al. (2012) extend De Loecker and Warzynski's approach to study the effect of trade

[2] It is interesting to note a similar result in monopolistic competition models, e.g., Melitz and Ottaviano (2008) and Behrens et al. (forthcoming), that average markup is unaffected by changes in trade friction.

[3] Atkeson and Burstein (2008) focus on the Cournot version of their model, but also consider a Bertrand variant. See also Devereux and Lee (2001) and Neary (2003) for related Cournot versions.

[4] There is empirical evidence that the threat of competition from imports can influence domestic outcomes, even if in the end, imports don't come in. See Salvo (2010) and Schmitz (2005).

[5] See also Ottaviano et al. (2002) for a treatment in a regional context.