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Trade and growth with heterogeneous firms revisited

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ABSTRACT

In a recent paper, Baldwin and Robert-Nicoud (2008) explore the growth and welfare effects of trade liberalization in a model with firm heterogeneity that allows for endogenous growth and a diversity of innovation mechanisms. Their main welfare conclusion is that freer trade has an unambiguously positive static effect while the sign of the dynamic effect, stemming from the change in the growth rate of varieties, depends on the type of technology imposed for innovations. This paper revisits these conclusions. By carefully following algebraic expressions in the original work, we point at inaccuracies and explore their consequences. Our main finding is that the sign of the static effect is not always positive. Consumers may experience an immediate loss from openness if the value of the firms they own decreases due to greater import competition. Moreover, the sign of the static effect on expenditure is always the opposite to that of the dynamic effect stemming from variety growth, so the results presented here highlight the existing tension between static and dynamic effects. Our results speak to the most recent literature on welfare effects in trade models.

1. Introduction

The seminal paper of Melitz (2003) boosted a large literature on the welfare effects of trade in a context of firm heterogeneity. In the heterogeneous firm trade model (HFT from now on), greater import competition promotes intra-industry reallocation and efficiency gains. This, together with the decreased costs from imported goods pushes down the ideal price index in all integrated economies and, as a result, consumers' purchase power, and welfare, increases.

The work of Baldwin and Robert-Nicoud (2008, hereafter BRN) introduces endogenous growth, with different types of spillovers in the innovation process, into the Melitz model, enabling the evaluation of growth effects of freer trade. Their contribution also tackles welfare effects of trade and stresses that, besides the effects that the change in the growth rate can bring about, the reallocation of resources following openness may create externalities on consumers' income that can ultimately affect long term welfare. At equilibrium, aggregate expenditure equals permanent income which is comprised by income from labour plus the revenues from savings. Since the value of the stock of savings is altered by firm selection, revenues from those investments are affected with openness. The main welfare conclusions of that work are that the static welfare effect of greater openness is always positive and a sufficient condition for openness to be welfare enhancing is that it reduces the expected cost of producing a new variety which promotes growth.

However, welfare conclusions in BRN are based on ungrounded algebraic expressions. This paper proposes a revised version of the model and a new welfare analysis, carefully following the premises of the original model and exploring the implications of the new expressions found. Results presented here show that the static effect is not always positive as originally stated in BRN. While openness immediately reduces the price level due to efficiency gains à la Melitz, the static effect on total expenditure depends on how firm selection affects permanent income. A sufficient condition for the net static effect to be positive is that greater openness increases the average value of firms pushing up income and expenditure. But under this condition the dynamic effect is negative because it is harder for potential entrants to develop successful new varieties. I establish new conditions for the total welfare effect to be positive which depend on the cost of producing a new variety, the size of the economy and the innovation technology imposed.

The present contribution fits the recent debate on the importance of firm heterogeneity when evaluating welfare effects of trade (see Arkolakis et al.,2012 and Melitz and Redding,2015). Our results highlight the role that firm heterogeneity can play when a dynamic setting is considered. As is pointed below, most of the effects driving welfare results in the present model are absent if firms are assumed to be homogeneous.

Since the publication of BRN, many others have pursued the task of introducing growth mechanisms into the HFT model to evaluate

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welfare effects of openness (see for example Atkeson and Burstein, 2010, Buera and Oberfield, 2014, Sampson, 2014 or Perla et al., 2015). As discussed below, this literature incorporates firms' decisions on innovations to explain how openness impacts growth and welfare in a context of heterogeneity. Results in this paper show how a variety of welfare effects can be obtained at the aggregate level, in a simple model that abstracts from the complexity at the micro level of the current literature.

The rest of the paper is organized as follows. Section 2 provides a brief description of the model underlining each correction and modification proposed. Section 3 presents the growth effects of greater openness. Results in this section remain mostly unchanged with respect to those in BRN with only one of the possible cases presenting modified conclusions. Section 4 constitutes the main part of this paper as it details the revised welfare conclusions stemming from the model. In Section 5 we contrast the new welfare results presented here with some of the most important works that emerged in the literature. A final section concludes. The reader can find a full description of the model in the Appendix.

2. The model

In our model time is continuous and the world economy is composed by two symmetric regions, each endowed with L workers who inelastically supply one unit of labour at every moment in time. Labour can be devoted to the production of final consumption goods or intermediate knowledge goods. Different varieties of the consumption good are produced monopolistically by manufacturing firms with heterogeneous productivity in a setting that is similar to that in Melitz (2003). The innovation sector produces knowledge enabling the emergence of new consumption varieties over time as in the standard model of endogenous growth with expanding product varieties (Grossman and Helpman, 1991, section 3.2).

2.1. Consumers

Consumers have to make two choices. First, they need to choose how much to consume and save at each moment in time, i.e. they decide their optimal expenditure level $E(t)$. Then, they need to establish how to split their consumption among the different varieties of final goods available at each t. Welfare at t is defined as the present value of future consumption of the final good composite:

$$U(t) = \int_t^\infty e^{-\rho(s-t)} \ln\left(\frac{E(s)}{P(s)}\right) \mathrm{d}s \tag{1}$$

where $\rho > 0$ is the rate of pure time preference and $P(t)$ is the aggregate price index of the final good at t. At every moment in time t, consumers maximise Eq. (1) subject to the budget constraint $Y(t) = E(t) + S(t)$ where $S(t)$ are savings and $Y(t)$ is current income. Consumers obtain their income from two sources: earnings from labour and profits made by domestic firms they own, i.e. $Y(t) = w(t)L + \Pi(t)$. Wages are taken as the numeraire ($w = 1$). The optimality conditions that arise from this dynamic problem are a transversality condition and the following Euler equation (see the Appendix for details)

$$\frac{\dot{E}(t)}{E(t)} = r(t) - \rho \tag{2}$$

where $r(t)$ is the rate of return of savings.

Regarding their static problem, at each t consumers choose how much of their expenditure $E(t)$ is spent in each variety θ belonging to the set $\Theta(t)$ of available varieties in this economy (both produced domestically and imported). Consumers preferences over varieties are CES with $\sigma > 1$ as the constant elasticity of substitution between any two varieties. This means that the aggregate expenditure in final goods can be expressed as

$$E(t) = \left[\int_{\theta\in\Theta(t)} d(\theta,t)^{1-1/\sigma} \mathrm{d}\theta\right]^{1/(1-1/\sigma)} P(t)$$

where $d(\theta, t)$ is the demand for each variety θ at time t. With Dixit–Stiglitz competition in the market of final goods the price level of the composite of final goods is

$$P(t) = \left[\int_{\theta\in\Theta(t)} p(\theta,t)^{1-\sigma} \mathrm{d}\theta\right]^{1/(1-\sigma)} \tag{3}$$

where $p(\theta, t)$ is the price of variety θ at time t (see Dixit and Stiglitz, 1977).

2.2. Final good producers

Technology in the final good sector is represented by a linear cost function where labour is the sole input, there are no fixed costs and the marginal cost is constant for each firm. Potential entrants into final good production must incur in a sunk cost F_I to discover their marginal cost of production a which is drawn once from a probability density function $g(a)$ with cumulative distribution $G(a)$ and $0 \leq a \leq a_0$. Once they know how productive they will be if producing, firms may choose to sink two extra costs: one for selling products in the domestic market (F_D) and another one for doing so abroad (F_X). Each of these costs can be expressed as $F_i = \kappa_i P_K$ for $i = I, D, X$ where κ_i represents the cost in terms of knowledge of each activity and P_K is the price of knowledge. Besides the sunk costs, exporters also face an iceberg cost of $\tau \geq 1$ to sell abroad, which means that a final producer needs to send τ units of the good for one unit to reach the final destination. The fact that it is costless for producers to differentiate their product together with the fact that all varieties enter the demand symmetrically gives firms no incentive to produce a variety that is produced by a competitor so firms and varieties are matched one to one. This allows us to denote firms and varieties using θ or a indistinctly.

Once in production a firm continues to produce until they receive a negative shock that pushes them out of business. The exogenous rate at which firms are hit by this shock is denoted by $\delta > 0$.[1] After learning their marginal cost a firms face no further sources of uncertainty which implies that they can perfectly estimate their discounted stream of income.

Dixit–Stiglitz competition in the final good sector implies that each firm sets a price of

$$p(m) = \frac{m}{1 - 1/\sigma} \tag{4}$$

where m is the marginal selling cost of a final producer with marginal cost a. Then we have $m = a$ in the domestic market and $m = \tau a$ in the foreign market. The pricing rule in Eq. (4) implies each final producer has a mark-up over its sales of $1/\sigma$ so aggregate operating profits are $\Pi(t) = E(t)/\sigma$ and operating profits of a firm with selling cost m and market share $s(m, t)$ is $\pi(m, t) = s(m, t)E(t)/\sigma$.

[1] The introduction of an exogenous and strictly positive death rate for firms is the only departure we propose with respect to BRN. As will be clear in what follows, this modification does not alter greatly the expressions we obtain from the model as we can obtain the same expressions in BRN by setting $\delta = 0$. Nevertheless, introducing a death rate allows the model to reproduce firm selection as in Melitz (2003) and yields a tractable expression for welfare in the BGP that is comparable to that in the literature.