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13. July 2012

Online at <https://mpra.ub.uni-muenchen.de/38118/>  
MPRA Paper No. 38118, posted 14. July 2012 13:55 UTC

# Strategic Trade Policy in General Oligopolistic Equilibrium \*

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July 13, 2012

## Abstract

This paper studies how cross-sector strategic trade policy affects wages, country-wide profits, and welfare. I develop a simple model of two-country continuum-of-sectors general oligopolistic equilibrium. Demands are linear and sectors involve one domestic firm competing on quantity with its foreign rival, producing a homogeneous good within a home-market framework. Firms have constant marginal costs in using the unique production factor. Unit labor requirements differ across sectors but are common within sectors. Countries face resource constraints, so that foreign and domestic wages are simultaneously determined. Before firms compete, only domestic government can set trade policy. Respect to free trade, cross-sector protectionism damages foreign wage whereas it does not affect domestic wage. Except for the special case where sectors share the same technology, domestic country-wide profits benefit from small import tariffs whereas foreign counterpart is hit. Consequences on income distributions are derived. Domestic social welfare is unambiguously penalized, suggesting political-economy implications.

**Keywords:** Cournot Competition; General Oligopolistic Equilibrium (GOLE); Home-Market; Import Tariff; Income Distribution; Welfare

**JEL Codes:** D43; D51; F12; F13; L11; L13

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\*This paper is based on the second essay of my Ph.D. dissertation at the Marche Polytechnic University. I am deeply grateful to my supervisor, Luca De Benedictis, for invaluable guidance, encouragement, and discussions. I also wish to thank seminar participants at the Marche Polytechnic University for useful comments. Part of this work was carried out while I was guest researcher at the Kiel Institute for the World Economics (IfW) in 2012. I thank the IfW for kind hospitality and support during my stay, and in particular Harmen Lehment. I am also grateful to the *Deutsche Zentralbibliothek für Wirtschaftswissenschaften* for library facilities. Financial support from the *Ministero dell'Istruzione, dell'Università e della Ricerca* during the whole Ph.D. is gratefully acknowledged. Needless to say, any remaining error is my own responsibility. The usual disclaimer applies.

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# 1 Introduction

How does strategic trade policy affect wage rates, country-wide aggregate profits, and social welfare in general equilibrium? What policy should a (benevolent or not) government set? Strategic trade policy (henceforth STP) is a stream of economic research that by its nature is based on the strategic interaction among economic actors. Thus it requires to be analyzed by means of the tools of game theory and oligopolistic competition.<sup>1</sup> Most of theoretical and empirical applications of oligopoly have, for both tradition and technical difficulties, faced many different issues, by not considering factor markets (e.g., by normalizing factor rewards to unity) and putting the emphasis on purely partial equilibrium analysis, without considering the rest of the economy within a general equilibrium framework.<sup>2</sup> STP has not been immunized from this partial equilibrium approach.

Of course, partial equilibrium analysis of STP has been very comprehensive. It has provided numerous and interesting, even though contrasting, findings since the seminal intuition by [Brander and Spencer \(1981\)](#). This wide set of theoretical evidence has produced a fairly interest, not only by governments of large economies, for such kind of policies to intervene in international competition, by means of the use of export subsidies ([Brander and Spencer, 1985](#)), tariffs ([Brander and Spencer, 1984](#)), or any other trade policy instrument, such as R&D subsidies or quotas, aiming to affect and shift the profits of foreign firms.

Since the works by [Brander and Spencer \(1985\)](#) and [Spencer and Brander \(1983\)](#), many models on strategic competition have showed how the government intervention may be beneficial for a country, by providing a strategic market advantage to domestic firms in a sector, with the shifting of oligopoly rents from foreign firms. The traditional motivation for STP relies on the following argument: as long as there exists a strategic interaction between domestic and foreign firms, the (benevolent) government can maximize welfare<sup>3</sup> by using a credible pre-commitment on its policy before firms engage in a strategic competition, by giving to domestic firms the possibility to become Stackelberg leaders.

For example, within a framework of third-market Cournot competition, STP aims to lower

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<sup>1</sup>See [Helpman and Krugman \(1989\)](#) and the well-known survey of the literature by [Brander \(1995\)](#).

<sup>2</sup>See [Tirole \(1988\)](#) and [Vives \(2001\)](#) for excellent studies on oligopoly theory. [Neary \(2010\)](#) argues that oligopoly in international trade theory has not reached the same status of monopolistic competition because it has not been embedded within a general equilibrium framework. In fact, traditionally, international trade theory has been more interested in how sectors, good markets, and factor markets interact.

<sup>3</sup>For partial equilibrium models, welfare is given by standard measures such as consumer surplus, profits, and trade policy revenue.

the domestic firms' costs by means of an export subsidy,<sup>4</sup> inducing domestic firms to expand their production for any given foreign firms' production (Brander and Spencer, 1985). Hence, foreign rival firms see the expansion in the outputs of the domestic firms as a credible move. As outputs are strategic substitutes the foreign firm has to shrink its equilibrium output, inducing a shift of the oligopolistic rent from the foreign to domestic firms. This leads to a rise in domestic profits, which are able to offset the cost of policy implementation. For an import-competing country, an opposite policy (i.e., a tariff) should be set instead, under some conditions (Brander and Spencer, 1984).

However, these findings may be inaccurate, by overlooking possible general equilibrium feedbacks. Partial equilibrium frameworks implicitly assume that the sector under observation is the only one affected by STP such that it takes factor prices and aggregate income as given, and pays no attention to interactions among markets. The partial equilibrium approach may be appropriate when the focus is on a matter of a single sector. If one would like to analyze features of the entire economy instead (e.g., changes in social welfare and income distribution once trade policy is applied to many sectors), the partial equilibrium approach shows its weakness. In particular, if the STP affects a broad set of sectors, it is likely that linkages among sectors matter. These linkages can arise whether different sectors have to compete for scarce factors of production.

Hence, the STP literature suffers from a lack of a strong theoretical foundation in general equilibrium on which policymakers ought to rely any policy decision and to better understand the role played by STP.<sup>5</sup> The aim of this paper is to help in filling this gap in the literature, by modeling STP in a simple general equilibrium framework, in which both domestic and foreign firms demand one scarce factor of production in their respective factor markets and compete in the domestic country only (i.e., home-market framework). I opt for this simple framework to focus on the consumption of the domestic country having the possibility to affect strategic competition among firms. The factor rewards will play a key role in bringing the main theoretical findings because a cross-sector STP is able to affect the competition within

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<sup>4</sup>This is valid under certain conditions. See, e.g., Dixit (1984) and Horstmann and Markusen (1986) for details.

<sup>5</sup>Brander and Spencer (1984), like much economic literature, claimed that their model of STP could be embedded within a general equilibrium framework. They invoked the use of an additional perfectly competitive sector producing a composite "outside" good, which is used as numéraire (whose price is often normalized to unity) absorbing all income effects. As pointed out by Leahy and Neary (2011), the justification that the "outside" good plays a large role in factor markets relative to the oligopolistic sector under analysis is not sufficient to pass from a partial to a general equilibrium environment, given the assumed constancy in factor rewards (viz., the oligopolistic sector is not able to affect any factor market).

sectors, by indirectly influencing the demand of inputs, and thus general equilibrium feedbacks from factor markets can arise. As in many international sectors firms imperfectly compete, analyzing STP from a general equilibrium perspective seems to be useful and bring important policy implications.

To better illustrate the source of general equilibrium feedbacks, consider the following simple example from the [Dixit and Grossman \(1986\)](#)'s insight. Take a country in which two sectors compete for a single inelastically supplied factor of production, say labor. An expansion in production in the first sector (due to the STP in favor of domestic firms in that sector) have to necessarily shrink the availability of the factor of production for firms operating in the second sector. From a different viewpoint: the factor reward has to go up due to the rise in factor demand coming from firms receiving the government help. The increase in factor reward might offset the positive effects on market shares and thus firms' profits.

[Neary \(2003b;c\)](#) provides a framework overcoming the difficulties to build oligopolistic models in general equilibrium. I build a model along his lines, by using the general oligopolistic equilibrium (henceforth GOLE) approach. The main feature of this approach is that to assume a continuum of sectors, each with a small number of firms competing à la Cournot. Firms have market power in their sector, permitting them to affect the price of their output. Hence, they are able to strategically behave against their direct rivals in the sector. The Neary's key insight is that *firms are large in their own sector, but small in the economy as a whole*, so that they are not able to affect factor rewards because they are many (from different sectors) demanding scarce inputs, and they take other good prices and national income as given (viz., monopsony power and Ford effect are assumed away). This simple assumption permits to overcome the difficulties in embedding oligopolistic models in general equilibrium, by also addressing the factor markets. The recent and growing stream of economic research using the GOLE approach has been focusing on multiple issues, much of them related to international trade.<sup>6</sup> All these contributions, even though interesting, have not analyzed any STP issue.

As I have already recalled, in a general equilibrium framework, STP can potentially affect

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<sup>6</sup>See, for Ricardian trade models, [Neary \(2003a;b\)](#) and [Neary \(2009\)](#); for cross-border mergers, [Neary \(2007\)](#) and its empirical side by [Brakman et al. \(2007\)](#); for wage inequality and skill-premium, [Bastos and Straume \(2012\)](#) and [Neary and Tharakan \(2012\)](#); for multi-product firms, [Eckel and Neary \(2010\)](#), [Eckel et al. \(2011\)](#) and [Egger and Koch \(2012\)](#); for unions and unemployment, [Basile and De Benedictis \(2008\)](#), [Bastos and Kreickemeier \(2009\)](#), [Egger and Etzel \(2012\)](#), [Egger and Koch \(2012\)](#), [Egger and Meland \(2011\)](#), and [Kreickemeier and Meland \(2011\)](#). See also [Crettez and Fagart \(2005\)](#) on the Pareto efficiency of the GOLE, and [Koska and Stähler \(2011\)](#) for a different set up employing Cobb-Douglas preferences and two production factors (viz., capital to establish firms and labor to produce commodities), focusing on factor prize equalization.

factor rewards and, via general equilibrium feedbacks, its total effect on the economic variables of relevant interest for policies. Hence, governments need to take care of these benefits and costs connected to STP, and thus there might be room for potential welfare reductions. An argument on this point was put forward by [Dixit and Grossman \(1986\)](#) in their seminal paper. The authors asked which industries should be interested in receiving government support by means of the use of STP (viz., an export or production subsidy). Their key finding is that, within a third-country framework with many Cournot duopolies having constant marginal costs, free trade is optimal. Applying an export (or production) subsidy as prescribed by [Brander and Spencer \(1985\)](#) to all sectors aiming to move all firms towards their Stackelberg leadership points, aiming to move all domestic firms to their Stackelberg leadership points, it gives no help to anyone, by bidding up the domestic factor reward of the inelastically supplied factor of production by the same amount of the subsidy. They suggested to help specific sectors with the strongest potential in improving the domestic welfare and to discourage those with the weakest potential. Hence, it would appear that their work weakens profit-shifting motives for any STP. As [Dixit and Grossman \(1986\)](#) highlighted

*“Needless to say, the correct calculation of the choices of industries for targeted subsidies involves some subtle reasoning and quite demanding information. [...] Empirical information [...] is unreliable even for established industries, and nonexistent for emerging high-technology industries. The danger of errors in practical implementation seems substantial.”* (p. 240-241, emphasis added)

This motivates the use of a more practical uniform trade policy across sectors. In the exercises of comparative statics I focus on this more simple trade policy, for its manageability and to easily bring the intuition.

In the main part of their model, [Dixit and Grossman \(1986\)](#) worked up with a foreign factor reward exogenously given so that foreign firms do not face any resource constraint, by focusing only on the domestic labor market. They admitted the lack of a linkage between foreign factor reward and foreign production. In concluding their work, they briefly explain that to extend the model to a full two-country framework, by considering the foreign labor constraint, would weaken further profit-shifting motives for export subsidies. However, if a domestic trade policy is able to affect the production of both domestic and foreign firms by means of general equilibrium feedbacks, a framework with both domestic and foreign factor markets is more suitable to bring intuitions, as foreign firms will also modify their demands in

the foreign labor market in response to the domestic trade policy. If the foreign country is a perfectly symmetric counterpart of the domestic one, as usually assumed in international trade, one should explicitly consider a foreign fixed labor supply as well.

This is one of the model ingredient I address in this paper, by simultaneously and endogenously deriving factor rewards in both countries and bringing clear theoretically relevant findings.<sup>7</sup> I show how a simple uniform trade policy design, given by an import tariff applied to all sectors of the economy (independently by their welfare-enhancing potential), is able to raise country-wide aggregate profits, respect to a free trade scenario. I remark that this paper, differently for standard STP literature, does not focus on single-sector variables but on economy-wide aggregate ones. This trade policy design has, however, a drawback: it is harmful for social welfare. In general, this does not means that a government would not apply such trade policy. As I sketch in the last part of the paper, political-economy considerations are able to play a role in such policy design within the GOLE framework.

The paper is organized as follows. In the next section I give an overview of the main features of model and summarize the theoretical findings. In section 3 I embed the simplest possible model of STP within a GOLE framework to answer the research questions. Section 4 conducts exercises of comparative statics offering theoretical intuitions by using the developed model. Section 5 briefly discusses possible political economy implications. In Section 6 I conclude by summarizing the contribution, discussing policy implications and caveats, and suggesting some extensions of the model.

## 2 Overview

To begin with, since this is the first paper to use the GOLE approach to analyze STP issues, I could choose any relevant paper on STP as a building block reference. A complete answer to the research questions I pose in the opening paragraph would need to address many aspects on which builds a model of STP in general equilibrium, going beyond the aim of a single work. The literature on STP has shown that the optimal trade policy may differ with price or quantity competition changing from an export subsidy to an export tax (e.g., [Eaton and Grossman \(1986\)](#)), integrated or segmented markets (e.g., [Markusen and Venables \(1988\)](#)),

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<sup>7</sup>The paper by [Glass and Saggi \(1999\)](#) is close to mine for what concerns the model setup. They extend the [Dixit and Grossman \(1986\)](#)'s third-country model and explicitly work up with both domestic and foreign wage rates as endogenous, by analyzing the effects of FDI policies in general equilibrium.

and perfect or imperfect substitutability among goods (e.g., [Cheng \(1988\)](#)). [Horstmann and Markusen \(1986\)](#) looks at the technology side of STP, by assuming increasing returns to scale and free entry. Many other features have been considered in literature, and I will come back on this point in Section 6, by suggesting some possible extensions. In order to convey the intuition, I choose the way of simplicity instead of generality, by abstracting from many realistic features. The main goal of this paper is to focus on general equilibrium feedbacks, which rely on the linkage between STP and factor markets.

Similar to many studies on oligopoly and in line with the GOLE approach, I assume that the competition within markets is à la Cournot, by permitting to have a framework that comes in handy for comparability. The two classical approaches to model STP are the third-country framework, in which the importer (i.e., the third country) passively acts on imports, and the [Brander \(1981\)](#)'s segmented-market (or its home-market variation) framework. The former, since [Spencer and Brander \(1983\)](#), abstracts from consumers' welfare, so that there exists no domestic and foreign consumptions as domestic and foreign markets are not considered. This approach focuses on profit-shifting policy, by avoiding possible consumer surplus changes in both exporting countries. Thus the national welfare is given by the sum of firm profits, and, sometimes, summed to the worth of trade policy revenue. The latter approach, introduced by [Brander and Spencer \(1984\)](#) and [Dixit \(1984\)](#), considers domestic market and thus domestic firms' profits, trade policy revenue as well as domestic consumer welfare. In this framework, the shifting in profits from foreign to domestic firms can be obtained through an import tariff if the foreign firms were selling in the domestic market ([Brander and Spencer, 1984](#)).<sup>8</sup> The revenue from the duty and the increase in profits of domestic firms can more than offset the falling in imports due to the rise in consumer prices, however, a trade-off might raise.

For the paper's purpose, the latter approach appears to be suitable as I aim to take into account general equilibrium feedbacks from different factor markets, which are linked with STP, on domestic variables of interest, primarily the social welfare in a broader sense, not given by the firms' profits only. As pointed out by [Helpman and Krugman \(1989\)](#), the third-country framework is not adequate to obtain indication of policy.<sup>9</sup> Hence, I integrate the home-market framework with the concerns raised by [Dixit and Grossman \(1986\)](#) on the competition for scarce factors of production, by means of the GOLE approach. To highlight the role played by

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<sup>8</sup>The import tariff is an optimal trade policy under some conditions. Specifically, a not "too" convex inverse demand function and constant marginal costs are required, as I assume in this paper.

<sup>9</sup>Trade policy has been more involved to directly affect foreign firms by means of protectionist tools, such as tariffs and quotas, than to use export subsidies.



STP on wage rates, country-wide aggregate profits, and social welfare in general equilibrium, I build the simplest possible model, by eliminating all asymmetries between firms within any sector (viz., any domestic firm's productivity equals the foreign rival's one), and asymmetries among countries. However, I continue to consider cross-sector differences in production technologies, as in Neary (2003b;c). This asymmetry plays a key role in the analysis. The model considers only one factor of production, say labor, with constant returns to scale (i.e., a simple Ricardian technology). Unlike Neary (2003b;c), I work only with a continuum of monopolistic sectors in each country. Hence, in any sector there exists a duopoly once foreign firms are allowed to compete in the domestic country (i.e., one domestic firm and one foreign firm). This is done because for the paper's purpose it suffices to have strategic interaction among domestic and foreign firms, by abstracting from strategic interaction among firms of the same country. Firms in any sector are assumed to produce a homogeneous good.<sup>10</sup> Given the assumption of home-market framework, domestic firms are not allowed to export abroad (and thus in the foreign country). For simplicity, foreign firms export all their outputs to the domestic country.

As standard in literature, I focus on situations in which only the domestic government implements a STP. The foreign government behaves passively as the focus is not on a policy strategic game among governments. Trade policies are observed by both domestic and foreign firms. The game has two stages. Firstly, the domestic government takes the committing decision on setting trade policy on outputs produced by foreign firms.<sup>11</sup> Secondly, domestic and foreign firms strategically compete, by taking the government trade policy as given. The game is solved by backward induction reaching a sub-game perfect equilibrium. I remark that the goal is not to establish the optimal trade policy for each sector: this is already well-known from the voluminous past literature on STP. The focus is shifted on the effects of an economy-wide STP on wage rates, country-wide aggregate profits, and social welfare. For ease of notation and tractability of findings, I work up with both linear inverse demand and cost functions, a benchmark for many oligopoly settings. This improves the understanding of the model and it permits to have simple closed-form equations.

The main theoretical contribution is to derive a link between trade policy instrument used by domestic government (i.e., the import tariff) and wage rates in both countries. These links

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<sup>10</sup>Horizontal differentiation is not central to the paper's issues.

<sup>11</sup>Although in reality government intervention aiming to distort international trade by means of import tariffs (or export subsidies) are prohibited, other forms of intervention are still applicable under specified conditions. For example, this is the WTO's position. Hence, the model can isomorphically consider other trade barriers (e.g., custom procedures, licensing, or red-tape barriers).

permit to obtain general equilibrium feedbacks on country-wide aggregate profits and social welfare. The model provides new insights, summarized as follows. On the one hand, once wage rates are simultaneously determined, domestic wage rate is independent from the domestic trade policy, which is able to unambiguously and negatively affect the foreign wage rate instead. This general equilibrium feedback gives a competitive advantage to foreign firms. The economic intuition for this result relies on the fact that after setting an import tariff, there will be a decrease in outputs produced by foreign firms, which reduce their labor demand. However, for a small rise in import tariff, respect to a situation of free trade, the general equilibrium feedback is not sufficient to revert the rationale for STP to improve the domestic country-wide aggregate profits. On the one hand, except for an extreme case in which all sectors share the same technology, domestic country-wide aggregate profits benefit from protectionism whereas the foreign country-wide aggregate profits are negatively affected, respect to a free trade scenario. These findings have also consequences for income distributions in both countries. On the other hand, import tariff has a negative effect on social welfare as it increases the heterogeneity in good prices, depending on technological differences across sectors.

The GOLE approach provides a different viewpoint on the rationale for STP respect to previous works based on standard partial equilibrium frameworks. Specifically, the model captures the general equilibrium feedbacks from wage rates, which are endogenously and simultaneously determined, with the foreign wage rate negatively affected by import tariff. Furthermore starting from the [Dixit and Grossman \(1986\)](#)'s insight, this paper also addresses the importing-country consumption, to have a fully understand of STP effects. The bottom line for policy implications is that a small uniform import tariff applied to all sectors is able to raise domestic country-wide aggregate profits. However, this trade policy negatively affects social welfare, by increasing heterogeneity of good prices among sectors. A government ought not to overlook these effects in taking trade policy decisions.

### 3 Model

This section builds a simple model of STP and embeds it into a GOLE framework.<sup>12</sup> Before going into details of the model, I give a short informal description of the main ingredients. I Assume there are two perfectly symmetric countries, the domestic country and the foreign

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<sup>12</sup>A file for most of mathematical derivations is available from the author upon request.

country, which trade homogeneous goods. For brevity, I will focus on the domestic country's equations, in the understanding that similar equations hold for the foreign country, given the assumption of perfect symmetry. Asterisked variables refer to foreign ones, which are used when there is the need. On demand side, I assume a representative consumer having preferences over two homogeneous varieties of a continuum of goods in a linear demand structure. The GOLE approach is, however, isomorphic to a model in which a single sector involves a continuum of industries using labor as a *specific* factor of production, in line with [Dixit and Grossman \(1986\)](#). In the tradition of the GOLE literature, I refer to country-label variables. Hence, within a GOLE framework, one can say that labor is *country-level* specific. On supply side, in each sector one domestic firm competes with its foreign rival. I consider a linear technology with constant marginal costs, common to domestic firm and foreign firm operating in the same sector. After having specified the demand side of the model, I set up a static Cournot oligopoly model, by presenting the standard equilibrium outcomes for a single sector. The model considers only an inelastically supplied factor of production, say labor, whose market is competitive in both countries. As motivated below, no “outside” good is used to pin down both wage rates. I embed this single-sector building block into a GOLE framework, by giving equilibrium closed-form solution to wage rates, which are endogenously and simultaneously determined. Wage rates allow for deriving closed-form solutions of country-wide aggregate profits and social welfare in general equilibrium. In the next section, I use this apparatus to conduct exercises of comparative statics. Continuity and differentiability in relevant arguments are assumed for the introduced functions up to the necessary order.

### 3.1 Demand side

The domestic country is populated by a representative consumer endowed with  $L$  units of labor, inelastically supplied (for a positive wage rate) to a perfectly competitive labor market.<sup>13</sup> Preferences are represented by an utility function additively separable over a continuum of sectors of unit mass, indexed by  $z \in [0, 1]$ , strictly increasing and strictly concave, given by

$$(1) \quad U [\{X(z)\}] = \int_0^1 u [X(z)] dz ,$$

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<sup>13</sup>The perfect competition in labor market is plausible if many, or better a continuum of, sectors compete by demanding for workforce.

assuming  $u'[\cdot] > 0$  and  $u''[\cdot] < 0$ , with quadratic sub-utility functions involving two homogeneous varieties of each good, given by

$$(2) \quad u[X(z)] = aX(z) - \frac{b}{2} [X(z)]^2 ,$$

with  $a > 0$  and  $b > 0$ . In Eqs. (1) and (2),  $X(z) = x(z) + x^*(z)$ . Let  $x(z)$  and  $x^*(z)$  denote the consumption of good produced in sector  $z$  from the domestic and the foreign firm, respectively. The good produced in each sector is not substitutable with goods produced in any other sector.<sup>14</sup> Note that  $a$  is assumed constant both within and between sectors. This means that the model abstracts from any difference in product quality (i.e., vertical differentiation), so that all inverse demand functions have the same intercept. This is done to avoid including an unnecessary source of heterogeneity.

The representative consumer maximizes her utility function given by Eq. (1) subject to the budget constraint:

$$(3) \quad \max_{X(z) \in \mathbb{R}_+, z \in [0,1]} U[\{X(z)\}] \quad s.t. \quad \int_0^1 p(z)X(z)dz \leq I ,$$

with  $I$  the national income or total expenditure in the economy, and  $p(z)$  the price of good produced in sector  $z$ . As goods are homogeneous within each sector, the demand for any domestic variety equals that for the foreign one, thus  $p(z) = p^*(z)$  for each  $z \in [0, 1]$ .

For the moment I focus on a representative sector  $z$ , which forms the building block for the general equilibrium framework. Solving the consumer's problem<sup>15</sup> in Eq. (3) gives the linear inverse demand function for the interior optimal consumption of  $X(z)$ :

$$(4) \quad \lambda p(z) = a - bX(z) ,$$

with  $\lambda$  the Lagrangian multiplier of the budget constraint, and as usual it is interpretable like

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<sup>14</sup>This kind of preferences provides linear demand functions in own prices and quantities, therefore they are able to approximate market outcomes around their equilibriums, and it permits to work with simple closed-form solutions. This preferences structure guarantees existence and uniqueness of the equilibrium within sectors, providing downward-sloping firm reaction functions of firms in quantity space (viz., the quantities are strategic substitutes as required by Cournot competition). Quadratic preferences are quasi homothetic being a case of [Gorman \(1961\)](#)'s polar form, so that they can be aggregated across individuals with different incomes if they share the same demand parameter  $b$ , implying linear and parallel Engel curves ([Neary, 2003c; 2009](#)). This feature justifies the representative consumer approach.

<sup>15</sup>As sub-utility functions are strictly concave, the first order conditions for utility maximization are both necessary and sufficient.

the marginal utility of national income. I assume throughout that  $p(z) > 0$  and non satiation (that is,  $\lambda > 0$ ), so that there exists a strictly positive demand for each good. Hence, all goods are essential at any (finite) positive price. This setting guarantees interior solutions.

For sake of brevity and as I will use the marginal utility of national income as numéraire, I do not derive the closed-form expression for  $\lambda$ .<sup>16</sup> It suffices to say that the marginal utility of national income is endogenous and it depends on the economy-wide variables only: factor rewards, good price distribution (i.e., good prices in the other sectors), and national income.<sup>17</sup> This completes the demand side of the model. I turn next to analyze the firms' behaviors, technology, and partial equilibrium outcomes.

### 3.2 Supply side and partial equilibrium in home-market sub-games

The government is able to commit its trade policy in the first stage, before firms engage in competition. Hence, in each sector a two-stage game is involved. As usual, by means of the backward induction, I begin from the second stage. As most of oligopolistic frameworks, in each sector I assume away both firm entry-and-exit process<sup>18</sup> and any capacity constraint. Firms play a static one-stage game, in which they have complete information, not cooperatively compete à la Cournot in their sector, by choosing their own profit-maximizing output, taking as given the direct rivals' outputs, factor rewards, and trade policy instrument set by the domestic government.

The key assumption of the GOLE approach is that *firms are large in their own sector but small with respect to the economy as a whole* (Neary, 2003b;c). This implies that firms take  $\lambda$  as given in their production decisions as each firm is not able to affect factor rewards, good price distribution, and national income. Namely each firm *perceives* its inverse demand function as linear within a neighborhood of the equilibrium (Negishi, 1961).<sup>19</sup> Hence, I can set  $\lambda = 1$ , so that the Lagrangian multiplier will play the role of numéraire.<sup>20</sup> In general equilibrium all nominal variables should be interpreted as relative to the inverse of the marginal utility of

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<sup>16</sup>Dixit and Grossman (1986) include a low-technology “aggregate” sector, whose good plays the role of numéraire that is produced by only unskilled workers in a perfectly competitive market. As the unit labor requirement for unskilled workers in the numéraire sector is normalized to unity and the good price in that sector is also normalized to unity, the wage rate for unskilled workers is equal to one as well.

<sup>17</sup>Refer to Neary (2003b;c) for further discussion.

<sup>18</sup>A detailed analysis of the long run is beyond the scope of the present work.

<sup>19</sup>The Neary's insight permits to avoid the well-known problem of monopsony power in embedding oligopoly in general equilibrium.

<sup>20</sup>Gabszewicz and Vial (1972) is a key reference on the numéraire problem in oligopolistic models in general equilibrium.

national income (i.e., *real at the margin*). This is standard in the GOLE literature to simplify the exposition without affecting the analysis, as the absolute value of  $\lambda$  is undetermined in real world.<sup>21</sup> However, variables at the margin behave like real variables and this suffices to obtain fairly intuitions from the analysis. In what follows I refer to real variables in the understanding that they are real at the margin. To put it differently, during the exercises of comparative statics, the variations in the variables of interest are in term of real-income impact.

Labor,  $L$ , the sole factor of production, is free to move across all sectors without any cost, so that the wage rate is fixed at country level. However, labor is not able to cross national borders.<sup>22</sup> Firms in any sector operate under a common technology with constant returns to scale, therefore cost functions,  $c(z)$  and  $c^*(z)$ , are linear in the output (viz., firms use a simple Ricardian technology). There may exist sufficiently high fixed costs that induce the oligopolistic market structure within sectors, but as the number of firms is exogenously given, the fixed (sunk) costs have no role in this model (as long as firms make positive profits as I assume). Hence, I set to zero the fixed costs, so that across sectors firms differ only in their marginal (or variable) costs.

I work up with a home-market framework. Specifically, I assume that in each sector the domestic firm and foreign firm produce only for the domestic country's consumption. No domestic export and no foreign consumption is involved. In addition, all foreign firms export to the domestic country only. This setting is well-known from partial equilibrium analysis, which has highlighted how imposing an import tariff (to single sectors) would be welfare-enhancing for the domestic social welfare (given by domestic profits) in case of a linear demand structure and constant marginal costs, as I assume.<sup>23</sup> For simplicity, no transport cost is considered, so that prices charged by domestic and foreign firms in each domestic market will be same (i.e., no arbitrage possibility) as I have assumed same intercepts for inverse demand functions within each sector. I model the import tariff as specific (i.e., an amount  $t(z) \geq 0$  per each unit of good that is produced in sector  $z$  by foreign firm and exported to the domestic country).<sup>24</sup>

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<sup>21</sup>Real variables are homogeneous of degree zero in factor rewards, the inverse of the marginal utility of national income, and trade policy instrument. This fact solves the numéraire problem as scale effects are negligible. See [Neary \(2003b;c\)](#) and [Neary \(2009\)](#) for further discussion.

<sup>22</sup>Production factors are likely to be less free to cross national borders than goods. This is standard in international trade literature.

<sup>23</sup>See, e.g., [Brander and Spencer \(1984\)](#) and [Brander \(1995\)](#) for further details.

<sup>24</sup>In general, specific and ad valorem trade policies are not equivalent under imperfect competition. See, e.g., [Brander and Spencer \(1984\)](#) and [Helpman and Krugman \(1989\)](#) for further discussion. In the present model setting, however, an ad valorem tariff does not permit to go further with the modeling as it implies that both domestic and foreign firms' outputs become independent from the policy instrument once wage rates are endogenously determined. See also footnote 29 to this paper.

Even though for the moment I model the import tariff as sector-specific, in the exercises of comparative statics I focus on the more practical case of an import tariff common for all sectors.

Each domestic firm maximizes its own profits subject to the (perceived) inverse demand function in Eq. (4), taking the direct rival's output, any government trade policy as well as both domestic and foreign wage rates as given:<sup>25</sup>

$$(5) \quad \max_{y(z) \in \mathbb{R}_+, z \in [0,1]} \pi(z) \equiv [p(z) - c(z)]y(z),$$

with  $y(z)$  the output of the domestic firm in sector  $z$  to be sold in the domestic market. Similarly, each foreign firm solves

$$(6) \quad \max_{y^*(z) \in \mathbb{R}_+, z \in [0,1]} \pi^*(z) \equiv [p(z) - c^*(z) - t(z)]y^*(z),$$

with  $y^*(z)$  the output of the foreign firm in sector  $z$  to be exported in the domestic market. The linearity in the inverse demand and cost functions guarantee the stability and therefore the uniqueness of Cournot–Nash equilibrium in pure strategies, in which no firm has any incentive to deviate from the equilibrium.

I assume that each firm's marginal cost in sector  $z$  depends on the economy-wide, endogenously determined, and competitive wage rate  $w > 0$  ( $w^* > 0$  for foreign firms) and on a sector-specific unit labor requirement  $\beta(z)$ . Firms with a unit labor requirement equal to  $\beta(z)$  have to use  $\beta(z)$  labor units to produce one unit of output. I recall that in each sector the domestic firm and foreign firm share the same unit labor requirement. I can write firm unit costs as  $c(z) = w\beta(z) > 0$  and  $c^*(z) = w^*\beta(z) > 0$ . The continuum of sectors are ordered in terms of their unit labor requirements and I normalize the most “efficient” sector(s)'s unit labor requirements so that they need exactly one unit of labor to produce one unit of output. Hence,  $\beta(z) \geq 1$ .

By imposing the market clearing condition and deriving the first order conditions from firms' problems in Eqs. (5) and (6) yield the best response function for each firm in any sector.<sup>26</sup> I omit some simple derivations as they are standard. Solving the given system of first order conditions yields the Cournot–Nash equilibrium outputs for the domestic firm and foreign firm

<sup>25</sup>As firms take the marginal utility of national income as given, they do not consider in their production decisions both national income and the other good prices.

<sup>26</sup>In this setting, it is easy to check that second order conditions for interior solutions are satisfied as profits functions are strictly concave.

to sell in any domestic country's market:

$$(7) \quad y(z)^{CN} = \frac{a - 2w\beta(z) + w^*\beta(z) + t(z)}{3b}$$

and

$$(8) \quad y^*(z)^{CN} = \frac{a + w\beta(z) - 2w^*\beta(z) - 2t(z)}{3b}.$$

The superscript  $CN$  refers to Cournot–Nash equilibrium outcomes. The Cournot–Nash equilibrium profits for each domestic firm are given by the standard result in Cournot competition:  $\pi(z)^{CN} = b [y(z)^{CN}]^2$ . This result clearly applies to each foreign firm as well. I move now to the labor markets and general equilibrium part of the model.

### 3.3 Labor markets and general equilibrium

Assume, without any loss of generality, that total wage income and country-wide aggregate profits are costlessly distributed to the representative consumer (e.g., she provides all labor force in the domestic country and holds the shares of all domestic firms), who uses them for the current consumption. Assume further that import tariff revenue is returned to the representative consumer as a lump sum. As standard in STP literature, I assume that government trade policy revenue has the same weight in the national income as total wage income and country-wide aggregate profits. Hence, to keep simple the model, I abstract from distribution and efficiency considerations related to the government.<sup>27</sup> Thus, the national income is given by  $I = wL + \Pi + T$ , with  $\Pi \equiv \int_0^1 \pi(z)dz$  the country-wide aggregate profits, and  $T \equiv \int_0^1 t(z)y^*(z)dz$  the total government tariff revenue coming from all sectors that accrues to the representative consumer.

I close the model by deriving the domestic wage rate in general equilibrium as a function of exogenous variables only. Full employment in the labor market implies that the exogenous inelastic labor supply equals the total labor demand coming from all sectors:

$$(9) \quad L = \int_0^1 \beta(z)y(z)dz.$$

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<sup>27</sup>See, for example, Neary (1994) for a model considering a different weight of government trade policy revenue in the welfare function.



Substituting in Eq. (9) for the Cournot–Nash equilibrium domestic firm’s production from Eq. (7) and solving for the wage rate,  $w$ , by evaluating the integral, yields

$$(10) \quad w = \frac{a\mu_1^\beta + \text{cov}(t, \beta) - 3bL}{2\mu_2^\beta} + \frac{w^*}{2},$$

where

$$\mu_1^\beta \equiv \int_0^1 \beta(z)dz, \quad \mu_2^\beta \equiv \int_0^1 [\beta(z)]^2 dz, \quad \text{cov}(t, \beta) \equiv \int_0^1 t(z)\beta(z)dz.$$

The first two terms are the first and second uncentred moments of the distribution across sectors of unit labor requirement in each sector, respectively. The third term is the cross-sector uncentred covariance between the import tariff and the unit labor requirement in each sector.

Given the assumption of perfect symmetry between the two countries, so that  $L = L^*$ , one can similarly obtain the equilibrium foreign wage rate by plugging Eq. (8) into Eq. (9) considering  $y^*(z)$  instead of  $y(z)$ . This yields

$$(11) \quad w^* = \frac{a\mu_1^\beta - 2\text{cov}(t, \beta) - 3bL}{2\mu_2^\beta} + \frac{w}{2}.$$

One can observe that each country’s wage rate depends on the other country’s wage rate. Hence, I can simultaneously solve Eqs. (10) and (11). This yields to the two equilibrium wage rates in terms of exogenous variables and policy instrument only:

$$(12) \quad w = \frac{a\mu_1^\beta - 3bL}{\mu_2^\beta}$$

and

$$(13) \quad w^* = \frac{a\mu_1^\beta - 3bL - \text{cov}(t, \beta)}{\mu_2^\beta} = w - \frac{\text{cov}(t, \beta)}{\mu_2^\beta} \leq w.$$

The domestic wage rate does not depend on the domestic government policy instrument whereas the foreign wage rate negatively responds to a more protectionist policy as proxied by a rise in  $\text{cov}(t, \beta)$ , which is clearly and positively linked to a rise in any  $t(z)$  as well as a rise in each  $t(z)$  across all sectors, as I will consider in the next section.<sup>28</sup> Hence, more protec-

<sup>28</sup>One might think to immediately equalize the domestic and foreign wage rates given the assumption of symmetry between the two countries. In general, however, in each sector domestic production is different from foreign one due to the import tariff and the home-market framework. Equalizing wage rates would lead to a contradiction

tionism places a wedge between the two wage rates, by damaging foreign workers. This is due to the decrease in foreign productions (to be exported in the domestic country), which shrink the total labor demand in the foreign labor market when the domestic country becomes more protectionist, and therefore, for a fixed labor supply, the foreign wage rate has to decrease. One would have wage equalization without any STP, so that  $t(z) = 0$  in all sectors, so that  $cov(t, \beta) = 0$ . Hence, the foreign wage rate, by incorporating domestic trade policy influence, is able to bring its effects to country-wide aggregate profits in both countries and to domestic social welfare, as I will argue more in the next section.

## 4 Comparative statics

I now analyze the first stage, in which the domestic government is able to commit its trade policy. To simplify further, I assume throughout a uniform import tariff across all sectors, that is  $t(z) = t$  for each  $z \in [0, 1]$ , and therefore  $cov(t, \beta) = t\mu_1^\beta$ .<sup>29</sup> Hence, I assume away the first-best solution. There is a fairly natural reason for such simplification. One can think of the impossibility for the government to acquire all the necessary (and demanding) information about the structure of each single sector of the economy, in order to discriminate trade policies by sector (Dixit and Grossman, 1986). Thus the domestic government would opt for a one-size-fits-all policy. Hence,  $t$  is the variable of interest in deriving the consequences of a

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once labor markets are considered. In other words, setting  $w = w^*$  in Eqs. (7) and (8), and calculate the endogenous values for both wage rates, by means of the labor market clearing conditions as that of Eq. (9), would lead to different wage rates, contradicting the initial wage equalization. The home-market framework is a distinguishing feature of this model respect to the previous ones in the GOLE literature (analyzing different issues from those in this paper), using the segmented-market framework, in which domestic and foreign wage rates are assumed to be the same. See Bastos and Kreickemeier (2009), Bastos and Straume (2012), and Kreickemeier and Meland (2011).

<sup>29</sup>In case of a uniform trade tariff across sectors, even though an ad valorem form appears to be more appropriate, I retain the specific form because the model does not permit to consider an ad valorem tariffs, which would lead to both domestic and foreign firms' outputs in any sector to be independent from the policy instrument. For a cost-based tariff (Dixit and Grossman (1986) adopt a cost-based uniform subsidy), it is easy to show that domestic and foreign equilibrium firms' outputs in any sector are

$$y(z)^{CN} = \frac{a - 2w\beta(z) + w^*\beta(z)(1+t)}{3b} \quad \text{and} \quad y^*(z)^{CN} = \frac{a + w\beta(z) - 2w^*\beta(z)(1+t)}{3b},$$

with

$$w = \frac{a\mu_1^\beta - 3bL}{\mu_2^\beta} \quad \text{and} \quad w^* = \frac{a\mu_1^\beta - 3bL}{\mu_2^\beta(1+t)}.$$

Hence, in case of a uniform ad valorem tariff, a rise in  $t$  is able to (negatively) affect the foreign wage rate only, without any further implications for outputs and profits. Of course, the uniform specific tariff is skew across sectors, with a stronger impact on those sectors with lower production costs, but this model feature helps, however, in bringing the intuition.

marginal raise in cross-sector STP on wage rates, country-wide aggregate profits, and social welfare. A marginal raise in  $t$  is coherent with the fact that few, if any, countries aim to halt the foreign competition altogether. However, no country aims a full free trade. Note that a uniform import tariff does not aim to shift all domestic firms towards their own respective Stackelberg leadership positions. This means that the government's aim is to increase the domestic country-wide aggregate profits. Having determined the solutions for both wage rates, it is now possible to give closed-form solutions in general equilibrium to the endogenous variables of interest, namely country-wide aggregate profits and social welfare. Throughout the analysis, I implicitly assume that all foreign firms remain active after the imposing of any trade policy. For the paper's purpose, I focus on the situation moving from a free trade scenario, in which  $t = 0$ .

#### 4.1 Country-wide aggregate profits and income distributions

I begin by considering the effect of a rise in the uniform import tariff across all sectors on country-wide aggregate profits. Cournot–Nash equilibrium country-wide aggregate profits are given by

$$(14) \quad \Pi^{CN} = \int_0^1 b [y(z)^{CN}]^2 dz = \int_0^1 \frac{(a - 2w\beta(z) + w^*\beta(z) + t)^2}{9b} dz.$$

By substituting for Eqs. (12) and (13) into Eq. (14) one obtains country-wide aggregate profits in term of exogenous variables only:

$$(15) \quad \Pi^{CN} = \int_0^1 \frac{\left( a - 2 \frac{a\mu_1^\beta - 3bL}{\mu_2^\beta} \beta(z) + \frac{a\mu_1^\beta - 3bL - t\mu_1^\beta}{\mu_2^\beta} \beta(z) + t \right)^2}{9b} dz.$$

This permits to observe the impact of the general equilibrium feedback coming from the foreign wage rate, which is negatively affected by the uniform import tariff by domestic government. Hence, domestic trade policy gives an indirect advantage to the foreign firms by decreasing the foreign labor cost. The question is whether this indirect effect is able to overcome the direct and negative effect on foreign firms that relies on a small rise in the uniform import tariff, moving from a situation of free trade.

Squaring the numerator in Eq. (15), integrating over all sectors, and rearranging gives

$$(16) \quad \Pi^{CN} = \frac{bL^2}{\mu_2^\beta} + \frac{v^2(a+t)^2}{9b\mu_2^\beta},$$

with  $v^2 = \mu_2^\beta - [\mu_1^\beta]^2$ , the variance across sectors of the technology distribution. Namely one can interpret  $v^2$  as an index of technological diversification across all sectors.

Partially differentiating Eq. (16) with respect to  $t$  and valuating it at  $t = 0$  yields

$$(17) \quad \left. \frac{\partial \Pi^{CN}}{\partial t} \right|_{t=0} = \left. \frac{2v^2(a+t)}{9b\mu_2^\beta} \right|_{t=0} = \frac{2v^2a}{9b\mu_2^\beta} \geq 0.$$

From Eq. (17), country-wide aggregate profits at  $t = 0$  are strictly increasing in  $t$  only if  $v > 0$ . Hence, starting from a situation of free trade, a rise in  $t$  in all sectors enhances the domestic country-wide aggregate profits. In addition, as the domestic wage rate is not affected by the trade policy, a rise in  $t$  is also able to affect the income distribution by means of a rise in the share of domestic country-wide aggregate profits in the national income (net of  $T$ ), respect to a free trade scenario:

$$(18) \quad \left. \frac{\partial(wL/\Pi^{CN})}{\partial t} \right|_{t=0} = - \left. \frac{18bL(a\mu_1^\beta - 3bL)(a+t)v^2}{(9b^2L^2 + (a+t)^2v^2)^2} \right|_{t=0} = - \frac{18bL(a\mu_1^\beta - 3bL)av^2}{(9b^2L^2 + a^2v^2)^2} \leq 0.^{30}$$

An interesting case is that in which  $v = 0$ , which is called by Neary (2003b;c) as the *featureless economy*. In this extreme case, all sectors use the same technology. When  $v = 0$  there exists no role for a cross-sector trade policy aiming to increase the domestic country-wide aggregate profits by means of a rise in the uniform import tariff, and from Eq. (18) no effect is shown for the domestic income distribution.<sup>31</sup> This is similar to what happens in the Dixit and Grossman (1986)'s model, in which if all sub-sectors (i.e., industries) are symmetric, there is no advantage to target anyone of them. As for competition policy in Neary (2003b;c), the general equilibrium viewpoint permits a better understanding of the effects of trade policy when it is applied to all sectors of the economy.

One can see the trade policy effects from the perspective of the foreign country where reverse implications (although under a parameter condition) hold for the foreign country-wide aggregate profits. Taking similar calculations by using Eq. (8) yields

$$(19) \quad \Pi^{*CN} = \frac{bL^2}{\mu_2^\beta} + \frac{v^2(a-2t)^2}{9b\mu_2^\beta},$$

<sup>30</sup>The term  $(a\mu_1^\beta - 3bL)$  in Eq. (18) is strictly positive given the positivity for the domestic wage rate.

<sup>31</sup>I omit to comment further on the comparative statics concerning  $v^2$  and its effects on country-wide aggregate profits and (in the next subsection) social welfare as they are easy to check and already provided by Neary (2003b;c).

and partially differentiating Eq. (19) with respect to  $t$  and valuating it at  $t = 0$  yields

$$(20) \quad \left. \frac{\partial \Pi^{*CN}}{\partial t} \right|_{t=0} = \left. \frac{-4v^2(a-2t)}{9b\mu_2^\beta} \right|_{t=0} = \frac{-4v^2a}{9b\mu_2^\beta} \leq 0.$$

Eq. (20) is strictly negative at  $t = 0$  only if  $v > 0$ .<sup>32</sup> This clearly highlights the profit-shifting effect due to the cross-sector uniform import tariff by the domestic government. Note that this is an economy-wide profit-shifting, it is not relative to *all* single sectors as in standard partial equilibrium STP.<sup>33</sup> In other words, I am providing a rent extracting argument at an economy-wide level. As for the domestic country, in the special case of featureless economy, a rise in the uniform import tariff by the domestic government has no effect on the foreign country-wide aggregate profits. However, as domestic government has not incentive to be protectionist in the featureless economy (in order to raise domestic country-wide aggregate profits), the negative effect of an import tariff on foreign workers remains an ad-hoc case, presented only for the sake of completeness.

A final consideration is in order for the foreign income distribution when  $v > 0$ . As already stated, a rise in  $t$  is always negative for the foreign wage rate.<sup>34</sup> In this case, as just seen, also foreign country-wide aggregate profits are damaged by a rise in  $t$  (for  $0 \leq t < a/2$ ) as well as foreign total wage income, which shrinks when  $t$  raises. The net effect depends on which variation is greater. To see this, as for the domestic country, it is sufficient to calculate the ratio between the foreign total wage income and the foreign country-wide aggregate profits, given by

$$(21) \quad \frac{\partial (w^*L/\Pi^{*CN})}{\partial t} = - \frac{9bL \left( 9b^2L^2\mu_1^\beta + (a-2t)v^2 \left( (a-2t)\mu_1^\beta - 4(a\mu_1^\beta - 3bL - t\mu_1^\beta) \right) \right)}{(9b^2L^2 + (a-2t)^2v^2)^2}.$$

For the featureless economy (i.e., for  $v = 0$ ), the derivative is strictly negative for both  $t = 0$  and  $t > 0$ . For the more interesting case in which sectors are technologically different, the

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<sup>32</sup>Note that at a generic value of  $t > 0$ , the comparative statics on the foreign country-wide aggregate profits is a bit more complex. This is due to the term  $(a-2t)$  in Eq. (20). For  $0 < t < a/2$  the derivative is always negative (or zero if  $v = 0$ ). For  $t = a/2$  the derivative is always zero, independently whether  $v$  is positive or zero. Finally, and surprisingly, for  $t > a/2$  and  $v > 0$  the derivative is positive. This last case is due to the general equilibrium feedback (coming from the decrease in the foreign wage rate) that is stronger than the negative effect due to the uniform import tariff, inducing an expansion in the *country-wide aggregate* foreign production. Throughout the paper I focus on the more interesting situations in which  $t$  is relatively small or zero (i.e., free trade), therefore to the cases in which  $0 \leq t < a/2$ , although I also discuss the other cases.

<sup>33</sup>In fact, as already noted by [Dixit and Grossman \(1986\)](#), one cannot help all sectors of the economy when resource constraints matter.

<sup>34</sup>Note that  $\partial w^*/\partial t = -\mu_1^\beta/\mu_2^\beta$ . In the featureless economy (i.e., for  $v^2 = 0$ ) one has that  $\partial w^*/\partial t = -1/\mu_1^\beta$ .

denominator of Eq. (21) is clearly positive whereas the numerator depends on the specific values of exogenous variables. However, it is easy to see that for  $t \geq a/2$  the sign of the right hand side of Eq. (21) is always negative. This is clear: for  $t = a/2$  only the negative effect of a rise in  $t$  on the foreign total wage income matters; for  $t > a/2$  the negative effect of a rise in  $t$  on the foreign total wage income is strengthened by the increase in the foreign country-wide aggregate profits.<sup>35</sup> For  $0 \leq t < a/2$  no clear sign can be derived. A factor that contributes to the indeterminacy relies on the fact that the foreign wage rate (as thus foreign total wage income) is a linear function in  $t$  whereas the country-wide aggregate profits are concave in  $t$ . Hence, when  $v > 0$  I am not able to determine a clear implication of the effect of a rise in  $t$  on the foreign income distribution. I summarize in Table I the findings of the exercises of comparative statics thus far.<sup>36</sup>

Table I: The effect of a small rise in  $t$  on domestic and foreign wage rates, country-wide aggregate profits, and income distributions, moving from a situation of free trade (derivatives valued at  $t = 0$ ). In parenthesis the signs for derivatives valued at  $t > 0$ .<sup>a</sup>

$v^2 > 0$					
$w$	$\Pi^{CN}$	$wL/\Pi^{CN}$	$w^*$	$\Pi^{*CN}$	$w^*L/\Pi^{*CN}$
0 (0)	+(+)	-(-)	-(-)	-(?b)	? (?c)
$v^2 = 0$					
$w$	$\Pi^{CN}$	$wL/\Pi^{CN}$	$w^*$	$\Pi^{*CN}$	$w^*L/\Pi^{*CN}$
0 (0)	0 (0)	0 (0)	-(-)	0 (0)	-(-)

<sup>a</sup> A '+', a '-', and a '0' indicate a positive, negative, and no change, respectively.

<sup>b</sup> - if  $t < a/2$ ; 0 if  $t = a/2$ ; + if  $t > a/2$ .

<sup>c</sup> ? if  $t < a/2$ ; - if  $t = a/2$ ; - if  $t > a/2$ .

I turn next to the normative side of the analysis, by considering the effect of a small rise in  $t$  on social welfare.

## 4.2 Social welfare

As I use the representative consumer approach having quasi-homothetic preferences, the social welfare can be obtained by the indirect utility function. By inverting Eq. (4) one has the

<sup>35</sup>The term  $(a\mu_1^\beta - 3bL - t\mu_1^\beta)$  in Eq. (21) is strictly positive given the positivity for the foreign wage rate.

<sup>36</sup>For correctness, in general the foreign variables should be valued by using the foreign marginal utility of foreign national income,  $\lambda^*$ , as unit of measure. Given the assumption of perfect symmetry,  $\lambda^* = \lambda$ . However, it is clear that the signs in Table I are not affected by changes in the unit of measure.

direct demand function for each good. Plugging these direct demand functions into Eq. (2) and integrating over all sectors, one obtains the indirect utility function. I adopt a transformed version of indirect utility function (abstracting from constants) given by  $V = -\mu_2^p$  with  $\mu_2^p = \int_0^1 [p(z)]^2$ , which is the uncentred second moment of the price distribution across all sectors. This means that the representative consumer dislikes differences in prices across sectors.

I need to express  $\mu_2^p$  in terms of exogenous variables only. To do so, I substitute the formulations for the Cournot–Nash equilibrium outputs given by Eqs. (7) and (8) into Eq. (4). Then by using the endogenous formulations for both wage rates given by Eqs. (12) and (13), squaring, and integrating over all sectors, yields

$$(22) \quad V = -\frac{(2bL - a\mu_1^\beta)^2}{\mu_2^\beta} - \frac{v^2 (a + t)^2}{9\mu_2^\beta}.$$

It is immediate to see from Eq. (22) that welfare monotonically falls (although not strictly) as  $t$  raises:

$$(23) \quad \left. \frac{\partial V}{\partial t} \right|_{t=0} = -\left. \frac{2v^2(a + t)}{9\mu_2^\beta} \right|_{t=0} = -\frac{2v^2a}{9\mu_2^\beta} \leq 0.$$

Hence, a domestic (benevolent) government that aims to maximize the country's social welfare should set  $t = 0$ , opting for free trade for all sectors.

The rationale for this finding, which goes against the imposition of any import tariff, relies on the fact that a rise in  $t$  increases good prices in some sectors and decreases good prices in other sectors. As the measure of social welfare depends on the uncentred second moment of the price distribution, it is clear that a more protectionist policy across all sectors by the domestic government raises the heterogeneity in prices across sectors, with a negative effect on social welfare. In the following subsection I explain in more detail the nature of this result.

### 4.3 The underlying mechanism: technological heterogeneity across sectors

To better see the origin of the finding on social welfare exposed above, it is sufficient to check what happens to the total production (the domestic plus the foreign one) in any sector  $z$  with a

rise in  $t$ . In any sector  $z$  it holds that

$$(24) \quad \frac{\partial (y(z) + y^*(z))}{\partial t} = \left( \beta(z) \frac{\mu_1^\beta}{\mu_2^\beta} - 1 \right) / 3b.$$

The derivative in Eq. (24) can be either positive, zero, or negative. The sign depends on the value of  $\beta(z)$  with respect to the aggregate technological variables (i.e., the two moments of the technological distribution). For high values of  $\beta(z)$  (viz., for  $\beta(z) > \mu_2^\beta/\mu_1^\beta$ ), namely for sectors with a high labor demand per unit of output (or, under another viewpoint, for relatively inefficient sectors), the sign is positive. This means that in high-labor-requirement sectors, the prices would fall for a small rise in  $t$ . Conversely, for low values of  $\beta(z)$  (viz., for  $\beta(z) < \mu_2^\beta/\mu_1^\beta$ ), namely for sectors with a low labor demand per unit of output (or for relatively efficient sectors), the sign is negative. Hence, in low-labor-requirement sectors, the prices would go up for a small rise in  $t$ . Finally, for  $\beta(z) = \mu_2^\beta/\mu_1^\beta$ , the sign of the derivative is zero, therefore no output (and thus price) would change.

I remark that there is no room for any comparative advantage argument. There are differences in unit labor requirements only across sectors. Within sectors, any domestic firm and its foreign rival use the same technology. This means that in some sectors the government intervention, by means of a small rise in  $t$ , would help the foreign firms at the expense of domestic ones. And in other sectors reverse patterns would hold. Specifically, it is easy to see that in high-labor-requirement sectors, the government intervention decreases the domestic production, which, however, is more than offset by the increase in the foreign production, inducing an increase in the total production in the sector. Hence, in these sectors, the general equilibrium feedback coming from the foreign wage rate is larger than the direct effect of the import tariff the domestic government levies, by giving a net advantage to the foreign firms.<sup>37</sup> Reversely, in low-labor-requirement sectors, the government intervention expands the domestic production, which, however, is more than offset by the decrease in the foreign production, inducing a decrease in the total production in the sector. In this second case the general equilibrium

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<sup>37</sup>In these sectors, applying an import tariff damages domestic firms. Although I have limited the analysis to nonnegative import tariffs, an opposite policy should be applied. This is similar to the [Dixit and Grossman \(1986\)](#)'s implications in which sectors with low profit-shifting potential should be taxed. However, in my model a reverse policy would be a bit outlandish, because it involves to directly affect foreign firms, not the domestic ones. This would call for the application of an *import subsidy*. This means to directly help foreign firms so that to increase their labor demand in the foreign labor market, bidding up the foreign wage rate and indirectly penalize them. This appears a rather unconventional policy and it implies a targeted trade policy, which requires demanding information as already discussed.



feedback is smaller than the effect of the import tariff, therefore a net advantage accrues to domestic firms. In general, the impact of a small rise in  $t$  on any foreign firm's output is always twice (with opposite sign) the impact on its direct rival (i.e., the domestic firm). The same result holds after integrating across all sectors.<sup>38</sup> Hence, a small rise in  $t$  induces a reallocation of labor from high- to low-labor-requirement sectors in the domestic country, whereas in the foreign country the labor moves from low- to high-labor-requirement sectors.

Behind these underlying mechanisms, the technological heterogeneity across sectors plays a prominent role in bringing the theoretical implications. In fact, for the featureless economy the labor reallocation among sectors is nullified. This is similar to what Neary (2003b;c; 2009) highlights about the efficacy of competition policy. Then, by integrating across all sectors the right hand side of (24) yields to the following aggregate condition:

$$(25) \quad \int_0^1 \left[ \left( \beta(z) \frac{\mu_1^\beta}{\mu_2^\beta} - 1 \right) / 3b \right] dz = \left( \frac{[\mu_1^\beta]^2}{\mu_2^\beta} - 1 \right) / 3b \leq 0.$$

The right hand side of Eq. (25) is negative only if  $v > 0$ . In fact, except for the featureless economy, one always has that  $[\mu_1^\beta]^2 / \mu_2^\beta < 1$ , implying that the sum of changes across all sectors shrinks with a rise in  $t$ . The finding that more protectionism is able to hit social welfare has implications for political economy, as briefly discussed in the next section. As any good price is linked linearly and negatively with the aggregate production in any sector, reverse implications would hold for aggregate price indexes like that in the inverse utility function,  $V$ , that is  $\mu_2^p$ . Namely, when  $t$  raises  $\mu_2^p$  has to increase, damaging the social welfare.

The only case in which  $t$  does not negatively affect  $V$  is the special case of the featureless economy, with  $v = 0$ , and therefore  $[\mu_1^\beta]^2 / \mu_2^\beta = 1$ , implying that the sum of changes across all sectors goes to zero with a rise in  $t$ . In this extreme situation, the derivative in Eq. (23) would be always zero, valued at any value of  $t$ .

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<sup>38</sup>In fact, in any sector it holds that  $\partial y(z)/\partial t = \left\{ \left( -\beta(z) \mu_1^\beta / \mu_2^\beta \right) + 1 \right\} / 3b$  and  $\partial y^*(z)/\partial t = 2 \left\{ \left( \beta(z) \mu_1^\beta / \mu_2^\beta \right) - 1 \right\} / 3b$ .

## 5 Possible political-economy implications in a nutshell

Thus far the theoretical results show that the gains from an active trade policy by the domestic government, via a uniform import tariff across all sectors of the economy, accrue to aggregate profits only (even though some domestic firms would be hurt). At the same time, this trade policy would damage social welfare, namely the consumer well-being, and therefore free trade would be the (Pareto) efficient trade policy to achieve. What cross-sector trade policy should a government design? The model's implications would fit with the political-economy literature of trade policy. In this section I try to justify the call for a political-economy explanation of the why governments would use cross-sector import tariffs. In fact, on the one hand, domestic firms have an incentive to carry on lobbying (or advocacy) activities to persuade government to be protectionist. On the other hand, consumers, forming the electorate, have the possibility to exert the right to vote against a government that limits free trade, leading to a higher heterogeneity in prices across sectors, generating consumers' dissatisfaction. If, for example, the government puts different weights on different groups (i.e., consumers and entrepreneurs), it is in a standard trade-off situation.

For example one can think of a stylized political-economy model of trade protection (Hillman, 1989). Consider a domestic government aiming to maximize its own function, which is different from social welfare as defined in the previous subsection but it is related to it, given by

$$\max_t G \equiv \alpha f(V) + (1 - \alpha)g(\Pi),$$

potentially subject to some constraints (e.g., domestic political objectives, internal law, and international trade agreements). Let  $0 \leq \alpha \leq 1$  the government's care for consumers that acts as weight in the government's function,  $G$ . Let  $f(\cdot)$  and  $g(\cdot)$  monotonic functions of social welfare and country-wide aggregate profits, respectively. The former is linked with the number of votes whereas the latter is linked with financial support during political campaign in coming elections. Let  $f'(\cdot) < 0$  and  $g'(\cdot) > 0$ . With  $\alpha = 0$ , the government does not care about consumers' well-being, therefore it has an incentive to set a positive import tariff. With  $\alpha = 1$ , the government cares the consumers' well-being only, and it would choose free trade, by setting  $t = 0$ . For intermediate values of  $\alpha$  a small tariff would be set, by justifying an active intervention of government in markets.

Although this prototype specification (e.g., no timing is been considered) may incorporate

conflicting lobbying activities of different sectors, as for example in [Grossman and Helpman \(1994\)](#), the GOLE approach (and its focus on aggregate variables) can provide a different viewpoint on lobbying activities. One could assume the existence of only one interest group, the “aggregate lobbyist”, representing all firms in the economy (e.g., the National Association of Manufactures in the U.S. or the Keidanren in Japan). In this case domestic firms not cooperatively compete with foreign direct rivals in their respective sectors, but they would cooperatively compete (say act) across sectors against all foreign firms, by playing on the aggregate lobbyist in influencing the government towards policies threatening the foreign competition. Of course, one might think of more complex and realistic political-economy specifications to consider such scenarios, but a complete modeling goes beyond the spirit of the present paper, which is to simply crystallize the underlined insights of embedding STP in general equilibrium.

## 6 Concluding remarks

This paper has offered a simple model of strategic trade policy within a general oligopolistic equilibrium framework. The aim has been to analyze how a more active cross-sector trade policy, set by domestic government, affects wage rates, country-wide aggregate profits, and social welfare. Standard literature on strategic trade policy focuses on single markets, without taking into consideration factor markets and how they are affected by trade policies. Governments ought to look at general equilibrium scenarios to better understand trade policy effects on the economy as a whole. A first attempt was done by [Dixit and Grossman \(1986\)](#) for a third-country framework, analyzing the effects of export subsidies. In this paper I have addressed a different and complementary scenario, that in which an import-competing country is able to use cross-sector import tariffs. I have focused on the domestic country, by using an home-market framework, to directly consider the consumption side. I have embed this scenario within the recently available apparatus provided by the GOLE approach. Hence, this paper is also a first attempt to shape the GOLE literature towards STP issues in general equilibrium.

Domestic and foreign wage rates have been endogenously and simultaneously derived in equilibrium. The model has permitted to explore the effect of a small increase in import tariffs across all sectors, when the domestic government aims to increase country-wide aggregate profits respect to a free trade scenario, with domestic firms that are in strategic competition with their foreign direct rivals. The main theoretical findings advance the existing literature

by showing that the domestic wage rate is not affected by a rise in the uniform import tariff whereas the foreign wage rate is always damaged, by partially giving an advantage to foreign firms. However, this general equilibrium feedback does not suffice to revert the rationale for government intervention in helping domestic firms against foreign ones, moving from an initial situation of free trade. This kind of trade policy, however, has a strong drawback: it always hits social welfare. This finding calls for a political-economy extension of the model, as I have briefly suggested in the previous section.

However, some caveats are in order on the previous results. First, the results admittedly rest on simple model specifications of demand and cost functions, in the interest of analytical tractability and along the lines of GOLE literature. Further investigations are needed to fully address other relevant features missing in this paper. Here I indicate four additional research avenues in addition to the political-economy extension. Firstly, one might explicitly model within-sector heterogeneity in unit labor requirements as in [Neary \(2009\)](#)'s Ricardian model of international trade, giving room for a possible interaction between comparative advantages and strategic trade policy. Secondly, I have assumed a passive foreign government. As the strategic trade policy viewed here damages the foreign country, an extension considering foreign retaliation (e.g., via export subsidies by foreign government) is worth to highlight the robustness of policy implications of the model. Third, I have assumed perfect competition in labor markets. There is an increasing literature using the GOLE approach to address labor market imperfections (e.g., unemployment and unions) in open economy. It would be interesting to study strategic trade policy with these labor market issues by using the GOLE approach. All these three missing characteristics represent limits in interpreting the model implications. I have no excuse for this except that to keep simplicity. However, these features are important and interesting but considering them goes beyond the scope of the present paper. Nevertheless I hope my model has offered new and useful insights for strategic trade policy literature. Finally, as further suggestion for future research, the model might be modified to take into account strategic environmental policy in open economy within a general equilibrium framework.

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