Strategic Trade Policy in General Oligopolistic Equilibrium*

by Rudy Colacicco†
Marche Polytechnic University

February 28, 2013

Abstract

I study how cross-sector strategic trade policy affects wages, countrywide profits, and welfare. I develop a model of two-country general oligopolistic equilibrium with a continuum of sectors. Demands are linear and sectors involve one domestic firm competing with its foreign rival on quantity of a homogeneous good. Firms use a homogeneous labor with constant returns to scale. Unit labor requirements differ across sectors but are common within sectors. Countries face resource constraints, therefore foreign and domestic wages are simultaneously determined. Before firms compete, the domestic government can set trade policy. Relative to free trade, cross-sector protectionism reduces the foreign wage whereas it does not affect the domestic wage. Except for the special case where sectors share the same technology, domestic countrywide profits benefit from small import tariffs whereas the foreign counterpart is hit. The consequences for income distributions are also derived. Domestic social welfare is unambiguously penalized. Hence, the general equilibrium perspective on trade policy goes against the well-known clue of the theory of optimal duty in partial equilibrium and suggests 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

*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 wish to thank Peter Neary for useful suggestions and stimulating discussions. I also appreciate comments from Bruno Chiarini, Gaetano Alfredo Minerva, Andrea Presbitero, and seminar participants at the Marche Polytechnic University, Higher School of Economics (Moscow and Saint Petersburg), and participants at the 6th FIW Research Conference "International Economics" (Vienna). 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, in particular Harmen Lehment. I am 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.

†*Address for Correspondence*: Department of Economic and Social Sciences, Marche Polytechnic University, Piazzale Martelli 8, 60121 Ancona, Italy; e-mail: r.colacicco@univpm.it; tel.: (+39) 071 2207102.

1 Introduction

How does strategic trade policy affect wage rates, countrywide aggregate profits, and social welfare in general equilibrium? What policy should a (benevolent) 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.[1] Most of theoretical and empirical applications of oligopoly to international trade do not consider factor markets (e.g., by normalizing factor rewards to unity), putting the emphasis on purely partial equilibrium analysis, without considering the rest of the economy within a general equilibrium framework.[2] The STP literature has not been immunized from the pervasiveness of the partial equilibrium approach.

Partial equilibrium analysis of STP has been quite comprehensive though. It has provided numerous and interesting, even though contrasting, findings since the seminal contribution by Brander and Spencer (1981). This wide set of theoretical evidence has produced a good deal of interest, not only by governments of large economies, for policies influencing international competition, by means of the use of export subsidies (Brander and Spencer, 1985), tariffs (Brander and Spencer, 1984), or other trade policy instruments, 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 of strategic competition have shown how the government intervention may be beneficial for a country, by providing a strategic market advantage to domestic firms in a sector, extracting 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[3] by using a credible pre-commitment on its policy before firms engage in a strategic competition, by giving to domestic firms the advantage of becoming Stackelberg leaders.

For example, within a third-market framework with Cournot competition, STP aims to lower the domestic firms' costs by means of an export subsidy,[4] inducing domestic firms to expand their production for any given foreign firms' production (Brander and Spencer, 1985).

[1] See Helpman and Krugman (1989) and the well-known survey of the literature by Brander (1995).

[2] See Tirole (1988) and Vives (2001) for excellent studies on oligopoly theory. Neary (2003b; 2010) argues that oligopoly in international trade theory has not reached the same status of monopolistic competition because it has not been embedded in general equilibrium.

[3] For partial equilibrium models, welfare is given by standard measures such as consumer surplus, profits, and trade policy revenues.

[4] This is valid under certain conditions. See, e.g., Dixit (1984) and Horstmann and Markusen (1986) for details.

For this reason, foreign rival firms see the expansion in the outputs of the domestic firms as a credible threat. Since outputs are strategic substitutes, the foreign firm has to shrink its optimal output, inducing a shift of the oligopolistic rent from foreign to domestic firms. This leads to a rise in domestic profits, offsetting the cost of a policy implementation. For an import-competing country an opposite policy (i.e., a tariff) should be set instead, though 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 single sector in the short run. If one would 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 when 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.[5] The aim of this paper is to fill 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 focus on the domestic country consuming goods produced by both domestic and foreign firms, and having the possibility to affect the strategic competition. The factor rewards will play a key role in bringing the main theoretical findings. A cross-sector STP is able to affect the competition within sectors, by indirectly influencing the demand for inputs, and, in turn, general equilibrium feedbacks from factor markets can arise. Since in many international sectors firms imperfectly compete, analyzing STP from a general equilibrium perspective seems to be useful and likely to offer important insights on policy implications.

[5] Brander and Spencer (1984), like much of 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 fact that the "outside" good plays a large role in factor markets relative to the oligopolistic sector under analysis it is not sufficient to move from a partial to a general equilibrium set-up, given the assumed constancy in factor rewards (viz., the oligopolistic sector is not able to affect any factor market).

To better illustrate the source of general equilibrium feedbacks, consider the following simple example from Dixit and Grossman (1986). Take a country in which two sectors compete for a single inelastically supplied factor of production, say labor. An expansion in the production of one sector (due to the STP in favor of domestic firms in that sector) has to necessarily shrink the availability of the factor of production for firms operating in the other sector. To put it another way, 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 effect on the market shares of some firms, induce a reduction in other firms' market share, and reduce both firms' profits.

I explore this issue with a model built along Neary (2003b;c)'s 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. 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) in demanding scarce inputs, and they take other good prices and national income as given.[6] This simple assumption permits to have a theory of oligopoly in general equilibrium, by also addressing the factors 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.[7] None of these contributions has analyzed any STP issue.

As I have already recalled, in a general equilibrium framework, STP can potentially affect factor rewards and, via general equilibrium feedbacks, other economic variables of potential relevant interest for policies. For this reason, governments need to take care of these benefits and costs connected to STP. This point was put forward by Dixit and Grossman (1986). The authors asked which industries should be interested in receiving government support by

[6]This means that monopsony power is assumed away. Furthermore, Ford effect is not taken into account, implying that pricing decisions of firms are not able to affect national income and in turn their demand functions.

[7]See, for Ricardian trade models, Neary (2003a;b) and Neary (2009); for cross-border mergers, Neary (2007); for wage inequality and skill-premium, Bastos and Straume (2012) and Neary and Tharakan (2012); for multi-product firms, Eckel and Neary (2010) 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 (2012), and Kreickemeier and Meland (2012). See also Crettez and Fagart (2005) on the Pareto efficiency of the GOLE in case all of sectors are identical, 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.

means of the use of STP (viz., an export or production subsidy). The key finding of their analysis 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 a condition of Stackelberg leadership, gives no benefit 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 the profit-shifting argument of STP. Dixit and Grossman (1986, pp. 240-241) have highlighted, however, that

> "*[n]eedless 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"* (emphasis added).

This motives the use of a more practical uniform trade policy across sectors. In the exercices of comparative statics I restrict attention to this simple trade policy, for its manageability and clarity in confirming the substance of the intuition.

In the main part of their model, Dixit and Grossman (1986) worked up with an exogenously given foreign factor reward, so that foreign firms do not face any resource constraint. The analysis focuses 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 extending 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 models, one should explicitly consider a foreign fixed labor supply as well.

This is one of the model ingredient I put forward in this paper, by simultaneously and endogenously deriving factor rewards in both countries and bringing clear-cut theoretical find-

ings.[8] I show how a simple uniform trade policy design, given by an import tariff applied to all sectors of the economy (independently of their welfare-enhancing potential), is able to raise countrywide aggregate profits, relative to a free trade scenario. This paper, differently for the 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 mean that a government would not apply such trade policy. As I will 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 rest of this 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 as well as 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 to build 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), 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. To convey the intuition, I choose the way of simplicity instead of generality, by abstracting from many realistic features. The main goal

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

of this paper is to focus on general equilibrium feedbacks, which rely on linkages 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 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 or foreign consumption as domestic and foreign (competing) 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, which are 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 in turn domestic firms' profits, trade policy revenue as well as domestic consumer welfare. In such a framework the shifting in profits from foreign to domestic firms can be obtained through an import tariff if foreign firms were selling in the domestic market (Brander and Spencer, 1984).[9]

For the paper's purpose, the latter approach appears to be suitable as I aim to account for 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 simply given by firms' profits only. As pointed out by Helpman and Krugman (1989), the third-country framework in not adequate to obtain indication of policy.[10] 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 the STP on wage rates, countrywide 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, as I will show, a key role in the

[9]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. As a result, a trade-off might arise. 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.

[10]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.

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. As a result, 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 simply suffices to recognize strategic interaction among domestic and foreign firms, abstracting from strategic interaction among firms of the same country. Firms in any sector are assumed to produce a homogeneous good.[11] 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.[12]

As standard in literature, I focus on situations in which only the domestic government implements a STP. The foreign government passively behaves as the focus of this paper is not on a policy strategic game among governments.[13] 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.[14] Secondly, domestic and foreign firms strategically compete, by taking the government trade policy as given. The game is solved, as usual, by backward induction. 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, countrywide 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 permits to have simple closed-form equations.

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

[11] Horizontal differentiation is not central to this paper's issues.

[12] The reader could be concerned of a balance-of-trade issue for the domestic country. To put away in a simple fashion this concern, it would suffice to think of all sectors but one as manufacturing sectors and add a financial sector in which the domestic country has a surplus with respect to the foreign country.

[13] Notice that without any foreign retaliation, the simpler framework of home market, which I adopt here, suffices for the paper's aims. Adding the domestic exports, as done in a framework with segmented markets, will not affect the results.

[14] 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. Indeed, the World Trade Report 2012 (WTO, 2012) is dedicated to the growing importance of non-tariff measures. The model can isomorphically consider other trade barriers (e.g., custom procedures, licensing, red-tape barriers, or regulatory standards) aiming to reduce imports.

These links permit to obtain general equilibrium feedbacks on countrywide aggregate profits and social welfare. The model provides new insights, summarized as follows. Once wage rates are simultaneously determined, the domestic wage rate is independent of 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, with respect to a situation of free trade, the general equilibrium feedback is not sufficient to reverse the rationale for STP to improve the domestic countrywide aggregate profits. Except for an extreme case in which all sectors share the same technology, domestic countrywide aggregate profits benefit from protectionism whereas the foreign countrywide aggregate profits are negatively affected, with respect a free trade scenario. These findings also have consequences for the income distributions in both countries. Finally, import tariff has a negative effect on social welfare as it increases the heterogeneity in prices of goods, which depend on the technological differences among sectors.

The GOLE approach provides a different viewpoint on the rationale for STP relative 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 tariffs. Furthermore, starting from Dixit and Grossman (1986)'s insight, this paper also addresses the importing-country consumption, to have a full understanding of STP effects. The bottom line for policy implications is that a small uniform import tariff applied to all (or many) sectors is able to raise domestic countrywide aggregate profits. However, this trade policy negatively affects social welfare, by increasing heterogeneity in prices of goods. This means that the GOLE approach is able to revert the clue of the theory of optimal duty, as developed in the well-known partial equilibrium literature (Brander, 1981, Brander and Spencer, 1984). Hence, a government ought not to overlook these general equilibrium effects in taking trade policy decisions.

3 Model

This section builds a simple model of STP and embeds it into a GOLE framework.[15] 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 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 symmetry. Asterisked variables refer to foreign ones, which are used when there is the need. On the demand side, I assume a representative consumer having preferences over two homogeneous varieties of a continuum of goods in a linear demand structure.[16] On the 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 I will argue below, no "outside" good is used to pin down the wage rate in both countries. I embed this single-sector building block into a GOLE framework, by giving equilibrium closed-form solution to both wage rates, which are endogenously and simultaneously determined. Wage rates allow for deriving closed-form solutions of countrywide aggregate profits and social welfare in general equilibrium in term of exogenous variables. Continuity and differentiability in relevant arguments are assumed for the introduced functions up to the necessary order. In the next section, I use this apparatus to conduct exercises of comparative statics.

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.[17] Preferences are represented by a utility function additively separable over a continuum of sectors of

[15] A file for most of mathematical derivations is available from the author upon request.

[16] 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.

[17] The perfect competition in labor market is plausible if many, or better a continuum of, sectors compete by demanding for workforce.

unit mass, indexed by $z \in [0,1]$. The utility function is strictly increasing and strictly concave, given by

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

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

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

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 the good produced in sector z by the domestic and foreign firm, respectively. The good produced in each sector is not substitutable with goods produced in any other sector.[18] 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:

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

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

For the time being, I focus on a representative sector z, which forms the building block for the general equilibrium framework. Solving the representative consumer's problem[19] in Eq. (3)

[18] 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 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 latter feature justifies the representative consumer approach.

[19] Since sub-utility functions are strictly concave, the first order conditions for utility maximization are both

gives the linear inverse demand function for the interior optimal consumption of $X(z)$:

$$\lambda p(z) = a - bX(z)\,, \tag{4}$$

where λ stands for the Lagrangian multiplier of the budget constraint, and as usual it is interpretable like the marginal utility of the 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 the 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 λ.[20] It suffices to say that the marginal utility of national income is endogenous and it depends on the economy-wide variables only: goods prices distribution (i.e., goods prices in all sectors) and national income.[21] 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[22] and any capacity constraint. Firms play a static one-stage game, in which they have complete information, do 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 the 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

necessary and sufficient.

[20] 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. Since 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 equals the unity too. Hence, in their model, unlike here, all income effects are neglected as they flow into in the numéraire good.

[21] Refer to Neary (2003b;c) for further discussion and details.

[22] A detailed analysis of the long run is beyond the scope of the present work.

λ as given in their production decisions as each firm is not able to affect the goods prices distribution, factor rewards, and in turn national income. Namely each firm *perceives* its inverse demand function as linear within a neighborhood of the equilibrium (Negishi, 1961).[23] For this reason, I can set $\lambda = 1$, so that the Lagrangian multiplier will play the role of numéraire.[24] In general equilibrium all nominal variables should be interpreted as relative to the inverse of the marginal utility of 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 λ is undetermined in the real world.[25] 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.[26] 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, 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 (i.e., variable) costs.

I work up with a home-market framework. Specifically, in each sector the domestic and foreign firms produce only for the domestic country's consumption. Neither domestic export nor foreign consumption are 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

[23] Neary's insight permits to avoid the well-known problem of monopsony power in embedding oligopoly in general equilibrium.

[24] Gabszewicz and Vial (1972) is a key reference on the numéraire problem in oligopolistic models in general equilibrium.

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

[26] Production factors are likely to be less free to cross national borders than goods. This is standard in international trade literature.

costs as assumed here.[27] For simplicity, no transport cost is considered, so that prices charged by domestic and foreign firms in each domestic market will be the same (i.e., no arbitrage possibility) as I have assumed equal 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).[28] 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:[29]

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

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

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

subject to the Eq. (4), with $y^*(z)$ the output of the foreign firm in sector z to be exported in the domestic market.[30] 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 and foreign firms share the same unit labor requirement. I can write firm unit costs as

[27] See, e.g., Brander and Spencer (1984) and Brander (1995) for further details.

[28] 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 of the policy instrument once wage rates are endogenously determined. See also footnote 35 of this paper.

[29] Since firms take the marginal utility of national income as given, they do not consider in their production decisions both national income and the other goods prices.

[30] Since goods are homogeneous firms cannot pass-through trade cost on consumption prices. As a result, any trade barrier reduces profits of any foreign firm.

$c(z) = w\beta(z) > 0$ 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, for any sector z it holds that $\beta(z) \geq 1$.

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.[31] 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 to sell in any domestic country's market:

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

and

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

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: $\pi(z)^{CN} = b\left[y(z)^{CN}\right]^2$. 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 that, without any loss of generality, total wage income and countrywide 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. Thus the national income is given by $I = wL + \Pi + T$, with $\Pi \equiv \int_0^1 \pi(z)dz$ the countrywide 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.[32]

[31] In this setting, it is easy to check that second order conditions for interior solutions are satisfied as profits functions are strictly concave in the outputs.

[32] As standard in the STP literature, I assume that the revenue from government trade policy has the same weight in the national income as total wage income and countrywide aggregate profits. Hence, to keep simple the model, I abstract from distribution and efficiency considerations related to the government. However, for the paper's purpose this assumption plays no role. See, for example, Neary (1994) for a model considering a different weight

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:

$$L = \int_0^1 \beta(z) y(z) dz \,. \tag{9}$$

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

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

where

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

The first two terms are the first and the second uncentred moments of the distribution across sectors of unit labor requirements in each sector, respectively. The third term is the cross-sector uncentred covariance between import tariff and unit labor requirements in each sector.[33]

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 leads

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

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:

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

of government trade policy revenue in the welfare function.

[33] Notice that $cov(t,\beta) \geq 0$, being the sum (i.e., the integral) of the products of two terms, which can be either positive or null in this model (viz., $t(z) \geq 0$ and $\beta(z) \geq 1$), for any sector z.

and

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

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 $cov(t,\beta)$, which is 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.[34] Hence, more protectionism 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 to restore the equilibrium. One would have wage equalization without any STP, so that $t(z) = 0$ in all sectors and in turn $cov(t,\beta) = 0$. Hence, the foreign wage rate, by incorporating domestic trade policy influence, is able to bring its effects to countrywide aggregate profits in both countries and to the domestic social welfare, as I argue in more detail in the next section.

4 Comparative statics

I now analyze the first stage, in which the domestic government can set its trade policy. To simplify further, I will go on in assuming throughout a uniform import tariff across all sectors, that is $t(z) = t$ for each $z \in [0,1]$, and therefore $cov(t,\beta) = t\mu_1^\beta$.[35] Hence, I assume away the first-best solution. There is a fairly natural reason for such simplification. One can think of

[34] One might be tempted to equalize immediately 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 once labor markets are considered. In other words, setting $w = w^*$ in Eqs. (7) and (8), and calculating 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 (2012).

[35] 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 ad valorem tariffs, which would lead to both domestic and foreign firms' outputs in any sector to be independent of 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

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

the impossibility for the government to acquire all the necessary (and demanding) information about the structure of each single sector of the economy, 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 marginal raise in cross-sector STP on wage rates, countrywide 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 countrywide 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 countrywide 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 mostly restrict attention to the situation moving from a free trade scenario, in which $t = 0$.

4.1 Countrywide aggregate profits and income distributions

I begin by considering the effect of a rise in the uniform import tariff across all sectors on the countrywide aggregate profits, which, in the Cournot–Nash equilibrium, are given by

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

By substituting for Eqs. (12) and (13) into Eq. (14) one obtains Π^{CN} in terms of exogenous variables only:

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

with

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

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 in turn profits. 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.

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. As a result, domestic trade policy gives an indirect advantage to 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

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

with $v^2 \equiv \mu_2^\beta - \left[\mu_1^\beta\right]^2$, which is 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

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

From Eq. (17), the Cournot–Nash countrywide 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 countrywide aggregate profits. In addition, as the domestic wage rate is not affected by trade policy, it is easy to see that a rise in t is also able to affect the income distribution by means of the rise in the share of domestic countrywide aggregate profits in the national income (net of T), with respect to a free trade scenario:

$$\left.\frac{\partial\left(wL/\Pi^{CN}\right)}{\partial t}\right|_{t=0} = -\left.\frac{18bL\left(a\mu_1^\beta - 3bL\right)(a+t)v^2}{(9b^2L^2 + (a+t)^2v^2)^2}\right|_{t=0} = -\frac{18bL\left(a\mu_1^\beta - 3bL\right)av^2}{(9b^2L^2 + a^2v^2)^2} \leq 0\,.^{36} \tag{18}$$

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 countrywide 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.[37] This is similar to what happens in Dixit and Grossman

[36] The term $(a\mu_1^\beta - 3bL)$ at the numerator of Eq. (18) is strictly positive given the positivity for the domestic wage rate.

[37] I omit to comment further on the comparative statics concerning v^2 and its effects on the countrywide aggregate profits and (as shown in the next subsection) social welfare as they are easy to check and already provided by

(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)'s model, 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 also analyze the trade policy effects from the perspective of the foreign country, where reverse implications (although under a parameter condition) hold for the foreign countrywide aggregate profits. Taking similar calculations by using Eq. (8) yields

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

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

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

Eq. (20) is strictly negative at $t = 0$ only if $v > 0$.[38] This 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 STP in partial equilibrium.[39] 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 countrywide aggregate profits. However, as domestic government has not incentive to be protectionist in the featureless economy (to raise domestic countrywide 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 I have already stated, a rise in t is always negative for the foreign wage rate.[40] In this case, as just

Neary (2003b;c).

[38] Note that at a generic value of $t > 0$, the comparative statics on the foreign countrywide aggregate profits is a bit more complex. This is due to the term $(a - 2t)$ in Eq. (20). For $0 < t < a/2$ the partial derivative is always negative (or zero if $v = 0$). For $t = a/2$ the partial derivative is always zero, independently whether v is positive or zero. Finally, and more surprisingly, for $t > a/2$ and $v > 0$ the partial 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 *countrywide aggregate* foreign production. Throughout the paper I am most interested in 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 situations.

[39] In fact, as already noted by Dixit and Grossman (1986), one cannot help all sectors of the economy when resource constraints matter.

[40] 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 $\partial w^*/\partial t = -1/\mu_1^\beta$.

seen, also foreign countrywide aggregate profits are reduced 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 countrywide aggregate profits, given by

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

For the featureless economy (i.e., for $v = 0$), the partial derivative is strictly negative for both $t = 0$ and $t > 0$. For the more interesting case in which sectors are technologically different, the denominator of Eq. (21) is 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 countrywide aggregate profits.[41] 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 countrywide 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 1 the findings of the exercises of comparative statics thus far.[42]

[Table 1 about here]

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

[41] 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. Hence, it is easy to see that the second term within the square brackets at the numerator of Eq. (21) is the product of two negative terms (and a positive one, v^2) for $t > a/2$.

[42] For the sake of correctness, in general the foreign variables should be valued by using the foreign marginal utility of foreign national income, λ^*, as unit of measure. Given the assumption of symmetry, $\lambda^* = \lambda$. However, it is clear that the signs in Table 1 are not affected by changes in the unit of measure.

4.2 Social welfare

Since I adopt the representative consumer approach having quasi-homothetic preferences, the social welfare can be obtained by the indirect utility function. By inverting Eq. (4) yields the direct demand function for each good. Then, by plugging these direct demand functions into Eq. (2) and integrating over all sectors one obtains the indirect utility function. I use a transformed version of indirect utility function (abstracting from constants) given by $V = -\mu_2^p$ with $\mu_2^p \equiv \int_0^1 [p(z)]^2$, 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 μ_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

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

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

$$\frac{\partial V}{\partial t} = -\frac{2v^2(a+t)}{9\mu_2^\beta} \leq 0\,. \tag{23}$$

This result holds for any $t \geq 0$. Note furthermore that the right-hand side of Eq. (23) would be zero only if $v = 0$. 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. Since 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 raises the heterogeneity in the 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: sectors technologically heterogeneous

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 production plus the foreign one) in any sector z with a rise in t. In any sector z it holds that

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

The partial 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 in sectors with a high labor demand per unit of output (or, under another viewpoint, in relatively inefficient sectors), the sign is positive. This means that in sectors with a high unit labor requirement, 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 in sectors with a low labor demand per unit of output (or in relatively efficient sectors), the sign is negative. Hence, in sectors with a low unit labor requirement the prices would go up for a small rise in t. Lastly, for $\beta(z) = \mu_2^\beta/\mu_1^\beta$, the sign of the partial 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.[43] 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 that the direct effect of the import tariff that the domestic government levies, by giving a net advantage to the foreign firms.[44] Reversely,

[43] Even though domestic and foreign firms face different production costs due exclusively to differences in wage rates, the oligopolistic competition can prevent firms to leave the market in case of a relatively small cost disadvantage.

[44] In high-labor-requirement sectors, applying an import tariff reduces profits of domestic firms. Although I have limited the analysis to nonnegative import tariffs, an opposite policy should be applied. This is similar to 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. In other words, this would call for the application of an *import subsidy*. This means

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 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. As a result, 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.[45]

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, integrating across all sectors the right-hand side of Eq. (24) yields to

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

The right-hand side of Eq. (25) is negative only if $v > 0$. In fact, except for the featureless economy, one always has that $\left[\mu_1^\beta\right]^2/\mu_2^\beta < 1$, 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 I briefly discuss in the next section. Since 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 μ_2^p. Namely, when t raises, μ_2^p has to increase, reducing 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 $\left[\mu_1^\beta\right]^2/\mu_2^\beta = 1$, implying that the sum of changes in

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 also implies a targeted trade policy, which requires demanding information as I have already discussed. One might theoretically imagine to help all of foreign sectors but this policy would carry the problem connected to a very onerous public financing. Furthermore, a uniform policy of import subsidies would reduce the domestic aggregate profits even though it would improve social welfare. Indeed, this implication is due to the fact that a cross-sector policy of import subsidies can be seen as a substitute for a cross-sector competition policy.

[45] 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 $\partial y^*(z)/\partial t = 2\left\{\left(\beta(z)\mu_1^\beta/\mu_2^\beta\right)-1\right\}/3b$.

sectoral productions across all sectors goes to zero with a rise in t. In this extreme situation, as I have already discussed, the right-hand side of Eq. (23) would be always zero, for any $t \geq 0$.

5 Political economy implications in a nutshell

Thus far the theoretical results have shown 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 the aggregate profits only (even though some domestic firms would be hurt). At the same time, this type of trade policy would reduce social welfare, namely the representative consumer's well-being, and therefore free trade would be the (Pareto) efficient trade policy to achieve. What cross-sector trade policy will a government design? The model's implications fit with the political economy literature of trade policy. In this section I briefly 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 the incumbent government to be protectionist. On the other hand, representative consumer, forming the electorate, have the possibility to exert the right to vote against the government that limits free trade, leading to a higher heterogeneity in prices across sectors, and in turn generating consumer's dissatisfaction or a lower standard of living. If, for example, the government places different weights on different groups (i.e., representative consumer and entrepreneurs), it is in a standard trade-off situation.

For example, one can think of a stylized political economy model of trade protection, along the lines of Hillman (1982; 1989). Consider a domestic government aiming to maximize its own objective function. Although related to the function of the social welfare, V, which has previously been defined, the government's objective function is different from it. The government's problem is given by

$$\max_{t} \quad G \equiv \alpha f(V) + (1-\alpha) g(\Pi)\,,$$

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 representative consumer that acts as weight in the government's objective function, G. Let $f(\cdot)$ and $g(\cdot)$ monotonic functions of social welfare and countrywide aggregate profits as defined above, 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 consumer's well-being, therefore it has an incentive to set a positive import tariff. With $\alpha = 1$, the (benevolent) government cares about the consumer's well-being only, and it would intuitively choose free trade, by setting $t = 0$. For intermediate values of α a small tariff would be set, by justifying a politically motivated active intervention of government in markets.

Although this prototype specification (e.g., no timing has 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 also 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., the Keidanren in Japan, or the Businesseurope in the E.U.). In this case domestic firms do 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. One can 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 a GOLE milieu.

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 a domestic government, is able to affect wage rates, countrywide 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, in which an import-competing country is able to use cross-sector import tariffs. I have focused on the domestic country, by using a home-

market framework, to directly consider the consumption side. I have embedded 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.

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 countrywide aggregate profits relative 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 reduced, by partially giving an advantage to foreign firms. However, this general equilibrium feedback does not suffice to reverse 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 reduces social welfare. Hence, this paper reverses the much-quoted result obtained in partial equilibrum literature. This finding naturally calls for a political economy extension of the model, as I have briefly suggested in the previous section.

Some caveats are in order on the previous results. First, the model admittedly rests on simple 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 besides to the political-economy extension. Firstly, one might explicitly model asymmetric technologies among domestic and foreign sectors 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. Since the strategic trade policy analyzed here reduces the foreign country, an extension considering foreign retaliation (i.e., helping foreign firms to export) is worth highlighting the robustness of policy (and political economy) implications of the model, though, in this case the negative effect on the domestic social welfare is expected to be even worse. 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 in a GOLE framework. All these three missing characteristics represent limits in interpreting the model

implications. I have no excuse for this except that to keep simplicity. These additional features are, however, 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.

References

Basile, R., De Benedictis, L., 2008. Regional Unemployment and Productivity in Europe. Papers in Regional Science 87, 173–192.

Bastos, P., Kreickemeier, U., 2009. Unions, Competition and International Trade in General Equilibrium. Journal of International Economics 79, 238–247.

Bastos, P., Straume, O.R., 2012. Globalization, Product Differentiation and Wage Inequality. Canadian Journal of Economics 45, 857–878.

Brander, J.A., 1981. Intra-industry Trade in Identical Commodities. Journal of International Economics 11, 1–14.

Brander, J.A., 1995. Strategic Trade Policy, in: Grossman, G.M., Rogoff, K. (Eds.), Handbook of International Economics. North Holland, Amsterdam. volume 3 of *Handbook of International Economics*. chapter 27, pp. 1395–1455.

Brander, J.A., Spencer, B.J., 1981. Tariffs and the Extraction of Foreign Monopoly Rents under Potential Entry. Canadian Journal of Economics 14, 371–89.

Brander, J.A., Spencer, B.J., 1984. Trade Warfare: Tariffs and Cartels. Journal of International Economics 16, 227–242.

Brander, J.A., Spencer, B.J., 1985. Export Subsidies and International Market Share Rivalry. Journal of International Economics 18, 83–100.

Cheng, L.K., 1988. Assisting Domestic Industries under International Oligopoly: The Relevance of the Nature of Competition to Optimal Policies. American Economic Review 78, 746–58.

Crettez, B., Fagart, M.C., 2005. A Note on The Pareto Efficiency of General Oligopolistic Equilibria. Working Papers 2005-05. Centre de Recherche en Economie et Statistique.

Dixit, A.K., 1984. International Trade Policy for Oligopolistic Industries. Economic Journal 94, 1–16.

Dixit, A.K., Grossman, G.M., 1986. Targeted Export Promotion with Several Oligopolistic Industries. Journal of International Economics 21, 233–249.

Eaton, J., Grossman, G.M., 1986. Optimal Trade and Industrial Policy under Oligopoly. The Quarterly Journal of Economics 101, 383–406.

Eckel, C., Neary, J.P., 2010. Multi-Product Firms and Flexible Manufacturing in the Global Economy. Review of Economic Studies 77, 188–217.

Egger, H., Etzel, D., 2012. The Impact of Trade on Employment, Welfare, and Income Distribution in Unionized General Oligopolistic Equilibrium. European Economic Review 56, 1119–1135.

Egger, H., Koch, M., 2012. Labor Unions and Multi-Product Firms in Closed and Open Economies. Canadian Journal of Economics 45, 1456–1479.

Egger, H., Meland, F., 2012. Differences in the Degree of Unionization as a Source of Comparative Advantage in Open Economies. mimeo. University of Bergen.

Gabszewicz, J.J., Vial, J.P., 1972. Oligopoly "A la Cournot" in a General Equilibrium Analysis. Journal of Economic Theory 4, 381–400.

Glass, A.J., Saggi, K., 1999. FDI Policies under Shared Factor Markets. Journal of International Economics 49, 309–332.

Gorman, W.M., 1961. On a Class of Preferences Fields. Metroeconomica 13, 53–56.

Grossman, G.M., Helpman, E., 1994. Protection for Sale. American Economic Review 84, 833–50.

Helpman, E., Krugman, P.R., 1989. Trade Policy and Market Structure. MIT Press, Cambridge, Massachusetts.

Hillman, A.L., 1982. Declining Industries and Political-Support Protectionist Motives. American Economic Review 72, 1180–87.

Hillman, A.L., 1989. The Political Economy of Protection. Harwood Academic Publishers, Chur.

Horstmann, I.J., Markusen, J.R., 1986. Up the Average Cost Curve: Inefficient Entry and the New Protectionism. Journal of International Economics 20, 225–247.

Koska, O.A., Stähler, F., 2011. Trade and Imperfect Competition in General Equilibrium. CESifo Working Paper Series 3543. CESifo Group Munich.

Kreickemeier, U., Meland, F., 2012. Non-Traded Goods, Globalisation, and Union Influence. Economica (forthcoming).

Leahy, D., Neary, J.P., 2011. Palgrave Handbook of International Trade. Palgrave Macmillan. chapter Oligopoly and Trade. pp. 197–235.

Markusen, J.R., Venables, A.J., 1988. Trade Policy with Increasing Returns and Imperfect Competition : Contradictory Results from Competing Assumptions. Journal of International Economics 24, 299–316.

Neary, J.P., 1994. Cost Asymmetries in International Subsidy Games: Should Governments Help Winners or Losers? Journal of International Economics 37, 197–218.

Neary, J.P., 2003a. Competitive versus Comparative Advantage. The World Economy 26, 457–470.

Neary, J.P., 2003b. Globalisation and Market Structure. Journal of the European Economic Association 1, 245–271.

Neary, J.P., 2003c. The Road less Travelled: Oligopoly and Competition Policy in General Equilibrium. MIT Press, Cambridge, Massachusetts. chapter in Economics for an Imperfect World: Essays in Honor of Joseph E. Stiglitz. pp. 485–500.

Neary, J.P., 2007. Cross-Border Mergers as Instruments of Comparative Advantage. Review of Economic Studies 74, 1229–1257.

Neary, J.P., 2009. International Trade and General Oligopolistic Equilibrium. mimeo. University of Oxford.

Neary, J.P., 2010. Two and a Half Theories of Trade. The World Economy 33, 1–19.

Neary, J.P., Tharakan, J., 2012. International Trade with Endogenous Mode of Competition in General Equilibrium. Journal of International Economics 86, 118–132.

Negishi, T., 1961. Monopolistic Competition and General Equilibrium. Review of Economic Studies 28, 196–201.

Spencer, B.J., Brander, J.A., 1983. International R&D Rivalry and Industrial Strategy. Review of Economic Studies 50, 702–722.

Tirole, J., 1988. The Theory of Industrial Organization. MIT Press Books, The MIT Press, Cambridge, Massachusetts.

Vives, X., 2001. Oligopoly Pricing: Old Ideas and New Tools. MIT Press Books, The MIT Press, Cambridge, Massachusetts.

WTO, 2012. Trade and Public Policies: A Closer Look at Non-tariff Measures in the 21st Century. World Trade Report 2012.

Table 1: The effect of a small rise in t on domestic and foreign wage rates, countrywide aggregate profits, and income distributions.[a]

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

[a] A '$+$', a '$-$', and a '0' indicate a positive, negative, and no change, respectively. Values outside parenthesis for partial derivatives valued at $t = 0$ whereas values within parenthesis for partial derivatives valued at $t > 0$.

[b] $-$ if $0 \leq t < a/2$; 0 if $t = a/2$; $+$ if $t > a/2$.

[c] $?$ if $0 \leq t < a/2$; $-$ if $t = a/2$; $-$ if $t > a/2$.