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Abstract

Entry in a homogeneous Cournot-oligopoly is excessive if and only if there is business-stealing (Amir et al. 2014). The excessive entry prediction has been derived primarily for closed economies and using a welfarist benchmark. We extend this framework and allow for (1) horizontal FDI in a multi-period setting and (2) interest group-based government behaviour. Opening the market to greenfield investments from abroad tends to aggravate the entry distortion. Moreover, market opening may reduce welfare if a more pronounced entry distortion dominates the gain in consumer surplus. Finally, a government, which places sufficiently little weight on the interests of consumers, will object to market opening, even if welfare rises.

Keywords: Excessive Entry, Cournot-Oligopoly, Horizontal FDI, Political Support Function

JEL: D 43, D 72, F 21, L 13

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1. Introduction

Between 2002 and 2016, the stock of world-wide Foreign Direct Investments (FDI) relative to GDP has risen by about 60% (Carril-Caccia and Pavlova 2018). While this development has not been reflected in according variations in flows, greenfield investments have picked up again in 2018 (UNCTAD 2019). Moreover, many (consumer) goods have become more homogeneous, in that increasingly similar items are produced and sold in different countries. This implies that knowledge about production techniques or distribution networks gained in one country can be utilised in another location as well. In consequence, the fixed costs of setting up a further production site abroad are likely to be lower than the costs of entering the first, domestic market. Hence, the incentives to undertake horizontal FDI have increased.

The increased relevance of FDI occurred at the same time, at which goods markets have become less competitive and more oligopolistic. Head and Spencer (2017), for example, commence their call for greater attention to oligopolies in the analysis of trade by asserting that "Oligopoly is pervasive in our daily live." (p. 1415). This statement is accentuated by findings that concentration of industries has increased considerably in the United States in recent decades (Autor et al. 2017, Grullon et al. 2019), and hardly declined in European Union (Gutiérrez and Philippon 2019). Accordingly, markets are far from being competitive and many industries feature oligopolistic characteristics.

In our subsequent analysis we combine these aspects and enquire how horizontal FDI affects outcomes in oligopoly. We focus on a long-run setting which allows for adjustments also at the extensive margin to accommodate the fact that oligopolistic markets are not static but change their composition. In order to ease comparability with earlier investigations, we assume a homogeneous Cournot-oligopoly with identical firms, linear demand and cost schedules and fixed costs of market entry. In such a setting, the number of entrants will be excessive in a closed economy if entry reduces output per firm, that is, if there is business-stealing (von Weizsäcker 1980, Mankiw and Whinston 1986, Suzumura and Kiyono 1987, Amir et al. 2014). We extend the analysis to a multi-country, two-period framework. In period one, there are only domestic competitors. At the beginning of period two, the market may be opened to horizontal FDI. Entry costs arise in each period, whereas additional set-up costs only occur in the first period of activity and for one market. Therefore, incumbents that undertake FDI do not have to incur set-up costs again. This captures the idea that horizontal (greenfield) FDI activities can utilise knowledge gained in earlier domestic production, such that firms spread fixed costs over more markets and, thereby, greater quantities.

In order to focus on the effects of FDI, we consider two settings: In the first, entry is not regulated. Firms take up production, as long it is profitable. Since FDI affects profitability, it alters entry choices in the second period and, if anticipated, also first period decisions. In the second setting, the government regulates entry, for example, by granting costless entry licences. Because such regulation is no longer effective if market opening occurs in period two, it also changes the government's first period choice. In contrast to earlier analyses, we assume that the government maximises a political support function, and not necessarily welfare. This modification enables us to investigate how the nature of the government's objective affects choices. For both settings, the unregulated market equilibrium and the one in which entry is restricted, we initially consider a closed economy. This provides a benchmark to which we compare outcomes, which will result if there is horizontal FDI. In our main analysis, market opening is non-discriminatory, that is, firms from none of the countries can be excluded from making greenfield investments. Moreover, entry regulations are decided upon unilaterally, i.e., by each country on its own.

Our analysis shows that the number of firms in a closed economy will be constant over time, though profits vary. This is true in market equilibrium and likewise if the government determines the maximum number of entrants. In this way, unit production costs are minimised. Moreover and irrespective of the government's objective, entry usually is excessive, not only in the closed economy, but also if horizontal FDI takes place. The intuition is as follows: Opening the market in period two raises the number of firms in market equilibrium in that period and reduces it in period one. These adjustments result in an increase in total output and, hence, welfare. The expansion comes about because production costs per firm decline and the cost effect of the drop in the number of firms in period one dominates the impact of additional entry in period two. If the government regulates entry, the change in the number of firms will qualitatively exhibit the same features as in market equilibrium. Therefore, entry tends to be excessive also in the presence of FDI. We further show that market opening may actually decrease welfare if entry is regulated. Such outcome can occur if the number of firms is relatively high prior to market opening. Therefore, the increase in output and consumer surplus due to market opening is limited and does not compensate the reduction in profits. We also demonstrate that even if market opening raises welfare, the government's payoff may decline. This can be the case if the fall in profits because of intensified competition is substantial, while the rise in consumer surplus is not valued sufficiently by the government. In an extension, we further establish that discriminatory market opening, that is, an agreement according to which firms of some but not all countries can invest abroad, can yield higher welfare than non-discriminatory market opening. The reason is that the expansion in the number of firms is restricted. Therefore, the detrimental welfare impact of market entry is reduced. Along the same lines, we clarify that coordination of entry regulations by competition authorities of all countries in period one can yield better outcomes than unilateral entry decisions by each of them.

This survey of results indicates that we add to the literature in at least four ways: First, we investigate whether the excessive entry prediction, derived almost exclusively for closed-economy settings, also results if there is FDI. Second, we demonstrate how an intertemporal optimisation process of firms can affect outcomes over time. Third, we illustrate new channels by which international integration can alter welfare. Fourth, we evaluate in how far the government's incentives to regulate entry depend on whose interests it pursues.

The above summary clarifies that our investigation is primarily related to two strands of literature, namely analyses of Cournot-oligopolies with endogenous market structure and of oligopolies in international trade. The excessive entry prediction has initially been derived by von Weizsäcker (1980), Perry (1984), Brander and Spencer (1985), Mankiw and Whinston (1986), and Suzumura and Kiyono (1987). The robustness of the prediction has been investigated for a variety of extensions, such as imperfectly competitive input markets (Okuno-Fujiwara and Suzumura, 1993, Ghosh and Morita, 2007a,b, Mukherjee 2009, 2013, de Pinto and Goerke 2020), R&D investments (Okuno-Fujiwara and Suzumura, 1993, Haruna and Goel, 2011, Mukherjee, 2012a, Chao et al. 2015, Mukherjee and Ray 2014), cost asymmetries (Ghosh and Saha 2007, Mukherjee 2012a), and alternative firm objectives (Varian 1995, Suzumura 1995, chap. 8, Hamada et al. 2018).

Analyses of the excess entry prediction have occasionally been expanded to open economy settings. Marjit and Mukherjee (2013, 2015) and Mukherjee (2013) assume that there is one foreign firm which enters the domestic oligopoly. They show that if trade costs decline, so do the foreign firm's costs, such that it produces a greater amount. This, in turn, reduces profits of domestic firms and deters their entry. Moreover, the number of firms in market equilibrium may be insufficient. The rationale for this outcome is that a government, which maximises domestic welfare, takes into account that additional entry raises domestic consumer surplus at the expense of foreign profits. However, this impact plays no role for the firms' entry decision in market equilibrium.[1] If collectively bargained wages constitute input prices, lower transport

[1] Mukherjee (2012b) also employs the assumption that the government focuses on domestic welfare. He shows in a leader-follower setting that making the leader a foreign instead of a domestic firm, such that its profits

cost may reduce welfare and entry is once again insufficient (Marjit and Mukherjee 2013, 2015). The latter effect arises because wages deter entry, but do not have a direct welfare effect (see de Pinto and Goerke (2020) for a similar approach).

Miyagiwa and Sato (2014) consider a two-country setting in which firms produce locally and can also export, facing linear trade costs. Domestic and foreign governments regulate entry by taxing operating profits of local firms. Miyagiwa and Sato (2014) show that entry is excessive, since domestic taxation fosters entry abroad.[2] Moreover, if entry costs are high, there are few competitors. Allowing for trade intensifies competition substantially. This trade effect exceeds the negative consequences of excessive entry. Hence, trade raises welfare. If market entry costs are low, the gains from trade are also relatively moderate, such that the excessive entry distortion dominates and welfare declines.

The second relevant strand of literature deals with the effects of trade between countries with oligopolistic markets in which the number of firms is determined by a zero-profit constraint. Trade raises welfare in comparison to autarky despite the occurrence of trade costs because fixed costs of entry can be distributed across a greater quantity (see, for example, Brander and Krugman 1983, Venables 1985). Under additional and relatively weak conditions, which hold for a linear demand schedule, trade raises the total number of suppliers, but not necessarily of domestic firms (Venables 1985, see also Anderson et al. 1989). Tanaka (1993) considers a two-country free-trade setting. The introduction of a small specific tariff raises welfare if demand is strictly concave. This effect occurs because the number of firms decreases, as Ikeda (2007) clarifies. In partial contrast, Amir et al. (2019) show that free trade can raise welfare and reduces the number of firms in a world in which there are no trade costs and international competition results in fully integrated markets. Finally, Stähler (2006) focuses on the welfare effects of FDI, but does not analyse the excessive entry distortion. He assumes a two-period setting in which domestic and foreign firms can enter their home market in period one and export part of their production. In period two, only incumbents can undertake horizontal FDI. Stähler (2006) shows that exports and FDI may co-exist. If that is the case, the number of firms shrinks with FDI, while welfare rises, for example, if demand is linear.

In sum, the studies on excessive entry outcomes in Cournot-oligopolies have ignored foreign competition via greenfield FDI, in particular, if the government does not maximise welfare. In

become irrelevant for the determination of the optimal number of followers in a Cournot-oligopoly, does not affect the market equilibrium. Since the optimal number of firms rises, entry becomes insufficient.

[2] Wang (2016) finds entry to be excessive in a somewhat different open economy setting with subsidisation of domestic firms and tariffs imposed on foreign competitors.

order to analyse this issue, the further paper proceeds as follows: In Section 2, we develop the model and describe output decisions and entry choices. Section 3 delineates the market equilibrium and the government's preferred outcome in an isolated, i.e., closed economy. Section 4 initially considers the market equilibrium and the government's choices, assuming non-discriminatory market opening. Subsequently, we present a numerical example and also scrutinise the effects of a multilateral agreement on firm entry and of discriminatory market opening if entry is regulated. Section 5 concludes. Most proofs are relegated to an appendix.

2. Model

2.1 Set-up

There are m, $m > 1$, identical countries. In each of them, there is an oligopolistic market, in which an endogenously determined number of firms produce a homogeneous good. We consider a two-period setting, $t = 1, 2$, without discounting. In the first period, markets are isolated and firms decide whether to set up one production site domestically. At the beginning of period two, firms choose whether to continue production domestically or to take it up, if they had not done so in the previous period. Moreover, markets may be opened up. In this case, firms can undertake horizontal FDI, i.e. enter foreign markets by greenfield investments. While a two-period framework is a stark simplification when considering long-term investments, such setting already suffices to analyse the impact of horizontal FDI over time.

The good under consideration is not tradeable and cannot be stored, such as it is the case with certain services, which, for example, require the physical presence of customers. Accordingly, the good is consumed in the country and period of production and markets are segmented.

Firms compete in quantities and take the choices of competitors as given (Cournot-Nash behaviour). In each country and period t, the (inverse) demand schedule equals $p(X_t) = 1 - X_t$, $X_t = x_{it} + X_{\_it}$, where p is the price, X_t the aggregate quantity, x_{it} the quantity produced and sold by firm i, and $X_{\_it}$ the quantity sold by all other firms.[3] Variable costs equal cx_{it}, $0 \leq c < 1$. In order to serve the market in period t, a firm has to make an investment k_t, $k_t > 0$. We can interpret k_t as fixed costs of production per period, for

[3] A linear demand schedule makes it possible to directly relate our findings to those earlier contributions, which use such simplification, as well. However, while the basic excessive entry prediction holds for more general specifications, such as log-concave demand, our subsequent findings on the welfare effects of market opening may depend on the specification of the demand schedule, since we need to compare changes in profits and consumer surplus. Such robustness issues may be a topic for future work.

example, for renting the production site. In addition to these periodic market entry costs, k_t, the firm incurs fixed set-up costs, k, which are also sunk and for which $k > |k_1 - k_2|$ holds. Therefore, set-up costs, k, are sufficiently high to dominate any difference in periodic market-entry costs, k_1 and k_2. Such set-up costs can, for example, be viewed as the expenditure for acquiring the knowledge about production or for purchasing the necessary patents. They arise only once, either domestically in period one or, for a late entrant, in period two in at most one market (see Horstmann and Markusen (1992) for a similar approach). If a firm does not produce, its payoff is zero.

The timing is as follows: First, agents learn whether market opening will take place. Second, at the beginning of period one entry is decided upon by domestic firms. Total fixed costs of an entrant equal $k + k_1$. In market equilibrium, firms are not restricted in their decisions. If the government decides about entry, it grants costless entry licences and can, thereby, determine the maximum number of (domestic) entrants.[4] Third, entrants decide on output. Fourth, each firm which entered the market, decides whether to exit at zero costs at the beginning of period two, or to remain and incur fixed costs, k_2. Fifth, previously inactive firms can enter the market at the beginning of period two at costs $k + k_2$. Moreover, in case of market opening, firms already active in period one can set up at most one production site in every foreign market, incurring fixed costs k_2 in each case. Sixth, active firms choose second period output.

Given the assumptions outlined above, we can focus the analysis on one country. We treat n_t, the number of firms, $n_t > 1$, as a continuous variable and, thus, ignore the integer constraint (see, for example, Ghosh and Morita, 2007a,b, Marjit and Mukherjee, 2013, and Seade, 1980).[5] Moreover, we consider an equilibrium in pure strategies.

2.2 Output and Profits

Firm i chooses the quantity, x_{it}, to maximise operating profits, π^o_{it}, in period t.

$$\pi^o_{it}(x_{it}) = \big(1 - (x_{it} + X_{\_it}) - c\big)x_{it} \tag{1}$$

[4] Richardson (1999) interprets a reduction in the maximum number of entrants as looser competition policy.
[5] Mankiw and Whinston (1986) have shown that profits may be higher if there are n competitors, and n is an integer, than if there are n + 1 firms, while welfare is higher for n +1 producers, assuming business stealing. Thus, entry may be insufficient in the presence of business-stealing by at most one firm in the presence of the integer constraint. An analysis of the interaction of the integer constraint and market opening on the extent of excessive or insufficient entry is beyond the scope of this contribution because investigations of the integer constraint usually rely on alternative specifications of cost and demand conditions (cf. Galera and Garcia-del-Barrio 2011), which are as simple as possible in the present set-up. Therefore, this issue warrants a separate investigation.

Since all firms face the same cost and demand conditions, they behave identically and we subsequently omit the firm index, i. Output per firm and aggregate output can be written as:

$$X_t(n_t) = n_t x_t = n_t \frac{1-c}{1+n_t} \tag{2}$$

Denoting the period of entry by τ, τ = 1, 2, resulting profits are given by

$$\pi_1 = (2-\tau)\left[\left(\frac{1-c}{1+n_1}\right)^2 - (k+k_1)\right] \tag{3a}$$

and

$$\pi_2 = \left(\frac{1-c}{1+n_2}\right)^2 - k_2 - (\tau-1)k. \tag{3b}$$

2.3 Entry Decisions

In market equilibrium, each firm decides whether to take up production. It will become active if total operating profits weakly exceed the sum-of set-up and entry costs, that is, if $\pi_1 + \pi_2 \geq 0$. If the firm enters only in one period, $\pi_t(\tau) \geq 0$, t = 1, 2, has to hold. Since n_t is a continuous variable, profit-constraints hold as equalities. In addition, we consider a setting in which the government determines the maximum number of entrants.[6]

Investigations of the excess entry theorem usually assume that the government maximises the sum of consumer surplus and profits. However, government actions are not restricted to the creation of wealth, but also affect its allocation across groups. Accordingly, the weights of consumer surplus and profits in the government objective may not be the same. If, for example, entry regulation is determined by a government subject to, for example, the influence of lobbying groups, their relative size may determine the value of β. Restricting the number of entrants constitutes a public good (or bad) for consumers and firms (if n > 1). Since small groups can overcome a free-rider problem more easily (Olson 1965), the impact of firms on the government's payoff may exceed that of consumers (Hillman 1989). However, Amir et al. (2019) forcefully argue that competition authorities may pursue a "populist" objective which consists of the sum of welfare and consumer surplus.[7] Moreover, in our

[6] von Weizsäcker (1980) and Suzumura and Kiyono (1987), for example, consider first-best settings in which the government can also affect output per firm directly.

[7] See also their reference to Schmalensee (2004) who presumes that the firms' payoff is irrelevant and explicitly discards the objective on which many of the analyses of excessive entry are based: "In what follows I accept the objective of consumer welfare, because it is the goal that U.S. antitrust policymakers have chosen. … (Thus, I do

setting consumption takes place domestically, whereas there is no restriction on the ownership of firms. As firms will make profits if entry is restricted, the full profit effect of such constraint will not be realised domestically, if some firms are foreign-owned.[8]

To incorporate such considerations, we assume that the government maximises a weighted sum, $\widetilde{W}$, of consumer surplus over two periods, $CS_1 + CS_2$, and domestic profits, $n_1\pi_1 + n_2\pi_2$, and interpret $\widetilde{W}$ as political support function in the spirit of Peltzman (1976) and Hillman (1982). The relative weight of profits is denoted by β, 0 < β, and independent of outcomes.

$$\widetilde{W}(n_1, n_2) = CS_1(n_1) + CS_2(n_2) + \beta n_1\pi_1(n_1) + \beta n_2\pi_2(n_2)$$
$$= \sum_{t=1}^{2} \frac{(X_t(n_t))^2}{2} + \beta \sum_{t=1}^{2} n_t[(1 - X_t(n_t) - c)x_t(n_t)] - \beta\kappa(n_1, n_2) \qquad (4)$$

In equation (4), $\kappa(n_1, n_2)$ represents total fixed costs, specified in more detail below. If β = 0 holds, the government is interested only in consumer surplus. The higher the parameter β is, the more important the firms' payoffs become (Richardson 1999). If β = 1, the government is a welfare maximiser. For values of β sufficiently in excess of unity, the government predominantly cares about profits.

We, finally, presume that the government can restrict entry but that it has no instruments at its disposal with which it can entice firms to take up production. However, as long as entry is profitable, the maximum allowed by the government will also represent the actual number of entrants. If, in contrast, the preferred number of firms makes production unprofitable, the zero-profit condition binds and the government faces a constrained optimisation problem.[9]

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not think the interesting definitions of … C. C. von Weizsäcker, which are based on total welfare considerations, are useful for U.S. antitrust.)" (p. 472)

[8] Marjit and Mukherjee (2013, 2015) implicitly assume such an objective in a setting with one foreign and n – 1 domestic firms. The former is profitable, but does not figure in the definition of welfare.

[9] Taxes, subsidies, and (possibly non-positive) entry fees could be used to induce or deter entry and to overcome the profit constraint (see, for example, Konishi 1990). The analysis of their optimal structure and levels and, more generally, of the optimal combination of policy instruments is beyond the scope of our investigation which focuses on the effects of FDI and an evaluation of the market equilibrium. Such investigation would require additional assumptions relating to the use of revenues or the financing of expenditure in settings in which the government does not maximise welfare because the distribution of payoff across firms and consumers determines $\widetilde{W}$ for β ≠ 1.

3. The Benchmark: Isolated Markets

3.1 Market Equilibrium

The market equilibrium features a constant number of entrants. We subsequently characterise the equilibrium and derive the resulting payoffs, which are denoted by a '*'. Moreover, in Appendix A.1 we show that this is the only equilibrium in pure strategies.

If all firms, which enter the market in period one, remain active in period two, while no additional entry takes place, the sum of profits over two periods can be obtained by adding (3a) and (3b) for $\tau = 1$. Setting this sum equal to zero, the equilibrium number of firms is (see Mas-Collell et al. 1995, p. 405 ff and Etro 2014, inter alia, for a one-period setting)

$$n^* = \frac{1-c}{\sqrt{\bar{k}}} - 1, \tag{5}$$

where $\bar{k} := (k + k_1 + k_2)/2$ defines the average of set-up and periodic entry costs over two periods. Using equations (2) and (5), output per firm can be computed as $x^* = \sqrt{\bar{k}}$, while aggregate output equals $X^* = 1 - c - \sqrt{\bar{k}}$. Profits, respectively losses, are given by $k > \pi_2(n^*) = 0.5(k + k_1 - k_2) = -\pi_1(n^*) > 0$. Accordingly, welfare, W, and the government's payoff, $\widetilde{W}^*$, coincide and amount to:

$$W = \widetilde{W}^* = \beta n^* \underbrace{[\pi_1(n^*) + \pi_2(n^*)]}_{=0} + 2\frac{(X^*(n^*))^2}{2} = (1-c)^2 - 2(1-c)\sqrt{\bar{k}} + \bar{k} \tag{6}$$

Because fixed costs vary over time, profits cannot be zero in each period. The number of firms which ensures zero profits in period one would be too low to guarantee that outcome in period two as well, because set-up cost, k, only arise in period one. However, it is not profitable to enter the market only in period two, because the fixed costs of taking up production for the first time, $k + k_2$, which a new entrant would incur, exceed operating profits. This is due to the assumption that $k_1 < k + k_2$ (see Appendix A.1). Accordingly, profits are maximised by spreading set-up costs over two periods, that is, by entering the market as early as possible.

3.2 Regulated Entry

In this sub-section, we characterise the government's preferred outcome, denoted by the superscript 'opt', given that it can costlessly restrict entry. Using (2), (3a) and (3b), the government's objective is given by:

$$\widetilde{W}^{opt}(n_1, n_2|\beta) = \frac{(X_1(n_1))^2 + (X_2(n_2))^2}{2} + \beta[n_1\pi_1^o(n_1) + n_2\pi_2^o(n_2) - \kappa(n_1, n_2)]$$

$$= \left(\frac{n_1}{2} + \beta\right) n_1 \left(\frac{1-c}{1+n_1}\right)^2 + \left(\frac{n_2}{2} + \beta\right) n_2 \left(\frac{1-c}{1+n_2}\right)^2 - \beta\kappa(n_1, n_2), \quad (7)$$

where total fixed costs equal

$$\kappa(n_1, n_2) = \begin{cases} n_1(k + k_1 + k_2) + (n_2 - n_1)(k + k_2) & \text{if } n_2 \geq n_1 \\ n_1(k + k_1 + k_2) + (n_2 - n_1)k_2 & \text{if } n_2 < n_1 \end{cases} \quad (8)$$

In Appendix A.2 we show that the optimal number of firms will be the same in both periods ($n^{opt} = n_1 = n_2$). This is the case for two reasons: First, a constant number of firms minimises aggregate set-up costs, for a given average number of firms. Moreover, set-up costs reduce the government's payoff either directly (see equation (7)) or indirectly via consumer surplus. Second, given an interior solution, consumer surplus is increasing and strictly concave in the number of firms. Hence, the government cannot increase its payoff by shifting output from one period to the next. Finally, the government has no incentive to alter its choice ex-post, that is, at the beginning of period two. Thus, a constant number of firms is also time-consistent and ex-post optimal (see Appendix A.2).

When choosing the optimal number of firms, the government has to observe the non-negative profit constraint. We do not explicitly incorporate the restriction, but take it into account when interpreting the first-order condition. Maximisation of $\widetilde{W}^{opt}$ for $n_1 = n_2 = n$ yields:

$$\frac{\partial \widetilde{W}^{opt}(n|\beta)}{\partial n}\Big|_{n=n_1=n_2} = \frac{\partial \widetilde{W}^{opt}}{\partial n_1} + \frac{\partial \widetilde{W}^{opt}}{\partial n_2} = 2\frac{(1-c)^2}{(1+n)^3}[(1-\beta)n + \beta] - 2\beta\bar{k} = 0 \quad (9)$$

The derivative in (9) decreases in the number of firms, as $n \geq 1$ holds, such that the second-order conditions is fulfilled. Moreover, it declines in the relative weight of profits, β. Hence, the government's preferred number of firms shrinks in the weight of their payoff in its objective. Moreover, it is straightforward to obtain an explicit solution of the first-order condition (9) for special cases.

If, for example, the government maximises welfare ($\beta = 1$), we have (see Mas-Collell et al. 1995, p. 405 ff and Etro 2014, inter alia, for a one-period setting):

$$n^{opt}(\beta = 1) = \left(\frac{(1-c)^2}{\bar{k}}\right)^{\frac{1}{3}} - 1 < n^* \quad (10)$$

This establishes the excess entry prediction for a welfare-maximising government. Substituting (10) into (2), we can calculate output, and using these findings in (7), we obtain:

$$W^{opt} = \widetilde{W}^{opt}(\beta = 1) = (1-c)^2 - 3\left((1-c)\bar{k}\right)^{\frac{2}{3}} + 2\bar{k} \tag{11}$$

The second special case assumes that the government cares only about consumer concerns (β = 0). Since the derivative in (9) is then unambiguously positive, the government will not restrict entry. In the absence of instruments that foster entry, the resulting number of firms is implicitly defined by the zero-profit constraint, i.e., the unrestricted market outcome ($n^{opt}(\beta = 0) = n^*$). The greater the relevance of the firms' payoff is, the more likely it becomes that the detrimental impact of more firms on profits affects the government's choice. Hence, by solving (9) for n = n* (as defined in equation (5)), we observe that $n^{opt}(\beta) = n^*$ holds for any

$$\beta \leq \beta^{crit,1} := \frac{1}{2}, \tag{12}$$

and $n^{opt}(\beta) < n^*$ if β > 0.5.

The third case assumes that the government predominantly cares about firms. For any

$$\beta \geq \beta^{crit,2} := \frac{(1-c)^2}{8\bar{k}} \tag{13}$$

equation (9) is unambiguously negative for n = 1 and the government establishes a monopoly. Output amounts to $X^{opt}\left(\beta \geq \beta^{crit,2}\right) = 0.5(1-c)$, while profits equal $\pi^{opt}\left(\beta \geq \beta^{crit,2}\right) = 0.25(1-c)^2 - \bar{k}$.

Summarising the above, we obtain:

Proposition A

Suppose, the government unilaterally determines the maximal number of firms.

a) This number of firms does not vary over time.

b) If $\beta \leq \beta^{crit,1}$, the government will not restrict entry, such that the market equilibrium results.

c) If β = 1, $n^{opt}(\beta = 1) = (1-c)^{2/3}/\bar{k}^{1/3} - 1$ firms enter the market.

d) If $\beta \geq \beta^{crit,2}$, the monopoly outcome results and $n^{opt}\left(\beta \geq \beta^{crit,2}\right) = 1$.

e) If $\beta^{crit,1} < \beta < \beta^{crit,2}$, we have $1 < n^{opt}(\beta) < n^*$, such that output and welfare levels lie in between the two cases implicitly described in parts c) and d).

Proof: See Appendix A.2 for part a) and Appendix A.3 for the remaining parts.

If the weight of the consumers' payoff is sufficiently high, the government wants to maximise aggregate output. Since production increases in the number of firms, the government will not restrict entry. Given a firm's opportunity not to enter, the number of firms is, hence, determined by the unregulated market equilibrium. Interestingly, the critical value of β, $\beta^{crit,1} = 0.5$, results from a "populist" objective (Amir et al. 2019), according to which consumer surplus has twice the weight of profits. If competition authorities have such objective, or one in which consumer surplus is assigned an even higher importance, they will not restrict entry into homogeneous Cournot oligopolies. Conversely, if the relevance of consumers is sufficiently low, the government's choice is determined by the fact that aggregate profits decline in the number of firms. Hence, their number is minimal. Finally, for intermediate values of the weight of the consumers' payoff, the government will allow more than one firm to enter, but fewer than in market equilibrium.

Almost universally, the standard used to establish excessive entry has been the number of firms a welfare-maximising government would choose (Suzumura 2012). Given our more general government objective, we could redefine excessive entry as a situation in which the number of competitors in the absence of intervention is greater than the number preferred by the government. In this case, the benchmark for evaluating the market equilibrium would depend on the nature of the political process and the mechanism by which preferences are aggregated or affect the government's actions. In the present setting, no decision with respect to the appropriate standard has to be taken. This is because the benchmark for establishing excessive entry plays no role for appraising the market outcome. Proposition A clarifies that there will never be fewer competitors in market equilibrium than desired by the government, irrespective of the combination of profits and consumer surplus in its objective.[10] Therefore, the number of entrants in market equilibrium is never less and usually (for $\beta > 0.5$) greater than the government's preferred extent of competition, also in a setting in which the standard for evaluating the market outcome is not the sum of consumer surplus and profits. This assessment, however, will no longer hold if the weight of consumers in the government's objective were sufficiently high and entry were not restricted by the zero-profit constraint. This would be the case because the government would prefer more than n* competitors if it could subsidise entry and maximise (7) without having to observe the profit restriction.

[10] Etro and Colciago (2010) analyse a DSGE-model and compare the market outcome with a situation in which steady-state consumption is maximised. Though their model differs substantially from the much simpler one outlined above, they also find entry to be excessive.

4. Market Opening

In this section we investigate the impact of market opening, first, for the market equilibrium and, second, if the government unilaterally regulates entry. These analyses constitute the open economy version of the investigation in Section 3. Market opening is interpreted as the possibility for firms from all m – 1 foreign countries to enter the domestic market by undertaking horizontal FDI. For simplicity, we assume that this applies to domestic firms also. This is without impact on results if the number of countries, m, is high enough. Hence, we consider non-discriminatory market opening, which effectively abolishes the government's ability to restrict entry. A numerical example illustrates some of the results. One of our findings is that market opening may not be beneficial if entry is regulated. Therefore, we also consider two alternatives to non-discriminatory market opening and unilateral regulation of entry. The first assumes that competition authorities of all m countries anticipate the outcome in period two and, therefore, coordinate their entry restrictions in period one. Thus, entry regulation is no longer unilateral. The second supposes that the domestic government – or competition authorities – are able to limit the number of entrants in period two to firms from some of the m countries. This can be viewed as discriminatory policy.

4.1 Non-discriminatory Market Opening in Market Equilibrium

In market equilibrium, entry in period two in case of non-discriminatory market-opening takes place, as long as operating profits, π_2^o, weakly exceed entry costs k_2. We assume that the number of domestic and foreign entrants is sufficient to ensure zero profits in that period.[11] Hence, when deciding whether to enter the market in period one, firms compare operating profits in that period with the sum of set-up and market entry costs, $k + k_1$.

Setting equations (3a) and (3b) equal to zero (for τ = 1), the number of domestic entrants, n_t^{*m}, in period t, can be calculated, where the superscript 'm' indicates that FDI is feasible.

[11] This is tantamount to the assumption that the number of countries, m, is sufficient to ensure $mn_1^{*m} \geq n_2^{*m}$. Substituting in accordance with (14) below, the condition can be rewritten as:

$$m \geq m^{crit} = \underbrace{\sqrt{\frac{k + k_1}{k_2}}}_{>1} \underbrace{\frac{1 - c - \sqrt{k_2}}{1 - c - \sqrt{k + k_1}}}_{>1}$$

If the number of countries were less than m^{crit}, profits in period two would be positive and the number of domestic firms entering in period one would be higher than n_1^{*m} because the marginal firm in period one could earn positive profits in period two. A similar conclusion can be drawn if FDI involves higher costs than k_2 (or $k + k_2$), as in Helpman et al. (2004).

$$n_t^{*m} = \frac{1-c}{\sqrt{(2-t)k + k_t}} - 1 \tag{14}$$

Output per firm equals $x_t^{*m} = \sqrt{(2-t)k + k_t}$, while aggregate output is given by:

$$X_t^{*m} = 1 - c - \sqrt{(2-t)k + k_t} \tag{15}$$

Therefore, the government's payoff, $\widetilde{W}^{*m}$, and welfare, W^{*m}, equal:

$$W^{*m} = \widetilde{W}^{*m} = \beta n_1^{*m} \underbrace{[\pi_1(n_1^{*m}) + \pi_2(n_2^{*m})]}_{=0} + 0.5((X_1^{*m})^2 + (X_2^{*m})^2)$$

$$= (1-c)^2 - (1-c)\left(\sqrt{k + k_1} + \sqrt{k_2}\right) + \bar{k} \tag{16}$$

This yields:

Proposition B

Suppose there are m, $m \geq n_2^{*m} / n_1^{*m}$, countries and there is non-discriminatory market opening at the beginning of period two.

The market equilibrium is characterised by $n_t^{*m} = (1-c)/\sqrt{(2-t)k + k_t} - 1$ firms, $n_1^{*m} < n^* < n_2^{*m}$, which together produce $X_t^{*m} = 1 - c - \sqrt{(2-t)k + k_t}$ units and obtain zero profits in each period. Aggregate output over both periods and welfare rise with market opening.

Proof: See Appendix A.4 and below.

Market opening implies that the number of firms in period two rises and output increases to above the level that results in the absence of market opening. The difference in the number of firms in period two due to market opening can be interpreted as the extent of FDI. This difference $n_2^{*m} - n^*$ rises with set-up costs, k, and market entry costs, k_1, in period one, and declines with entry costs, k_2, in period two. This is the case because these costs determine the extent to which operating profits differ across periods in the absence of market opening and, hence, the incentives to enter in period two, once FDI becomes feasible.

Turning to the comparison of outcomes in period one, we can observe that the number of firms and aggregate output decline, relative to a world in which no FDI is feasible. This change comes about because firms cannot distribute set-up costs over two periods, as it is feasible in a closed setting. Accordingly, operating profits in period one have to equal the sum of set-up costs, k, and market entry costs, k_1. Since this level is higher than operating profits resulting if there is no market opening, incentives to enter in period one decline with FDI activities occurring in period two.

Contrasting outcomes over both periods, the feature that firms can enter the foreign market in period two at costs k_2 implies that total fixed costs per market decline. Hence, the average number of firms rises, output per firm falls and aggregate output goes up.[12] Because profits are zero, irrespective of whether there is market opening or not, the welfare increase and the rise in consumer surplus coincide. Additionally, they entirely accrue to the domestic economy. Thus, the government's payoff rises, provided consumer surplus figures in its objective.

Our results can be related to those which consider a reduction in trade costs in Cournot-models. Brander and Krugman (1983) show that welfare rises due to trade on account of the decline in average costs. Venables (1985) also finds a non-negative welfare effect and the number of firms to rise with trade if demand is linear. Hence, with respect to these outcomes, trade and FDI appear to have similar consequences.

Note, finally, that the predictions stated above also obtain for alternative assumptions with respect to unilateral and non-discriminatory results market opening. If, for example, market opening took place in period one, profits would be zero in both periods. Because set-up costs could be distributed over more than one market, they would drop to below k. Hence, aggregate output would rise beyond X_1^{*m} and welfare with market opening would exceed W^{*m}. Therefore, the timing of unilateral and non-discriminatory market opening does not qualitatively affect its consequences in equilibrium. Alternatively, we could assume that set-up costs arise in the first period of activity on each market, irrespective of the number of markets served. This would imply that a firm entering in period two would have to pay set-up costs domestically and possibly abroad, whereas the payoff of a firm entering domestically in period one would be unaffected. Therefore, such modification would not alter findings either, as firms always enter in period one and then only pay set-up costs on the domestic market.

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[12] The reduction in total fixed costs is given by $n_1^{*m}(k+k_1)+n_2^{*m}k_2-2n^*\bar{k}=(1-c)\left[\sqrt{k+k_1}+\sqrt{k_2}-2\sqrt{\bar{k}}\right]<0$. The fall in average output per firm amounts to $x_1^{*m}+x_2^{*m}-2x_1^*=\sqrt{k+k_1}+\sqrt{k_2}-2\sqrt{\bar{k}}<0$. Moreover, aggregate output rises, as $X_1^{*m}+X_2^{*m}-2(X^*)=2(1-c)-\sqrt{k+k_1}-\sqrt{k_2}-2\left(1-c-\sqrt{\bar{k}}\right)=2\sqrt{0.5(k+k_1+k_2)}-\sqrt{k+k_1}-\sqrt{k_2}>0$. Therefore, the average number of firms rises.

4.2 Non-discriminatory Market Opening with Unilaterally Regulated Entry

A government, which regulates entry in a closed economy, can do so in both periods. If market opening takes place at the beginning of period two, entry in period one continues to be limited by the government unilaterally. In period two, firms from all other countries can become active on the domestic market. We assume that there are enough of them, such that the profit constraint binds (see equation (14)).[13]

Given n_2^{*m} active firms in period two, aggregate output, $X_2^{*m} = x_2^{*m} n_2^{*m}$, and consumer surplus, $0.5(X_2^{*m})^2 = 0.5(1 - c - \sqrt{k_2})^2$, are independent of period one outcomes. Accordingly, the government effectively maximises its first period payoff and its objective is:

$$\widetilde{W}_1^{opt,m}(n_1|\beta) = n_1 \frac{2\beta + n_1}{2}\left(\frac{1-c}{1+n_1}\right)^2 - \beta n_1(k + k_1) + 0.5(X_2^{*m})^2 \tag{17}$$

Maximisation with respect to the number of firms in period one yields:

$$\frac{\partial \widetilde{W}_1^{opt,m}(n_1|\beta)}{\partial n_1} = \frac{(1-c)^2[(1-\beta)n_1 + \beta]}{(1+n_1)^3} - \beta(k + k_1) = 0 \tag{18}$$

Since the derivatives of (18) with respect to n_1 and β are negative (given $n_1 \geq 1$), the government's preferred number of firms declines with the relevance of the firms' payoff in its objective also in the presence of horizontal FDI. Following the same approach as in Subsection 4.1, we compute $n_1^{opt,m}$ for special cases

$$n_1^{opt,m} = \begin{cases} 1 & \text{if } \beta \geq \beta^{crit,3} := \dfrac{(1-c)^2}{8(k+k_1)} \\ \left(\dfrac{(1-c)^2}{k+k_1}\right)^{1/3} - 1 & \text{if } \beta = 1 \\ \dfrac{1-c}{\sqrt{k+k_1}} - 1 = n_1^{*m} & \text{if } \beta \leq \beta^{crit,1} = 0.5 \end{cases} \tag{19}$$

If $\beta \geq \beta^{crit,3}$ holds, the monopoly outcome arises. If, in contrast, the consumers' payoff is sufficiently prominent, $\beta \leq \beta^{crit,1} = 0.5$, the government mimics the market equilibrium. For any value of the parameter β such that $\beta^{crit,1} < \beta < \beta^{crit,3}$ holds, $1 < n_1^{opt,m} < n_1^{*,m}$ obtains. Given the unique relationship between output and the number of firms, we have $X_1^{opt,m}(\beta \geq \beta^{crit,3}) > X_1^{opt,m}(\beta = 1) > X_1^{opt,m}(\beta \leq \beta^{crit,1})$.

[13] If this assumption did not hold, the level of profits in period two would depend, inter alia, on the number of countries and market entry costs k_2. Moreover, the government would take into account that a rise in the number of firms in period one reduced profits in period two.

We can also calculate welfare and the government's payoff for the various objectives:

$$\widetilde{W}^{opt,m}\left(\beta \geq \beta^{crit,3}\right) = (1+2\beta)\frac{(1-c)^2}{8} - \beta(k+k_1) + 0.5\left(1-c-\sqrt{k_2}\right)^2 \quad (20)$$

$$\widetilde{W}^{opt,m}(\beta = 1) = W^{opt,m}(\beta = 1)$$

$$= 0.5(1-c)^2 - 1.5\left((1-c)(k+k_1)\right)^{\frac{2}{3}} + k + k_1 + 0.5\left(1-c-\sqrt{k_2}\right)^2 \quad (21)$$

$$\widetilde{W}^{opt,m}\left(\beta \leq \beta^{crit,1}\right) = W^{*m} = \frac{(X_1^{*m})^2 + (X_2^{*m})^2}{2}$$

$$= (1-c)^2 - (1-c)\left(\sqrt{k+k_1} + \sqrt{k_2}\right) + \bar{k} \quad (22)$$

We summarise our findings with respect to the number of firms, output and profits as follows:

Proposition C

Suppose, the government unilaterally determines the maximal number of domestic firms in period one and there is non-discriminatory market opening at the beginning of period two to competitors of m, $m \geq n_2^{*m} / n_1^{opt,m}$, countries.

a) In period two, there are $n_2^{*m} = (1-c)/\sqrt{k_2} - 1 > n^*$ active firms, which earn zero profits.

b) If $\beta \leq \beta^{crit,1}$, the government will not restrict entry in period one, such that the market equilibrium results .

c) If β = 1, $n_1^{opt,m} = (1-c)^{2/3}/(k+k_1)^{1/3} - 1$ domestic firms enter the market in period one. Firms are profitable.

d) If $\beta \geq \beta^{crit,3}$, $n_1^{opt,m} = 1$, and monopoly payoffs will result in period one.

e) Finally, if $\beta^{crit,1} < \beta < \beta^{crit,3}$, we have $1 < n_1^{opt,m} < n_1^{*m}$, such that outcomes lie in between the two cases described in parts b) and d).

For the proof, see Appendix A.5.

If the difference in the number of firms in period two due to market opening, $n_2^{*m} - n_2^{opt}(\beta)$, describes the extent of FDI, its magnitude rises with the weight of consumers in the government's objective. This is the case since n_2^{*m} is determined by the zero-profit outcome, while the optimal number declines with β if the government determines entry. Hence, FDI can be argued to be less prevalent the greater the political importance of consumers is and the less relevant firms are.[14] The reason for this prediction is that consumers prefer as large an aggregate output as possible. Thus, FDI is less beneficial than if aggregate output and the number of firms were lower prior to market opening. Moreover, as in the case of the market equilibrium, FDI rises both with set-up costs, k, and market entry costs, k_1, in period one because they reduce the optimal number of firms in a world without FDI.

Comparing the government's preferred outcome in a closed economy with that resulting if market opening occurs at the beginning of period two, we obtain:

Corollary D

Assume the maximum number of domestic firms in period one is determined unilaterally by the government. Market opening at the beginning of period two

a) raises the number of firms and aggregate output in period two,

b) reduces the number of firms and aggregate output in period one, unless the weight of profits in the government's objective exceeds a critical value $\beta^{crit,2}$,

c) may raise welfare and simultaneously reduce the payoff of the government, and

d) may raise or lower welfare.

Proof: See Appendix A.6.

The number of firms in an open market in period two exceeds the number of firms allowed to enter by the government in a closed economy for two reasons: First, the government in the closed economy takes the business-stealing externality into account, whereas this is no longer feasible in an open market. Second, the entry decision in an open economy is governed by entry costs in period two, whereas the government in the closed economy bases its decision on the average of set-up and periodic entry costs over two periods.

To provide intuition for part b) of Corollary D, note that the alteration in profits in period two requires the governments to make firms more profitable in period one, by restricting their number. If all countries reduce the number of entrants in period one, the total number of active firms (in the world) will drop from mn_1^{*m} to $mn_1^{opt,m}$.[15] This statement is valid, as long as the number of firms in period one is not already minimal, i.e. a monopoly exists.

[14] Harms and Ursprung (2002) find a positive impact of trade unions and a negative of political repression on FDI. If a lower value of β indicates a greater relevance of unions, their empirical results are commensurate with our prediction. However, since the analysis by Harms and Ursprung (2002) uses total FDI inflows as dependent variable and does not provide a direct proxy of β, it cannot empirically substantiate our theoretical prediction.

[15] See Venables (1985) and Richardson (1999) for similar findings in settings with trade.

Part c) indicates that the government may object to market opening although welfare rises. This will be the case if the weight of firms in the government's objective is sufficiently large. If $\beta > \beta^{crit,2}$ ($> \beta^{crit,3}$) holds, the government prefers a monopoly in both periods in a closed setting and if market opening takes place only in period one (cf. Propositions A and C). Market opening reduces period two profits to zero, while consumer surplus increases. This raises welfare. However, if consumer surplus affects the government's payoff, $\widetilde{W}$, to a sufficiently small extent, relative to profits, $\widetilde{W}$ will decline. Consequently, we can establish a further argument why detrimental protectionist policies may not be abolished.

Finally, part d) of Corollary D indicates that welfare may change in either direction with non-discriminatory market opening if entry is regulated. On the one hand, the mechanism is the same as in the equilibrium. Market opening allows firms to spread set-up costs, such that average costs decline. Therefore, aggregate output rises in period two. The increase in welfare due to the resulting ascent in consumer surplus in period two is partially balanced by a decline in period one. It occurs because set-up costs cannot be distributed over time, such that entry costs in period one rise. In consequence, the government reduces entry in that period. This results in a decline in aggregate output. Tables 2 and 3 in Sub-section 4.3 provide examples.

Comparing the findings for the market equilibrium with those for a setting in which the government determines entry, we can state:

Proposition E

Assume that there is non-discriminatory market opening at the beginning of period two. Entry is excessive in period one if the firms' payoff is sufficiently important, i.e., $\beta > \beta^{crit,1}$.

Proof: The government's preferred number of firms is n_1^{*m} if $\beta \leq \beta^{crit,1}$ and less otherwise. ■

If the importance of consumers in the government's payoff is sufficiently high, the government desires aggregate output to be maximal. Since output rises in the number of firms, the market outcome and the preferred number of firms will coincide. If the weight of firms in the government's objective is higher than $\beta^{crit,1} = 0.5$, the government will prefer fewer firms in period one, such that excessive entry results. Moreover, the government in a closed economy prefers at most n^* firms in period two (cf. Proposition A). Because $n_2^{*m} > n^*$, there will surely be excessive entry. As in a closed economy, we can conclude that the number of entrants in market equilibrium is never less and usually (for $\beta > 0.5$) greater than the government's preferred extent of competition, irrespective of the standard employed to evaluate the market outcome. This statement holds, like in a setting without FDI, as long as the government cannot overcome the zero-profit constraint.

4.3 Numerical Examples

In this sub-section, we illustrate some of the findings summarised in the Propositions A to C and E, as well as Corollary D, using numerical example. These computations can also provide an idea of the magnitude of effects. The examples in Tables 1 and 2 describe outcomes for a welfare-maximising government. In Table 1, set-up costs are relatively low and exceed market entry costs by a factor of four ($\mathrm{k} = 0.04 = 4\mathrm{k_t}$). The computations depicted in Tables 2 and 3 are based on high set-up costs ($\mathrm{k} = 0.09 = 9\mathrm{k_t}$). Table 3, in contrast to Table 2, assumes a government, which places a comparatively high importance on the firms' payoffs.

In all cases, the government's preferred number of firms for an isolated market is substantially lower than if FDI is allowed for. Moreover, output per firm drops markedly when comparing either period one with period two in a setting with market opening or period two in a closed setting with a situation in the presence of FDI. Thus, the rise in aggregate output in period two is less pronounced than the increase in the number of firms in a world with FDI.

Tables 1 and 2, furthermore, illustrate part d) of Corollary D. Market opening increases consumer surplus substantially, particularly if set-up costs are high. This is the case because the government's preferred number of firms in a closed economy is lower, the higher set-up costs are. Hence, the rise in the number of firms and in aggregate output due to market opening is more pronounced. Besides, aggregate profits fall by about the same amount, irrespective of the level of set-up costs. In consequence, the decline in profits if set-up costs are low dominates the rise in consumer surplus and welfare falls due to market opening. However, if set-up costs are high, the rise in consumer surplus is greater and welfare rises.

Table 3 exemplifies part c) of Corollary D, namely that the government's payoff and welfare change in different directions. It is based on the same values as used in Table 2. Moreover, the government allows only one firm to enter in a closed economy. Accordingly, market opening increases the number of firms in period two by the factor eight and consumer surplus more than doubles. As in the example of Table 2, welfare rises with market opening because the consumer surplus effect dominates. Since the government places a relatively low weight on consumer surplus, but assigns relatively more importance to profits, its payoff declines.

Table 1: Socially Optimal Outcomes (β = 1) and Payoffs if Set-up Costs are Low: k = 0.04

	Number of firms	Output per firm	Aggregate output	Consumer Surplus	Profits	Welfare
Closed	$n_1^{opt} = 2$ $n_2^{opt} = 2$	$x_1^{opt} = 0.3$ $x_2^{opt} = 0.3$	$X_1^{opt} = 0.6$ $X_2^{opt} = 0.6$	$CS_1^{opt} + CS_2^{opt} = 0.36$	$\pi_1^{opt} = 0.06$ $\pi_2^{opt} = 0.06$	$W^{opt} = 0.6$
Market Opening	$n_1^{opt,m} = 1.53$ $n_2^{*m} = 8$	$x_1^{opt,m} = 0.356$ $x_2^{*m} = 0.1$	$X_1^{opt,m} = 0.544$ $X_2^{*m} = 0.8$	$CS_1^{opt,m} + CS_2^{opt,m} = 0.468$	$\pi_1^{opt,m} = 0.076$ $\pi_2^{*m} = 0$	$W^{opt,m} = 0.584$

Note: c = 0.1, k = 0.04, $k_1 = k_2 = 0.01$. Values are rounded.

Table 2: Socially Optimal Outcomes (β = 1) and Payoffs if Set-up Costs are High: k = 0.09

	Number of firms	Output per firm	Aggregate output	Consumer Surplus	Profits	Welfare
Closed	$n_1^{opt} = 1.45$ $n_2^{opt} = 1.45$	$x_1^{opt} = 0.37$ $x_2^{opt} = 0.37$	$X_1^{opt} = 0.53$ $X_2^{opt} = 0.53$	$CS_1^{opt} + CS_2^{opt} = 0.281$	$\pi_1^{opt} = 0.08$ $\pi_2^{opt} = 0.08$	$W^{opt} = 0.513$
Market Opening	$n_1^{opt,m} = 1.008$ $n_2^{*m} = 8$	$x_1^{opt,m} = 0.45$ $x_2^{*m} = 0.1$	$X_1^{opt,m} = 0.45$ $X_2^{*m} = 0.8$	$CS_1^{opt,m} + CS_2^{opt,m} = 0.421$	$\pi_1^{opt,m} = 0.1$ $\pi_2^{*m} = 0$	$W^{opt,m} = 0.522$

Note: c = 0.1, k = 0.09, $k_1 = k_2 = 0.01$. Values are rounded.

Table 3: Entry Regulated by Government for β = 2 > $\beta^{crit,3}$. Outcomes and Payoffs if Set-up Costs are High: k = 0.09

	Number of firms	Output per firm	Aggregate output	Consumer Surplus	Profits	Welfare (β = 1)	Government Payoff
Closed	$n_1^{opt} = 1$ $n_2^{opt} = 1$	$x_1^{opt} = 0.45$ $x_2^{opt} = 0.45$	$X_1^{opt} = 0.45$ $X_2^{opt} = 0.45$	$CS_1^{opt} + CS_2^{opt}$ $= 0.203$	$\pi_1^{opt} = 0.15$ $\pi_2^{opt} = 0.15$	$W^{opt} = 0.503$	$\widetilde{W}^{opt} = 0.803$
Market Opening	$n_1^{opt,m} = 1$ $n_2^{*m} = 8$	$x_1^{opt,m} = 0.45$ $x_2^{*m} = 0.1$	$X_1^{opt,m} = 0.45$ $X_2^{*m} = 0.8$	$CS_1^{opt,m} + CS_2^{opt,m}$ $= 0.421$	$\pi_1^{opt,m} = 0.1$ $\pi_2^{*m} = 0$	$W^{opt,m} = 0.521$	$\widetilde{W}^{opt,m} = 0.621$

Note: c = 0.1, k = 0.09, $k_1 = k_2 = 0.01$, $\beta^{crit,3} = (1-c)^2/(8(k+k_1)) = 0.01/0.8 = 0.0125$. Values are rounded.

We can also compute outcomes, using the parameter values of Table 1, for a setting without market opening and compare the market equilibrium to the situation if a welfare-maximising government regulates entry (results are not depicted and available upon request). The calculations show that about 12% of welfare is lost in market equilibrium due to excessive entry in a closed setting, while the respective loss is 6% in the presence of FDI. The main reason is that the entry distortion (in period one) is less pronounced if market opening occurs.

4.4 Non-discriminatory Market Opening with Multilaterally Regulated Entry

Table 1 in Sub-section 4.3 demonstrates that non-discriminatory market-opening combined with a unilateral determination of the number of firms in period one may decrease welfare. In this sub-section, we analyse whether such detrimental effect can be avoided if governments multilaterally coordinate entry in period one. By doing so, they can implicitly limit entry in period two. In particular, we assume that governments or competition authorities of all m countries harmonise the number of costless entry licences they issue in period one. Formally, we assume that they sign a binding, non-reversible agreement according to which in each country at most $n_1^{opt,m,reg}$ firms can enter the market in period one. All these firms can undertake FDI in period two. Hence, market-opening is non-discriminatory and the maximum number of competitors in period two equals $mn_1^{opt,m,reg}$. The trade-off which governments face is between too few entrants in period one, if $n_1^{opt,m,reg} < n_1^{opt,m}$, and the reduction in excessive entry in period two, if $mn_1^{opt,m,reg} < n_2^{*m}$. The objective of a welfare-maximising government facing such a trade-off is given by:

$$W^{opt,reg}(n_1) = n_1\pi_1(n_1) + mn_1\pi_2(mn_1) + CS_1(n_1) + CS_2(mn_1) \tag{23}$$

The specification of $W^{opt,reg}(n_1)$ implies that all domestic period one entrants remain active in period two and enter all (m – 1) foreign markets, and vice versa. Given $mn_1^{opt,m,reg} < n_2^{*m}$, we can employ equations (2), (3a) and (3b), and substitute in (23) accordingly to obtain:

$$\begin{aligned} W^{opt,reg}(n_1) = n_1\left(\frac{1-c}{1+n_1}\right)^2 - n_1(k+k_1) + mn_1\left(\frac{1-c}{1+mn_1}\right)^2 - mn_1k_2 \\ + \frac{{n_1}^2}{2}\left(\frac{1-c}{1+n_1}\right)^2 + 0.5(mn_1)^2\left(\frac{1-c}{1+mn_1}\right)^2 \end{aligned} \tag{24}$$

Maximisation of (24) yields:

$$\frac{\partial W^{opt,reg}}{\partial n_1} = \frac{(1-c)^2}{(1+n_1)^3} - (k+k_1+mk_2) + \frac{m(1-c)^2}{(1+mn_1)^3} = 0 \tag{25}$$

Since (25) declines in n_1, its solution constitutes a maximum of (24). We can illustrate the outcome, using a numerical example and assuming $c = 0.1 = 10k_t$ (see Sub-section 4.3). Moreover, set-up costs are low, $k = 0.04$, such that uncoordinated market opening results in a welfare loss (see Table 1). Finally, m = 6 ensures that the zero-profit constraint determines entry without coordinated policies by competition authorities. The optimal number of firms in period one in case of market opening is $n_1^{opt,m} = 1.53$. Solving (25) yields an optimal value of $n_1^{opt,m,reg}(m = 6) = 1.03$. Therefore, in period two there are $mn_1^{opt,m,reg} = 6.18$ competitors and output per firm and in aggregate amounts to $x_1^{opt,m,reg} = 0.44$ and $x_2^{opt,m,reg} = 0.125$, respectively $X_1^{opt,m,reg} = 0.46$ and $X_2^{opt,m,reg} = 0.77$. This results in profits of $\pi_1^{opt,m,reg} = 0.151$ and $\pi_2^{opt,m,reg} = 0.035$, and a welfare level $W^{opt,reg}(m = 6) = 0.5906$. Hence, if there is non-discriminatory market opening with multilaterally coordinated entry in period one, welfare is still lower than in a closed setting ($W^{opt} = 0.6$, cf. Table 1), but it increases relative to unilateral entry choices ($W^{opt,m}$ = 0.584).

4.5 Discriminatory Market Opening with Unilaterally Regulated Entry

Sub-section 4.4 demonstrates that market opening will not necessarily make the economy better off, if set-up costs are low and the number of countries is large. However, a partial or discriminatory market opening can ensure that welfare rises. Suppose, therefore, that the government agrees on market opening with just one other country (m = 2). Solving (25) for two countries yields $n_1^{opt,m,reg}(m = 2) = 1.576$ and, following the same procedure as above, to $W^{opt,reg}(m = 2) = 0.615$. Hence, welfare increases in comparison to the closed economy setting because excessive entry in period two is reduced substantially. Moreover, opening up a second market allows firms to spread set-up costs, k, such that unit production costs decline. This decrease is pronounced enough to bring about a welfare increase.

5. Conclusions

We analyse a two-period Cournot-model with costly entry, in which fixed costs of production vary over time. As a benchmark, we investigate a closed-economy. Our main contribution is to extend the analysis to an open economy setting in which firms can undertake greenfield investments abroad. Such market opening allows firms to spread fixed cost over more markets and, thus, to lower unit production costs. This beneficial impact of horizontal FDI is mitigated or dominated by the increase in the number of firms. This entails a welfare loss due to the business stealing externality. In particular, we compare the unregulated market equilibrium with a situation in which governments restrict entry at least in the first period. Going beyond previous contributions in a further dimension, we compare the market equilibrium not only to the (second-best) welfare-maximum, but also to the outcome which arises if the government maximises a political support function.

Within this set-up, we have established a number of findings. Three of them are particularly noteworthy. First, market opening surely aggravates the excess entry problem in period two and has the same effect in period one, unless the government primarily maximises consumer surplus. In consequence, providing regulatory bodies with a sufficient set of instruments to restrict entry is a more pressing problem in an open than in a closed economy.

Second, non-discriminatory market opening has beneficial welfare effects in market equilibrium, but may have detrimental ones if the government can restrict entry. In a closed economy, the number of firms in market equilibrium is too high. Therefore, welfare is less than maximal because of the excessive entry distortion and the firms' market power. If the market is opened up, the number of firms in market equilibrium in period one declines, while the increase in period two is relatively moderate because there had already been excessive entry. Therefore, total fixed costs born by domestic firms decline. Moreover, consumer surplus rises. The latter effect ensures that market opening raises welfare in market equilibrium. If, however, the government determines the number of firms in a closed economy, the entry distortion is much less pronounced, unless the weight of consumers in the government's objective is sufficiently large. Market opening brings about too many competitors in period two. Hence, welfare declines on account of higher market entry costs in period two. This effect is slightly mitigated by the fall in the number of firms producing in period one. The rise in consumer surplus will only dominate if the excessive entry distortion introduced by market opening is not too large. Moreover, the countervailing effects in a situation in which the government determines entry also explain why welfare may decrease. Put differently, the feature that the welfare loss due a free-entry Cournot-oligopoly in a closed economy is relatively small if entry is regulated, reduces the gross gain from market opening and raises the negative impact. Hence, market opening may have a negative welfare impact. We also show by way of an example that the detrimental consequences of market opening can be mitigated or avoided if competition authorities can internationally coordinate entry restrictions or if market opening does not apply to firms from all countries.

Third, welfare and the payoff of a government maximising a political support function may vary in different directions. This is the case because a variation of profits and consumer surplus of equal magnitude but opposite direction will leave welfare constant, whereas this will generally not be the case for the government's payoff. Because market opening tends to reduce profits if entry is regulated, a government is more likely to oppose it the greater the firms' weight in the government's objective is. Hence, our analysis indicates a further reason why protectionist tendencies may result if political activities of interest groups determine government behaviour (see Ethier and Hillman 2019 for a recent survey).

The conclusions above and, more generally, many of our findings depend on a number of modelling features. In future work, it may be worthwhile to explore in how far they affect the theoretical predictions. As one example, the weight of the consumers' and firms' payoffs in the government's objective is exogenous and constant. However, it could be argued that the respective parameters are endogenous and depend on the payoffs obtained. This would imply that market opening affects the relative importance given to consumer surplus and profits when determining competition policy (see Hillman and Ursprung (1993) for an according approach idea in the context of trade policy). Since market opening tends to reduce aggregate profits, the consumers' interests may then become more important for entry regulations. As a second example, we have not allowed for exporting activities. However, if the good under consideration could be transported across borders easily, this restriction can no longer be justified. The findings of Miyagiwa and Sato (2014) suggest that there will also be excessive entry if firms can export their products, but not undertake FDI. The combination of both activities, exporting and investing abroad, however, may have different consequences if interaction effects occur (see Helpman et al. 2004 and Markusen and Stähler 2011). Third, we have assumed horizontal FDI, whereas a substantial fraction of such investments relate to vertical activities. Finally, we have limited the set of policy instruments to (costless) entry licences. If the government could use fiscal incentives to affect entry and output decisions, it could also employ them to redistribute income from consumers to firms or vice versa. This would further affect its payoff, unless it aimed to maximise welfare. In sum, the above analysis does not (yet) provide a framework for comprehensive policy advice.

6. Appendix

A.1: Equilibrium in Isolated Markets

To prove that the outcome described in Sub-section 3.1 is a unique equilibrium, we show, first, that $n_1 = n_2 = n^*$ is a stable outcome and, second, that it is the only one in pure strategies. Note for that purpose that if $k_1 \geq k_2$, the constraint $k > |k_1 - k_2|$ entails $k + k_2 > k_1$ and $k + k_1 > 2k_1 - k_2 \geq 2k_2 - k_2 = k_2$. The same inequalities can be derived for $k_1 < k_2$.

To establish the first part, we show that neither entry nor exit is profitable. Exit at the beginning of period two yields a payoff of zero, whereas producing the profit-maximising quantity generates profits of $\pi_2(n^*) = 0.5(k + k_1 - k_2) > 0$. Hence, no firm will exit in period two. Entry in period two of a firm which had not produced in period one will at most generate losses of $\pi_2(n^*) - k = 0.5(k_1 - k_2 - k) < 0$, as $k > |k_1 - k_2|$, and because profits decline in the number of firms. Turning to period one, an additional entrant would incur higher contemporaneous losses and lower profits in period two than an incumbent, since profits decline in the number of firms. Thus, there is no additional entry. Not entering at all would yield zero profits, that is, no improvement relative to the equilibrium described. Not entering in period one, but then entering in period two would generate a payoff of $\pi_2(n^*) - k < 0$. Hence, waiting to enter does not pay. In consequence, the outcome constitutes a stable equilibrium. In addition, profits decrease in the number of firms if firms choose output optimally (cf. equations (3a) and (3b)). Therefore, if n < n*, profits will be positive and firms have an incentive to enter, whereas firms will no longer enter if n > n*. Because, furthermore, all firms are identical and the resulting equilibrium is symmetric, it is the only one in pure strategies.

A.2: Optimal Number of Firms

Maximisation of $\widetilde{W}^{opt}$ (as defined in (7)) with respect to n_t, t = 1, 2, yields:

$$\frac{\partial \widetilde{W}^{opt}}{\partial n_1} = \frac{(1-c)^2[(1-\beta)n_1 + \beta]}{(1+n_1)^3} - \frac{\partial \kappa}{\partial n_1} = 0 \tag{A.1}$$

$$\frac{\partial \widetilde{W}^{opt}}{\partial n_2} = \frac{(1-c)^2[(1-\beta)n_2 + \beta]}{(1+n_2)^3} - \frac{\partial \kappa}{\partial n_2} = 0 \tag{A.2}$$

If the terms in square brackets are both negative, the derivatives in (A.1) and (A.2) will be negative as well, and n_1 and n_2 attain the smallest feasible values of unity in both periods. Suppose an interior solution next. Since κ, as defined in (8), is linearly increasing in n_1 and n_2, the expression in square brackets in (A.1) and in (A.2) is positive and the first terms are decreasing in the number of firms. If $n_1 > n_2$, the first term in (A.1) is thus smaller than the first term in (A.2), while the second term, which is deducted, is larger in absolute value in (A.1) than in (A.2). Hence, if n_2 is chosen such as to warrant (A.2), (A.1) is negative for any $n_1 > n_2$. Therefore, any choice of the number of firms which (1) implies interior solutions to the maximisation problem and (2) that more firms are allowed to enter in period one than in period two, or vice versa, cannot be optimal.

Finally, it may be the case that the term in square brackets is positive in (A.1) and negative in (A.2), or vice versa. In the former case, the optimal number of firms in period two would be minimal, i.e. one. If the optimal number of firms in period one is unity, the two-period monopoly case discussed above would result. If, however, the optimal number of firms in period one were greater than one, $(1-\beta)n_1+\beta<(1-\beta)n_2+\beta$ would hold because $n_1>n_2$ by assumption and since $(1-\beta)n_2+\beta<0$ requires $1-\beta<0$. This, however, is in contradiction to the assumption that the term in square brackets in (A.1) is positive and negative in (A.2). Hence, a choice of the number of firms such that $n_1>n_2=1$ cannot be optimal for a government, irrespective of its exact objective. A comparable argument establishes that $1=n_1<n_2$ cannot maximise the government's payoff either. Note, finally, that the sign of (A.2) is independent of n_1. Thus, the government has no incentive to alter its choice in period two ex-post and optimal choices $n^{opt}=n_1=n_2$ are also time-consistent.

A.3: Proof of Proposition A, Parts b) to e)

The arguments prior to Proposition A establish part c). Combining them with the results of Sub-section 3.1 proves part b). Part d) follows straightforwardly from the fact that the government establishes a monopoly. Finally, the optimal number of firms exceeds unity but falls short of n^*. In addition, output per firm and profits decline in the number of firms, while aggregate output rises in n (cf. equation (2)). Moreover, welfare is strictly concave in n and maximal at $n = n^*$. Since $1<n^{opt}\left(\beta^{crit,1}<\beta<\beta^{crit,2}\right)<n^*$, we have proven e).

A.4: Proof of Proposition B

We have to establish that (1) there are no incentives for firms to deviate from the outcome characterised in the Proposition and (2) this is the only equilibrium in pure strategies.

In period two, a domestic firm, which leaves the market, obtains a payoff of zero. Hence, it is not beneficial to exit. The same is true for foreign firms which have undertaken FDI and entered the domestic market. Additionally, profits decline in the number of firms. Hence, an additional entrant would obtain a negative payoff. Accordingly, no firm has an incentive to deviate from its choice in period two. In period one, profits decline with entry as well. Moreover, entrants make zero profits. Thus, no additional firm has an incentive to enter the market in period one. Furthermore, postponing entry until period two will result in a loss, since set-up costs would be incurred in period two. Moreover, not entering at all would yield a payoff of zero. Therefore, the outcome described in Proposition B is locally stable. Applying the same argument as in Appendix A.1, we can establish that there is no other equilibrium.

Aggregate output over both periods rises, as

$$X_1^{*m}+X_2^{*m}-2(X^*)=2\sqrt{0.5(k+k_1+k_2)}-\sqrt{k+k_1}-\sqrt{k_2}>0 \qquad (A.3)$$

Since welfare equals the sum of consumer surpluses, while the government's payoff is linearly increasing in welfare (unless consumer surplus is irrelevant), both rise with market opening.

A.5: Proof of Proposition C

If $m \geq n_2^{*m} / n_1^{opt,m}$, profits will be zero in period 2. The number of firms in period two is given by (5), replacing $\bar{k}$ by k_2. This proves part a). The proofs of parts b) and d) follow those of Proposition A. In particular, if $\beta \geq \beta^{crit,3}$ output will be given by $X_1^{opt,m} = 0.5(1-c)$, and profits equal $\pi_1^{opt,m} = 0.25(1-c)^2 - (k+k_1)$. The findings in part c) can been derived, taking into account $X_1^{opt,m}(\beta = 1) = 1 - c - x_1^{opt,m}(\beta = 1) = 1 - c - ((1-c)(k+k_1))^{1/3}$ and $\pi_1^{opt,m}(\beta = 1) = (k+k_1)\left(n_1^{opt,m} + 1\right)^{1/3} - (k+k_1)$. Finally, the outcomes and payoffs summarised in part e) for $\beta^{crit,1} < \beta < \beta^{crit,3}$, are given by: $1 < n_1^{opt,m} < n_1^{*m}$, $\sqrt{k+k_1} = x_1^{*m} < x_1^{opt,m}(\beta) < x_1^{opt,m}\left(\beta \geq \beta^{crit,3}\right) = 0.5(1-c)$, and $0.5(1-c) = X_1^{opt,m}\left(\beta \geq \beta^{crit,3}\right) < X_1^{opt,m}(\beta) < X_1^{*m} = 1 - c - \sqrt{k+k_1}$, $0 < \pi_1^{opt,m}(\beta) < \pi_1^{opt,m}\left(\beta \geq \beta^{crit,3}\right) = 0.25(1-c)^2 - (k+k_1)$. They follow from the unique relationship between the number of firms, n_1, and output, respectively the parameter β, and the negative effect of n_1 on profits.

A.6: Proof of Corollary D

ad a) The difference in the number of firms in period two can be computed using (5) and (14):

$$n_2^{*m} - n^{opt} = \frac{1-c}{\sqrt{k_2}} - \left(\frac{(1-c)^2}{\bar{k}}\right)^{\frac{1}{3}} = \frac{1-c}{\sqrt{k_2}} - \left(\frac{1-c}{\sqrt{\bar{k}}}\right)^{\frac{2}{3}}$$

$$> \frac{1-c}{\sqrt{k_2}} - \left(\frac{1-c}{\sqrt{k_2}}\right)^{\frac{2}{3}} = 1 + n_2^{*m} - (1 + n_2^{*m})^{\frac{2}{3}} > 0 \qquad \text{(A.4)}$$

The first inequality in (A.4) results because $k + k_1 > k_2$, such that $2\bar{k} = k + k_1 + k_2 > 2k_2$. The results for output follow immediately from (2).

ad b) From Propositions A and C we know that the government will establish a monopoly in the closed market and also after market opening in period one, if $\beta > \beta^{crit,2}$. Moreover, for all $\beta < \beta^{crit,1}$, the number of firms in a closed setting is given by n^*, whereas the respective number, if market opening takes place, is $n_1^{*m} < n^*$ (cf. (5) and (14)). In addition, the government's preferred number of firms is one if there is market opening also for $\beta^{crit,3} < \beta < \beta^{crit,2}$, whereas it exceeds one in the case of a closed market (cf. Propositions A and C). Finally, the government's preferred number of firms declines linearly in β, as the derivatives of (9) and (18) clarify. Hence, we have $n_1^{opt,m} < n^{opt}$ for all $\beta < \beta^{crit,2}$ and $n_1^{opt,m} = n^{opt} = 1$ otherwise. The relationship between the number of firms and output follows from (2).

ad c) and d) The examples in Tables 2 and 3 prove both claims.

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