Dynamic Analysis for Voluntary Import Expansions (VIEs) in the "Post GATT/WTO Era": Free Trade Promoter or Trade Barrier

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Abstract

Voluntary Imports Expansions (VIEs) are increasingly becoming an important item in the agendas of trade negotiators since it could survivor within the GATT/WTO structure, while other tariffs and non-tariffs trade barriers are diminished gradually in the "Post GATT/WTO Era". This paper, as the first paper to use the dynamic game model, analyzes the dynamic effect of VIEs on the global welfare, the importing country's welfare, firms' profits and outputs in both importing and exporting countries, and the price, with highlighting some elements that are missed in static analysis. With adopting habit format for consumers, we shows that in the closed loop (or Markov perfect) Nash equilibrium, the importing country's welfare and output are reduced, while the foreign firms' profits and prices increases, while the global welfare ambiguous in the Markov perfect Nash equilibrium. This conclusion confirms some results from static analysis about the home (importing) country's welfare and output decreasing and price increasing, but indicates the difference for the global welfare changing with those in static analysis. The previous static results about reduction of competition with VIE are not confirmed exactly if there are many firms in the foreign country, especially in the oligopolistic model. The dynamic effect for the extended model with multi-firm and different marginal costs such VIE negotiation is also discussed.

JEL classification: F12, F13, F42

Keywords: Voluntary Import Expansions, Managed Trade, Trade Negotiation, International Political Economy

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1 Introduction

With GATT/WTO (i.e. General Agreement of Tariffs and Trade and its inheritor: World Trade Organization) framework of global trade system established, traditional trade barriers, such as various tariffs, and non-tariff barriers, such as import quotas, voluntary export restraints (VERs) and others, will be diminished gradually. In some way, we could enter a new era -- "Post GATT/WTO Era". In this period, we could incur some new trade barriers. Some existing trade barriers could survive in the GATT/WTO framework, since they are not considered as the "trade barrier" in common. In the other words, there are divergent views on such issues among economists. In this kind of trade policies, voluntary imports expansions (VIEs) is one of most significant issues. That is we discuss in this paper.

There is one more reason to show the increasing importance of VIEs in the recent period. Although most academic research prefer and focus regulation-oriented policies based on principles of international trade theory, result-oriented policies attract more attention recently in the real world. World Trade Organization (WTO) based on bilateral trade agreements provides the possibility of using such result-oriented policies. Voluntary Import Expansion (VIEs) is the latest tool to conduct such result-oriented policies.

VIEs, although it also belongs to result-oriented trade policies, is significantly different, however, with other result-oriented policies. First of all, it is argued by some economists that it could not be viewed as non-tariff trade barrier like voluntary export restraint (VERs), and other quotas. They even think that VIE is a trade promoter against the domestic policy barrier and other cultural restrictions for free trade. At least there is a

debate for this policy among economists. Secondly, it usually takes the form of market-share in the import country normally. Therefore, conducting and precisely measuring such market-share for VIEs is not easy as VER and other trade restriction. And it is not, in some extent, enforceable. The effect of punishment for violating such bilateral agreement about VIEs is only viewed as the hysteresis effect for bilateral trade, if such punishment exists. These characteristics make VIEs significantly difference with other trade restriction.

VIEs had begun with the semiconductor import agreement between U.S. and Japan in 1986. The U.S. side thought that Japan uses some non-trade barrier to defy U.S. semiconductors into Japanese market even U.S. product are high quality with relative low price. Otherwise U.S. semiconductors should take significant market share, like in the other countries' market. Through several years' negotiation, Japanese government agreed to "voluntarily" import U.S. semiconductor parts and let them having 20% Japanese market share gradually. With the next year's additional agreement for semiconductor import, this kind of agreement has become a sort of binding-agreement which should be enforceable and should accompany with the punishment policy for the domestic firms by home country's government. With the success of U.S. semiconductor industry in Japan, other industries, such as automobile parts, automobile, beef, have tried to sign similar agreements with Japan. Currently, there is some trend to use VIEs, as an effective tool to open foreign markets, widely with other countries' trade. Since WTO, as the globally multilateral trade agreement framework, is based on the bilateral agreements, VIEs, when it is accepted by both countries without significant trade discrimination, will be a part of whole bilateral trade agreement framework, and consequently, be accepted by WTO, although there is the potential conflict between regulation-oriented policies and its theoretical ground--trade theory. So such result-oriented policies should still exist.

Generally, the research on VIEs is far less than that on VERs and other traditional trade restriction, whatever in the amount of researches or in the extent of research. Moreover, as far as we know, there is not any dynamic analysis for VIEs. Research for other aspects of VIEs, such as the determination of market share, punishment executing,

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total trade balance and coordination between regulation-oriented and result-oriented agreement, have not been done yet.

In this paper, we try to find the dynamic effect of VIEs to total surplus expressing the global welfare, home country's welfare, price, both firms' profits, and outputs. In Section 2, we review recent ten years models concerning VIEs. We will set up our model in this paper as a two-country duopoly model with each country having one firm without VIEs as a benchmark for our further analysis in Section 3. Section 4 shows the dynamic analysis for VIEs with Markov Perfect Nash Equilibrium (MPNE). We conclude our main results and discuss this paper's limitation with potential future research for this topic in Section 5.

2. Literature Review and Model Setting

Since the U.S. government uses this tool in the negotiation with Japan on semiconductor industry in 1986, voluntary imports expansions (VIEs) have become an important item in the agendas of trade negotiators. In a typical theoretical set-up, a negotiating team from a foreign country (F) may insist that the home country (H) should take measures to increase the imports of a particular commodity produced in F (for example, cars). In exchanges, F would lift its own restrictions on the goods exported by H (for example, steel.)

There is an increasingly theoretical literature on VIEs. The theoretical analysis for VIEs has begun from Bhagwati's paper (1987). Dinopoulos and Kreinin (1990), Bjorksten (1994), Greaney (1993, 1996, 1999), Masao and Yeo (1999), and Saxonhouse (1999) did research directly on VIEs comparing with other trade restrictions such as VERs or import tariffs. Recently research on VIEs has been significantly increased, including some Ph.D. dissertations from Stanford University, University of Michigan (e.g. Nakamura (1995), Song, (1997)) and others. When Dinopoulos and Kreinin (1990) use conventional trade geometry in perfect competitive market to analyze the effect of VIEs with offer curve shifting, most trade economists uses oligopoly model think about this issue. For example, Bjorksten (1990) uses the simple Cournot model and the Kreps-

Scheinkman duopoly model (1983) with price competition and capacity constraints in the three-country world. Masao and Yeo (1999?) just use the Cournot (duopoly) model in the two-firm (country) world with the extension of different cost, differentiated goods and n firms. Among some of the papers dealing with VIEs, Greaney's (1993, 1996, 1999) contribution is outstanding with plenty of citing. In her 1996's paper, she used Bertrand Model with the non-perfect substitute goods in the two-firm (country) world to analyze the impact of market-share VIEs on both a free-trade equilibrium and an assumed protected market equilibrium in the home country market, with comparison with import subsidy and VER. In her 1999's paper, she extended the research to the formation of the share of VIEs and showed the distortion on firms' output decisions. In this way the firms will change their competition strategy in the third country market and adopt this VIEs as policy options.

All of literatures mentioned above agree that VIEs will hurt the home country's welfare, with decreasing the total output and increasing price in the home country market. There are still debates, however, with this topic. For example, Gary Saxonhouse (1999) indicated in the book of "Development, Duality, and the International Economic Regime" that the VIEs could be voluntary and the increasing consumer's welfare with raising output and falling price in the home country market, using a traditional Cournot duopoly model with homogenous goods. This situation shows that at least there is a need to continue the research on VIEs. Moreover, since all of research on VIEs use the static analysis, even some of papers adopt the two-stage game, there should be a need for the dynamic analysis to extend the research dimension and, could clear some current puzzles on VIEs.

Since the VIEs is relative new trade policy instrument in international trade history, researchers attempt to adopt many related literatures to analyze VIEs. There are several aspects researchers working on. They think the differences (1) between policy-oriented and result-oriented policies; (2) among result-oriented policies; (3) between market-share and volume restriction instruments; (4) between VIEs and import subsidy; and (5) among competition models such as perfect Competition, Cournot, Bertrand, Price Leadership, and etc. Basically, they focus on the trade policy instruments, and international market conditions. For the former part, VER is a very often used instrument for comparing

analysis with VIE, since its close features with quotas and VIEs which is exogeneously given by the governments, and its plenty research on it and its comparison with tariffs and subsidies. For the later part, since the oligopoly is the usual market structure in the international market, Cournot, Bertrand, Price-leadership and Stackelberg models can frequently cited. Harris (1985) used the Bertrand and price-leadership models for non-perfect substitute goods to comparing VER or quota with import tariffs, to find their effects on price and profits. Krishna (1989) analyzed the same questions when he adopted the same Bertrand model but simultaneous-moving model instead of price leadership model. Only comparing these two papers, we can find the effect of different models on their conclusion. Some papers attempt to the very different way to approach this issue. For example, Cronshow and Markusen (1995), Ethier and Horn (1996) use the political economy approach with asymmetric information between countries regarding the existence of trade barriers to discuss the result-oriented trade policy. It is helpful when we consider about the impact of asymmetric information on domestic policy-making and firm decision-making.

Since the VIEs are appeared in the U.S.-Japan trade negotiation first. There is the third group of literatures reviewed for research on VIEs, except for above two groups of papers mentioned. Irwin's book (1994) can be viewed as a fundamental theory in so-called "managed trade". Lawrence (1987, 1993), Saxonhouse (1993) discussed the Japanese trade policy and trade regime. Adding Irwin (1996) and report from U.S. Semiconductor Industry Association (1996), we should have a clear view about the U.S.-Japan trade and the primary effect of VIEs.

Besides the model describing the market structure we review above, there is one more important aspect for research on VIEs we should mention here: modeling the consumer's demand. All above papers use the traditional model for the consumer's demand. It is simple and straightforward. There is, however, an increasing tendency in modeling the consumer's demand in the habit formation. It is, at least in this paper, a non-stationary demand, which is considered as a better way to describe the consumer's behavior for endogenizing the consumer's preference in path of her long time consumption. For some products, the strength of consumer demand increases with the consumption experience;

for example, the more photograph you take, the more you like taking photographs. On the other hand, if you stop consuming the products, your strength of demand will decline.

The first paper about habit formation appeared, as we know, is Robert A. Pollak's paper "Habit Formation and Dynamic Demand Functions" on *Journal of Political Economy* in 1970. Since then there are at least more than one hundred paper published on refereed journals to build up the strong background and wide application of habit formation on consumption and other relevant areas such as different utility functions, saving behavior, fiscal and monetary policies, and social behavior. According to the property of habit formation, adopting this formation to trade and VIEs seems quite reasonable, even there is only one homogenous good. The habit for consumption will make the actual consumption different from the simple demand function without any consideration about the consumer's preference or habit.

Generally speaking, the papers mentioned above share a common characteristic: firms are static maximizers and the games are one-shot games. The static approach is useful as a first step in understanding some of the key elements of VIEs. Therefore, in the following sections in this paper we attempt to highlight some elements that are missed in static analysis. These are (i) firms typically Maximize over a long horizon, (ii) consequently, the game played by firms involves strategies that are forward looking , (iii) government may induce domestic firms to become less aggressive against foreign firms in order to achieve some VIEs targets, and such inducement may take the form of a marginal modification of the strategies of domestic firms.

3 The Basic Model

We model an international duopoly, with one firm in each country. The firms compete in the market of the home country. To introduce dynamic elements into the model, we assume that consumption takes place with habit formation.

Our dynamic game is formulated in continuous time, and we use differential game[1] framework to define and characterized equilibrium. A time-honoured tradition in

[1] For a comprehensive treatment of differential games, see Dockner et al. (2000)

differential game theory is the comparison of open-loop Nash equilibrium with closed loop (or Markov perfect) Nash equilibrium.(See for example, Benchekroun and Long(1998), or Fudenberg and Tirole (1991, section 4.7 and 13.1)for a brief exposition of the two concepts.) In this paper, we will, however, characterize only Markov Perfect Nash Equilibrium (MPNE) in our model.

Broadly speaking, in the open-loop Nash equilibrium (OLNE), each player (country) chooses, right at the beginning of the game, its time paths of consumption, and of investment in knowledge capital and physical capital, while taking the time paths chosen by other players (countries)as given. To be an OLNE, the chosen vector of time paths by any country must be its best response to the vectors of time paths by all other countries. The equilibrium is called "open loop" because it is assumed that each country is committed to its vector of time paths, and does not condition its future actions on the future observed values of the state variables. The concept of OLNE has often been criticized as unsatisfactory because open loop Nash equilibra, in general, are not subgame perfect in following sense: if for some reason, at some time in the future, a state variable deviates from its expected equilibrium path, then it is no longer rational for countries to remain committed to their originally announced paths. This is the main reason why economists tend to prefer an alternative equilibrium concept, Markov perfect Nash equilibrium (MPNE), which is subgame perfect, because of the use of the closed loop information structure[2] and Bellman's optimality principle in its construction.

Normally, we should apply both equilibria concepts, if we adopt the dynamic games with simultaneous action which each player can not observe its rival's current behavior because of system noise or others. In this situation, OLNE can not only "serve as a useful benchmark for discussing the effects of strategic incentives in the closed loop information structure" (Fudenberg and Tirole, 1991, p. 131), but also avoid the disadvantage of subgame perfect equilibrium which is much weakened in many simultaneous-move games with symmetric agents because of inability of the elimination of unreasonable Nash equilibria supported by non-credible threats. However, now we meet the special problem VIEs which is not simultaneous-move game since both home and foreign firms

[2] For a fuller discussion of closed-loop information structure and open-loop information structure, see Fudenberg and Tirole (1991, section 4.7 and 13.3), and Dockner et al. (2000).

know the effect of the agreement. For this kind of sequential game, we should use Markov perfect Nash equilibrium, since there is not reasonable for the foreign firm not to adjust its strategy to optimize its profit when it knows the home firm's output and market share will be reduced.

3.1 Assumptions and Notations

There are two countries, Home(H) and Foreign (F). We focus the home market for a particular commodity. This market is supplied by two firms, the home firm and the foreign firm. The foreign government G^F is not happy about the market share of the foreign firm in the home market, perhaps because G^F believes that the home government, G^H, is unfairly and secretly subsidizing the home firm, or is making life different for the foreign firm by setting up administrative barriers (such as safety inspection, health quarantine, etc.) Whatever the reason, we suppose that G^F successfully puts pressure on G^H to take action to increase the foreign firm's market share. G^H may adopt several policy measures to achieve the VIEs. In what follows, we focus on one type of measures : pressuring the home firm to be marginally less aggressive in its strategic, by requiring the home firm to modify its strategic marginally. Our focus is on the effects of such marginal modifications of equilibrium strategies.

We now describe the model. We assume a duopoly with homogenous product, and Cournot competition. Let $X_1(t)$ and $X_2(t)$ denote the output levels of the home and foreign firms, respectively, at time t. Let $Q(t) = X_1(t) + X_2(t)$

The inverse demand function is

$$P(t) = G[Q(t), A(t)]$$

Where A(t) is a state variable that indicates the strength of consumer demand for the good product by the duopolists. We assume

$$\frac{\partial G}{\partial Q} < 0, \quad \text{and} \quad \frac{\partial \mathrm{G}}{\partial \mathrm{A}} \leq 0.$$

Here, we are appealing to the literature on habit formation according to which, for some products, the strength of consumer demand increases with the consumption experience; for example, the more photograph you take, the more you like taking photographs. On the other hand, if you stop consuming the products, your strength of demand will decline. We capture this by a simple differential equation

$$\dot{A}(t) = [X_1(t) + X_2(t)] - \delta A(t) \quad (1)$$

Where δ and γ are positive parameters.

The profit of the home firm at time is

$$\pi_1(X_1(t)) = G[X_1(t) + X_2(t), A(t)]X_1(t) - c_1 X_1(t)$$

Where c_1 is the home firm s unit cost (inclusive of any production tax, or production subsidy). The home firm seeks to maximize the present value of the stream of profits

$$\int_0^\infty \pi_1(X_1(t)e^{-rt}dt \quad (2)$$

Where r is the interest rate. Similarly, the foreign firm maximizes

$$\int_0^\infty \pi_2(X_2(t)e^{-rt}dt \quad (3)$$

where

$$\pi_2(X_2(t)) = G[X_1(t) + X_2(t), A(t)]X_2(t) - c_2 X_2(t)$$

3.2 Markov perfect Nash Equilibrium in the absence of VIEs

We now consider the benchmark scenario where there is no VIEs. We seek a Markov perfect Nash equilibrium for the duopoly. Each firm takes as given the production strategy of the other firm. We assume that firms choose their strategic in the space of stationary Markov strategies, which are rules that condition output at time t as a function of the observed value of the state variable at that time, A(t). A Markov perfect Nash equilibrium (MPNE) for the duopoly is a pair of strategies, Xi = ϕ_i(A), i = 1, 2 , such that given ϕ_2, the strategy ϕ_1 maximizes the objective function (2) , and given ϕ_1, the strategy ϕ_2 maximizes the objective function (3).

To find a MPNE, we write the Hamilton-Jacobi-Bellman (HJB) equation for each firm:

$$rV_1(A) = \max_{X_1}\left[G[X_1 + \phi_2(A), A]X_1 - c_1 X_1 + \left[\frac{dV_1}{dA}\right](X_1 + \phi_2(A) - \delta A)\right] \quad (4)$$

and

$$rV_2(A) = \max_{X_2}\left[G[X_2 + \phi_1(A), A]X_2 - c_2 X_2 + \left[\frac{dV_2}{dA}\right](X_2 + \phi_1(A) - \delta A)\right] \quad (5)$$

To proceed further, let us assume that the inverse demand is of the form

$$P(t) = \gamma A(t) + D - BQ(t) \quad (6)$$

Where D > max [c_1, c_2], B > 0, and A(0) = A_0 > 0. Under this assumption, we know that with suitable restriction on parameter values, one can find a pair of equilibrium strategies that are linear in the variable A and consequently, the value function V_i(A) are quadradic. We obtain these strategies by the method of undetermined coefficients, which we outline below. (Notice that if $\gamma = 0$ then the model reduces to a Cournot model without habit formation.)

From (4) and (6), we obtain

$$X_1 = \frac{1}{2B}\left[V_1'(A) + \gamma A + D - c_1 - B\phi_2(A)\right] \quad (7)$$

Consider the strategies

$$X_i = \phi_i(A_i) = a_i + b_i A (i = 1,2) \quad (8)$$

where the coefficients a_i and b_i are to be determined. We try the value functions

$$V_i(A) = E_i A^2 + M_i A + N_i \quad (9)$$

where the coefficients E_i, M_i and N_i are also to be determined. We must group together all terms that have A as a multiplicative factor, and all terms that do not have A.

To simplify, we will consider only the symmetric case, so that $E_1 = E_2 = E$ etc. Then

$$a_1 = a_2 = a = \frac{M + D - c}{3B} \quad \text{and} \quad b_1 = b_2 = b = \frac{\gamma + 2E}{3B}$$

We group all the terms that has A^2 as a factor. We then have the following equation to determine E:

$$[24 - 8\gamma]E^2 + [18\gamma - 9B(r + 2\delta)]E + \gamma^2 = 0 \tag{10}$$

(notice that if $\gamma = 0$, then E = 0 is one solution).

In what follows we set $\gamma = 1$ for simplicity. Then

$$16E^2 + [10 - 9B(\gamma + 2\delta)]E + 1 = 0 \tag{11}$$

Assumption A1: $9B(r + 2\delta) > 18$.

Remark on Assumption A1:

Assumption A1 ensures that equation (19) has two positive real roots, which we denote by E^* and E^{**}, where

$$E^{**} > \frac{1}{4} > E^* > 0 \tag{12}$$

and the smaller root is

$$E^* = \frac{1}{36}[9B(r + 2\delta) - 10] - \frac{1}{36}\sqrt{[9B(r + 2\delta) - 10]^2 - 64} \tag{13}$$

Note that E^* tends to zero if becomes very large. (since $E^* E^{**} = 1/16$ and $E^* + E^{**} = 9B(r+2\delta)-10$, the intersection of these two curves gives a very small E^* for large B.)

Next, we group all the terms that has A as a factor, to determine M.

$$\left[3B(r + \delta) - 3\gamma - 8E + \frac{4}{3}\gamma(\gamma + 2E)\right]M = [D - c]\left[2\gamma + 6E - \tfrac{4}{3}\gamma(\gamma + 2E)\right]$$

(note: if $\gamma = 0$ and E = 0 then M = 0.)

Thus

$$M = \frac{[D-c]\left[2\gamma + 6E - \frac{4}{3}\gamma(\gamma+2E)\right]}{\left[3B(r+\delta) - 3\gamma - 8E + \frac{4}{3}\gamma(\gamma+2E)\right]}$$

and

$$a = \frac{M+D-c}{3B} = \left[\frac{D-c}{3B}\right]\frac{[9B(r+\delta) - 3\gamma - 6E]}{[9B(r+\delta) - 9\gamma - 24E + 4\gamma(\gamma+2E)]}$$

which is positive for large B. For $\gamma = 1$,

$$a = \frac{M+D-c}{3B} = \left[\frac{D-c}{3B}\right]\frac{[9B(r+\delta) - 3 - 6E]}{[9B(r+\delta) - 5 - 16E]}$$

Note that

$$b = \frac{\gamma + 2E}{3B} > 0 \quad \text{for } \gamma = 1 \text{ and } E = E^* > 1/4.$$

We note that the production strategy a+bA yields an output with habit formation. Comparing the standard static Cournot output in a model without habit formation (which is (D - c) / 3B). Then we have the following proposition.

Proposition 1:

The dynamic Cournot output with habit formation is greater than the standard static Cournot output in a model without habit formation. It is true whatever in the dynamic situation or static situation.

Proof: see Appendix 1.

In order to obtain the firms' output, price, home country's welfare and total surplus, we need to find the steady state value of A first. In (1), allowing $\dot{A} = 0$.

Then we have $X_1 + X_2 - \delta\tilde{A} = 0$. Therefore we obtain: $\tilde{A} = \frac{2a}{\delta - 2b} = \frac{2(M+D-c)}{3\delta B - 2(\gamma + 2E)}$,

where M, E are known.

The new outputs for both firms are:

$$\tilde{X}_1 = a + b\tilde{A}, \quad \tilde{X}_2 = \frac{(M+D-c) + (\gamma+2E)\tilde{A}}{3B} + \frac{\varepsilon}{2}$$

Since the steady state price is: $P = \gamma\tilde{A} + D - BQ = \gamma\tilde{A} + D - B(\tilde{X}_1 + \tilde{X}_2)$

The profits for both firms will be: $\pi_1 = (P - c)\tilde{X}_1$, $\pi_2 = (P - c)\tilde{X}_2$

The home country's social welfare is the summation of consumer's surplus in the home country and the home firm's profit. That is: $W_H = \int_{\tilde{X}_1+\tilde{X}_2}^{0} [\gamma\tilde{A} + D - B\upsilon]d\upsilon - P(\tilde{X}_1 + \tilde{X}_2)$.

Moreover, as the definition from some research papers and Japanese government, the total surplus should be the home country's welfare plus the foreign firm's profit, which is viewed as the global welfare. $W = W_H + \pi_2$

4 Markov perfect Nash Equilibrium with VIEs

Suppose that the home country government uses same methods to let the home firm's production reduced. That is, the home firm's output is:

$X_1(t) = \hat{a}_1 + \hat{b}_1 A - \varepsilon$, where ε is given (14)

Remark on ε:

we did not use the explicit assumption for the market-share VIEs here. The reason is that the market-share for VIEs is decided by the estimation of the future market development. That is one of reasons that VIEs are hard to be enforceable precisely. Moreover, even VIEs are determined by the market share, the home country government still need to transform to the scale of volume and force the home firm to reduce some amount of output, eventually. Based on these reasons, we do think there is a great difference between the market-share and volume-restraint VIEs for their effects on trade and economy. So we assume, in this paper, a fixed amount ε as the home government order to reduce home firm's production, which is the common knowledge for both home and foreign firms.

Since the foreign firm, i.e. Firm 2, also knows (22), which is the common knowledge for everyone, Firm 2 maximizes the same objective function:

$$\int_0^{\infty} \pi_2(X_2(t)e^{-rt}dt \tag{15}$$

where

$$\pi_2(X_2(t)) = G[X_1(t) + X_2(t), A(t)]X_2(t) - c_2X_2(t), \quad \text{given } X_1(t) = a_1 + b_1A - \varepsilon .$$

We still use the Hamilton-Jacobi-Bellman (HJB) equation to find MPNE for Firm 2:

$$rV_2(A) = \max_{X_2}\left[G[X_2 + \phi_1(A) - \varepsilon, A]X_2 - c_2X_2 + \left[\frac{dV_2}{dA}\right](X_2 + \phi_1(A) - \varepsilon - \delta A)\right]$$

We still try the value functions as a quadratic form as that in the last section without VIEs:

$$V_i(A) = \hat{E}_i A^2 + \hat{M}_i A + \hat{N}_i \tag{16}$$

where the coefficients $\hat{E}_i$, $\hat{M}_i$ and $\hat{N}_i$ are also to be determined.

Then, we get values of $\hat{a}$ and $\hat{b}$ in the same way we used before for those of a and b. For the simplified situation, we assume that there is symmetry between both firms. Therefore we have

$$\hat{a}_1 = \hat{a}_2 = \hat{a} = \frac{\hat{M} + D - c}{3B} \quad \text{and} \quad \hat{b}_1 = \hat{b}_2 = \hat{b} = \frac{\gamma + 2\hat{E}}{3B}$$

Suppose we have the same value function for both firms, thus substitute the above into the the HJB function and find the first order condition. We get:

$$X_2 = \frac{[\gamma A + D - B(\hat{a} + \hat{b}A - \varepsilon)] - c_2 + (2\hat{E}A + \hat{M})}{2B} \tag{17}$$

$$X_2 = \frac{(\hat{M} + D - c) + (\gamma + 2\hat{E})A}{3B} + \frac{\varepsilon}{2} \tag{17'}$$

Using the same way to group all parameters for A^2, A and the constant, respectively. We have :

$$(\frac{2\delta}{9B})\hat{E}^2 + [\frac{2\gamma + \gamma\delta}{9B} - 2r\delta + r]\hat{E} + \frac{\gamma^2}{9B} = 0$$

$$\hat{M} = \frac{(6D + c + 9B\varepsilon - 3rB\varepsilon) + 9\delta rB}{\gamma - 4\hat{E} - 9Br}$$

$$\hat{N} = \frac{(2\hat{M} + D - c)(\hat{M} + D - c)}{9B} + \frac{\hat{M}\varepsilon}{6} - \frac{\varepsilon^2 B}{4}$$

So, we have X_2 in all known values.

Now look at the steady state $\hat{A}$ from the differential equation: $\dot{A} = X_1 + X_2 - \delta A$.

Let $\dot{A}$=0, we have $X_1 + X_2 - \delta\hat{A} = 0$. Then we obtain:

$$\hat{A} = \frac{D + B(a - \varepsilon) - c + \hat{M}}{2\delta B - (\gamma + Br + 2E)} = \frac{4D - 4c - 2\hat{M} - 3\varepsilon B}{6\delta B - 4\gamma - 8\hat{E}},$$ where all parameters are known.

Then we get the new outputs for both firms are:

$\hat{X}_1 = \hat{a} + \hat{b}\hat{A}$, and $X_2 = \frac{(\hat{M} + D - c) + (\gamma + 2\hat{E})\hat{A}}{3B} + \frac{\varepsilon}{2}$

The steady state price, the profits for both firms, the home country's social welfare, and the global welfare (i.e. the total surplus mentioned in the last section) are determined as well. So, compariing the above results with those in Section 3, we have the following proposition.

Proposition 2:

In the dynamic context, the home country's social welfare, and the home firm's output will be reduced with VIEs comparing the situation without VIEs, while the price moves the opposite way. The change of total surplus between different scenarios is ambiguous.

Proof. See Appendix 2.

5 Conclusion and the Further Potential Research

We have shown that comparing to the situation of bilateral trade without VIEs, when we incur the VIEs as an enforceable agreement, the home country's welfare, total output will be reduced, and price of the homogenous good will increase in the dynamic context. However, the dynamic total surplus, which is mentioned heavily by the Japanese government and officials as a measurement of the global welfare in the bilateral trade, is

ambiguous. It is different from the static results from most recent literatures. Since the model we use is the general model, which considers the habit formation in consumer's behavior and obtains the Markov Perfect Nash Equilibrium in the dynamic context, the result should be robust.

We can extend our model to the different marginal costs for both home and foreign firms, and to the multi-firm environment in the two-country model, as other existing papers did in the static context. For our brief analysis (see Appendix 3), the main results listed above are not changed.

However, we could try the situation of heterogeneous goods in our model. Since we adopt the habit formation for consumption, the results could be different from that adopting the standard demand function. That is one way for our future research in this topic.

Formatting the determination of market share from countries' negotiation is important for our research. Some recent papers try to compare the volume-constrained VIEs and market-share VIEs. We do not think, as we discuss in Section 4, this kind of distinction is important. The reason is that the domestic market is changed over time. So the negotiated market-share is only the estimation for future market, and eventually, the home country government use this estimation to set a volume to restrict the home firms' production. What is interesting here is how to find this market share for VIEs. Research in this direction will coincide with another main stream in trade policy research which focuses the effect of domestic policy, and process of trade negotiation, on the international trade agreement.

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