

# Market integration in network industries

A. Mauleon, V. Vannetelbosch and C. Vergari

Discussion Paper 2008-18

Département des Sciences Économiques  
de l'Université catholique de Louvain



**UCL**

CORE DISCUSSION PAPER  
2008/25

**Market integration in network industries**

Ana MAULEON<sup>1</sup>, Vincent VANNETELBOSCH<sup>2</sup>  
and Cecilia VERGARI<sup>3</sup>

May 2008

**Abstract**

What is the effect of product market integration on the market equilibrium in the presence of international network externalities in consumption? To address this question, we set up a spatial two-country model and we find that the economic forces at work may have an ambiguous effect on prices.

**Keywords:** compatibility, horizontal differentiation, network effect

**JEL Classification:** L13, L15

---

<sup>1</sup> FNRS and CEREC, Facultés Universitaires Saint-Louis; CORE, Université catholique de Louvain, Belgium.

<sup>2</sup> FNRS and CORE, Université catholique de Louvain, Belgium. E-mail: [Vincent.vannetelbosch@uclouvain.be](mailto:Vincent.vannetelbosch@uclouvain.be). This author is also member of ECORE, the newly created association between CORE and ECARES.

<sup>3</sup> Department of Economics, University of Bologna, Italy.

This paper presents research results of the Belgian Program on Interuniversity Poles of Attraction initiated by the Belgian State, Prime Minister's Office, Science Policy Programming. The scientific responsibility is assumed by the authors.



# 1 Introduction

European integration and its economic implications constitute important and debated issues. In the general literature, product market integration has been interpreted as a reduction in costs associated with international trade (e.g., transport costs, tariffs, information costs about foreign markets, etc.). More integrated product markets would reduce firms' power and make markets more competitive. As it is widely recognized, and remarked in a recent speech by Jean-Claude Trichet, President of the ECB, "economic integration benefits consumers through lower prices" (Berlin, 13 June 2007).<sup>1</sup> In this short note, we show that once one takes into account goods characterized by "international" network externalities, this need not be the case.

International network externalities arise when consumer's utility increases with the number of consumers adopting the same good or compatible goods regardless of whether they live in their own country or abroad.<sup>2</sup> Indeed, market integration affects not only "traditional" trade barriers but also less visible non-tariff barriers, such as the proportion of foreign network that consumers of one country can enjoy. Namely, international network externalities can be *partial* because of trade policy reasons (where international standardization constitutes a key instrument),<sup>3</sup> or because of technical reasons linked to the good of interest.

Accordingly, we address the following question: what is the effect of product market integration on the market equilibrium in the presence of international network externalities in consumption? We set up a spatial two-country model with two network goods (one per country) and consumers with heterogeneous preferences for the local (foreign) good. We find that the economic forces at work may have an ambiguous effect on prices.

As far as we know, there are a few studies about international trade in the presence of consumption externalities. Janeba (2007) studies the benefits from free trade in the context of consumption externalities via a general equilibrium two country-model with perfectly competitive markets. Iwasa and Kikuchi (2007) develop a two-country model with incompatible country-specific hardware technologies which is an extension of Gandal and Shy (1992) closed-economy model. In particular, they study the software provision decision of software firms to hardware firms. Their work thus deals with firms' strategies towards vertically related firms, whereas we focus on horizontal competitors.

---

<sup>1</sup><http://www.ecb.int/press/key/date/2007/html/sp070613.en.html>.

<sup>2</sup>There is a substantial amount of literature on network externalities. The seminal paper is Katz and Shapiro (1985).

<sup>3</sup>Gandal and Shy (2001) study governments' incentives to recognize foreign standards in the presence of network effects and conversion costs.

## 2 Model

As far as the *supply side* is concerned, suppose that firm  $A$ , installed in country 1, produces network good  $A$  and charges price  $p_A$ ; firm  $B$ , installed in country 2, produces network good  $B$  and charges price  $p_B$ . These two network goods are compatible, that is consumers adopting good  $A$  benefit from the number of consumers buying good  $A$  as well as from the number of consumers buying good  $B$ . Nevertheless, the network effect coming from consumers living abroad is only partial as long as markets are not fully integrated. Product market integration implies cost reductions that we model via an increase in the network effect. As an example, we think of *mobile communication services*. A network operator providing this kind of service usually allows you to communicate with both consumers adopting the same operator and consumers adopting a rival operator regardless of where the consumers live. In other words, we can say that these services are compatible. However, living in one country and communicating with people abroad via a mobile phone is far more expensive than calling people in the same country. The network operator, through roaming agreements which allow it to use the foreign network, can provide its customers abroad with the service. Thanks to market integration, these costs are progressively decreasing. For example, in the European Union, the Regulation on roaming charges within the European Union which is in force since June 30, 2007, is forcing service providers to lower their roaming fees across the 27-member bloc. The new tariffs will be applied by September 30, 2007. Moreover, it has been planned that these "Eurotariffs" will gradually decrease over the next three years.<sup>4</sup>

As for the *demand side*, we assume that each country has a continuum of consumers of mass  $n$  indexed by  $x$  which are uniformly distributed along the interval  $[0, 1]$ . Each consumer has a unit demand and can buy either good  $A$  or good  $B$ . In a standard way, the utility coming from consumption depends on the intrinsic benefit of the good, on the network effect, on the price and on some trade costs to buy the foreign good. Consumers differ in their valuation of the intrinsic benefit as well as in their valuation of the network benefit. In particular, consumers which are "foreign brand-oriented" value little the (intrinsic and network) benefit from buying the local good and viceversa consumers which are "local brand-oriented" value little the (intrinsic and network) benefit from buying the foreign good. We also assume that the degree of product market integration between the two countries affects consumers' utility in three ways: through the intrinsic benefit, the network benefit as well as through the trade costs. Namely, let  $n_1$  and  $n_2$  denote the number of buyers (of either good) in country 1 and 2, respectively. Obviously,  $n_i \leq n$ , for  $i = 1, 2$ . A consumer buys at most one good and purchases either one or no unit of

---

<sup>4</sup>[http://ec.europa.eu/information\\_society/activities/roaming/roaming\\_regulation/index\\_en.htm](http://ec.europa.eu/information_society/activities/roaming/roaming_regulation/index_en.htm).

any given good. Define  $\delta \geq 0$  our inverse measure of product market integration: as  $\delta$  approaches zero markets become more integrated. The utility of consumer  $x \in [0, 1]$  living in country 1 is given by:

$$U^1(x) = \begin{cases} \bar{u} - c(\delta)x + \beta(n_1 + \gamma(\delta)n_2)(1-x) - p_A & \text{if he buys good } A, \\ \bar{u} - c(\delta)(1-x) + \beta(n_1 + \gamma(\delta)n_2)x - t(\delta) - p_B & \text{if he buys good } B, \\ 0 & \text{if he buys nothing.} \end{cases}$$

Similarly, the utility of consumer  $x$  living in country 2 is:

$$U^2(x) = \begin{cases} \bar{u} - c(\delta)x + \beta(n_2 + \gamma(\delta)n_1)(1-x) - p_B & \text{if he buys good } B, \\ \bar{u} - c(\delta)(1-x) + \beta(n_2 + \gamma(\delta)n_1)x - t(\delta) - p_A & \text{if he buys good } A, \\ 0 & \text{if he buys nothing.} \end{cases}$$

Thus,  $x \in [0, 1]$  measures the consumer's valuation of the foreign good. A high consumer type ( $x \rightarrow 1$ ) is "foreign brand-oriented"; on the other hand, a low consumer type ( $x \rightarrow 0$ ) is "local brand-oriented". Notice that indeed consumers living closer the border may prefer a foreign good since they are likely to have more connections with foreign residents.<sup>5</sup>

As far as the *intrinsic benefit* is concerned, a consumer living in country 1 (in country 2) has a utility of  $\bar{u} - c(\delta)x$ , if he buys the good  $A$  ( $B$ ) produced in his country, and a utility of  $\bar{u} - c(\delta)(1-x)$ , if he buys the good  $B$  (or  $A$ ) produced in the other country. The intrinsic benefit increases with product market integration (i.e.,  $c'(\delta) > 0$ ): the more the two countries are integrated, the higher the quality of mobile phones because of a higher mobility of high skilled workers (experts in the field).<sup>6</sup> In order to purchase the foreign good, a consumer has to bear the additional cost  $t(\delta)$  which is a function of the degree of product market integration and represents the level of administrative costs for buying abroad. We posit  $t(\delta) \geq 0$  and  $t'(\delta) \geq 0$ .

As for the *network benefit*, a consumer living in country  $i = \{1, 2\}$  and buying good  $l = \{A, B\}$  has a utility of  $\beta(n_i + n_j\gamma(\delta))(1-x)$ , if he buys the local good  $l$ , and a utility of  $\beta(n_i + \gamma(\delta)n_j)x$ , if he buys the foreign good (with  $j \neq i$  and  $j = \{1, 2\}$ ).  $\gamma(\delta) \in (0, 1)$  is the proportion of foreign network that a consumer can enjoy; it depends on product market integration:  $\gamma'(\delta) < 0$ . The parameter  $\beta \geq 0$  measures the importance of the network size effect for consumers. Therefore, the network benefit also increases with product market integration: the more markets are integrated the more consumers of one country benefit from the number of consumers of the other country adopting the same network good or compatible goods. If we think again of the mobile communication

<sup>5</sup>Think of people living in Trentino (an Italian region located in the extreme north) versus people living in Sicily (extreme south).

<sup>6</sup>We could think of  $c(\delta)$  as a learning cost which decreases with product market integration and in turn makes higher the intrinsic benefit of the good.

services example, product market integration reduces the roaming costs and in turn makes the network benefit higher. Also, market integration makes more accessible to consumers complementary products, like post-purchase services.

Overall, consumer's utility is increasing in product market integration.

## 2.1 Demands

In order to solve the model, we assume that the market is fully covered, i.e.,  $\bar{u}$  is large enough so that each consumer buys one unit of either good.<sup>7</sup> Formally, market coverage means that  $n_1 = n_2 = n$ . We first analyze the *decision problem of consumers* which choose between the goods maximizing their net surplus (for any level of prices). In this maximization problem they take as given the decisions of the other consumers.

In each country, consumer type  $x$  buys the local good  $l$  rather than the foreign good  $k$  if and only if  $U_l^i(x) \geq U_k^i(x)$ . Solving this inequality for both countries, we determine the indifferent consumer in country 1 and 2, denoted by  $x_{1A}^C$  and  $x_{2B}^C$ , respectively:

$$U_A^1(x) - U_B^1(x) \geq 0 \Leftrightarrow x \leq \frac{1}{2} + \frac{t(\delta) + (p_B - p_A)}{2(\beta n(1 + \gamma(\delta)) + c(\delta))} \equiv x_{1A}^C,$$

$$U_A^2(x) - U_B^2(x) \geq 0 \Leftrightarrow x \geq \frac{1}{2} + \frac{t(\delta) + (p_A - p_B)}{2(\beta n(1 + \gamma(\delta)) + c(\delta))} \equiv x_{2B}^C.$$

In words, in country 1, consumer types  $x \in [0, x_{1A}^C]$  prefer the local good  $A$  and in contrast consumer types  $x \in (x_{1A}^C, 1]$  prefer the foreign good  $B$ . Similarly, in country 2, consumer types  $x \in [0, x_{2B}^C]$  prefer the local good  $B$  and consumer types  $x \in (x_{2B}^C, 1]$  prefer the foreign good  $A$ .<sup>8</sup> We can thus find the total demands for the two goods, say  $q_A$  and  $q_B$ , as the sum of the demands in the two countries:<sup>9</sup>

$$q_A = n(x_{1A}^C + 1 - x_{2B}^C) = n \left( 1 + \frac{(p_B - p_A)}{n\beta(1 + \gamma(\delta)) + c(\delta)} \right),$$

$$q_B = n(x_{2B}^C + 1 - x_{1A}^C) = n \left( 1 + \frac{(p_A - p_B)}{n\beta(1 + \gamma(\delta)) + c(\delta)} \right).$$

As we can see from the expressions above, quantities are independent of the administrative costs  $t(\delta)$  as they are the same in both countries. Moreover, at the same price,  $p = p_A = p_B$ , both firms enjoy a positive demand, in particular,  $q_A = q_B = n > 0$  because of the

<sup>7</sup>We assume that  $\bar{u} - c(\delta)$  approaches zero: consumer type  $x = 1$  never prefers the local over the foreign good.

<sup>8</sup>As in most "location" models, goods should be sufficiently differentiated in order to have interior equilibria. In particular, we here focus on the market coverage case and so we have:  $x_{1A}^C$  and  $x_{2B}^C$  belong to the interval  $[0, 1]$  if  $p_A - p_B \in [t(\delta) - (\beta n(1 + \gamma(\delta)) + c(\delta)), (\beta n(1 + \gamma(\delta)) + c(\delta)) - t(\delta)]$ , which is a non-empty interval if  $c(\delta) > t(\delta) - \beta n(1 + \gamma(\delta))$ .

<sup>9</sup>We rule out market segmentation which means that the price of each brand is the same anywhere in the world.

presence of horizontal differentiation.<sup>10</sup> We can also reasonably assume that the demand for the local good increases with  $\delta$ , as a result, there will exist an upperbound for  $\delta$ , that is the degree of product market integration at which countries are perfectly separated, i.e.  $x_{1A}^C = x_{2B}^C = 1$ .

## 2.2 Price competition

Let  $\Pi_l$  be the profit of firm  $l = \{A, B\}$ . Both firms are producing without incurring any production cost. Then, firm  $l$ 's maximization problem becomes:  $\max_{p_l} \Pi_l = \max_{p_l} p_l q_l$ . This optimization problem results in the following equilibrium prices and quantities:

$$\begin{aligned} p_A^C &= p_B^C = p^C = c(\delta) + \beta n(1 + \gamma(\delta)), \\ q_A^C &= q_B^C = q^C = n. \end{aligned}$$

As in a standard linear city model, the price positively depends on what we can interpret to be the transportation cost,  $c(\delta)$ . However, it also depends on the network effect. We have that  $\partial p^C / \partial \delta \geq 0 \Leftrightarrow c'(\delta) \geq -\beta n \gamma'(\delta)$ .

**Proposition 1** *When consumers have heterogeneous preferences towards a local and a foreign good, an increase in market integration has an ambiguous effect on prices in presence of international network externalities. The higher (smaller)  $\beta$  is the more likely an increase in market integration will increase (decrease) prices.*

Thus, product market integration has an ambiguous effect on equilibrium prices due to the presence of two opposite forces:  $c'(\delta) > 0$  and  $\gamma'(\delta) < 0$ . As markets become more separated, on the one hand, firms' market power increases so that they can set higher prices; on the other hand, the reduction in network benefit induces consumers to value less both goods, that is their willingness to pay decreases which in turn has a negative effect on prices.

## 3 Concluding comments

We have shown that market integration may have an ambiguous effect on prices in presence of international network externalities. This result depends on the assumption about the compatibility between the local and foreign good. This is reasonable if we think of mobile phones: they allow you to communicate with both consumers adopting the same

---

<sup>10</sup>This does not mean that there is no trade when prices are equal. Indeed, if  $(p_B - p_A) = 0$ , we obtain that  $x_{1A}^C = x_{2B}^C = x_l^C \leq 1 \Leftrightarrow t(\delta) < (\beta n(1 + \gamma(\delta)) + c(\delta))$  which means that trade occurs as long as trade costs are sufficiently low.



operator and consumers adopting a rival operator. However, this result does not hold under *incompatible goods*. Indeed, developing the same model as before but assuming that what matters for consumers' choice is only the number of users choosing the same good in both countries, it can be shown that, the price only depends on  $c(\delta)$  and the effect of  $\delta$  is then clearly positive. Comparing compatible vs incompatible goods, we can make the following remarks. As far as the equilibrium variables are concerned, the important difference is that when goods are compatible, the *network size* is the same for both goods, as a result the network has a positive effect on their values for consumers and in turn a positive effect on their prices, which indeed are increasing in  $\beta$ . On the other hand, when goods are not compatible, competition is tougher because firms try to conquer as many consumers as possible in order to get a higher network than the rival firm and in turn more consumers which, for a given intrinsic benefit, value just their own network size. As a consequence, firms price their good at the lowest possible value, i.e. as if  $\beta = 0$ .

## Acknowledgments

We are grateful to Oscar Amerighi, Rabah Amir, Paul Belleflamme, Vincenzo Denicolo, Jean Gabszewicz and Xavier Wauthy for helpful comments and suggestions. Ana Mauleon and Vincent Vannetelbosch are Research Associates of the National Fund for Scientific Research (FNRS), Belgium. Vincent Vannetelbosch is Associate Fellow of CEREC, Facultés Universitaires Saint-Louis. Financial support from Spanish Ministerio de Educación y Ciencia under the project SEJ2006-06309/ECON, support from the Belgian French Community's program Action de Recherches Concertée 03/08-302 and 05/10-331 (UCL), and support of a SSTC grant from the Belgian State - Belgian Science Policy under the IAP contract P6/09 are gratefully acknowledged.

## References

- [1] Church, J. and N. Gandal, "Network Effects, Software Provision, and Standardization," *Journal of Industrial Economics* 40, 85-103 (1992).
- [2] Gandal, N. and O. Shy, "Standardization Policy and International Trade," *Journal of International Economics* 53, 363-383 (2001).
- [3] Iwasa, K. and T. Kikuchi, "Indirect Network Effects and Trade Patterns," *Economics Bulletin* 6, 1-9 (2007).

- [4] Janeba, E., "International Trade and Consumption Externalities," *European Economic Review* 51, 781-803 (2007).
- [5] Katz, M. and C. Shapiro, "Network Externalities, Competition and Compatibility," *American Economic Review* 75, 424-440 (1985).

## Recent titles

### CORE Discussion Papers

- 2007/82. Jacques H. DREZE, Oussama LACHIRI and Enrico MINELLI. Shareholder-efficient production plans in a multi-period economy.
- 2007/83. Jan JOHANNES, Sébastien VAN BELLEGEM and Anne VANHEMS. A unified approach to solve ill-posed inverse problems in econometrics.
- 2007/84. Pablo AMOROS and M. Socorro PUY. Dialogue or issue divergence in the political campaign?
- 2007/85. Jean-Pierre FLORENS, Jan JOHANNES and Sébastien VAN BELLEGEM. Identification and estimation by penalization in nonparametric instrumental regression.
- 2007/86. Louis EECKHOUDT, Johanna ETNER and Fred SCHROYEN. A benchmark value for relative prudence.
- 2007/87. Ayse AKBALIK and Yves POCHET. Valid inequalities for the single-item capacitated lot sizing problem with step-wise costs.
- 2007/88. David CRAINICH and Louis EECKHOUDT. On the intensity of downside risk aversion.
- 2007/89. Alberto MARTIN and Wouter VERGOTE. On the role of retaliation in trade agreements.
- 2007/90. Marc FLEURBAEY and Erik SCHOKKAERT. Unfair inequalities in health and health care.
- 2007/91. Frédéric BABONNEAU and Jean-Philippe VIAL. A partitioning algorithm for the network loading problem.
- 2007/92. Luc BAUWENS, Giordano MION and Jacques-François THISSE. The resistible decline of European science.
- 2007/93. Gaetano BLOISE and Filippo L. CALCIANO. A characterization of inefficiency in stochastic overlapping generations economies.
- 2007/94. Pierre DEHEZ. Shapley compensation scheme.
- 2007/95. Helmuth CREMER, Pierre PESTIEAU and Maria RACIONERO. Unequal wages for equal utilities.
- 2007/96. Helmuth CREMER, Jean-Marie LOZACHMEUR and Pierre PESTIEAU. Collective annuities and redistribution.
- 2007/97. Mohammed BOUADDI and Jeroen V.K. ROMBOUTS. Mixed exponential power asymmetric conditional heteroskedasticity.
- 2008/1. Giorgia OGGIONI and Yves SMEERS. Evaluating the impact of average cost based contracts on the industrial sector in the European emission trading scheme.
- 2008/2. Oscar AMERIGHI and Giuseppe DE FEO. Privatization and policy competition for FDI.
- 2008/3. Włodzimierz SZWARC. On cycling in the simplex method of the Transportation Problem.
- 2008/4. John-John D'ARGENSIO and Frédéric LAURIN. The real estate risk premium: A developed/emerging country panel data analysis.
- 2008/5. Giuseppe DE FEO. Efficiency gains and mergers.
- 2008/6. Gabriella MURATORE. Equilibria in markets with non-convexities and a solution to the missing money phenomenon in energy markets.
- 2008/7. Andreas EHRENMANN and Yves SMEERS. Energy only, capacity market and security of supply. A stochastic equilibrium analysis.
- 2008/8. Géraldine STRACK and Yves POCHET. An integrated model for warehouse and inventory planning.
- 2008/9. Yves SMEERS. Gas models and three difficult objectives.
- 2008/10. Pierre DEHEZ and Daniela TELLONE. Data games. Sharing public goods with exclusion.
- 2008/11. Pierre PESTIEAU and Uri POSSEN. Prodigality and myopia. Two rationales for social security.
- 2008/12. Tim COELLI, Mathieu LEFEBVRE and Pierre PESTIEAU. Social protection performance in the European Union: comparison and convergence.
- 2008/13. Loran CHOLLETE, Andréas HEINEN and Alfonso VALDESOGO. Modeling international financial returns with a multivariate regime switching copula.
- 2008/14. Filomena GARCIA and Cecilia VERGARI. Compatibility choice in vertically differentiated technologies.

## Recent titles

### CORE Discussion Papers - continued

- 2008/15. Juan D. MORENO-TERNERO. Interdependent preferences in the design of equal-opportunity policies.
- 2008/16. Ana MAULEON, Vincent VANNETELBOSCH and Wouter VERGOTE. Von Neumann-Morgenstern farsightedly stable sets in two-sided matching.
- 2008/17. Tanguy ISAAC. Information revelation in markets with pairwise meetings: complete information revelation in dynamic analysis.
- 2008/18. Juan D. MORENO-TERNERO and John E. ROEMER. Axiomatic resource allocation for heterogeneous agents.
- 2008/19. Carlo CAPUANO and Giuseppe DE FEO. Mixed duopoly, privatization and the shadow cost of public funds.
- 2008/20. Helmuth CREMER, Philippe DE DONDER, Dario MALDONADO and Pierre PESTIEAU. Forced saving, redistribution and nonlinear social security schemes.
- 2008/21. Philippe CHEVALIER and Jean-Christophe VAN DEN SCHRIECK. Approximating multiple class queueing models with loss models.
- 2008/22. Pierre PESTIEAU and Uri M. POSSEN. Interaction of defined benefit pension plans and social security.
- 2008/23. Marco MARINUCCI. Optimal ownership in joint ventures with contributions of asymmetric partners.
- 2008/24. Raouf BOUCEKKINE, Natali HRITONENKO and Yuri YATSENKO. Optimal firm behavior under environmental constraints.
- 2008/25. Ana MAULEON, Vincent VANNETELBOSCH and Cecilia VERGARI. Market integration in network industries.

### Books

- Y. POCHET and L. WOLSEY (eds.) (2006), *Production planning by mixed integer programming*. New York, Springer-Verlag.
- P. PESTIEAU (ed.) (2006), *The welfare state in the European Union: economic and social perspectives*. Oxford, Oxford University Press.
- H. TULKENS (ed.) (2006), *Public goods, environmental externalities and fiscal competition*. New York, Springer-Verlag.
- V. GINSBURGH and D. THROSBY (eds.) (2006), *Handbook of the economics of art and culture*. Amsterdam, Elsevier.
- J. GABSZEWICZ (ed.) (2006), *La différenciation des produits*. Paris, La découverte.
- L. BAUWENS, W. POHLMEIER and D. VEREDAS (eds.) (2008), *High frequency financial econometrics: recent developments*. Heidelberg, Physica-Verlag.
- P. VAN HENTENRYCKE and L. WOLSEY (eds.) (2007), *Integration of AI and OR techniques in constraint programming for combinatorial optimization problems*. Berlin, Springer.

### CORE Lecture Series

- C. GOURIÉROUX and A. MONFORT (1995), *Simulation Based Econometric Methods*.
- A. RUBINSTEIN (1996), *Lectures on Modeling Bounded Rationality*.
- J. RENEGAR (1999), *A Mathematical View of Interior-Point Methods in Convex Optimization*.
- B.D. BERNHEIM and M.D. WHINSTON (1999), *Anticompetitive Exclusion and Foreclosure Through Vertical Agreements*.
- D. BIENSTOCK (2001), *Potential function methods for approximately solving linear programming problems: theory and practice*.
- R. AMIR (2002), *Supermodularity and complementarity in economics*.
- R. WEISMANTEL (2006), *Lectures on mixed nonlinear programming*.

Département des Sciences Économiques  
de l'Université catholique de Louvain  
Institut de Recherches Économiques et Sociales

Place Montesquieu, 3  
1348 Louvain-la-Neuve, Belgique