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Implications of financial transaction costs on the real economy: A note

Matthias Pelster¹

ABSTRACT

This note studies the influence of a financial transaction tax and transaction costs on the optimal production and hedging strategies of a duopoly. Firms are exposed to demand uncertainty that leads to price risk and can hedge their risk exposure on a forward market. However, the forward position is subject to transaction costs. We investigate two settings: first, we explore the Cournot duopoly with a simultaneous hedging opportunity; second, we analyze the case with a sequential forward market. We show that in both settings transaction costs lead to a less competitive market and that prices increase as the producers limit their output.

KEY WORDS:

price risk; hedging; transaction cost; financial transaction tax; duopoly

JEL Classification: D21, D43, F10, F11

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1 Introduction

As a consequence of the recent financial crisis, the European Commission discusses the introduction of a financial transaction tax (FTT). The exchange of shares and bonds would be taxed at a rate of 0.1%, while derivative contracts would be subject to a 0.01% tax rate. We study the impact of such a financial transaction tax and transaction costs in general on the optimal production and corporate hedging decision of a duopoly. We analyze whether the existence of transaction costs influences the market equilibrium. To perform the analysis, we study a Cournot duopoly because many product markets are dominated by only two firms. Firms are exposed to uncertain demand. This demand uncertainty leads to price risk. However, firms are able to hedge their risk exposure

on a forward market. We regard a simultaneous setting as well as a sequential setting. We show that in both cases, firms decrease their production level. Competition on the output market drops, and prices increase. Thus, we show the implications of transaction costs on the real economy and highlight the importance of excluding financial transactions that serve risk management purposes from the FTT.

Both empirical as well as theoretical studies indisputably show the importance of financial risk management for the firm. Empirical studies, such as Kajüter (2012), Glaum and Klöcker (2009) or International Swaps and Derivatives Association [ISDA], (2009), show that more than 91.5% of the largest companies worldwide use derivatives to manage their risk exposure. Likewise, theoretical considerations show the importance of financial risk management. For example, corporate hedging helps to reduce the costs of financial distress and to reduce the costs of external financing. An elaborate discussion of theoretical arguments for hedging can be found in McDonald (2013). Consequently, the issue of

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corporate hedging is of interest for both economics and finance, and several theoretical studies address the issue. For example, Holthausen (1979) or Wong and Xu (2006) examine optimal corporate hedging strategies of the competitive producing firm in different settings. As the market structure of duopoly is more important than generally recognized, Broll, Wahl and Wessel (2011) regard the issue of corporate hedging for the duopoly case in both the simultaneous and sequential setting. Broll, Sobiech and Wahl (2012) discuss risk management with value at risk for the banking firm because financial risk management does not only concern the manufacturing industry but financial institutions as well.

However, only little attention is paid to the existence of transaction costs despite the fact that typically every forward transaction induces transaction costs. The relevancy of this topic is even increased as the G20 and the European Commission consider ways to introduce a FTT. This note contributes to fill this void. Other studies that are concerned with hedging strategies in the presence of transaction costs are very limited; short surveys can be found in Stulz (1984) or Zakamouline (2009).

The paper is organized as follows. Section 2 studies the model with the simultaneous hedging opportunity. The model with the sequential hedging opportunity is considered in section 3. The last section concludes.

2 The simultaneous setting

The simultaneous setting without transaction costs is introduced by Eldor and Zilcha (1990) and further analyzed by Broll et al. (2011). To study the duopoly case with a simultaneous forward market we introduce a model with two firms that are producing a homogeneous good: $q^i \geq 0, i = i, j$. We consider two dates, $t = 0$ and $t = 1$. Production takes place between the two dates and causes costs, $c^i q^i, i = i, j$, which occur in $t = 1$. However, production capacity is limited. The entire output is sold on the same market in $t = 1$. The sales price is determined by the inverse demand function, $\tilde{p} = \tilde{p}(Q) = \tilde{\varepsilon} M - bQ$, with $Q = \sum q^i = q^i + q^j$. The demand uncertainty is expressed by $\tilde{\varepsilon}$. (Throughout the paper, a tilde denotes a random variable. When the tilde is missing, the variable signifies the realization of the stochastic parameter). The probability distribution of ε is common knowledge and fulfills $\varepsilon \in \mathbb{R}_+$, and $E[\tilde{\varepsilon}] = 1$. All players can trade the

output on a forward market in $t = 0$. Because entering into a financial transaction on a forward market is much easier and carries less consequence than establishing production, the forward market is competitive so that the firm cannot influence the forward price p_f by the position taken on the forward market. The forward contracts call for delivery at $t = 1$. Yet, the forward price depends on the industry production, which is correctly anticipated by the forward market participants. It is $p_f = p_f(Q) = M_f - bQ$ with $p_f'(Q) = p'(Q)$. The taken forward position induces transaction costs t_k^i proportional to the amount of contracts traded. We name the transaction costs with the index i to include the case of different transaction costs for the players

The profit of firm i , for all $i, j = i, j, i \neq j$ in the simultaneous hedging case reads

$$\tilde{\pi}^i = \tilde{p}(q^i + q^j)q^i - c^i q^i + h^i \left(p_f(q^i + q^j) + \tilde{p}(q^i + q^j) \right) - t_k^i |h^i|, \tag{1}$$

where $t_k^i |h^i|$ denotes the transaction costs. All variables are common knowledge. At time $t = 0$, the firm decides on the production q^i and the amount of forward contracts to sell, h^i .

The firm has mean-variance preferences and thus maximizes the objective function $\Phi^i(\tilde{\pi}^i), i = i, j$, given by

$$\Phi^i(\tilde{\pi}^i) = E[\tilde{\pi}^i] - \frac{\alpha^i}{2} \text{var}(\tilde{\pi}^i)$$

Meyer and Robison (1988) justify mean-variance preferences and show that this approach is consistent with the expected utility approach under certain circumstances. Using an expected utilities approach does not weight our results. Thus, the firm maximizes the function

$$\Phi^i(\tilde{\pi}^i) = (M - b(q^i + q^j))q^i - c^i q^i + h^i (M_f - M) + \tilde{p}(q^i + q^j)q^i - t_k^i |h^i| - \frac{\alpha^i}{2} \text{var}(\tilde{\varepsilon}) M^2 (q^i - h^i)^2.$$

Market equilibrium Under normal circumstances, we can expect the producing firm to take a short position on the forward market. The producer will only take a long position if the forward market experiences

strong backwardation. Thus, to simplify the equation, we assume that the decision makers take a short position on the forward market. For the considered optimization problem, a unique Cournot-Nash equilibrium exists (see Vives (1999)). The first order conditions (for all $i, j = i, j, i \neq j$) are:

$$M - b(2q^i + q^j) - c^i - \alpha^i \text{var}(\tilde{\varepsilon}) M^2 (q^i - h^i) = 0 \quad (2)$$

$$M_j - M - t_k^i + \alpha^i \text{var}(\tilde{\varepsilon}) M^2 (q^i - h^i) = 0 \quad (3)$$

Production decision Equations (2) and (3) yield the separation theorem, which remains valid as transaction costs are considered.

Theorem 1 (separation theorem). The production decision can be made separated from the preferences, the expectations and the hedging decision of the players.

Proof. Addition of the equations yields

$$M_j - b(2q^i + q^j) = c^i + t_k^i.$$

The reaction function of player i reads

$$R^i(q^j) = \frac{M_j - bq^j - c^i - t_k^i}{2b}$$

and results in the equilibrium production

$$q^i = \frac{M_j - 2c^i + c^j - 2t_k^i + t_k^j}{3b}$$

The transaction costs are included in the decision process of the firm and influence the market equilibrium.

Comparative statics The consideration of transaction costs and FTT has implications on the producing economy. The reaction function of firm i is subject to an inwards shift,

$$\frac{\partial R^i}{\partial t_k^i} = -\frac{1}{2b} < 0$$

Thus, increasing transaction costs t_k^i

yield a smaller output. It is $\frac{\partial q^i}{\partial t_k^i} = -\frac{2}{3b} < 0$

As the transaction costs of the competitor j remain constant or are also increasing, the competition is weaker. The industry production decreases and the price increases.

Hedging decision To determine the optimal hedging decision we rearrange equation (3):

$$h^i = q^i + \frac{M_j - M}{\alpha^i \text{var}(\tilde{\varepsilon}) M^2} - \frac{t_k^i}{\alpha^i \text{var}(\tilde{\varepsilon}) M^2}$$

Theorem 2. The amount of forward contracts to sell depends on the production decision, the state of the forward market and the transaction costs. With respect to the degree of risk aversion α^i , and the risk, $\text{var}(\tilde{\varepsilon})$, the forward position is decreased in accordance to the transaction costs. If the forward market is unbiased ($M_j = M$), the full hedge theorem is no longer valid. Instead, the player chooses an underhedge. If the forward market experiences backwardation, the firm chooses an underhedge as well. If the forward market is in contango, the position on the forward market is not clear-cut but depends on the degree of contango and on the transaction costs.

Thus, transaction costs provide a rationality for the results of the study of Glaum and Klöcker (2009). The authors show that only 10 to 15 percent of firms choose a full hedge.

The consideration of transaction costs influences the real economy. As the costs for financial risk management increase, the decision makers reduce output. Namely, the production decision can still be made separately from the preferences and the expectations of the firm, but costs occur for the necessary forward position. In this context, increasing transaction costs have the same influence on the real economy as increasing marginal production costs do. The player reduces production to realize a higher marginal revenue.

In addition to the higher costs, the firm is also confronted with a new risk situation. Without any transaction costs the firm chooses a full hedge on an unbiased forward market and can operate in analogy to the situation under certainty. With transaction costs however, the firm chooses an underhedge even on an unbiased forward market and thus cannot establish a situation under certainty.

3 The sequential setting

In the simultaneous setting, transaction costs influence the equilibrium on the output market. The market is less competitive, and the price is higher. The current section addresses the consideration of trans-

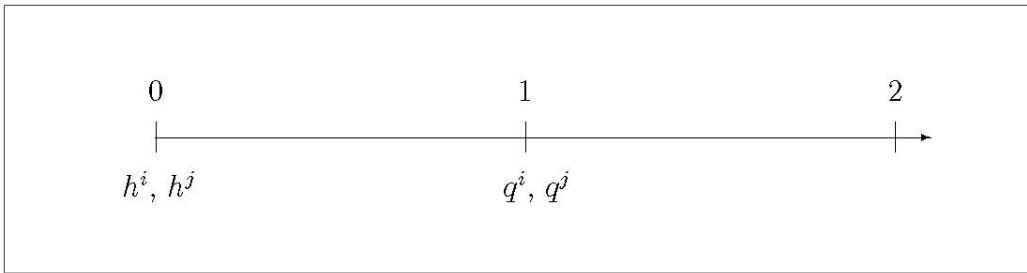


Figure 1. Chronological sequence in the sequential hedging case

action costs in the sequential setting. The sequential setting without transaction costs is introduced by Allaz (1992) and Allaz and Vila (1993). The authors show the strategic implications of the sequential hedging device in the duopoly case. Broll et al. (2011) further investigate this setting. Neither article considers the existence of transaction costs with respect to the size of the forward position. Thus, we will analyze the influence of transaction costs and the FTT in the sequential setting as well.

To be able to do so, we introduce a two-period model with three dates and a sequential forward market where the players can trade the production good. After the hedging decision is made, players have to set the production decision. Thus, at $t = 0$, the firms decide on their hedging volume. The decision is binding and observable for the other player (see Hughes and Kao (1997)). At time $t = 1$, the decision makers set their output level. Production takes place in the second period, and at $t = 2$, the output is sold to the then realized spot price. The forward positions are settled at $t = 2$. Figure 1 illustrates the chronological sequence. The equilibrium is determined with the help of the concept of a subgame perfect Nash equilibrium (SPNE) introduced by Selten (1965).

The assumptions from section 2 regarding the probability distributions of $\tilde{\varepsilon}$ remain valid. The profit of firm i , $i, j = i, j, i \neq j$ is given by

$$\begin{aligned} \tilde{\pi}^i = & \tilde{p}(q^i(h^i, h^i) + q^j(h^i, h^i)) - c^i q^i(h^i, h^i) + \\ & + h^i(p_f - \tilde{p}(q^i(h^i, h^i) + q^j(h^i, h^i))) - t_k^i |h^i| \end{aligned}$$

At time $t = 0$, the firm decides on the number of forward contracts to sell, and at $t = 1$, the player decides on the production level. The output is subject to the previous set hedging volumes.

At time $t = 1$, the forward price is fixed and does not react to a change in production any more as the forward position is already fixed at this time. We have

$$\frac{\partial p_f}{\partial q^i} \equiv 0. \text{ Yet, in } t = 0, \text{ the forward price is subject to}$$

the expected production decision. The influence on the forward price is the same as the influence on the

expected spot price. It is $\frac{\partial p_f}{\partial q^i} = \frac{\partial p}{\partial q^i}$. The participants

on the forward market correctly anticipate the industry production.

The objective functions of the players read

$$\begin{aligned} \Phi^i(\tilde{\pi}^i) = & (M - b(q^i + q^j))q^i - c^i q^i + h^i(p_f - p) + \\ & - t_k^i |h^i| - \frac{\alpha^i}{2} \text{var}(\tilde{\varepsilon}) M^2 (q^i - h^i)^2. \end{aligned}$$

Production decision The first step to find the SPNE is to determine the production in $t = 1$. The first order conditions for $i, j = i, j, i \neq j$ read

$$M - b(2q^i + q^j) - c^i + bh^i - \alpha^i \text{var}(\tilde{\varepsilon}) M^2 (q^i - h^i) = 0$$

Thus, the reaction function of player i is

$$R^i(q^j) = \frac{M - bq^j - c^i + (b + \alpha^i \text{var}(\tilde{\varepsilon}) M^2) h^i}{2b + \alpha^i \text{var}(\tilde{\varepsilon}) M^2}$$

Obviously, the transaction costs do not influence the production decision directly.

However, we cannot rule out indirect effects on the production due to the hedging decision from the previous period. Possible real economy implications thus follow from the hedging decision in $t = 0$.

The forward position influences the production level of the firm. It is

$$\frac{\partial R^i(q^i)}{\partial h^i} = \frac{b + \alpha^i \text{var}(\tilde{\varepsilon}) M^2}{2b + \alpha^i \text{var}(\tilde{\varepsilon}) M^2} < 1.$$

Therefore, with a larger forward position, the reaction function of the firm is pushed outwards. A larger forward position yields a larger output. However, the output increases at a lower rate than the forward position. The production levels in equilibrium can be found by solving the equation system given by the two reaction functions and is subject to the hedging decision from the previous period.

Hedging Decision We assume an unbiased forward market to establish the hedging decision. The output decision $q^i(h^i, h^j)$, $i, j = i, j, i \neq j$ will be taken into account. Then, the first order condition for player i reads

$$(M - b(q^i + q^j)) \frac{\partial q^i}{\partial h^i} - b \left(\frac{\partial q^i}{\partial h^i} + \frac{\partial q^j}{\partial h^i} \right) q^i - c^i \frac{\partial q^i}{\partial h^i} - t_k^i + \alpha^i \text{var}(\tilde{\varepsilon}) M^2 (q^i - h^i) \left(\frac{\partial q^i}{\partial h^i} - 1 \right) = 0.$$

As transaction costs increase, the forward position decreases. The firm chooses an underhedge, and as the transaction costs increase, the underhedge increases in absolute value.

The absolute value in a smaller forward position influences the production level the firm chooses in $t = 1$. With the hedging position, the output decreases as well. As the transaction costs increase, the industry production decreases. Competition is weaker, and the price increases. Thus, as in the previous section 2, the transaction costs have implications on the real economy in the duopoly case.

In both settings, we considered the duopoly case. However, the model can be easily extended to a multiple firm scenario with n firms. To achieve the extension, we have to treat the decision variables of the com-

petitor, that is, the variables with index j , as a sum of the production quantity q and forward position h of all other firms except firm i . Thus, the number of equations to consider to establish the market equilibrium increases. In this scenario, competition with n increases, but our results concerning the FTT and transaction costs remain the same.

4 Concluding remarks

The purpose of our study is to extend the literature concerning optimal hedging strategies of the firm. We study the influence of transaction costs and a FTT on the real economy. We consider two settings: the simultaneous as well as the sequential hedging opportunity in the case of duopoly. In both cases, transaction costs have implications on the real economy. Firms reduce their output level. Competition is weaker and prices increase. Thus, to facilitate competition, it is important to keep transaction costs at a low level. Consequently, the introduction of a financial transaction tax has to be treated with caution. As such a tax is introduced, it is important to ensure that producing firms are able to perform their financial risk management without additional costs. Hence, financial transactions that serve risk management purposes should be excluded from the FTT.

References

Allaz, B. (1992). Oligopoly, uncertainty and strategic forward transactions. *International Journal of Industrial Organization*, 10 (2), 297–308.

Allaz, B., Vila, J. L. (1993). Cournot Competition, Forward Markets and Efficiency. *Journal of Economic Theory*, 59 (1), 1–16.

Broll, U., Sobiech, A., Wahl, J. E. (2012). Banking Firm, Equity and Value at Risk. *Contemporary Economics*, 6 (4), 50–53.

Broll, U., Wahl, J. E., Wessel, C. (2011). Export, Exchange Rate Risk and Hedging: The Duopoly Case. *German Economic Review*, 12 (4), 490–502.

Eldor, R., Zilcha, I. (1990). Oligopoly, Uncertain Demand, and Forward Markets. *Journal of Economics and Business*, 42 (1), 17–26.

Glaum, M., Klöcker, A. (2009). Hedging von Finanzrisiken und Hedge Accounting gemäß IAS 39 [Hedging Financial Risks and Hedge Accounting under IAS 39]. Frankfurt (Main): Fachverlag Moderne Wirtschaft.

- Holthausen, D. M. (1979). Hedging and the Competitive Firm under Price Uncertainty. *The American Economic Review*, 69 (5), 989–995.
- Hughes, J. S., Kao, J. L. (1997). Strategic forward contracting and observability. *International Journal of Industrial Organization*, 16 (1), 121–133.
- International Swaps and Derivatives Association. (2009). Research Notes Number 2 Derivatives Usage Survey. New York, NY: ISDA.
- Kajüter, P. (2012). *Risikomanagement im Konzern - Eine empirische Analyse börsennotierter Aktienkonzerne* [Risk Management for consolidated companies - an empirical analysis of listed consolidated companies]. Munich: Verlag Franz Vahlen.
- McDonald, R. L. (2013). *Derivatives Markets*. (3rd ed.). Essex, UK: Pearson.
- Meyer, J.; Robison L. J. (1988). Hedging Under Output Price Randomness. *American Journal of Agricultural Economics*, 70 (2), 268-272.
- Selten, R. (1965). Spieltheoretische Behandlung eines Oligopolmodells mit Nachfrageträgheit [Game-theoretical view of an oligopoly with demand inactivity]. *Zeitschrift für die gesamte Staatswissenschaft* [Journal for the entire political science], 121 (2), 301-324.
- Stulz, R. M. (1984). Optimal Hedging Policies. *Journal of Financial and Quantitative Analysis*, 19 (2), 127–140.
- Vives, X. (1999). *Oligopoly Pricing*. Cambridge, MA: The MIT Press.
- Wong, K. P., Xu, J. (2006). Liquidity Risk and the Hedging Role of Options. *The Journal of Futures Markets*, 26 (8), 789–808.
- Zakamouline, V. (2009). The Best Hedging Strategy in the Presence of Transaction Costs. *International Journal of Theoretical and Applied Finance*, 12 (6), 833–860.

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