

Documentos de Trabalho  
Working Paper Series

**“A theory on merger timing and announcement  
returns”**

Paulo J. Pereira  
Artur Rodrigues

NIPE WP 13/ 2015

# “A theory on merger timing and announcement returns”

Paulo J. Pereira  
Artur Rodrigues

**NIPE\* WP 13/2015**

**URL:**

<http://www.eeg.uminho.pt/economia/nipe>



# A theory on merger timing and announcement returns\*

*Paulo J. Pereira<sup>‡</sup> and Artur Rodrigues<sup>§†</sup>*

<sup>‡</sup>*CEF.UP and Faculdade de Economia, Universidade do Porto.*

<sup>§</sup>*NIPE and School of Economics and Management, University of Minho.*

July 2015

## **Abstract**

This paper develops a dynamic model for the timing and terms of mergers and acquisitions. In contrast to other models, we show that firms agree about the timing independently from how the merger surplus is shared. Firms agree on the timing and discuss the sharing rule of the merger surplus according to their bargaining power or some other exogenous factor. We also show that, under asymmetric information, the combination of surprises regarding merger timing and merger terms, can produce either negative or positive abnormal returns for the merging firms.

**Keywords:** Mergers, Merger terms, Timing, Uncertainty, Real Options, Event studies.

**JEL codes:** G34, D81.

---

\*This research has been supported by FCT Fundação para a Ciência e a Tecnologia (Portuguese Foundation for Science and Technology). We thank Dean Paxson, Luís Aguiar-Conraria, and participants of the 2015 Annual Real Options Conference for their helpful comments. Any remaining errors are the sole responsibility of the authors.

<sup>†</sup>Corresponding author. School of Economics and Management. University of Minho. 4710-057 Braga (Portugal). E-mail: artur.rodrigues@eeg.uminho.pt; Phone: +351 253 601 923; Fax:+351 253 601 380.

# A theory on merger timing and announcement returns

## 1 Introduction

The motivations that govern merger and acquisition (M&A) decisions are well established in the literature. Typically, when firms merge, they look for gains related to operating efficiencies (e.g.: economies of scale), market power conditions, economies by vertical integration, technology transfers, among others. These gains are generally presented in the form of synergies.

However, since the final outcome of a merger process is usually uncertain, companies may have an incentive to delay the decision, waiting for a given optimal timing. Recent literature addresses this topic, following the real options theory. For instance, Lambrecht (2004) studies the timing of mergers motivated by economies of scale, and Thijssen (2008) addresses the timing when both efficiency gains and diversification benefits are considered. The optimal timing (or strategic timing) appears also in Alvarez and Stenbacka (2006), Lambrecht and Myers (2007), Hackbarth and Morellec (2008), Bernile et al. (2012), and in Tarsalewska (2015).

Also an important topic regarding M&A is how the merger potential gains are split between firms. The split of potential gains is established by the exchange terms of the merger, which can be proposed by the acquiring firm or negotiated by both firms. Some literature discusses what drives the definition of the terms, how they can be determined and the effects on the value of merging firms.

For instance, Lambrecht (2004) defines a two-round process where firstly the firms agree about the timing of the merger, maximizing the overall merger gains, and then the merger terms are defined as those that induce both firms to merge at this efficient threshold. A similar approach appears in Morellec and Zhdanov (2005) and Hackbarth and Morellec (2008). The terms of the merger play an important role in these papers, since they are the unique solutions that ensure the firms agree on the efficient timing. Accordingly, the timing of the merger and the exchange terms seem to be closely related.

However, differently from the related literature, our paper suggests that the timing and the terms are not necessarily linked. In fact, our approach shows that the firms agree about the timing independently from the way merger synergies are split. The merger terms are not needed to align firms behavior with the efficient threshold, suggesting that some other factors may explain how the surplus is shared.

In fact, the determinants of the merger terms are based on different considerations, namely, the relative negotiating power (bargaining power) of firms, that can be influenced by takeover defenses, termination fees, and stock ownership, among others. If managers

are considered, also agency problems may arise.

This paper also shows that some of the mixed results regarding the announcement effects of merger and acquisitions can be explained in the context of asymmetry of information, as suggested by Moeller et al. (2007). In efficient markets, abnormal returns can only be explained by new information conveyed by the announcement. The announcement reveals information to the market about on the merger gains or synergies and the merger terms. i.e. how synergies will be split between the firms (Barraclough et al. 2013). Under asymmetry of information, the market can only form expectations about these parameter values, adjusting share prices depending on the (lack of) occurrence of a merger announcement. This process of incorporating information into share prices, can explain all sorts of abnormal returns, as computed in the event studies methodology. Incomplete information has also been considered before a dynamic mergers model by Morellec and Zhdanov (2005), who suggest it plays a role in explaining positive announcement returns and a price run-up prior to the announcement. However, they can only explain negative abnormal returns for target firms introducing multiple competing bidders in the model. In our model, imperfect information is the only ingredient necessary to produce negative and positive abnormal returns, for both firms. Furthermore, and contrary to their proposition, the combined returns of firms in our model can only be explained by an earlier than expected announcement, meaning higher than expected synergies.

The paper proceeds as follows. Section 2 presents a dynamic model where merger timing and merger terms are derived in the context of Lambrecht and Myers (2007) model. Section 3 generalizes the analysis for any merger payoff. Section 4 discusses the determinants of mergers terms. Section 5 shows that asymmetric information can explain the empirical mixed results on the announcement abnormal returns. Section 6 concludes.

## 2 The timing and terms of mergers

This section presents a dynamic model of the timing of mergers and acquisitions and discusses how the merger terms - the merger surplus accruing to the bidder and target firm shareholders - can be obtained.

We build on Lambrecht (2004) setting and show that the merger terms cannot be endogenously obtained. According to Lambrecht (2004) the merger terms are unique and are obtained endogenously, as part of the optimization process. We argue that, contrary to what he suggests, there are multiple Nash equilibriums, and his model is a particular case of a more general model, under the restrictive assumption of constant merger terms across the state variable.

According to the Lambrecht (2004) model, two firms have the irreversible option to merge into a single firm benefiting from economies of scale produced by their production functions. The firms are price takers producing an output with a Cobb-Douglas profit

function, with  $p$ , the output price, following a geometric Brownian motion (gBm):

$$\frac{dp}{p} = \mu dt + \sigma dz \quad (1)$$

where  $\mu < r$  is the drift rate,  $\sigma > 0$  is the instantaneous volatility, and  $dz$  is the standard increment of a Wiener process. Throughout the text we assume risk neutrality and a constant risk-free interest rate,  $r$ .

Following Dixit and Pindyck (1994) the value of a firm without the option to merge, or the stand-alone firm, is given by:

$$V_i(p) = \alpha_i p^\eta \quad (2)$$

where

$$\alpha_i = \frac{\Omega K_i^\theta}{r - g(\eta)} \quad (3)$$

$$g(\eta) = r - \mu\eta - 0.5\sigma^2\eta(\eta - 1) \quad (4)$$

$$\eta = \frac{1}{1 - a} \quad (5)$$

$$\theta = \frac{b}{1 - a} \quad (6)$$

$$\Omega = \left( a^{\frac{a}{1-a}} - a^{\frac{1}{1-a}} \right) w^{-\frac{a}{1-a}} \quad (7)$$

Equation (2) denotes the value of firm  $i$  ( $i \in \{1, 2\}$ ), both the stand-alone firms and the merged firm ( $i = M$ ).  $K_i$  is the fixed input (capital), and  $K_M = K_1 + K_2$ . The instantaneous profit function, determined by a Cobb-Douglas profit function is:

$$pL_i^a K_i^b - wL_i \quad (8)$$

where  $L$  stands for the variable input,  $K$  for the fixed input, and  $w$  is the cost per unit of variable input. This function is assumed to have decreasing returns of scale with respect to  $L$  ( $a < 1$ ). However, if both inputs are variable, which is the case when a merge takes place combining firms fixed inputs, increasing returns of scale are assumed ( $a + b > 1$ ).

When firms merge, they combine their fixed inputs ( $K_M = K_1 + K_2$ ), incurring in some fixed sunk costs,  $X_i > 0$ . Therefore, the payoff of merging for firm  $i$  is:

$$\Pi_i(p) = \Gamma_i(p)V_M(p) - V_i(p) - X_i = (\Gamma_i(p)\alpha_M - \alpha_i)p^\eta - X_i \quad (9)$$

where  $\Gamma_i(p)$  is the fraction of the merged firm owned by firm  $i$ , and  $\Gamma_1(p) + \Gamma_2(p) = 1$ . Denoting the fraction of firm 1 as  $\gamma(p) = \Gamma_1(p)$ , the fraction of firm 2 becomes  $\Gamma_2(p) = 1 - \gamma(p)$ .

All previous models derive the merge terms,  $\gamma(p)$ , assuming that they are constant

across  $p$ , i.e.  $\gamma(p) = \bar{\gamma}$ , which implies that the terms are independent of the value of firms prior to merge. This assumption allowed them to obtain endogenously the merger terms.

We conjecture that merger terms should depend on the relative value of firms or the value of the state variable ( $p$ ). This is more perceivable in the case of Morellec and Zhdanov (2005) model, where the state variable is precisely the stochastic relative value of the firms. This means that when a firm is considering to merge for a certain level  $p$ , and compares the payoff with the so-called continuation value, she has to consider that merging later can change the merger terms, i.e.  $\gamma$  could be a function of  $p$ .

Following standard procedures any perpetual contingent claim on  $p$ ,  $F_i(p)$ , must satisfy the following ordinary differential equation:

$$0.5\sigma^2 p^2 F_i''(p) + \mu p F_i'(p) - r F_i(p) = 0 \quad (10)$$

yielding the following general solution:

$$F_i(p) = A_i p^{\beta_1} + B_i p^{\beta_2} \quad (11)$$

where  $\beta_1$  and  $\beta_2$  are the solutions to the fundamental quadratic equation:  $0.5\sigma^2\beta(\beta-1) + \mu\beta - r = 0$ .

When analyzing the option to merge, each firm must consider the optimal behavior of the other firm, i.e. what are the terms that the other firm would require in order to agree merging for different values of  $p$ .

Let us start by analyzing how firm 1 incorporates the optimal behavior of the firm 2. She must know what are the merger terms that make firm 2 indifferent to merge for any  $p$  ( $\gamma_2(p)$ ).  $\gamma_2(p)$  is firm 1 share of the merged firm that firm 2 is willing to concede, such that every  $p$  is an optimal merger trigger. The value of the option to merge for firm 2 ( $O_2$ ) must satisfy the following boundary conditions:

$$O_2(p) = A_2 p^{\beta_1} = [(1 - \gamma_2(p)) \alpha_M - \alpha_2] p^\eta - X_2 \quad (12)$$

$$O_2'(p) = \beta_1 A_2 p^{\beta_1-1} = \eta [(1 - \gamma_2(p)) \alpha_M - \alpha_2] p^{\eta-1} - \gamma_2'(p) \alpha_M p^\eta \quad (13)$$

Please notice that we require every  $p$  to be an optimal trigger, and so these boundary conditions must be valid to every  $p$ , an not only for a single trigger ( $p^*$ ) as in standard models. Given that the payoff is determined by  $\gamma_2(p)$ , this function can be arranged in order to allow every  $p$  to become a trigger for investment.

**Proposition 1.** *The value of the option to merge for firm 2, that makes her indifferent to merge for any  $p$  is:<sup>1</sup>*

$$O_2(p) = C_2 \alpha_M p^{\beta_1} \quad (14)$$

---

<sup>1</sup>All proofs can be found in the Appendix.

where  $C_2 > 0$  is a constant yet to be determined, and

$$\beta_1 = \frac{1}{2} - \frac{\alpha}{\sigma^2} + \sqrt{\left(-\frac{1}{2} + \frac{\alpha}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} > 1 \quad (15)$$

The share of the bidder that the target is willing to concede is:

$$\gamma_2(p) = 1 - \frac{C_2 \alpha_M p^{\beta_1} + \alpha_2 p^\eta + X_2}{\alpha_M p^\eta} \quad (16)$$

The other firm (firm 1) must now consider  $\gamma_2(p)$  in her decision to merge. Taking into consideration  $\gamma_2(p)$  (i.e. replacing  $\Gamma_1(p)$  or  $\gamma(p)$  by  $\gamma_2(p)$  in equation (9)), firm 1 receives the following payoff on merging at  $p = p_1$ :

$$\Pi_{12}(p_1) = (\alpha_M - \alpha_1 - \alpha_2) p_1^\eta - C_2 p_1^{\beta_1} - (X_1 + X_2) \quad (17)$$

where 12 denotes the case when firm 1 incorporates firm 2 required terms.

**Proposition 2.** *The value of the option to merge for firm 1, taking into account the merger terms required by firm 2 is:*

$$O_{12}(p) = \begin{cases} \Pi_{12}(p_1^a) \left(\frac{p}{p_1^a}\right)^{\beta_1} & \text{for } p < p_1^a \\ \Pi_{12}(p) & \text{for } p_1^a \leq p < p_1^b \\ \Pi_{12}(p_1^b) \left(\frac{p}{p_1^b}\right)^{\beta_2} & \text{for } p \geq p_1^b \end{cases} \quad (18)$$

where

$$p_1^a = \left( \frac{\beta_1}{\beta_1 - \eta} \frac{X_1 + X_2}{\alpha_M - \alpha_1 - \alpha_2} \right)^{\frac{1}{\eta}} \quad (19)$$

and

$$\Pi_{12}(p) = (\alpha_M - \alpha_1 - \alpha_2) p^\eta - C_2 p^{\beta_1} - (X_1 + X_2) \quad (20)$$

and  $p_1^b$  is the solution to this nonlinear equation:

$$(\beta_2 - \eta) (\alpha_M - \alpha_1 - \alpha_2) (p_1^b)^\eta - (\beta_2 - \eta) C_2 (p_1^b)^{\beta_1} - \beta_2 (X_1 + X_2) = 0 \quad (21)$$

Firm 1 will be willing to merge when  $p$  crosses  $p_1^a$  from below. If, for any circumstance, the first observation of  $p$  occurs at a higher level, merging will only be optimal for  $p < p_1^b$ . This second trigger is relevant if the starting value of  $p$  is above  $p_1^b$ , and merging becomes optimal when  $p$  crosses  $p_1^b$  from above. However it is possible to show that at this trigger mergers are not possible, because the two firms will not agree on merger terms.

Following similar steps for firm 1, we can obtain the value of the option to merge and the terms that firm 1 requires in order to make she indifferent to merge for any  $p$  ( $\gamma_1(p)$ ).

**Proposition 3.** *The value of the option to merge for firm 1, that makes her indifferent to merge for any  $p$  is:*

$$O_1(p) = C_1 \alpha_M p^{\beta_1} \quad (22)$$

where  $C_1 > 0$  is a constant yet to be determined.

The share that firm 1 requires is:

$$\gamma_1(p) = \frac{C_1 \alpha_M p^{\beta_1} + \alpha_1 p^\eta + X_1}{\alpha_M p^\eta} \quad (23)$$

Incorporating  $\gamma_1(p)$  in the decision of firm 2 (i.e. replacing  $\Gamma_2(p)$  by  $1 - \gamma_1(p)$  in equation (9)), the payoff accruing to firm 2 on merging at  $p = p_2$  is:

$$\Pi_{21}(p_2) = (\alpha_M - \alpha_1 - \alpha_2) p_2^\eta - C_1 p_2^{\beta_1} - (X_1 + X_2) \quad (24)$$

**Proposition 4.** *The value of the option to merge for firm 2, taking into account the merger terms by required firm 1 is:*

$$O_{21}(p) = \begin{cases} \Pi_{21}(p_2^a) \left(\frac{p}{p_2^a}\right)^{\beta_1} & \text{for } p < p_2^a \\ \Pi_{21}(p) & \text{for } p_2^a \leq p < p_2^b \\ \Pi_{21}(p_2^b) \left(\frac{p}{p_2^b}\right)^{\beta_2} & \text{for } p \geq p_2^b \end{cases} \quad (25)$$

where

$$p_2^a = \left( \frac{\beta_1}{\beta_1 - \eta} \frac{X_1 + X_2}{\alpha_M - \alpha_1 - \alpha_2} \right)^{\frac{1}{\eta}} \quad (26)$$

and

$$\Pi_{21}(p) = (\alpha_M - \alpha_1 - \alpha_2) p^\eta - C_1 p^{\beta_1} - (X_1 + X_2) \quad (27)$$

and  $p_2^b$  is the solution to this nonlinear equation:

$$(\beta_2 - \eta) (\alpha_M - \alpha_1 - \alpha_2) (p_2^b)^\eta - (\beta_2 - \eta) C_1 (p_2^b)^{\beta_1} - \beta_2 (X_1 + X_2) = 0 \quad (28)$$

As mentioned before the second trigger is not relevant, since mergers are not possible at  $p_2^b$ .

From equations (19) and (26) we find that  $p_1^a = p_2^a (= p_M)$ , making mergers optimal for that level of  $p$ . The most relevant characteristic of this solution is that the timing of mergers is independent of the constants  $C_1$  and  $C_2$ , meaning that it is also independent

of the terms of the merger ( $\gamma(p)$ ). Both firms agree to merge at  $p_M$ , but the terms of the merger are not determined endogenously by the parameters that explain the trigger for merging.

Interestingly enough, this solution is the central planner solution, that has the advantage of ensuring the maximization of the overall merger gain. In fact, a central planner would maximize the following payoff:

$$\Pi_C(p_M) = (\alpha_M - \alpha_1 - \alpha_2) p_M^\eta - (X_1 + X_2) \quad (29)$$

which yields the same trigger,  $p_M$ .

The timing of mergers found in our model is the same obtained by Lambrecht (2004).

### 3 Generic payoff

In the previous section it was shown that for Lambrecht (2004) model the merger timing is independent of the merger terms and that these terms are not unique, and must be explained by some exogenous factor. In this section we show that these propositions hold for any general merger payoff.

Let us assume a generic merger surplus  $\pi(p)$ , and that this surplus is shared by both firms:  $\gamma(p)$  to firm 1 and  $1 - \gamma(p)$  for firm 2. The merge payoffs for each firm are:

$$\Pi_1(p) = \gamma(p)\pi(p) - X_1 \quad (30)$$

$$\Pi_2(p) = (1 - \gamma(p))\pi(p) - X_2 \quad (31)$$

Firm 2 is willing to merge for any  $p$  if the following boundary conditions are met:

$$A_2 p_1^\beta = (1 - \gamma_2(p)) \pi(p) - X_2 \quad (32)$$

$$\beta_1 A_2 p_1^{\beta_1 - 1} = (1 - \gamma_2(p)) \pi'(p) - \gamma_2'(p) \pi(p) \quad (33)$$

where  $\gamma_2(p)$  is firm 1 share of the merger surplus that firm 2 is willing to concede. These boundary conditions can be reduced to the following differential equation, which  $\gamma_2(p)$  must solve:

$$p\pi(p)\gamma_2'(p) + p\pi'(p)\gamma_2(p) - \beta_1\pi(p)\gamma_2(p) - p\pi'(p) + \beta_1\pi(p) - \beta_1X_2 = 0 \quad (34)$$

When firm 1 considers  $\gamma_2(p)$  in her decision, the following boundary conditions apply:

$$A_1 p_1^{a\beta_1} = \gamma_2(p_1^a) \pi(p_1^a) - X_1 \quad (35)$$

$$\beta_1 A_1 p_1^{a\beta_1 - 1} = \gamma_2(p_1^a) \pi'(p_1^a) + \gamma_2'(p_1^a) \pi(p_1^a) \quad (36)$$

where  $p_1^a$  is the trigger value. These conditions can also be reduced to the following differential equation:

$$p_1^a \pi(p_1^a) \gamma_2'(p_1^a) + p \pi'(p_1^a) \gamma_2(p_1^a) - \beta_1 \pi(p_1^a) \gamma_2(p_1^a) - \beta_1 X_1 = 0 \quad (37)$$

Combining equations (34) and (37), and considering that, for firm 2,  $p$  is always a trigger, we are able to find the trigger value for firm 1. The same approach, starting for firm 1 and considering for firm 2 the optimal  $\gamma(p)$  for firm 1 ( $\gamma_1(p)$ ), leads to the solution for the trigger of firm 2.

**Proposition 5.** *Two firms considering a merger with a shared surplus of any general payoff  $\pi(p)$  will agree to merge at:*

$$p_M = \frac{\beta_1 (\pi(p_M) - (X_1 + X_2))}{\pi'(p_M)} \quad (38)$$

*and their trigger is the central planner solution.*

As in the previous section, the trigger is independent of the merger terms ( $\gamma(p)$ ).

Proposition 5 shows that if our approach is applied to other real option models of mergers and acquisitions, it produces the same result. For example, using Morellec and Zhdanov (2005) setting we would find the same solution trigger. However, we show that the merger terms are not unique as in their model.

## 4 Finding merger terms

In the related literature the terms of the merger are usually endogenously determined, i.e. the terms result as part of the global solution.

Lambrecht (2004) defines a two round procedure where parties first negotiate and agree about the timing, and then decide how to share the new company. In the first round the author assumes that it is in the best interest of each firm to merge at the central planner trigger. In the second round they agree on the terms that induce both to exercise the merger option at that optimal timing. In doing so, he assumes that those terms are constant over time and are independent of the state variables. In this model, the post-merging shareholding is unique and is a function of the stock of capital of each firm and the merger costs. Our model differs from this model in two important aspects. First, we do not need to impose the restriction that the firms must *ex ante* agree to merge on the central planner trigger. The central planner solution arises as the result of the equilibrium strategies of both firms. Second, we show that there are multiple acceptable sharing rules.

The approach of Morellec and Zhdanov (2005) is different. First, firms compute their own optimal merger timing, and then the sharing rule is found as the unique solution that ensures both firms agree on the timing. They conclude that the timing is the same as

the central planner solution. Although their model is different from Lambrecht's (2004) model, if their procedure is used for the same model setting, it is straightforward to show that the solution is exactly the same. Differently from our model, the merger terms are constant and independent of the state variable, which produces an unique sharing rule, in contrast to the multiple viable sharing rules in our model.

Thijssen (2008) is closely related with our paper. He assumes that the share of the merged firm is a function of the state variables. However, in his model the timing and terms are obtained endogenously, being a function of each other. In our model they are independent. His model produces a single sharing rule, while in our model there are multiple solutions. Similarly to our paper, he assumes that the bidder makes an offer that makes the target shareholder indifferent between accepting and rejecting the bid. However he assumes that this only occurs when the target payoff is set to zero, which corresponds in our setting to the case of a null bargaining power for the target. When he allows both firms to enter in a strategic merger game with the roles endogenously determined, he suggests that the option value completely disappears and the timing is independent of the bargaining power. This results from the assumption that the unique indifference rule for the other firm is to have a null payoff. This is in contrast with our results, since we show that the option value does not vanish, making worth delaying the merger until the optimal timing. Similarly to his model, we show that the bargaining power determines the merger terms and does not influences the timing of mergers.

Alvarez and Stenbacka (2006) make use of an exogenous bargaining power, and show that it determines the merger terms. However, contrary to our results, they suggest that the merger timing is influenced by firms bargaining power.

The outcome of the merger is, as we show, determined by the bargaining power of each firm or any other exogenous factor. The determinants of that bargaining power are a relevant question. The observation of the merger terms is however extremely difficult, if not impossible. In perfect markets, the shares in the merged firm, will be exactly the relative values of the firms before merging. The value of each firm before merging includes already the merger option value, i.e. a given expectation about the sharing rule of the merger surplus. The occurrence of any abnormal return can only be explained as the result of a surprise to the market, either in terms of timing or the sharing rule of the merger surplus.

## **5 Explaining announcement abnormal returns**

Literature on mergers and acquisitions traditionally reports empirical evidence showing positive returns for target firms and negative (or zero) returns for the shareholders of the acquirers (Jensen and Ruback (1983), Jarrell and Poulsen (1989), and Andrade et al. (2001)). Value-loss for the acquiring shareholder is also reported by Moeller et al. (2005)

for large deals in the late 90's.

Recent studies suggest mixed results. Martynova and Renneboog (2011) show evidence of positive abnormal returns for both parties, significant for the targets, but only slightly positive for the bidder (previously, similar results appear in Bradley et al. (1988)). Barraclough et al. (2013) shows mixed signs for the returns, depending on the base price used in the analysis. However, the results indicate that the returns of the bidding firms are relatively small when compared with the returns of the target. In a different approach, opposite evidence is reported by Ahern (2012), where the average gains for target firms are only modestly larger than the gains obtained by the acquirers.

Different explanations for the realized abnormal returns have been suggested in the literature. Some of the arguments are: the relative size of the firms (e.g. Moeller et al. (2004)), the existence of information asymmetry (e.g. Moeller et al. (2007)), the success of the offer (e.g. Barraclough et al. (2013)), the rivalry of the merging firms (e.g. Song and Walkling (2000)), the form of payment (e.g. Gao (2011) and Barraclough et al. (2013)), and the nature (public or private) of the target firm (e.g. Fuller et al. (2002)), among others.

In the context of the model herein presented, we follow the information asymmetry argument of Moeller et al. (2007). The abnormal returns are driven by the adjustment of prices to the information revealed by the announcement. In line with Barraclough et al. (2013), the announcement informs the market about both the merger gains (synergies) and the merger terms (how the synergies will be split between the firms shareholders). Under asymmetry of information, the market can only form expectations about this relevant piece of information, adjusting immediately the share prices once it becomes public. This adjustment can produce all types of abnormal returns, depending on the prior assessment, made by the shareholders of each firm about the merger gains and the bargaining power of their own managers.

## 5.1 Asymmetry of information between firms and the market

Let us assume that managers have private information about the merger synergies, not yet released to the market. Shareholders can only form expectations on the value of the merged firm ( $E(V_M)$ ) and the expected merger terms ( $E(\gamma)$ ). We assume furthermore that managers of both firms negotiate, and shareholders agree on the terms and timing of the merge, excluding any revision of the terms negotiated by the managers. In this setting, the true  $V_M$  is only observable by the managers of the merging firms.

The announcement of the merger reveals the timing and terms negotiated by the managers, and the market reacts adjusting the share prices to the information revealed by the announcement. If the announcement information is different from market expectations, an abnormal return occurs. Since the merger timing is independent from the terms, the timing of the announcement reveals the value of the merger synergies (or equivalently the

value of  $V_M$ ).

Let us study the impact of a surprise in each of the two variables, starting with the expected value of the synergies, assuming perfect information about the merger terms, leaving for the next section the analysis of the combined effect.

The expectations of the market on  $V_M$  can predict, under or overestimate the true value revealed by the announcement. If expectations are exceeded ( $V_M > E(V_M)$ ), the announcement occurs earlier than expected, producing a positive abnormal return. On the contrary, if expectations are not met by an announcement, the market will revise the expectations on the value (timing) of the merger until an announcement occurs. This late announcement produces a negative abnormal return.

The announcement effects are traditionally computed using the event study methodology, under which the return ( $R$ ) during the event window around the announcement date is measured against the expected return  $E(R)$ , that is calculated using a given estimation window prior to the event. The abnormal return ( $AR$ ) is simply  $R - E(R)$ .

The diffusion process of the option to merge, prior to the expected merger timing, is given by<sup>2</sup>:

$$\frac{dO_C}{O_C} = rdt + \beta_1\sigma dz \quad (39)$$

and therefore the expected option return is:

$$E(R) = \frac{E[dO_C]}{O_C} = r \quad (40)$$

For early announcements, the event window return is positive and greater than the expected (option) return, producing a positive abnormal return:

$$AR = R - E(R) > 0 \quad (41)$$

Consider now the case where  $p$  reaches  $E(p_M)$  and the announcement does not occurs. The absence of an announcement reveals that the synergies are lower than expected by the market participants. Without any additional information, the market will revise the expected trigger to the next infinitesimal increment of  $p$ . The diffusion of the price will depend on what parameter explains the late announcement. For example, in the context of Lambrecht and Myers (2007) model it can be either the value of synergies (the alphas)

---

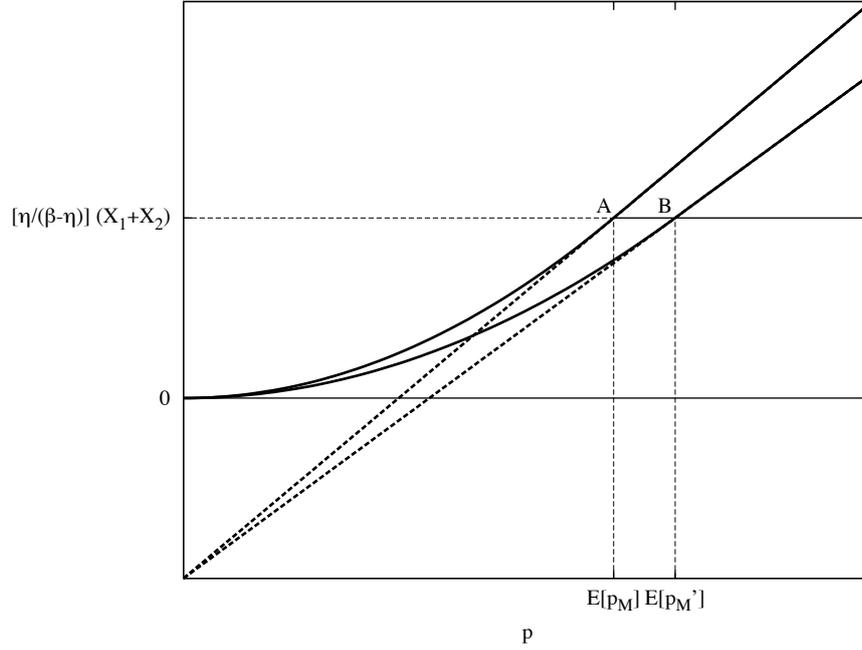
<sup>2</sup>Please note, that using Itô's lemma:

$$dO_C = \frac{\partial O_C}{\partial p} dp + \frac{1}{2} \frac{\partial^2 O_C}{\partial p^2} (dp)^2 = \left( \mu\beta_1 O_C + \frac{1}{2} \sigma^2 \beta_1 (\beta_1 - 1) O_C \right) dt + \sigma \beta_1 O_C dz.$$

From the fundamental quadratic equation

$$\frac{1}{2} \sigma^2 \beta_1 (\beta_1 - 1) = r - \mu\beta_1,$$

we obtain equation (39).



**Figure 1:** Value of the option to merge for late announcements with updated synergy parameters

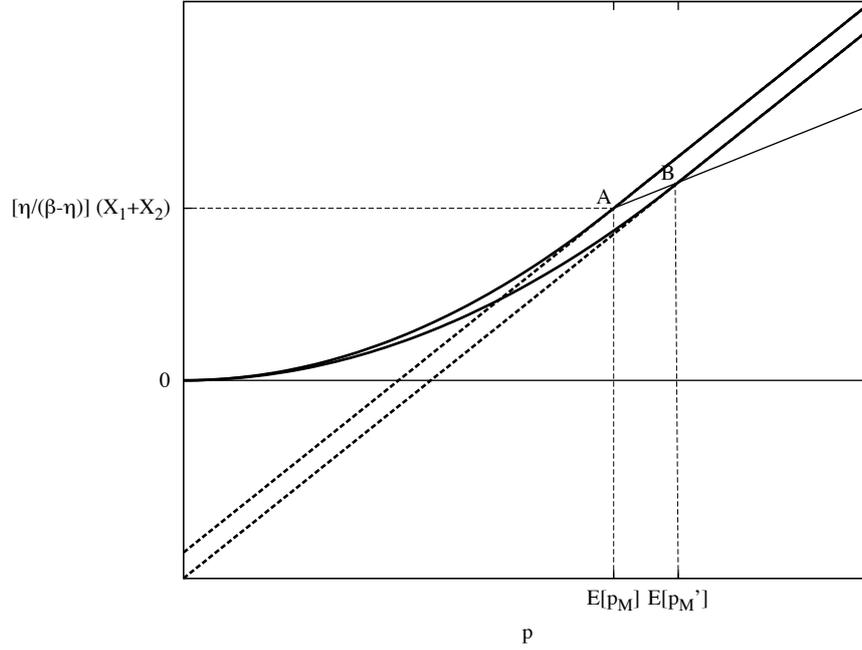
or the merging costs. If we assume that the market updates the expectations on synergy related parameters, let us assume  $\alpha_M$ , the value of the option will remain at  $O_C(E(p_M)) = \frac{\eta}{\beta_1 - \eta}(X_1 + X_2)$  until the announcement occurs (figure 1). A normal movement of  $p$ , increasing and decreasing over time, will always produces a positive average return in the estimation window.<sup>3</sup> The window will capture days of null returns and positive returns. This is illustrated by figure 1. If the initial market expectation is that the merger occurs at  $E[p_M]$ , share prices will remain along the line  $0A$ , with average positive returns. If the announcement is delayed until  $E[p'_M]$ , the share prices can move along the line  $AB$ , with null returns, or along any option value function, from 0 to the segment  $AB$ , if the prices move down, with positive returns.

For late announcements, given that the expected return is positive and the realized return on the event date is zero, the abnormal return is negative:

$$AR = R - E(R) < 0 \quad (42)$$

If the surprise of the lack of an announcement leads to a revision of the merging costs  $X_i$ , the movement of prices is illustrated by figure 2. A late announcement will move prices

<sup>3</sup>Only for unlikely case where  $p$  always increases during the estimation window, and it begins after the first expected  $p_M$ , the return during the estimation window will be zero.



**Figure 2:** Value of the option to merge for late announcements with updated merging costs

along  $AB$ , which means positive but lower returns than along  $OA$ . The realized return on the event date will be also lower than the expected return, producing a negative abnormal return.

Furthermore it is possible that even if information asymmetry disappears, abnormal returns can persist. Let us suppose that that all information is released to the market after  $E[p_M]$ , meaning that all market participants and firms agree that a merger should occur, let us assume at  $E[p'_M]$ . As long as the estimation window captures any period during which there is imperfect information the event window return will be lower than the expected return, producing a negative abnormal return.

As mentioned before, the announcement also reveals how the firms will split the synergies. The merging terms can differ from those expected by the market. This can also produce positive or negative returns in the announcement event window. If the fraction of the merged firm accruing to firm 1 announced is higher than expected ( $\gamma > E(\gamma)$ ), firm 1 will have a positive AR, while the other firm will have a negative return. If  $\gamma < E(\gamma)$ , firm 1 obtains a negative AR, and firm 2 obtains a positive AR.

## 5.2 Summary of announcement returns

Combining the effects of a surprise in the merger timing and the merger terms, it is possible to show that for either firm the announcement can produce negative, null or positive abnormal returns. Table 1 presents the summary of those effects.

**Table 1:** Summary of the announcement returns

	Early announcement		Timely announcement		Late announcement	
	Firm 1	Firm 2	Firm 1	Firm 2	Firm 1	Firm 2
Smaller $\gamma$	+/-	+	-	+	-	-/+
Expected $\gamma$	+	+	0	0	-	-
Larger $\gamma$	+	+/-	+	-	-/+	-

$\gamma$  is the share of the merged firm accruing to firm 1.

Early announcements produce positive returns for both firms that can be offset by the negative effect of a smaller than expected share of the merged firm. Late announcements produce negative abnormal returns for both firms. A higher than expected fraction on the merged firm reduces this negative effect. For timely mergers, the only effect that can arise comes from a surprise in the merger terms. Since the roles of bidder and target are not endogenously determined in this model, it can explain positive, null and negative abnormal returns for each firm.

The combined abnormal return of both firms can only be explained by a surprise in the timing, since that a surprise in the terms can only transfer the gains from one firm to the other. Therefore, early announcements produce positive returns and late announcements negative returns for both firms.

Morellec and Zhdanov (2005) have also proposed a real options model where incomplete information of the market regarding the parameters of the merger plays a role in explaining positive announcement returns and a price run-up prior to the announcement. However, they can only explain negative abnormal returns for target firms introducing multiple competing bidders in the model. In our model, imperfect information is the only ingredient necessary to produce negative and positive abnormal returns, for both firms. Furthermore, and contrary to their proposition, positive combined returns in our model can only be explained by an earlier than expected announcement, meaning higher than expected synergies.

## 6 Conclusion

This paper develops a dynamic real options model for the timing and terms of mergers. Under perfect information, we show that firms always agree on the merger timing

independently from how the surplus is shared between firms. Contrary to most of the previous related models, the terms are shown not to be unique, and must depend on some exogenous factor, namely the bargaining power of each firm.

Under asymmetry of information between managers and the market, the merger announcement can arrive as a surprise to the market, and produce abnormal returns. We show that the combination of surprises in the merger timing and merger terms can produce negative or positive abnormal returns for either firm.

Further research could also consider the effect asymmetric information between firms and the effect of managers compensation along with takeover incentives and defences.

## References

- Ahern, K. R.: 2012, Bargaining power and industry dependence in mergers, *Journal of Financial Economics* **103**(3), 530–550.
- Alvarez, L. H. R. and Stenbacka, R.: 2006, Takeover Timing, Implementation Uncertainty, and Embedded Divestment Options, *Review of Finance* **10**(3), 417–441.
- Andrade, G., Mitchell, M. and Stafford, E.: 2001, New evidence and perspectives on mergers, *Journal of Economic Perspectives* **15**(2), 103–120.
- Barraclough, K., Robinson, D. T., Smith, T. and Whaley, R. E.: 2013, Using option prices to infer overpayments and synergies in M&A transactions, *Review of Financial Studies* **26**(3), 695–722.
- Bernile, G., Lyandres, E. and Zhdanov, A.: 2012, A theory of strategic mergers, *Review of Finance* **16**(2), 517–575.
- Bradley, M., Desai, A. and Kim, E. H.: 1988, Synergistic gains from corporate acquisitions and their division between the stockholders of target and acquiring firms, *Journal of Financial Economics* **21**(1), 3–40.
- Dixit, A. and Pindyck, R.: 1994, *Investment Under Uncertainty*, Princeton University Press, New Jersey.
- Fuller, K., Netter, J. and Stegemoller, M.: 2002, What do returns to acquiring firms tell us? evidence from firms that make many acquisitions, *The Journal of Finance* **57**(4), 1763–1793.
- Gao, N.: 2011, The adverse selection effect of corporate cash reserve: Evidence from acquisitions solely financed by stock, *Journal of Corporate Finance* **17**(4), 789 – 808.
- Hackbarth, D. and Morellec, E.: 2008, Stock returns in mergers and acquisitions, *The Journal of Finance* **63**(3), 1213–1252.

- Jarrell, G. A. and Poulsen, A. B.: 1989, The returns to acquiring firms in tender offers: Evidence from three decades, *Financial Management* pp. 12–19.
- Jensen, M. C. and Ruback, R. S.: 1983, The market for corporate control: The scientific evidence, *Journal of Financial Economics* **11**(1), 5–50.
- Lambrecht, B.: 2004, The timing and terms of mergers motivated by economies of scale, *Journal of Financial Economics* **72**(1), 41–62.
- Lambrecht, B. and Myers, S.: 2007, A Theory of Takeovers and Disinvestment, *The Journal of Finance* **62**(2), 809–845.
- Martynova, M. and Renneboog, L.: 2011, The performance of the european market for corporate control: Evidence from the fifth takeover wave, *European Financial Management* **17**(2), 208–259.
- Moeller, S. B., Schlingemann, F. P. and Stulz, R. M.: 2004, Firm size and the gains from acquisitions, *Journal of Financial Economics* **73**(2), 201–228.
- Moeller, S. B., Schlingemann, F. P. and Stulz, R. M.: 2005, Wealth destruction on a massive scale? a study of acquiring-firm returns in the recent merger wave, *The Journal of Finance* **60**(2), 757–782.
- Moeller, S. B., Schlingemann, F. P. and Stulz, R. M.: 2007, How do diversity of opinion and information asymmetry affect acquirer returns?, *Review of Financial Studies* **20**(6), 2047–2078.
- Morellec, E. and Zhdanov, A.: 2005, The dynamics of mergers and acquisitions, *Journal of Financial Economics* **77**(3), 649–672.
- Song, M. H. and Walkling, R. A.: 2000, Abnormal returns to rivals of acquisition targets: A test of the acquisition probability hypothesis', *Journal of Financial Economics* **55**(2), 143–171.
- Tarsalewska, M.: 2015, The timing of mergers along the production chain, capital structure, and risk dynamics, *Journal of Banking & Finance* **57**, 51–64.
- Thijssen, J.: 2008, Optimal and strategic timing of mergers and acquisitions motivated by synergies and risk diversification, *Journal of Economic Dynamics and Control* **32**(5), 1701–1720.

## Appendix

*Proof of Proposition 1.* Since the merger payoff must be positive, and given that  $X_2 > 0$ ,  $\eta > 0$ , and  $\gamma_2(p) < 1$ , then  $\lim_{p \rightarrow +\infty} O_2(p) = +\infty$ , and  $\lim_{p \rightarrow 0} O_2(p) = 0$ . Therefore,  $B_2$  must be set to 0, and so  $O_2(p) = A_2 p^{\beta_1}$ . Replacing in the boundary conditions,  $\gamma_2(p)$  is the solution to the following differential equation:

$$\gamma_2'(p) p \alpha_M p^\eta + (\beta_1 - \eta) [(1 - \gamma_2(p)) \alpha_M - \alpha_2] p^\eta - \beta_1 X_2 = 0 \quad (43)$$

yielding:

$$\gamma_2(p) = 1 - \frac{C_2 \alpha_M p^{\beta_1} + \alpha_2 p^\eta + X_2}{\alpha_M p^\eta} \quad (44)$$

where  $C_2$  is a constant yet to be determined.

Replacing in Equation (12), the value of the option to merge for the target firm becomes:

$$O_2(p) = C_2 \alpha_M p^{\beta_1} \quad (45)$$

and, therefore,  $C_2 > 0$ . □

*Proof of Proposition 2.* Given that  $\alpha_M - \alpha_1 - \alpha_2 > 0$ ,  $\beta_1 > \eta > 0$ ,  $\gamma_2(p) < 1$ , and  $C_2 > 0$ ,  $\lim_{p \rightarrow +\infty} \Pi_{12}(p) = -\infty$ , and  $\lim_{p \rightarrow 0} \Pi_{12}(p) = -(X_1 + X_2)$ . The option value  $O_{12}(p)$  must be non-negative, and therefore  $\lim_{p \rightarrow +\infty} O_{12}(p) = 0$ , and  $\lim_{p \rightarrow 0} O_{12}(p) = 0$ . Therefore, both constants  $A_{12}$  and  $B_{12}$  in the general solution (11) can not be set to 0, and  $O_{12}(p)$  is a concave function, producing two possible merger triggers:

$$O_{12}(p) = \begin{cases} A_{12} p^{\beta_1} & \text{for } p < p_1^a \\ (\alpha_M - \alpha_1 - \alpha_2) p^\eta - C_2 p^{\beta_1} - (X_1 + X_2) & \text{for } p_1^a \leq p < p_1^b \\ B_{12} p^{\beta_2} & \text{for } p \geq p_1^b \end{cases} \quad (46)$$

The first trigger  $p_1^a$  is obtained with the usual boundary conditions:

$$A_{12} p_1^{a\beta_1} = (\alpha_M - \alpha_1 - \alpha_2) (p_1^a)^\eta + C_2 (p_1^a)^{\beta_1} - (X_1 + X_2) \quad (47)$$

$$\beta_1 A_{12} (p_1^a)^{\beta_1-1} = \eta (\alpha_M - \alpha_1 - \alpha_2) (p_1^a)^{\eta-1} + \beta_1 C_2 (p_1^a)^{\beta_1-1} \quad (48)$$

Solving these two equations, we obtain  $p_1^a$ :

$$p_1^a = \left( \frac{\beta_1}{\beta_1 - \eta} \frac{X_1 + X_2}{\alpha_M - \alpha_1 - \alpha_2} \right)^{\frac{1}{\eta}} \quad (49)$$

The second trigger  $p_1^b$  is obtained with the following boundary conditions:

$$B_{12}(p_1^b)^{\beta_2} = (\alpha_M - \alpha_1 - \alpha_2) (p_1^b)^\eta + C_2(p_1^b)^{\beta_1} - (X_1 + X_2) \quad (50)$$

$$\beta_2 B_{12}(p_1^b)^{\beta_2-1} = \eta (\alpha_M - \alpha_1 - \alpha_2) (p_1^b)^{\eta-1} + \beta_1 C_2(p_1^b)^{\beta_1-1} \quad (51)$$

$p_1^b$  is the solution to this nonlinear equation:

$$(\beta_2 - \eta) (\alpha_M - \alpha_1 - \alpha_2) (p_1^b)^\eta - (\beta_2 - \eta) C_2(p_1^b)^{\beta_1} - \beta_2(X_1 + X_2) = 0 \quad (52)$$

□

*Proof of Proposition 3.* Following similar steps for the firm 1, the share that she requires in order to make she indifferent to merge for any  $p$ ,  $\gamma_1(p)$ , is the solution to the following differential equation:

$$\gamma_1'(p)p\alpha_M p^\eta - [\beta_1 - \eta] (\gamma_1(p)\alpha_M - \alpha_2] p^\eta + \beta_1 X_1 = 0 \quad (53)$$

yielding:

$$\gamma_1(p) = \frac{C_1 \alpha_M p^{\beta_1} + \alpha_1 p^\eta + X_1}{\alpha_M p^\eta} \quad (54)$$

where  $C_1$  is a constant yet to be determined.

The value of the option to merge for firm 1 is:

$$O_1(p) = C_1 \alpha_M p^{\beta_1} \quad (55)$$

and, therefore,  $C_1 > 0$ .

□

*Proof of Proposition 4.* Given that  $\alpha_M - \alpha_1 - \alpha_2 > 0$ ,  $\beta_1 > \eta > 0$ ,  $\gamma_1(p) < 1$ , and  $C_1 > 0$ ,  $\lim_{p \rightarrow +\infty} O_{21}(p) = -\infty$ , and  $\lim_{p \rightarrow 0} O_{21}(p) = -(X_1 + X_2)$ . The option value  $O_{21}(p)$  must be non-negative, and therefore  $\lim_{p \rightarrow +\infty} O_{21}(p) = 0$ , and  $\lim_{p \rightarrow 0} O_{21}(p) = 0$ .  $B_{21}$  can not be set to 0, and  $O_{21}(p)$  is a concave function, producing two possible merger triggers, and the option to merge for the target,  $O_{21}(p)$ , is a concave function:

$$O_{21}(p) = \begin{cases} A_{21} p^{\beta_1} & \text{for } p < p_2^a \\ (\alpha_M - \alpha_1 - \alpha_2) p^\eta - C_1 p^{\beta_1} - (X_1 + X_2) & \text{for } p_2^a \leq p < p_2^b \\ B_{21} p^{\beta_2} & \text{for } p \geq p_2^b \end{cases} \quad (56)$$

The first trigger  $p_2^a$  is obtained with the usual boundary conditions:

$$A_{21}p_2^{a\beta_1} = (\alpha_M - \alpha_1 - \alpha_2)(p_2^a)^\eta - C_1p_2^{a\beta_1} - (X_1 + X_2) \quad (57)$$

$$\beta_1 A_{21}(p_2^a)^{\beta_1-1} = \eta(\alpha_M - \alpha_1 - \alpha_2)(p_2^a)^{\eta-1} - \beta_1 C_1(p_2^a)^{\beta_1-1} \quad (58)$$

Solving these two equations, we obtain  $p_2^a$ :

$$p_2^a = \left( \frac{\beta_1}{\beta_1 - \eta} \frac{X_1 + X_2}{\alpha_M - \alpha_1 - \alpha_2} \right)^{\frac{1}{\eta}} \quad (59)$$

The second trigger  $p_2^b$  is obtained with the following boundary conditions:

$$A_{21}(p_2^b)^{\beta_1} = (\alpha_M - \alpha_1 - \alpha_2)(p_2^b)^\eta - C_1(p_2^b)^{\beta_1} - (X_1 + X_2) \quad (60)$$

$$\beta_1 A_{21}(p_2^b)^{\beta_1-1} = \eta(\alpha_M - \alpha_1 - \alpha_2)(p_2^b)^{\eta-1} - \beta_1 C_1(p_2^b)^{\beta_1-1} \quad (61)$$

$p_2^b$  is the solution to this nonlinear equation:

$$(\beta_2 - \eta)(\alpha_M - \alpha_1 - \alpha_2)(p_2^b)^\eta - (\beta_2 - \eta)C_1(p_2^b)^{\beta_1} - \beta_2(X_1 + X_2) = 0 \quad (62)$$

□

*Proof of Proposition 5.* Combining equations (34) and (37) and simplifying produces the following trigger:

$$p_1^a = \frac{\beta_1(\pi(p_1^a) - (X_1 + X_2))}{\pi'(p_1^a)} \quad (63)$$

Following similar steps from firm 2 produces the trigger:

$$p_2^a = \frac{\beta_1(\pi(p_2^a) - (X_1 + X_2))}{\pi'(p_2^a)} \quad (64)$$

It is straightforward to show that this is the same trigger of the central planner that has the following payoff:

$$\Pi_C(p) = \Pi_1(p) + \Pi_2(p) = \pi(p) - (X_1 + X_2). \quad (65)$$

□

## *Most Recent Working Paper*

NIPE WP 13/2015	Pereira, Paulo J. e <b>Artur Rodrigues</b> , “ A theory on merger timing and announcement returns”, 2015
NIPE WP 12/2015	Bernardino, Susana e <b>Santos, J. Freitas</b> , "Financing social ventures by crowdfunding: The influence of entrepreneurs' personality traits", 2015
NIPE WP 11/2015	D'Almeida, André Corrêa e <b>Paulo Reis Mourão</b> , “ The Irrelevance of Political Parties' Differences for Public Finances - Evidence from Public Deficit and Debt in Portugal (1974-2012)”, 2015
NIPE WP 10/2015	<b>Santos, José Freitas</b> , Laurentina Vareiro, Paula Remoaldo e <b>J. Cadima Ribeiro</b> , “Mega cultural events: Does attendance affect residents' perceptions of a city's identity?”, 2015
NIPE WP 09/2015	Brekke, Kurt R., Rosella Levaggi, Luigi Siciliani e <b>Odd Rune Straume</b> , “Patient Mobility and Health Care Quality when Regions and Patients Differ in Income”, 2015
NIPE WP 08/2015	Cellini , Roberto, Luigi Siciliani e <b>Odd Rune Straume</b> , “A dynamic model of quality competition with endogenous prices”, 2015
NIPE WP 07/2015	Brekke, Kurt R., Tor Helge Holmås, Karin Monstad e <b>Odd Rune Straume</b> , “Do Treatment Decisions Depend on Physicians' Financial Incentives?”, 2015
NIPE WP 06/2015	Brekke, Kurt R., Chiara Canta e <b>Odd Rune Straume</b> , “Does Reference Pricing Drive Out Generic Competition in Pharmaceutical Markets? Evidence from a Policy Reform”, 2015
NIPE WP 05/2015	Brekke, Kurt R., Tor Helge Holmås, Karin Monstad e <b>Odd Rune Straume</b> , “Socioeconomic Status and Physicians' Treatment Decisions”, 2015
NIPE WP 04/2015	<b>Castro, Vítor</b> e Rodrigo Martins, “Budget, expenditures composition and political manipulation: Evidence from Portugal”, 2015
NIPE WP 03/2015	<b>Maria Thompson</b> , “Social Capital, Innovation and Economic Growth”, 2015
NIPE WP 02/2015	Kurt R. Brekke, Chiara Canta, <b>Odd Rune Straume</b> , “Reference pricing with endogenous generic entry”, 2015
NIPE WP 01/2015	<b>Aguiar-Conraria, Luís</b> , Pedro Brinca, Haukur Viðar Guðjónsson e <b>Maria Joana Soares</b> “Optimum Currency Area and Business Cycle Synchronization Across U.S. States”, 2015
NIPE WP 23/2014	Morozumi, Atsuyoshi, <b>Francisco José Veiga</b> e <b>Linda Gonçalves Veiga</b> , “Electoral effects on the composition of public spending and revenue: evidence from a large panel of countries”, 2014
NIPE WP 22/2014	<b>Castro, Vítor</b> e Rodrigo Martins, “Are there political cycles hidden inside government expenditures?”, 2014
NIPE WP 21/2014	Conceição, Oscarina e <b>Ana Paula Faria</b> , “Determinants of research-based spin-offs survival”, 2014
NIPE WP 20/2014	Conceição, Oscarina, <b>Ana Paula Faria</b> e Margarida Fontes, “Location of research-based spin-offs: how relevant are regional effects?”, 2014
NIPE WP 19/2014	Sousa, Rita, <b>Luís Aguiar-Conraria</b> e <b>Maria Joana Soares</b> , “Carbon and Energy Prices: Surfing the Wavelets of California”, 2014
NIPE WP 18/2014	<b>Aguiar-Conraria, Luís</b> , Manuel M. F. Martins e <b>Maria Joana Soares</b> , “Estimating the Taylor Rule in the Time-Frequency Domain”, 2014
NIPE WP 17/2014	<b>Veiga, Linda Gonçalves</b> , “Descentralização orçamental: questões de autonomia e responsabilização”, 2014
NIPE WP 16/2014	<b>Veiga, Linda Gonçalves</b> e <b>Francisco José Veiga</b> , “Determinants of Portuguese local governments' indebtedness”, 2014
NIPE WP 15/2014	<b>Baleiras, Rui Nuno</b> , “Em prol da previsibilidade e da sustentabilidade das finanças públicas: um comentário a ‘Controlo da Execução Orçamental no Estado’”, 2014
NIPE WP 14/2014	Bernardino, Susana e <b>J. Freitas Santos</b> “Implicações do contexto político-legal para o lançamento de novas iniciativas sociais em Portugal”, 2014
NIPE WP 13/2014	<b>Lebre de Freitas, Miguel</b> “ On inflation and money demand in a portfolio model with shopping costs ”, 2014
NIPE WP 12/2014	<b>Lebre de Freitas, Miguel</b> e Miguel de Faria e Castro “The Portuguese real exchange rate, 1995-2010: competitiveness or price effects”, 2014
NIPE WP 11/2014	Morozumi, Atsuyoshi e <b>Veiga, Francisco José</b> , “Public spending and growth: the role of institutions”, 2014