“A solution to the Palm—3Com spin-off puzzles”

Abstract

This paper revisits the relative pricing of Palm and 3Com shares in 2000. We offer a simple rational explanation of the Palm/3Com price relationship before Palm’s spinoff is completed. Lending fees and spin-off uncertainty are crucially important to understanding the relative levels and co-movement of Palm and 3Com share prices. We use Palm’s post-spinoff forward prices (calculated from the market prices of calls and puts) and model the spin-off uncertainty in valuing 3Com. Considering forward pricing and spin-off uncertainty resolves various pricing puzzles and explains the observed empirical evidence, including a sharp change in relative price behavior once the spinoff uncertainty is resolved on May 8, 2000.

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Preface

A fundamental paradigm and bedrock principle in modern financial economics is the efficiency of market pricing and the absence of arbitrage.[1] An important challenge to this paradigm comes from the hypothesis that asset prices are instead largely driven by behavioral biases. A celebrated example is the spin-off of Palm from 3Com in 2000. After the carve-out of Palm and IPO of 5% of its shares, 3Com still owned the remaining 95% of Palm. Extrapolating the market valuation of the traded Palm shares to the remaining 95% of Palm, the total stock market value of 3Com was much lower than 3Com's holdings of Palm. Can a parent really be worth less than one of its subsidiaries, especially when the subsidiary is about to be spun off? At its most general level, Palm—3Com has been interpreted as suggesting that its market pricing represents an apparent violation of the law of one price and even questioning the ability of the marketplace to undertake basic relative valuation arithmetic. For example, Lamont and Thaler (2003b) entitle their well-known paper, "Can the Market Add and Subtract? Mispricing in Tech Stock Carve-outs."[2] In light of the striking nature of the Palm—3Com example and the wide attention paid to it,[3] a fully rational reconciliation of the evidence seems like an impossible challenge. However, this paper shows that a model with reasonable differences of opinion about the uncertainty associated with the spinoff, combined with shorting constraints, can indeed explain the relative levels and comovements between Palm and 3Com share prices.

1. Introduction

Here are the main facts of the Palm-3Com saga. At the end of 1999, 3Com began the process of spinning off its wholly-owned subsidiary Palm, Inc., and on March 2, 2000 about 23 million Palm shares (about 5% of the

[1]See, for example, Ross (1976, 1978, and 2004).
[2]The 3Com-Palm example is one of a large number of situations in which the value of the parent is nominally less than the value of the subsidiary (e.g., Lamont and Thaler (2003b), Cornell and Liu (2001), Schill and Zhou (2001) and Mitchell, Pulvino and Stafford (2002)).
[3]This situation was discussed extensively contemporaneously in such outlets as the *New York Times* and *Wall Street Journal* and received attention by many investors, in addition to being subject to considerable academic study.

company) were offered to the public in an initial public offering (IPO). By the end of the first day of trading, Palm's closing share price was about $95, giving it a market value of $54 billion, while 3Com's closing price was about $81, making its market value $28 billion.

But 3Com still owned 532 million Palm shares valued at $50 billion, implying that the value of 3Com's non-Palm assets (its "stub" value) was a staggering -$22 billion!!! The record shows that 3Com had no debt, more than $1 billion in cash, and a positive market value before acquiring Palm. Furthermore, 3Com had a $5 billion capitalization the day after Palm's spin-off was completed later that year. Obviously, the financial market recognized the considerable residual value in 3Com before and after the Palm IPO. How then can 3Com's stub value be negative on March 2? We claim that the paradox emerges from a faulty valuation procedure: Palm shares held outside of 3Com are quite different from Palm shares inside of 3Com, so the market value of the floating Palm shares should not be mechanically applied to the remaining 95% of Palm shares still owned by 3Com.

The most obvious difference between the two types of Palm shares is their ability to be lent. Owners of floating Palm shares are free to lend their shares, while 3Com cannot lend out its Palm shares. Thus, valuation of a traded Palm share includes the capitalized value of the lending fees that owners of Palm shares accrue, while the valuation of the remaining 532 million shares (owned by 3Com) does not.[4] This introduces a potentially large wedge between the valuation of 3Com's owned Palm shares and Palm's floating shares.[5]

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[4] See, for example, Duffie, Gârleanu and Pedersen (2002).

[5] The size of fees is substantial: "the evidence from D'Avolio (2000) indicates a[n up to]]…35 percent… shorting cost for Palm during this period…" [Lamont and Thaler (2003b, p. 256)]. D'Avolio (p. 273) states that -"less than 1% of stocks (roughly seven per month) on loan become extremely special, demanding negative rebate rates (i.e., loan fees in excess of the risk-free rate). Krispy Kreme Doughnuts and Palm Inc. are examples of such stocks, exhibiting loan fees as high as 50% and 35%, respectively." Taking into account the risk-free rate, a negative rebate rate of 35% implies an annual lending fee of 35% + 6.3% = 41.3% during this time period.

To correctly value 3Com's non-Palm assets (its stub) we must use the value of a Palm share net of the capitalized value of lending fees. Here the importance of the spin-off date comes into focus. All else equal, the capitalized value of lending fees depends on the spin-off date: a shorter time to the spin-off date translates into a smaller present value of earned lending fees, whereas a distant spin-off date translates into a larger present value of earned lending fees.

A simple example may be instructive. Assume a negative rebate rate of 28% per year on the Palm shares, with a spin-off date one year hence. This is equivalent to a 34% lending fee per year if the risk-free rate is 6%. If Palm's share price is $100, this reflects $28 of lending fees (ignoring compounding in this example) and an intrinsic value (alternatively, the value of a Palm share retained by 3Com) of $72. In addition, traded Palm shares are more volatile than Palm shares held by 3Com, because the traded Palm shares are grossed-up in value by the capitalized lending fees. The presence of lending fees also changes the co-movement of returns on Palm and 3Com. For example, if the share price of Palm changes by $1 and rebate rates do not change, the value of a 3Com share should increase by $0.72 * 1.5 = $1.08, not $1.50.

Now assume that the spin-off date is moved half a year closer with no other changes. The capitalized wedge is much smaller: about 14% of the value of a traded Palm share is due to the present value of lending fees. In addition, a $1 change in the Palm share price should increase the share price of 3Com by $0.86 * 1.5 = $1.29, closer to but still less than the first-blush expectation of $1.50.

As the example shows, the spin-off time is critical in assessing Palm's contribution to 3Com's valuation. If the spin-off date is sufficiently far away, the wedge between the prices of traded Palm shares and Palm shares held by 3Com can be arbitrarily large. As we show, this wedge is equivalent to the difference between shares purchased today and shares purchased today for forward delivery on the spinoff date (a "prepaid forward"). Thus, traded forwards can be used to investigate the market's expectations about the date of the spin-off and the

lending fees expected at various intervals in the future.[6] In this case, we calculate forward prices at various dates using calls and puts to assess the market's expectations about the timing of the spin-off and future lending fees.

When we do this, the various paradoxes disappear. The correctly-calculated stub value is always positive (Section 4), and Palm's synthetic forward price behavior is consistent with significant uncertainty about the spinoff that is later resolved (Section 6) . Lastly, the perceived violations of put-call parity and of the law of one price are absent (Section 7). More importantly, we derive a novel theoretical relationship for the comovement of the share price of Palm and 3Com (Section 2) and then test it against data: Section 3 tests the Palm/3Com relationship and Section 5 compares the model-implied lending fees vs. actual lending fees. The empirical tests strongly support our theory.

We conclude that markets correctly priced in the uncertainty associated with Palm's spin-off and the size of Palm's lending fees. We also conclude that no-arbitrage relationships prescribed by classical finance theory were satisfied during the Palm-3Com episode. In the last section, we discuss the single remaining puzzle: there must be investors who choose to hold traded Palm shares without lending them out. For these investors, it might appear that holding 3Com is a dominant strategy. However, holding Palm is rational if an investor is pessimistic about the likelihood of the spinoff and thus convergence between Palm and 3Com.

Of course, there is a possible "arbitrage" trade: 3Com states that it plans to spin off the rest of Palm by December 2000 at a rate of 1.5 Palm shares for every 3Com share. At the first-day closing price of $95, 1.5

[6] Analogously, in commodity valuation analyses the forward price of a commodity does not reflect its use value prior to the expiration of the forward contract, while the spot price of a commodity reflects the value of the option to "use" the commodity in "stock-out" states prior to the expiration of the forward contract .The use value of a commodity can be interpreted as "convenience yield," as illustrated by the equilibrium analysis in Routledge, Seppi and Spatt (2000). The lending fees for Palm reflect the overall "use" values for direct ownership of a share of Palm even prior to the date of spin-off, but these are not reflected in the implicit ownership of Palm through ownership of 3Com. Absent storage costs, this results in a downward sloping forward curve for commodities.

shares of Palm are worth 1.5 * 95= $143, while a 3Com share trades at $81.81. If an investor buys one share of 3com and shorts 1.5 Palm shares, she can pocket the difference of over $61 and wait until the spin-off to cover the short position by returning 1.5 spin-off shares of Palm to the share lender.

But this discussion ignores two important factors: the cost to borrow Palm shares, and the uncertainty of the spin-off. We describe in the Appendix our unique dataset (provided by a major broker) showing that Palm lending fees were above 25% between April 10 and May 9 and above 50% after May 9. Separately, Mitchell, Pulvino and Stafford (2003) locate 84 cases with "negative stub" values. In 30 % of these cases prices did not converge for some reason, such as cancellation of the spin-off, repurchase of subsidiary shares by the parent, or a takeover. Mitchell, Pulvino and Stafford conclude that "… significant risk [is] faced by an arbitrageur attempting to profit from negative stub values …[as] the path to convergence can be long and bumpy... [T]he length of the interval over which convergence will occur is unknown. Increasing the length of the path reduces the arbitrageur's return… Increasing the volatility of the path increases the likelihood that the arbitrageur will be forced to terminate the negative-stub-value trade prematurely... If the arbitrageur is unable to maintain his short position, he will be forced to terminate the trade" with the potential for substantial losses. These facts indicate that the proposed relative-value position was costly and risky — and it was not an arbitrage trade at all!

Over-all, despite the considerable frictions and impediments to short-selling, our empirical analyses suggest that the market approached the relative valuation of 3Com and Palm in a highly sophisticated manner.

2. Modeling Palm/3Com price relationship when the spin-off is uncertain.

Uncertainty about the spin-off date and its resolution on May 8. The Palm spin-off was contractually governed by the December 12, 1999 "Master Separation and Distribution Agreement - 3Com Corp. and Palm Computing Inc." The agreement stated that 3Com's board (in its sole discretion) could expedite or delay the spin-off date.

The board could also cancel the spin-off if it deems (in its sole discretion) that "… result [of Palm's spin-off and] the Distribution [of shares could have]… a material adverse effect on 3Com".[7] Among other conditions, the spin-off was dependent on a favorable IRS ruling that the company could distribute the remaining 532 million shares without incurring any tax liability. The IRS ruling was expected in mid –September 2000, but the 3Com board could cancel the spin-off even if all stated conditions were met. For example, an offer from another firm to acquire 3Com could be treated as having a "material adverse effect" against the Distribution. Consequently, the spin-off was uncertain. Mitchell, Pulvino and Stafford (2003) document that this is a common feature of the many carve-outs and spin-offs of that era.

The uncertainty was resolved in the after-hours of May 8 when 3Com unexpectedly announced that a positive Internal Revenue Service ruling occurred earlier than expected and that 3Com "will distribute on July 27th … months earlier than scheduled -- about 1.5 Palm shares for each 3Com share."[8]

The case of a known spin-off date.

Let $F_{T,t}$ denote the time t forward price of a Palm share with delivery date T, let S_t denote the time t price of Palm, and let T^* be the (known) spin-off date. A buyer of a 3Com share pays up front for the 3Com stub plus

[7] Section 4.3 of the agreement states: "3Com currently intends, following the consummation of the IPO, to complete the Distribution by December 1, 2000. 3Com shall, in its sole and absolute discretion, determine the date of the consummation of the Distribution and all terms of the Distribution. …3Com may … modify or change the terms of the Distribution, including, without limitation, by accelerating or delaying the timing of the consummation of all or part of the Distribution." Section 4.4 of the agreement states that: "The following are conditions that must take place prior to the consummation of the Distribution. The conditions are for the sole benefit of 3Com and shall not give rise to or create any duty on the part of 3Com or the 3Com Board of Directors to waive or not waive any such condition.
(a) IRS Ruling. 3Com shall have obtained a private letter ruling from the Internal Revenue Service in form and substance satisfactory to 3Com (in its sole discretion) … [that] the transfer by the 3Com Group to the Palm Group of the property … will qualify as a reorganization under Sections368(a)(1)(D) and 355 of the Code;
(d) No Material Adverse Effect. No other events or developments shall have occurred subsequent to the IPO Closing Date that, in the judgment of the Board of Directors of 3Com, would result in the Distribution having a material adverse effect on 3Com or on the stockholders of 3Com."

[8] See "Stock Watch: Buyback, Palm Spinoff Plans Drive 3Com" by Nora Macaluso in E-Commerce Times on 05/09/00

the forward claim on 1.5 Palm shares. Thus, the value of 3Com is the value of the stub plus a prepaid date T^* forward on 1.5 Palm shares:[9]

$$S_{3COM,t} = STUB_t + 1.5\ \mathrm{PV}\left[\mathrm{F}_{\mathrm{T}^*,\mathrm{t}}\right] \quad (1)$$

Assume a constant continuous risk-free rate[10] R and continuous constant "lending fees" δ for all $t < T^*$. Then

$$F_{\mathrm{T}^*,t} = S_{\mathrm{t}} e^{(\mathrm{R}-\delta)(\mathrm{T}^*-t)} \quad (2)$$

And

$$\mathrm{PV}\left[\mathrm{F}_{\mathrm{T}^*,\mathrm{t}}\right] = S_{\mathrm{t}} e^{-\delta(\mathrm{T}^*-t)} \quad (3)$$

We can rewrite this to express the value of a Palm share as the present value of the stream of lending fees up to T^* plus the PV of the T^* forward price:

$$S_t = \mathrm{PV(lending\ fees)} + \mathrm{PV}\left[\mathrm{F}_{\mathrm{T}^*,\mathrm{t}}\right] \quad (4)$$

From (3) we get

$$\mathrm{PV(lending\ fees)} = S_t(1 - e^{-\delta(T-t)}) \quad (5)$$

Palm's contribution to the price of a share of 3Com is $1.5\ \mathrm{PV}\left[\mathrm{F}_{\mathrm{T}^*,\mathrm{t}}\right] = 1.5\ S_{\mathrm{t}} e^{-\delta(\mathrm{T}^*-t)}$ and (1) becomes:

$$S_{3COM,t} = STUB_t + 1.5 S_{\mathrm{t}} e^{-\delta(\mathrm{T}^*-t)} \quad (6)$$

We rewrite the latter as

[9] Compare to Lamont and Thaler (2003b), who argue that the value of a 3Com share should be $S_{3COM,t} = STUB_{\mathrm{t}} + 1.5 * S_{\mathrm{t}}$.
[10] In this article we use R=6.3% as the risk –free rate- for reasons explained below.

$$S_{3COM,t} = STUB_{\mathrm{t}} + \mathrm{G}(\mathrm{T}^*, \mathrm{t}, \delta) * \mathrm{S}_{\mathrm{t}} \quad (7)$$

where $\mathrm{G}(\mathrm{T}^*, \mathrm{t}, \delta)$ measures the contribution of 1.5 3Com-held Palm shares to the valuation of one 3Com share.

In our case $\mathrm{G}(\mathrm{T}^*, t, \delta) = 1.5\ e^{-\delta(\mathrm{T}^* - t)}$.

Uncertainty of the spin-off.

To model the uncertainty about the spin-off time, we assume for simplicity that T^* is uniformly distributed between two dates, U(a, $a + z$), with a denoting the first possible spin-off date and $a + z$ denoting the latest possible date of spin-off with $z \geq 0$.

Under uncertainty, equation (1) depends on the discounted expected forward price:

$$S_{3COM} = STUB + 1.5E(\mathrm{PV}[\mathrm{F}_{\widetilde{\mathrm{T}^*},\mathrm{t}}]) \quad (8)$$

in this case with $\widetilde{\mathrm{T}^*}$ uniformly distributed[11] over $[\mathrm{a}, \mathrm{a} + \mathrm{z}]$. Integrating over possible stopping times, it can easily be shown that equation (7) continues to hold with:

$$\mathrm{G}(\mathrm{T}^*, \mathrm{t}, \delta) \approx 1.5(1 - 2\delta a - \delta z) \quad (9)$$

which implies that $\frac{\partial G}{\partial a}<0$ and $\frac{\partial G}{\partial z}<0$. That is, an increase in the time to the earliest reasonable distribution date a and/or an increase in the length of the spin-off interval measured by z reduces the impact of the Palm share price on S_{3COM} .

[11] The tilde sign will be dropped whenever it does not cause ambiguity.

Calculating synthetic Palm forwards. Beginning on March 16, 2000, there were active markets in Palm's puts and calls, with May, August and November expiration dates. We utilize these options to calculate synthetic forwards for these dates.

Let $C_t(X,T)$ and $P_t(X,T)$ be the time t value of a European call and put, respectively, with strike price X and maturity T.[12] From put-call parity, the forward price is given by:

$$C(X,T) - P(X,T) = PV(F_T - X) \tag{10}$$

As noted earlier, we use $r = 0.063$ throughout. Solving for F_T gives:

$$F_T = [C(X,T) - P(X,T)]e^{rT} + X \tag{11}$$

To build a long position in synthetic forward requires buying the call at the ask price and selling the corresponding put at bid price. Therefore the cost of creating a synthetic long forward is:

$$F_T^A = [C^A(X,T) - P^B(X,T)]e^{rT} + X \tag{12}$$

Analogously, the cost of creating a synthetic short forward is:

$$F_T^B = [C^B(X,T) - P^A(X,T)]e^{rT} + X \tag{13}$$

And $$F_T^{MID} = \frac{F_T^B + F_T^A}{2} \tag{14}$$

3. Empirical verification of the predicted comovement between Palm and 3Com

[12] Unless specified otherwise, t = 0 and is often omitted. The formula is derived for European options, but the available data are prices of American options, which biases the results against us.

In this section we estimate $S_{3COM,t} = \alpha + \beta * S_t$ via regression for different data sets at different points in time. The slope coefficient is an estimator of $G(T^*, t, \delta)$ in equation (7), and equation (9) allows us to determine whether the estimates are consistent with plausible values of the parameters *a*, δ, and *z*. Over each interval we study, we find a good fit between our theory and the empirical observations.

Empirical estimation of $G(T^*, t, \delta)$ from March 2 data.

Palm shares started trading at 11:30am on March 2; we examine the minute-by-minute Palm and 3Com prices between 11:30am and 4:30pm that day. We then estimate the following regression, with t-values in parentheses:[13]

$$S_{3COM,t} = \underset{(26.82)}{33.57} + \underset{(43.13)}{0.52}\, S_{PALM,t} \qquad \text{Adj } R^2 = 0.86 \text{ ; 300 observation}$$

That is, on March 2 $G(T^*, \delta, t) = 0.52$. This is consistent with the parameter triplet $\delta = 0.25, a = 0.8, and\ z = 1$, implying considerable uncertainty about the spin-off time. This seems consistent with the evidence in the sample of spinoffs examined by Mitchell, Pulvino and Stafford (2003), where the average time to convergence is 236 days and the maximum time to convergence is 2,796 days.

We graph in Fig.1 the minute-by-minute Palm and 3Com prices between 11:30am and 4:30pm on March 2. One can see that the markets for Palm and 3Com were in continuous minute-by-minute coordination, that the valuation process was orderly and that a $1 change in Palm price was matched by a change of about $0.52 in price of 3Com. It is striking that the adjusted R-square from the regression (86%) and correlation in the movement of the pair of stock prices (illustrated by the graph below) is so high—emphasizing that there is a close connection between the markets for Palm and 3Com.

[13] This can be thought of as estimating the cointegrating relationship between the two share prices.

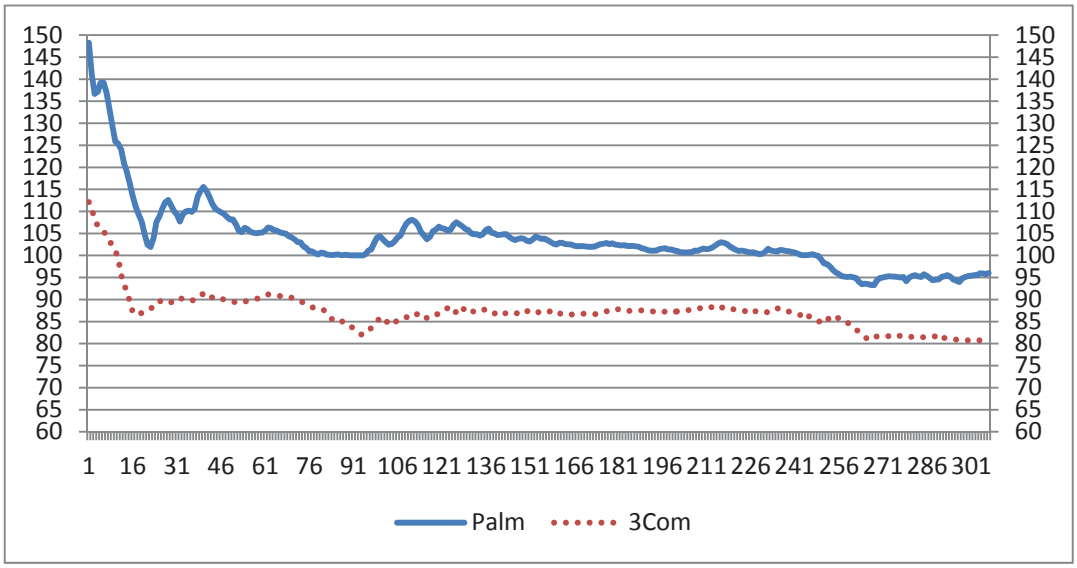


Figure 1: March 2, 2000 minute-by-minute prices of Palm and 3Com

The resolution of uncertainty on May 8 and its impact on $G(T^*, t, \delta)$.

In the after-hours of May 8, 3Com announced that it would spin-off its shares of Palm on July 27, 2000, well before its original estimated spinoff date of December 2000.[14] The following day, 3Com's share price rose more than 10%, from $43.69 to $48.25. Palm's share price fell almost 10%, from $32.25 on May 8 to $29.13 at the close on May 9. How can we explain the opposite movement of Palm and 3Com prices when 3Com owns 95% of Palm? The May 8 announcement sharply changed the distribution of the spin-off time, and the uncertainty disappeared. Using our uniform distribution, the parameter *a* became 0.24, *z* went to zero, and we know from our data about lending fees that δ went from 0.35 to 0.57, as the removal of much of the spinoff uncertainty increased the demand to short sell Palm as part of the relative-value trade discussed earlier. Can the new values of these parameters explain the comovement of Palm and 3Com?

To investigate this we estimate two regressions (with t-values in parentheses):

Using 9:30am- 4:00pm minute-by-minute price data from May 8, we find that:

[14] At the same time, 3Com declared a $1 billion open-market share repurchase. This could also influence 3Com's valuation.

$$S_{3COM,t} = 21.49 + 0.70 * S_{PALM,t} \text{ Adj. R Square} = 0.38; \text{ Observations} = 389$$

(14.91) (15.30)

For similar (10:00am to 4:00pm) data from May 9, we find:

$$S_{3COM,t} = 9.67 + 1.33 * S_{PALM,t} \text{ Adjusted R Square} = 0.72; \text{ Observations} = 361;$$

(7.8**)** **(**30.71**)**

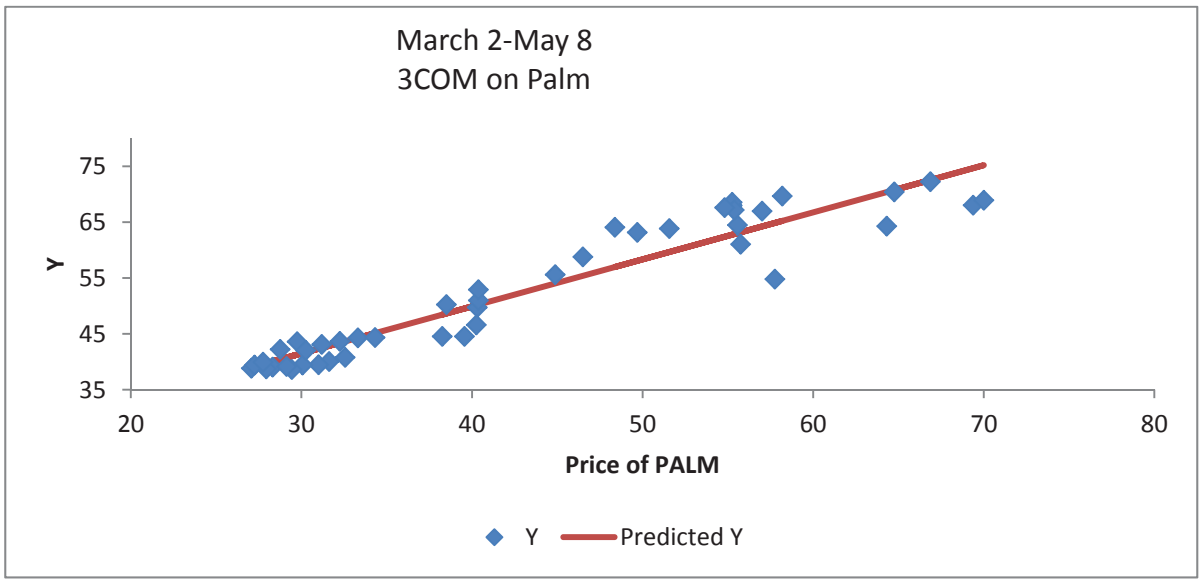
That is, the estimated $G(T^*, \delta, t) = 0.70$ just before the announcement, and $G(T^*, \delta, t) = 1.33$ immediately thereafter. The new parameter values (a = 0.24, z = 0, and δ = 0.57) imply a slope coefficient of about 1.3, which matches the observed value quite closely. The May 8 slope coefficient of 0.70 is also exactly what we would expect before the uncertainty is resolved, as it is consistent with a = 0.58, z = 0.4, (that is, a spinoff equally likely to occur at any point between 0.58 and 0.98 years in the future) and δ = 0.35.

The May 8 announcement removed uncertainty about the spin-off time and shortened the expected spin-off time. A quicker spin-off explains why the share price of Palm went down: the expected future lending fees from owning Palm shares suddenly shrank. The change in $G(T^*, t, \delta)$ from 0.70 to 1.33 can explain how a drop in Palm's price is consistent with an increase in 3Com's price: the much larger share of Palm price is now reflected in 3Com's price.

Next we split our sample at May 8, 2000 and investigate the joint daily evolution of Palm and 3Com's share price before and after the spin-off announcement. During the March 2 to May 8 period, there is substantial uncertainty about the spin-off date, and we should expect a relatively small $G(T^*,t,\delta)$, as discussed above. Starting May 9, we should see a much higher $G(T^*,t,\delta)$.

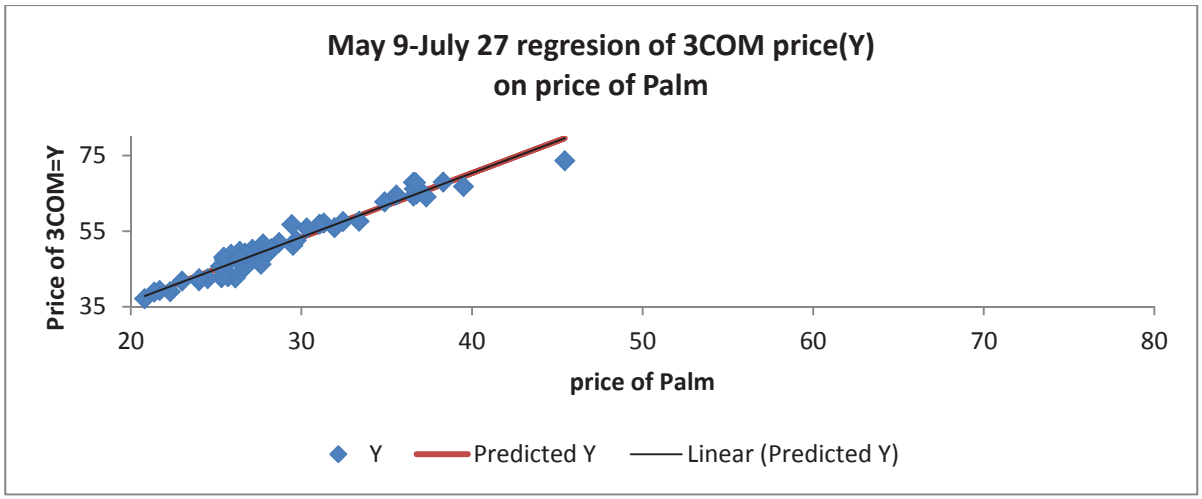
The regression results are provided and graphed below. Our estimates of $G(T^*,t,\delta)$ over these longer time periods show similar patterns:[15] a slope coefficient of 0.78 before May 9 and 1.69 after May 8, with a very high R^2 for both sub-periods[16]. We conclude that the Palm/Com price relationship theory that we have derived above is able to explain the joint share price behavior as completely rational.

March 2 – May 8: $S_{3COM,t} = 18.7 + \mathbf{0.78}\, S_{PALM,t}$
(10.5) (21.0) Adj R^2 =0.91; 47 observation



May 9 – July 27: $S_{3COM,t} = 2.51 + \mathbf{1.69} S_{PALM,t}$
(1.59) (31.9) Adj R^2 =0.95 ; 56 observation

[15] Compare to Cochrane "Stocks as Money: Convenience Yield and the Tech-stock Bubble," Working Paper 8987 http://www.nber.org/papers/w8987
[16] Interestingly, there is no relationship between prices after July 27
July 28 – Oct 11: $S_{3COM,t} = 16.35 + 0.0087\, S_{PALM,t}$
(10.47) (.24)
There were 53 observation and Adj R2 = 0.01 i.e., once the spin-off is complete there is no remaining correlation in the pricing between Palm and 3Com



4. Empirical verification that 3Com's stub value was never negative

Equation (7) shows that 3Com's stub value is equal to price of 3Com minus 1.5 times Palm's price net-of-lending-fees. Below we verify that this value is always positive.

March 16 data. For simplicity of comparison we start with March 16, 2000 data from Lamont and Thaler (2003b). Palm's closing share price on that date is $55.25, so the table below considers puts and calls on Palm for various expiration dates that are approximately at-the-money. The table is identical to their Table 6, with the last 3 columns added by us. Forward prices are based on a riskless rate of 6.30%.

Table 1

Panel A		Call	Call	Put	Put			
	years	Bid	Ask	Bid	Ask	synthetic Long forward	synthetic Short forward	mid
May 55	0.17	5.75	7.25	10.63	12.63	**51.84**	**48.30**	**50.07**
August 55	0.42	9.25	10.75	17.25	19.25	**48.58**	**44.98**	**46.78**
November 55	0.67	10.00	11.50	21.63	23.63	**44.69**	**41.04**	**42.87**

First, we observe from the last column that longer-dated forward prices are lower, as one would expect from $F_{T^*,t} = S_t * e^{(R-\delta)*(T^*-t)}$.

November 2000 is the longest option expiration available, so that is also the latest date for which one can calculate synthetic forward prices. Using November 2000 forward prices results in a conservative estimate of the 3Com stub value if the spin-off is actually expected later than Nov 2000, as was the case when the IPO occurred. For T^* = November 17, 2000, the value of the 3Com stub on March 16 equals $7.35 per share. A negative $22 billion stub only appears if the stub is calculated using Palm's spot price rather than using the appropriate post-spinoff forward price.

Calculating stub value for all dates:

Figure 2 gives 3Com's stub value for the entire period from March 16 to July 27. To estimate 3Com's stub value for all dates between March 16 and July 27, we calculate $F_{T^*,t}$ for all $t < T^*$ assuming T^* = Nov 2000 during the period before May 9, and T^* = Aug 2000 during the period after May 8. Recall that T^* =Nov 2000 underestimates the stub value of 3Com if the spinoff is expected after this date and lending fees are expected to remain positive.

With few exceptions (all of them before April 13, 2000) the value of the stub is positive and above $3.75

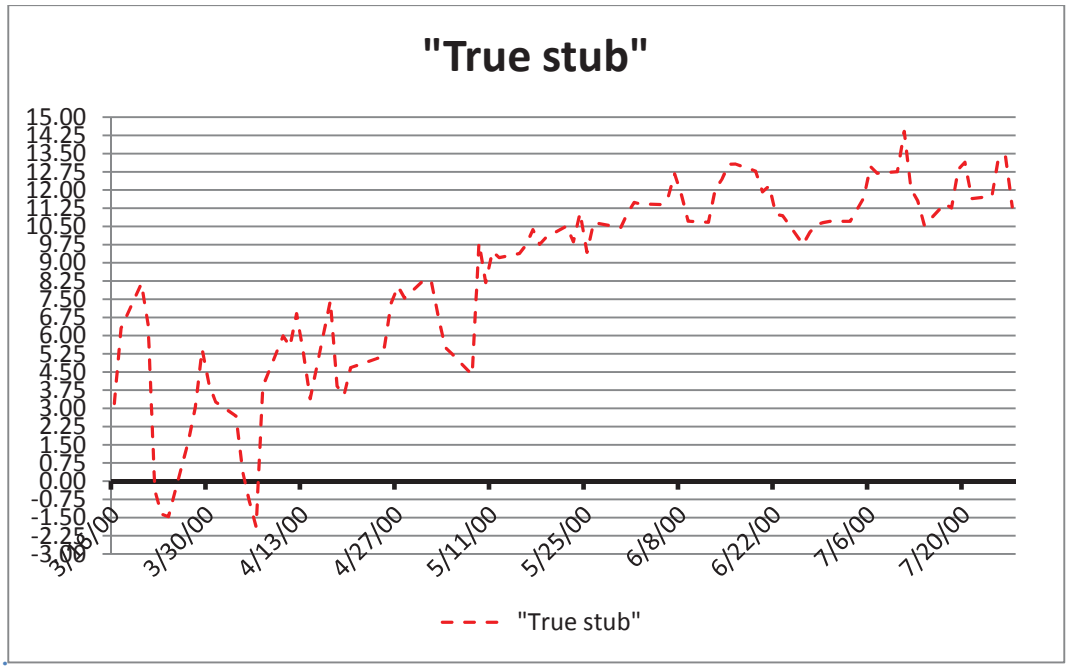


Figure 2 "true stub" defined as price of 3Com minus 1.5 shares of "true contribution" of Palm

Figure 2 shows that throughout this period, the part is never larger than the whole.

5. Comparing the implied and the actual lending fees during the March–July period .

Once implied forward prices are derived from put and call prices, forward-looking market estimates of future lending fees δ over a given interval can be derived from the equation $F_T = S_0 * e^{(0.063-\delta)*T}$

Figure 3 graphs the implied lending fees. The graph employs November 2000 forwards for dates before May 9, with August 2000 forwards used thereafter. The average implied lending fee is 41.3% for the March 16 to May 8 period, and the average implied lending fee is 44% for the May 9 to July 27 period.

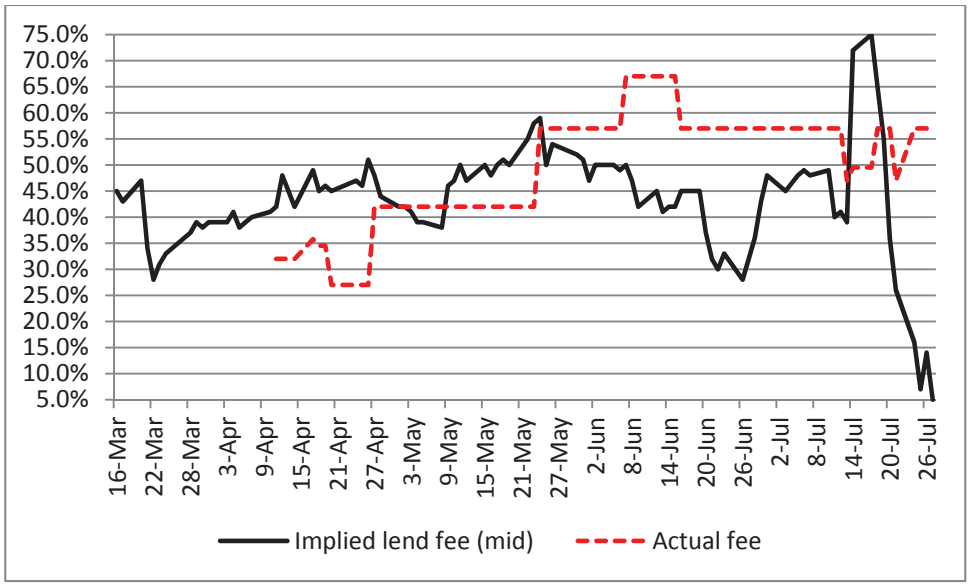


Figure 3 Palm lending fees implied by forward prices calculated on various dates.

Figure 3 shows the lending fees charged on a sample of actual Palm share loans obtained from a large agency broker. More details on the lending sample are given in the appendix. Overall, the implied future lending fees are quite consistent with observed ex-post market lending rates.

6. Implied lending fees for the period from Aug 16, 2000 to Nov 17, 2000

From $F_{Aug,t} * (e^{(0.063-\widehat{\delta})*(\text{Nov}-Aug)} = F_{\text{Nov},t}$, we can estimate the lending fees expected for period from August 16, 2000 to November17, 2000. Our theory predicts that if the markets expect the spinoff to occur after the end of November (which was the expectation prior to May 8), there will be positive implied lending fees for the August to November interval. On the other hand, if markets are certain that the spinoff will occur before August, and that lending fees will vanish thereafter, there should be zero implied lending fees for the August to November interval. Implied forward prices reflect these expectations pefectly. The results are reported in Figure 4, which shows the implied fee averaging about 28 % before May 9, but becoming essentially zero once the July 27 spinoff date is announced, exactly as the theory would predict!

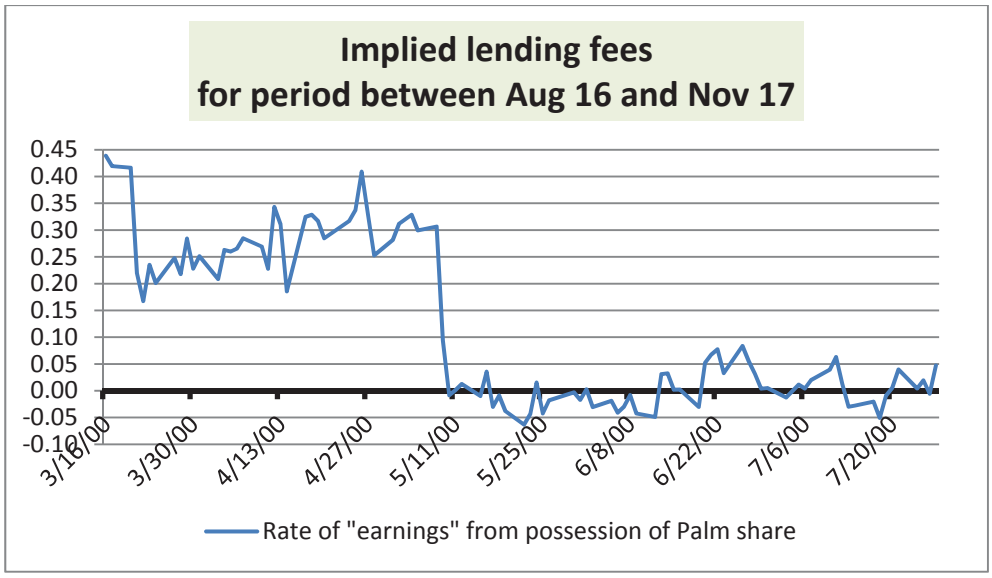


Figure 4: Palm lending fees implied from Aug 2000 and Nov 2000 forward prices.

7. No violation of put-call parity, and no violations of LOOP

Put-call parity. Lamont and Thaler (2003b) state that on March 16, 2000, "[o]ptions on Palm display massive violations of put-call parity [for European options] and violate the weaker inequality [for American options] as well. Instead of observing at-the-money call prices that are greater than put prices, we find that puts were about twice as expensive as calls.[Also]…[o]n March 16 the price of the synthetic short was about $39.12[= PV of synthetic forward], far below the actual trading price of Palm of $55.25. This constellation of prices is a significant violation of the law of one price since the synthetic security is worth 29 percent less than the actual security." (Lamont and Thaler (2003b, pp 255). But this discussion disregards the fact that a Palm share allows the owner to earn the lending fee δ.

The lending fee can be viewed as a continuous dividend paid to the owner of the share, and the put-call parity relationship for at-the-money options on a dividend-paying stock is:

$$S_0 * e^{-\delta T} - PV(S_0) = C(S_0, T) - P(S_0, T) \quad (15)$$

Because lending fees δ are much larger than the 6.3% riskless rate at the time (see Figure 3), puts should be much more expensive than calls, and there was no violation of put-call parity.

Law of one price (LOOP). Lamont and Thaler (2003b) suggest that the Law of One Price [LOOP] was violated by the 3Com-Palm data. To recapitulate, LOOP requires that assets be deliverable in lieu of the other for the law to be observed within the limits of transaction costs. As 3Com could not be delivered in lieu of a shorted Palm share until the spin-off had occurred, LOOP is not violated. As the time of spin-off was uncertain, the Palm-3Com case offers at most a "risk arbitrage" opportunity.

In other markets, there are similar opportunities that appear to be arbitrage opportunities at first glance. For example, one can purchase silver half-dollar coins in bulk. A bag of 2,000 silver Kennedy half dollar coins contains approximately 295 ounces of pure silver. On April 25, 2012, the cash asking price[17] for the $1,000 face value bag was $8,985.70, and the bid price was $8,425.20. On that day the silver spot price was $30.56 per ounce, making the silver content of the bag of coins worth $9015.20 (= $30.56 * 295), higher than $8,985.70, the ask price for the whole bag.[18] Here the part is more valuable than the whole. But it does not mean that these two markets break the LOOP: these are two separate markets, that serve different clienteles, and there is no way to arbitrage between them as it takes $400-$600 to refine a bag of these coins into silver and copper.

The parallel with Palm and 3Com is straightforward: only 3Com management can "refine" the pre-spinoff 3Com share into two separate stocks. This "refinement" was in doubt on March 2, so a $95 price for Palm and a 3Com share at $81 did not violate LOOP. Lamont and Thaler focus upon notions of "fundamental value" or

[17] Source: http://www.providentmetals.com/1000-face-value-40-silver-us-kennedy-half-dollars-1965-1970.html Visited April 25-2012

[18] In addition, a bag of coins contains copper that was worth about $80 on that date.

"intrinsic value," but the "fundamental value" or "intrinsic value" of 3Com or Palm is unobservable. Our analysis offers more precise implications than the broader perspective that there is huge latitude within limits of arbitrage.

The case of rational investors with access to two segmented markets

Lamont and Thaler (2003b) ponder who buys the expensive Palm shares when 1.5 shares of Palm plus the stub can be acquired cheaper by buying a share of 3Com. They rely on a different version of LOOP: two identical assets should trade at same price in different markets when a buyer has costless access to both markets.

But this version of LOOP requires careful calibration. Two apartments should sell for the same price if their size, view, exposure to sun, level of noise, and other characteristics are identical, but all these characteristics have to be matched precisely to get the LOOP result. Matching physical attributes is not enough: otherwise identical apartments may trade at a 30% price difference if one is in a co-op and the other is a condo[19]! Matching of cash-flows is not enough, as we learn from "on-the-run" vs. "off-the-run" treasury bond markets or closed-end funds trading at a discount.

Assets have a number of parameters that define their valuation, such as cash flows, trading costs, ownership structure, and agency issues. Prices in the two markets will be identical if all parameters are carefully matched. This was not the case in the Palm-3Com story: outright ownership of Palm shares vs indirect ownership of Palm shares via ownership of 3Com may be the crucial difference that drives these prices apart.

Kolasinski, Reed, and Ringgenberg (2013) document that the lending supply curve for shares is strongly upward sloping, so the observed lending fees in the Palm-3Com case are not surprising. However, some set of investors must ultimately hold the outstanding stock of Palm shares without lending them out. We know that

[19] Co-ops are trading at a 12% discount to identical condo apartments [Goodman& Goodman]

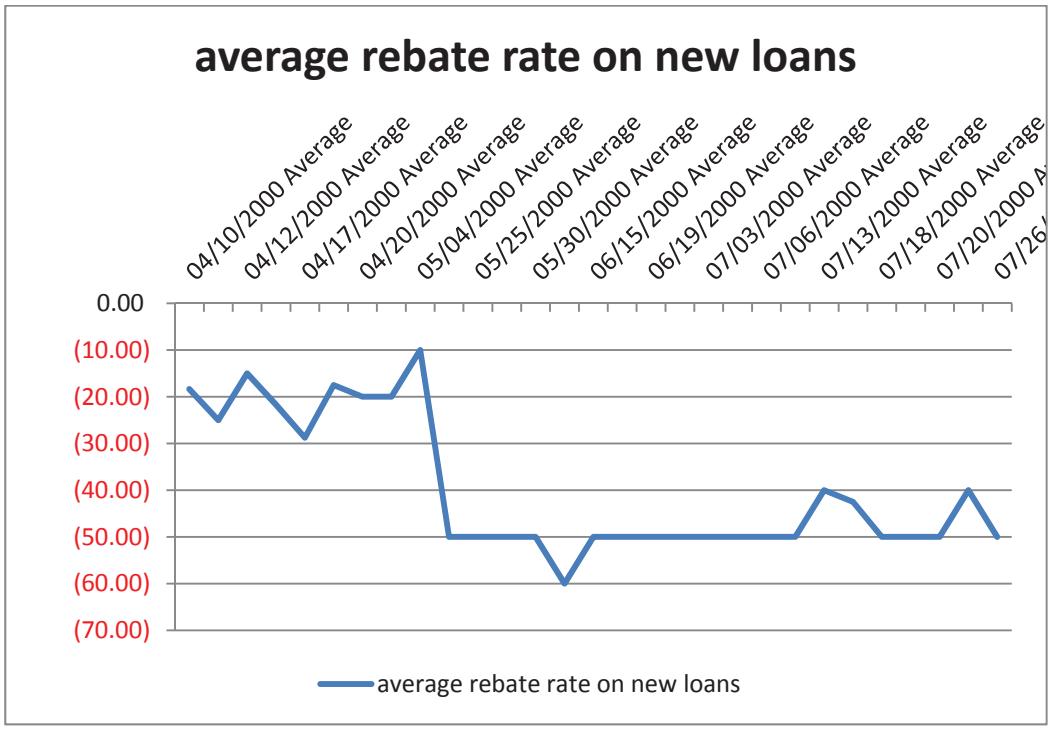
many investors do not have access to the “lending technology.” Brokers do not pass lending fees through to retail customers, and some institutional shareholders do not have a share lending program in place. For these investors, the question is whether it can be rational to buy the more-expensive Palm shares instead of buying Palm shares via 3Com. If these investors are sufficiently pessimistic about the spinoff and the prospects for convergence, or these investors attach large marginal utilities to a divergence outcome, an investment in Palm shares could be quite rational.

8. Conclusions

The Palm—3Com episode is a memorable one. It appears to provide a singular challenge to the notion of rational market pricing. This paper offers an alternative interpretation. We provide novel and systematic evidence that, throughout this episode, markets are jointly pricing both Palm and 3Com in a rational way, and no-arbitrage pricing is preserved.

Appendix: Lending Palm for money

We have a share lending dataset from a large agency broker covering 56 loans during 2000 for a total of about 5.4 million shares, which is about 23% of the available float of 23 million shares. All loans were originated sometime between April 10 and July 26 and all were closed (i.e., repaid) on August 1 once the spin-off was completed. The graph below shows the rebate rates for loans originated at different dates.



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