THIRD WAY

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# The Need For Speed: How High Frequency Trading Really Works

**Third Way**

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*Introduction:*

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*Location:*

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MS. LAUREN OPPENHEIMER: Hi everyone, sorry, we were stuck outside in an evacuation, meaning we'll be starting shortly.

JAMES ANGEL: Yeah, well, actually, I know your time is real valuable, so we can get started right away while, you know, we set up the PowerPoints and stuff. And I think we are going to have handouts, right?

MS. LAUREN OPPENHEIMER: Yes.

MR. ANGEL: Oh, OK, so visualize PowerPoints; I'll introduce myself. My name is Jim Angel. I am a finance professor at the Wharton School, although actually they're borrowing me from Georgetown. So I'll be back at Georgetown someday.

And I am here to basically talk about, you know, how the stock market works and how high-frequency trading works. And what are people complaining about, anyways?

But first of all, it looks like we have a lot of food, so feel free to help yourself. And while we're setting up, did any of you have any particular – a microphone, power. So while we're setting up, did any of you have any particular questions that you really want to see addressed today in our discussion this morning?

Yes, sir.

Q: (Off mic) – at some point, you can address the question of whether high-frequency trading is a problem, is it a form of negative externalities that – or does it have negative externalities that need to be addressed? What's the best way to – if so, what's the best way to address them?

MR. ANGEL: Great question, and that's one of the things that I was planning on talking about. So I'm thinking, prepared the right stuff, good, OK.

And any other questions that – or any other stuff you want to see me address today while we're setting up?

Yes, sir.

Q: (Off mic) – just kind of like for some of the larger corporate dealers, you might have kind of like a – some high-frequency trade capability that ends up being proprietary trading kind of on their desk?

MR. ANGEL: So the question becomes, what is proprietary trading versus what is market making? That – oh, that's a fun question.

Other things you want to see handled today? Yes, sir.

Q: Is there any validity to the connection between newer IPOs being introduced today – (off mic) –

MR. ANGEL: Is there – oh, that's a good question, because I've been, you know, following this, you know, why are a

number of stocks just plummeting in the United States, and does it have anything to do with high-frequency trading? That'll be a fun one to get to.

Other topics you want to see handled today? Yes, sir.

Q: I understand that a lot of trades are put in and taken back – (off mic) – so are a lot of these trades not meant to be executed?

MR. ANGEL: Good question, you know, why do we see, you know, so much in-and-out trading and why do we see so many cancellations of people who put in an order and then suddenly cancel it? That is definitely an issue in today's markets.

Yes.

Q: Kind of there's been some talk in the SEC about going back to fractions, getting away from decimalization, kind of what kind of impact could those rules have on kind of preventing some of the high-frequency trade?

MR. ANGEL: Yes, so the question – we call that the tick size in terms of, you know, what is the minimum price increment? You know, right now, we can do a trade at $10 or $10 and a penny but not $10 and half a penny, sort of. OK, I'll try to get to that, time permitting.

And by the way, if any of you have any questions – if I throw out a buzz word that you're not quite familiar with, stop me right there. This will be a lot more fun if I'm – we're interactive, if you have a lot more questions and answers, because I'm very good at putting people to sleep, the – I can go blah, blah, blah, blah, blah and have all of you be – (inaudible) – you know, begging for coffee within seconds. I'll try not to do that, you know, that's a cruel thing to do to an audience. And especially when you have a subject as exciting as the stock market, I mean, it's really – well, it's hard not to be excited about this topic.

So anyhow, well, do we have the PowerPoint set up yet, or –

MR. JIM KESSLER: I'd like to wait – (off mic ) –

MR. ANGEL: OK, we're still waiting for some people to come through security. Well, anyway, you know, the first slide is just to tell you a little bit about who I am, a little bit about what I do. As I mentioned, I'm a finance professor at Wharton and Georgetown and the – you know, I study the nuts-and-bolts details of how markets operate and I love to talk about it. And I've been doing it for 70 stock exchanges around the world. I've got over 10 patents on trade technology, you know, so I love getting to the nuts-and-bolts details of how this stuff works.

So anyways, I'll start off with the very basics. You know, how – what happens here? When you click the "buy" button on E-Trade, you know, what happens at that point? And really, if you want to understand the stock market, the easiest way to understand it is to – is to think about eBay. How many of you have ever bought or sold something on eBay? Oh, OK, so most of you know how it works there. If you want to buy something, you can put in a bid, like in an auction. But with a lot of those auctions, there's a Buy It Now price. So if you don't want to wait and maybe your bid will be accepted, maybe not, maybe somebody will outbid you; if you just want to buy it now, you can pay it that higher Buy It Now price.

Well, that's kind of the way it works when you put in an order in the stock market. You know, if you want to buy a stock, you know, you can basically put in a bid just like you do on eBay and say, you know, I would like to buy some of these shares of Apple stock and I'm not willing to pay more than $400. That's what we call a limit order, OK?

You know, or you could put in what we call a market order at which you're basically saying, I'm taking the Buy It Now price. So you can say, I'd like to buy, you know, some shares of Apple stock at the market, whatever the market happens to be, OK? So that's whatever the Buy It Now price is or the ask price, as we call it in the market. So you have a choice in what kind of order you put in.

So you give your order to a broker, an outfit like eBay (sic: E-Trade) or Ameritrade or Schwab or whomever. And then they have to figure out how to fill your order. Now, this is a country which has a very competitive marketplace. You know, by law – you know, in 1975, Congress passed a thing called the National Market Systems Amendments to the Securities Exchange Act of 1934. And those 1975 amendments basically told the SEC to foster a very competitive market structure. They wanted a system where – Congress mandated a system where exchanges could compete with each other and where investors could trade directly with each other without having to go through a dealer.

And indeed, you know, that's what the SEC has done. You know, you may complain at times that the SEC, you know, doesn't always do exactly what Congress wants it to do when they want them to do it, but Congress said – specified a competitive market system and, lo and behold, we've got a competitive market system.

So that now, you got the handouts and pretty soon, I'm sure you're going to have some PowerPoints. In the meantime, anybody have any questions about what I've said so far? So to summarize, the stock market works a lot like eBay. You put in your order; you can specify Buy It Now or you can put your bid price on there. Same thing if you want to go to sell, OK? You can either go put your own Buy It Now price on there, or you can accept whatever the best bid is at any given moment.

So the – but then your broker has a choice of many different places to send your order. Now, some brokerage firms, like E-Trade, will give you one-stop shopping. You give them an order, you say you want to buy some Apple; about half the time, they'll sell it to you out of their inventory. Or the rest of the time, they'll ship your order someplace else.

Now, they have a duty to get you so-called best execution to make sure that you get the best price around. But they do a lot of price matching. They say, wait a minute; the best price in town happens to be $400 a share, whatever it happens to

be today. Hmm, OK, I'd love to sell it to the customer at that price because I happen to have some ready for sale.

Bum-bu-dum – now, do we have a clicker? Well, we've got a page down key. OK, so –

MR. JIM KESSLER: Want me to – want me to do that for you while you stand up here and you can just tell me when to page down?

MR. ANGEL: Oh, OK, well, the – oh, OK, so we talked about the stock market works a lot like eBay. Now, the people who are putting in orders include not only people like you and me who, you know, really want to own the stock for a period of time, but also there are a number of people who participate in the market who really don't want to own stock. These are – you know, like the equivalent of used car dealers.

Think about this, OK – some of my best friends are used car dealers; OK, they're actually nice people sometimes. The – think about it, if you want to sell your only car, you have a couple of choices: You know, you can, you know, go to Craigslist, you know, put in an ad and then wait and then a number of shady people call you up on the phone. Yeah, I can see some people have experience with this. Yeah, OK.

Or you can go to the used car dealer and they will bid you a low price for your car. Now, the used car dealer really doesn't want to own that car for the long run; they don't really want to drive it home at night. They'd love to turn right around and sell it a few minutes later to somebody at the high retail price. And what they're doing is, they're providing a service of immediacy and convenience, and we call that liquidity because, you know, in a theoretical world, the buy orders come in and the sell orders come in all at exactly the same moment. And the exchange matches them, and everybody lives happily after. But in the real world, it doesn't quite happen that way. Sometimes the buy orders come in and there are no sell orders sitting there, or vice versa.

So these stock dealers or market makers, as we call them, have a business model where they say aha. I'll put in a buy

order to buy at the lower bid price and a sell order to sell at the higher ask price and my dream is to buy at the low trade-in price, sell at the retailer – the ask price and do that a couple thousand times a day. And usually there are only, you know, a few pennies at most difference between that bid and that ask price, but they're hoping to capture that difference. We call that difference the bid-ask spread. And that's a key transaction cost in the market, because if you were going to buy your stock right now and then sell it right now – immediately, you know, you'd be buying it at the higher ask price and selling it at the lower bid price. So your transaction cost is that bid-ask spread as we call it. So think of that as, you know, the cost of a round-trip trade based on the prices you get. Any questions so far?

Now, again – you know, so a lot of the people who put orders into our market are people who are following this market-making strategy. You know – you know, their idea is, they're selling a service, and that service is convenience to investors. You know – you know, basically sort of lubricating the gears by making sure that when people want to sell, there are buyers there, or when people want to buy, there are sellers there. So just like the used car dealer will always take your car, even if nobody else does, for a low price, that's what the dealers do. You know – OK?

So let's move on. So this is what a typical order entry screen looks like at, you know, your typical retail firm. So you put in a thing called a ticker symbol; it's an abbreviation. Every U.S. common stock has its own unique abbreviation. So you see AAPL for Apple – and so you can click buy or sell. You say how many shares you want to buy or sell. Then you put in an order type – as I said, a limit order – that's where you're putting in your own bid – your own price. So this limit order says, on this screen, this person's not willing to pay more than $500 per share for 10 shares of Apple stock. And then the timing – you can specify how long your bid is going to stay alive. So this day order says OK, I'm going to put this order into the market, and I'm going to say aha. It'll stay there. It'll be good for today. You know, at 4:00 today when the market closes,

the order evaporates if nobody's been willing to sell to me at that price. Next slide.

So you put in the order. Now your broker – this is where life gets fun. This is what you hired the broker to do. You know, you're hiring the broker to get you best execution. So your broker now has a choice of over 30 different – excuse me, 13 different exchanges and over 40 different brokerage firm-operated systems of people saying give me your order, because you know what? Everybody likes to trade with the retail orders, you know, because they know that, you know, little people like us – like me especially – really are not going to move the price with, you know, my 10-share order. And I don't have any special inside information as to where Apple's stock is going over the next half-hour. So an order from somebody like me is like, oh, everybody wants to trade with that.

And indeed, we have a very competitive market structure, which is exactly what Congress told the SEC to create. Now, some of these computerized trading systems are things we call "dark pools." (Scattered laughter.) The – and it's a great title, but it's kind of a misnomer, because they're only dark before the trade occurs. After a trade takes place, by law, that price and quantity become public information almost instantaneously so that, you know, within a few seconds, the entire world finds out, you know, the trade has taken place. So they're only dark before the trade, not after the trade.

Now, what does a dark pool do? Well, in the so-called lit markets like the exchanges, when you put in that limit order to buy, they display it in their limit order book, which I think is the next slide here, if I remember my slides. Ah – I'll get to that in a moment, OK?

The – at an exchange, you know, they'll take all the buy orders, all the sell orders that have prices attached to them, and they will rank them. So they'll rank them by price, and then usually by time. If there's a tie – if two people are trying to buy at the same price, it's usually first come, first served. So next slide. So here's an example of the limit order book

that – from the so-called BATS Exchange. And, you know, they have this for free in their website. So if you ever want to go to look at batstrading.com, you know, they have a nice thing here.

And so you can see here, for Apple, Inc., there are the bids – these are the people trying to buy, and then the asks – these are the people trying to sell. So what they do is – you'll notice here there's somebody trying to buy a hundred shares, and when I put this slide together, Apple was at 500 (dollars). Now they're closer to 400 (dollars.)

So somebody's trying to buy a hundred shares for $502.01. Somebody else is trying to sell 16 shares at $502.27. And then somebody else is trying to sell 400 shares at $502.35. So in other words, you know, just like eBay, you put in your bids, the bids sit in the computer. They're ranked; the highest bid price is at the top of the queue. So if somebody wanted to sell Apple right now – and this is where the market is – let me make this a quiz for you, OK? So if you were going to sell Apple right now, and you wanted to sell up to a hundred shares, what's the best price you could get on the BATS exchange? $502.01. Right. You're good. OK?

Now, if you were going to buy Apple right now – and let's suppose you wanted to buy a hundred shares of Apple, OK? So you wanted to buy a hundred shares. You could buy 16 at $502.27. So what would happen is, you would knock out those 16 shares. You'd get those for $502.27, but you still want to buy 84 more shares. So then, you'd buy 84 at $502.35. So that's how the prices move. You know, people put in, you know, their priced orders – called the limit orders – and then, when people who want to trade immediately accept those orders, that's how the price gets determined. You know, there's no flesh and blood human sitting there going, you know, I think the official price of Apple should be $502.50. You know, it's all done mechanically by the computer. Any questions on this so far?

Now, this is an exchange – we call it a lit market because, you know, they show you the orders that are in their book. A dark

pool doesn't show you the orders. They let you hide the orders. And by the way, the exchanges also allow you to put hidden orders into their systems as well. But any idea why anybody might want to hide their orders? Yeah.

MS. : (Off mic.)

MR. ANGEL: Exactly. You know, let's suppose you want to buy yourself a really large block. So let's suppose you are a Fidelity or a Vanguard or a big institutional investor and, you know, you need to buy or sell a big chunk. OK. If you just say hey, I want to buy 10 million shares, well – and the order was publicly posted in the exchange book, suddenly everybody goes, wow, there's a 10-million-share buy order there. Somebody must know something. Stock must be going up. So you know what I'm going to do? My sell order, since I think the price is going up, I'm going to cancel my sell order and resubmit it at a higher price. So, the other buyers there go, hmm, big institution is loading up; they're trying to buy 10 million shares? They must know something. They must think the price is going up, so I'll put in a bid a penny higher than theirs, and that way it's a no-lose situation for me, you know. I buy it a penny ahead of them and if I'm right that they're right and it's going up and selling at a profit, hmm, if I – if I'm wrong, I can turn right around and sell to them at only a one-penny loss.

So, there are some very good reasons why large institutions and mutual funds that represent, you know, us retail investors, you know, like to use these so-called dark pools. Now, of course, the dark pools will generally say, OK, give us your orders, we won't tell anybody they're in here, and then, but if we do get a match, we'll just match it at in between the buy and the sell order here. You know, halfway, you know, at the midpoint, as we say – (off mic).

Yes, sir.

Q: Do you know, Professor, on a percentage basis what percentage of trading is dark on any given day and whether that's changing over time?

MR. ANGEL: Ooh, good question. Yes, on the exchanges, the exchanges right now have a market share of about, let's see, about 60 percent is on exchange; about 40 percent is off-exchange. Now, of that off-exchange, about a quarter of that is what we call dark pools, so roughly 10 to 12 percent of U.S. trading volume is in so-called dark pools. Roughly 20 percent is what we call internalized flow.

So in other words, you give the order to E*TRADE, and E*TRADE itself decides, oh, we're going to, as an accommodation to our customer, bill it directly and not bother sending it off to an exchange. So, yeah, one issue that comes up is, oh my god, market's gotten complicated. Well, yeah, it is a complex market structure. And as I mentioned before, Congress basically said USA's competitive market structure, and so that's what we've got today. That's what the law basically says. Competition between exchanges, competitions between exchange and off-exchange trading platforms, systems where investors can trade directly with other investors without having to go through a dealer.

Now, what this means is that unlike in the ancient days when the NYSE was a de facto national monopoly, we now do have a very competitive market structure in which the exchanges compete very much with each other and with off-exchange trading systems for order flow.

So, this pie chart shows us where NYSE-listed shares traded in December of last year. OK, now, just because a stock – rather just because a company pays a fee to the New York Stock exchange to be listed on their market or if they pay a fee to Nasdaq to be listed on their exchange, it doesn't mean all the trading has to go there, OK. This is a free country, we have a competitive market structure. Shareholders own shares and they have a right to trade it any way they want to because it's their stock, not the company's.

So, we see, you know, the classic NYSE traded in December roughly 21 percent of the volume of NYSE-listed stocks. That's the blue in the upper right. Their all-electronic Arca system – because they operate two exchanges in that space –

trade's another 10 percent. Nasdaq does 13 percent. DirectEdge does 8.9 percent and indisclosure – I mean, public independent member of the exchange board for DirectEdge. We see BATS in 10.8 percent and we see approximately 35 percent was an off-exchange. Both the dealers and the dark pools.

Next slide.

The Nasdaq world is very similar, in that we see the big chunk on Nasdaq itself; we see another chunk on DirectEdge, we see a chunk on the NYSE's Arca platform, on BATS, and we see about 38 percent took place, you know, off-exchange. And, again, that's – roughly a fourth of that was dark pools and the rest internalized flow at the dealers.

Now, one of the issues that comes up is, what are these high-frequency traders actually doing? You know, how can people who are trading in and out all day long actually do anything good for the rest of us? And, indeed, that's a legitimate question. But when you look at what they do, the phrase "high-frequency trading" quickly falls apart because there are so many people doing so many different things that to, you know, pretend that all high-frequency traders are the same is like saying all drivers on the highway are the same. Some people use fast cars in perfectly legitimate ways; you know, taxis help us get back and forth, buses help us get back and forth. And some people do dangerous things with them. So, if we look at a lot of the strategies that these people are using, a lot of them are beneficial to people like me, and I'm probably the lowest-frequency trader on the plant.

You know, for example, a lot of these so-called high-frequency traders are doing stuff we call market-making. They're trying to buy the bid, sell up the offer, and they're providing a service of convenience for the rest of us. Again, like a used-car dealer, they don't really want you to drive the car till midnight. You know, the market-makers really don't want to, you know, own the stock overnight. But their willingness to trade is something that is – you know, helps the rest of the market.

And, indeed, one of the things we learned in the flash crash was because of the data disruptions, a lot of the people who do that kind of market-making turned off their computers because they didn't believe the data they were seeing, according to the SEC report. And when they turned off their computers and you had only the real long-term investors trading with each other, putting in market orders, prices went haywire.

So the – so we want those market makers in as stabilizers. There's another thing that high-frequency traders are doing, and we call it arbitrage. It's the essence of buying low and selling high. For example, how many of you have heard of an exchanged traded find or an ETF? OK. How many have you not and would like me to describe what it is? (No audible response.)

OK. The ETF is a basket product. It represents a basket of stocks, but you can buy or sell it with one ticker symbol. And you know, there are now hundreds of them out there – actually more than a thousand now. But some of the big ones, like, you know, the Vanguard – excuse me – like the S&P 500 SPRD represent a basket of all 500 stocks in the S&P 500. Well, they make it easy for a retail investor like me to basically buy the entire stock market, have a nice well-diversified portfolio, but I can buy or sell, you know, very cheaply, very easily. You know, it's the kind of stock that I recommend to my brother-in-law because it gives you the average market return. You know, you don't have to worry about, you know, is the manager any good or any of that stuff. And – but it trades just like a stock. Its price is driven by supply and demand.

Well, you'll notice there's a relationship between the basket stocks that goes into the ETF and the price of the ETF. Now, you know, in the ideal world everybody sees everything and the price is always going to be the same, right? But the real world is noisy, you know? So the price of the individual stocks that go into that ETF can bounce around, and the pricing of the ETF itself is going to bounce around. You know, so when I go to buy some shares of the ETI Vanguard total stock market

index fund, you know, I'm not, you know, analyzing the price of all thousand-plus spots in that ETF. You know, I basically, you know, look at it, the price looks good, buy some, my retirement plan – you know, easy, done.

What I'm depending upon is the arbitragers have their computers set up so they are actually looking at the prices of all those stocks that go into it. They're looking at the price of the ETF. And normally they're in line, but when they get out of line, they buy low and they sell high. And by doing so, they buy whatever side's cheap. So if the stocks are cheaper, then the ETF. They'll buy the stocks, which will price the stocks up, and they'll sell the ETF, pushing the price of the ETF down, and in so doing, it's going to close that gap. And that arbitrage activity actually guarantees, most of the time, that the ETF is going to track the underlying stocks. So they benefit, you know, me. Even though, you know, I buy the thing and hold it forever, I know that when I do buy it the price is going to be exactly where it should be to reflect the prices of all the stocks that go into it. And that requires people with fast computers, people, you know, who can respond very quickly.

Now, you'll notice that, you know, these basic strategies are very low-tech. You know, I'm going to see whatever the bid is in the market, I'm going to put in a bid price, I'm going to see what the ask price is and I'm going to sort of, you know, compete with all the other people doing exactly the same thing – hmm. Or, think about the arbitrage strategy: I'm going to program my computer, you know, to sort of scan the prices of all 500 stocks in the S&P 500, and then I'm going to, you know, also monitor the price of the S&P 500 ETF. And when they get out of line, I'm going to buy low and sell high.

What – it's such an easy, low-tech strategy that you've got a race because plenty of other people out there are trying to do exactly the same thing. Now, this competition is good for me, the retail consumer, because so many people are out there doing that arbitrage, that means that that price is always going to reflect the price of the underlying stocks, you know, but those guys realized that they're in a race. So when the

price does get out of line, the first one who grabs that good trade wins, the second one loses. And it doesn't matter whether they lose my a minute or a millisecond, you know? If they lose the race, they've lost the race.

So you know, they're in a race with each other to try to be the fastest gun in town. So the – so they'll do a whole bunch of things to try to be the fastest people in town. You know, for example, there's a limit to how fast information can travel. It can't travel faster than the speed of light. So they'll pay extra to locate their computers inside the same data centers as the stock exchanges, because that way, you know, they don't have to wait for the electronic signal to get from their home office all the way to the exchange, you know, because light moves approximately one foot per nanosecond, which is about one foot for every billionth of a second.

You know, and indeed what the exchanges do is, to make sure it's fair, you know, they make sure that the length of the, you know, fiber optic cables is the same for everybody who connects into the system. Now, they also – you know, the big race is to get market information between New York and Chicago faster. As you know, the futures industry is located in Chicago; equity is in New York.

And so if you're looking at the futures contracts that are based on equities, you really want to get information as fast as possible between New York and Chicago, and that's what a lot of the complaints are about. It's – people are going, wait a minute, somebody comes up with a new data transmission service that trade – shaves a few thousandths of a second off of the link between New York and Chicago, and we all end up paying for it. But anyways, that's one of the complaints.

Now, a very legitimate complaint has to do with, wait a minute, you know, we've gradually evolved from a market in which humans traded with humans to one in which machines trade with machines. Is the market too fragile? Yes. I'm the guy who warned the SEC in writing five times in the year before the flash crash that our markets were vulnerable to big, technological disruptions like that. And you know, I'm

still very concerned. They've taken a lot of steps since the flash crash to improve things, but you know, we're not done yet.

But you know, as you know, hey, computers allow us to do many things far better, faster and cheaper than ever before. That – I'm of an age when, you know, a telephone was something that was attached to a wall that you dialed with a rotary dial. And the thought of downloading an app onto your phone was just not even science fiction to me as a kid.

So – but I also never thought that, you know, my – I'd be worried about my phone's battery dying because the phone had no battery, it was hooked up to the wire in the wall. It even worked during a power failure. So technology allows us do a lot – to do a lot of things better than before, but it breaks in different ways. And this is something that is very important for all policymakers to realize, that the markets are different now. They're mostly better, but they do break in different ways.

Now, another question that comes up is: Are these people doing bad things with computers? And undoubtedly, some of them are – just like some people do bad things with automobiles. Most of the people who are on the roads today, you know, are doing OK things with their cars, but you know, I'm sure there are a few criminals out there going back and forth. But – and we need to be able to catch them. But not everybody who drives a car is necessarily a criminal.

And I think that's the important thing to remember, that you know, a lot of the manipulative strategies that we see out there are really very similar to old-fashioned, low-tech manipulative strategies. And you know – however, in this high-speed world, we need to make sure that the police force, you know, has cars fast enough to catch the fastest guys on the road, you know? So we want to make sure that, you know, when other people are driving fast cars, our policemen aren't out there with horses and buggies.

So one issue that comes up is the excessive number of order cancellations that we see in the market, that when you actually looking at trading port data – and I'm the kind of nerd I love looking at this stuff – you'll see, you know, situations where there are tons of orders that are fired into the market and then immediately cancelled. Now, what's going on here? Is this some kind of, you know, overt, manipulative act of somebody trying to do so-called quote stuffing – basically shove so many messages into the system that you slow it down for everybody else and then you create so much fog and you only – you know what kind of fog you've created so you can catch other people in the fog?

Or is it some sloppy computer algorithm that is just going, you know, haywire? I've done enough programing in my life, and I've written enough bad code that – (chuckles) – I'm willing to believe somebody else's code is as bad as mine. So – or, is it some complex interaction between, you know, two different computerized trading programs doing some kind of dance of you go here, I go there, I go here, you go there – just back and forth as the speed of light?

Yes?

Q: Hi. Given – if I think about the markets, like, given the fact that, like, money managers and sophisticated investors are going to have a view – let's say even a long-term view on what they're hoping to do when they go into the market to trade, do you think that, from what you're describing about high-frequency traders – that unsophisticated investors – like, everyday sort of, like, you know, Joe, your neighbor across the street – will be more likely to be disadvantaged by the actions that you're describing?

MR. ANGEL: No, I think they're actually – the average person on the street, who's a fairly low-frequency trader, actually benefits from the computerized market we're in because, you know, having the computerized market-makers and arbitragers, what they've done is the spread between the bid and the ask prices has basically collapsed.

You know, and now there's some concern that it might actually be too small which, time permitting, I hope to get to that later. That – you know, I mean, if you look at every measurable measure of market quality, whether it is the, you know, spread between the bid and the ask or execution speed or even institutional trading costs, you know, they've come down dramatically in the last decade.

Now, the person who is disadvantaged would be what I'll call the medium-frequency trader – you know, the kind of person who used to, like, you know, hang out in a brokerage firm and watch the ticker tape, we called them tape watchers, or the kind of person who, you know, would be, you know, staring at their screen all day long, you know, hoping to sort of say, aha, I think IBM is going to tick up the in the next 30 seconds – chu, chu, chu, chu. So the people who are in that race for speed, you know, are clearly, you know, losing out just like a car loses out to a – just like a pedestrian loses out to a car.

But, you know, for the average person who just says, hey, I think Apple's a steal at 400 because I think it's going to go back to 500, the fact that you have those people out there competing for that person's order actually helps that person. So as with any technological change, some people are better off, some people are worse off. But you know, for the average retail investor they've never had it so good.

MR. : So why don't you – but – on the same token, one of the concerns is the volatility that high-frequency trade as introduced, which could disturb market confidence. That would hurt – (inaudible).

MR. ANGEL: Yes. And that is – and that's why we need to be very concerned about the technical fragility of the markets. You know, the SEC has taken some steps to try to tame that fragility. You know, they've put in so-called circuit breakers, and they're rolling out a new system called "limit up-limit down." I think it needs a lot more technical refinement than what they've done so far. But, you know, clearly we do need to worry about, you know, excess volatility. And you know, this is something that, you know, we need to have a regulatory

system that understands what's going on and has the tools to really understand what's going on to make the appropriate policy decisions and to catch the bad guys, because there are always going to be bad guys in financial markets. Money attracts fees just like garbage attracts flies. (Laughter.) You know, so we need to have good police officers in our financial markets, just like we have to have security guards at the bank. You know, that's never going to change.

And we need to make sure that we have people, you know, in our regulatory positions who are smart enough to understand the games being played and to differentiate between the good guys and bad guys and, you know, who can also have enough sense of the technology that they can come up with the right rules and regulations to tame that volatility. And, you know, unfortunately, you know, the SEC has a long history of really not hiring people with, you know, financial expertise or with technological expertise. You know, they generally hire people, you know, fresh out of school who don't have industry experience. And historically, they didn't even do a very good job of training them. Now, you know, they say they've changed their tune on that. It remains to be seen how well they've been at it. But the – you know, I think, you know, the solution to those kinds of issues like volatility is to make sure that the regulators know what they're doing.

Q: Yeah. But I mean, if I'm a retail investor – say I'm Apple; I have a stop-loss at 350 – it's a flash crash – I sell at 350, and I've lost, you know, like 50 bucks and it kind of returns, I'm stuck with the loss as the retail investor. I wasn't kind of able to – I mean, that's where it can hurt me too.

MR. ANGEL: Exactly. And, you know, I agree a hundred percent with you, but, you know, that's why, you know, these issues of the technical stability of the market are important, and, you know, they won't go away if we just throw all the computers in the ocean. You know, electronic trading is here to stay, and even if you said, oh, you can't co-locate or, you know, you can't do this or that, people are still going to have computers that are, you know, primed to react to every news

announcement or everything else going on. So what we need to do is make sure we understand the new world order and put the right safeguards in place.

Q: (Off mic) – what's the purpose of buying, then cancelling and creating that fog? Why would you create the fog and then cancel your order?

MR. ANGEL: Well, the idea is, you're trying to sort of out-game all the other people who are trying to out-game you. So the idea – you know, the allegation – and I haven't seen any credible evidence of people actually doing this, but you know, this is sort of one of the explanations for what we've observed is, boom, if you create the fog, then you slow down other people's systems and so they're slow to update their quotes and you can pick off the slow players. You know, that's the story.

Now, how true is that story? I don't know. But I do think excessive cancellations are a problem. And the common-sense thing to do is to charge people for cancelations, create the right financial incentive so that – you know, because every time you put a message into the market, you cost everybody because everybody is using that information; everybody is processing that information, storing that information. So it provides an externality, like pollution, into the market. So Nasdaq actually has put in a, quote, "cancellation," fee, and I would hope the other exchanges go along with it, because excessive cancellations really do hurt everybody else. And again, this is the kind of thing that all regulators should be thinking about, but we need to make sure that they really understand what they're doing. And so many times in the past, they've shown they really haven't, and that's the scary thing.

OK, now one question that came up as to, you know, whether high-frequency trading is responsible for the decrease in the number of companies we have on our markets, and indeed, we now have roughly half as many U.S. public companies listed in our exchanges as we had 15 years ago. And I think the next slide, I think, has a chart of this.

OK. So you can see back in 1997, we had nearly 8,000 public companies listed on our exchanges. Now we have less than 4,000. And, you know, so you'll notice that this decline started long before high-frequency trading, you know, became popular, that, you know, this has been a trend that's been going on for many, many years. And there are numerous contributing factors to it. So there's no one silver bullet. But indeed, it is a crisis in capital formation because if you close off the public markets to smaller companies, it means the smaller companies can't get capital to grow. The only place they can go would be the private equity shops, so we create a financial apartheid in which, you know, the retail investors and the mutual funds that invest on our behalf don't get access to, you know, the good investment opportunities, you know, but the private equity firms actually do.

So, now, I could talk for hours on this. I know we're scheduled to go to 12:30. I'm happy to stick around later that – because I know we got a late start because of the security evacuation. But the – this is a very important point. There are numerous contributing factors. There are, you know, things like Sarbanes-Oxley. That didn't get kick in until 2002. We have the dot-com bubble, but there are only about 500 dot-coms, and we lost about 4,000 companies. We've got overall market conditions, but this has been steady throughout the decade, even during the recovery mid-decade. We could say foreign competition, but I'm only looking at U.S. companies here. I'm not talking about, you know, the AVRs, you know, the foreign companies that aren't listed on (our list ?). It's a combination of things.

But we've also made a number of changes in our market structure because back in the mid-'90s, the old Nasdaq system worked very differently from the old New York system, and I could go into a lot of technical details as to how it was different. But we've essentially eliminated the whole differences between New York and Nasdaq and the OTC market, so we now have a one-size-fits-all world. And guess what? The optimal market structure for trading Apple and IBM is not necessarily the same as trading some tiny little

startup company. And yet, you know, the SEC seems to have a one-size-fits-all mentality. And whenever the exchanges try to come up with something different for smaller markets, by the time the SEC staff is done with it, it looks just like the big market mechanism. So that is definitely an issue. The question is, is high-frequency trading to blame for this? Not in and of itself, that, you know, clearly there are the technical stability issues that, you know, when a flash crash occurs, that scares people. You know, that's a technical issue that – well, we've got technical fixes. The – one of the problems then – and this was something that was addressed in the Jones (sp) Act – is there's a concern that, you know, the tick size may be too small for smaller companies. You know, the tick size is the minimum gap between, you know, each price. You know, you can trade at $10 and $10 and a penny but not 10.00001.

Now in 2005, the SEC came out with Rule 612, which basically said the tick size is one penny for every stock, but it doesn't matter whether it is a, you know, $12 stock like Bank of America or a $400 stock like Apple or a $150 stock like Bircher Hathaway. You know, the minimum gap between, you know, one price to the next is a penny.

Now for a lot of technical reasons, one size does not fit all. And indeed, you know, the tick may be too small for smaller illiquid companies because a lot of the liquidity becomes – you know, comes from market makers, and the tick size is basically the minimum gap between, you know, the buy and the sell price. Now if you make that gap wider, you basically benefit the patient traders who trade with limit orders and you benefit the liquidity providers, but if you make that spread wider, you are basically penalizing the inpatient traders who trade with market orders. And you know, the optimal size is going to be different for different companies. And right now, the SEC is sort of slowly evaluating this with the authority they've been given under the JOBS Act.

So other questions? Yes.

Q: (Off mic) – transactions tax affect high-frequency trading?

MR. ANGEL: Oh, the – I suspected somebody might ask that question. OK, the real question is, who bears the incidence of such a tax? Even if you try to do a carve out and say, oh, retail investors don't pay or, you know, pension funds don't pay, remember, a lot of the liquidity is coming from people whose business model is to, you know, basically be a dealer, buy at the bid, sell at the offer. So if you put a transactions tax on, and you don't exempt them – and by the way, in the United Kingdom they are exempted – if you don't exempt them, what you do is you widen that spread. And that's something that all investors wind up paying as a round trip.

So when you increase the transaction costs, OK, clearly you have – it's more expensive to trade, you'll have less trading. But you make it more expensive to trade, then you're reducing returns to investors. Hmm, that means you're raising the cost of capital to companies trying to raise capital. So you make capital more expensive, you have less investment, fewer jobs. So you know, there's a big debate going on as to who bears the incidence of such a tax and what the overall impact is on the economy.

I find it very interesting to see what the European Union's own economists from the EU staff said would be the impact of one of their previous proposals for a transactions tax. And you know, they basically said, hey, the reduction in GDP was actually greater than the amount of revenue they expected to raise from the tax. Now, you know, who knows how much you trust economists models, but you know, clearly, you know, it's not a freebie kind of, oh, let's, you know, just tax transactions.

As a matter of fact, we used to have a transactions tax in the U.S. from approximately 1914 till 1965. And Congress got rid of it a very broad, bipartisan majority vote, even though they were well-aware of the funding needs of the Vietnam War. And I actually went back and reread the congressional testimony on this, and you know, they knew the government

needed money, but they just realized that, whoa, this tax was not really doing any good.

So the – yeah, I don't think a transaction tax is a – you know, a solution to really any – you know, any of the problems, whether it's allegedly too much trading or whether it's, you know, a fiscal panacea. It doesn't really solve either one of those.

Q: So, but keep the cancel orders – (off mic).

MR. ANGEL: Yes. Oh, yeah. A cancellation fee definitely makes sense.

Other questions? And I'll be happy to stick around – yes.

Q: (Off mic) – question of market structure. Does – how does the U.S.' one-size-fit-all market structure compare to what you see in Europe and Asia? And if you were to do this same graph would it look similar, different? What would the – what would the trend line – (inaudible) –

MR. ANGEL: Oh, OK. (Inaudible) – trend in Asia – voop. (Laughter.) OK, they've been adding to their public markets. In Europe, it's been sort of up slightly. And you'll notice, they do allow explicit differences. You know, for example, the European markets explicitly allow companies to subsidize market makers in their stock. You know, corporations understand that it is helpful for smaller companies to have people being willing to buy or sell the stock when their investors want to buy and sell. And for a little company, where there's not a lot of interest in the stock, it's not really profitable for market makers.

So the European countries permit, you know, the issuing company to cut a deal where they'll actually pay somebody – say, OK, I'll hire you to be the market maker in the stock, you'll always have – you'll always be standing there willing to buy when other people want to sell or sell when other people want to buy. And you know, we know that you may lose a little bit on that, and that's why we're subsidizing this. It's a reasonable thing. It works well in Europe. But you know, the

SEC has repeatedly refused to allow similar programs in the U.S.

And just recently, they just how are now allowing Nasdaq to try something a little different with some exchange-traded funds, but it's still – you know, they really are not allowing an atmosphere of innovation. You know, they are sort of so slow moving, so afraid of doing anything differently than the way they've always done it, that, you know, they look at this – now, SEC staffers are actually – think this is a good thing.

You know, they think little companies are bad investments and that they're doing investors a favor by not giving them the opportunity to invest in the next Apple or the next Microsoft, that, you know, they think they're doing invest – they're doing their job of protecting investors by keeping them from investing in small, growing companies, which – (gasp) – might fail. (Laughter.)

Now, I can talk – I've got more and more slides. I can talk on and on and on.

Q: How does the line change when you account for companies that were taken private? Does it flatten out appreciably?

MR. ANGEL: Oh, OK, so the mortality rate – the – there are a lot of sort of taking privates. There's sort of just a company that just says, hey, I'm out of here. They file a Form 15. They go to the pink sheets. You know, that's sort of where stocks go to trade when they leave the exchanges, if there are shares left, you know, bankrupt companies, stuff like that. Or they might actually be bought by a separate firm. You know, clearly, if you added back the ones that, you know, just, you know, purely went private with a Form 15, you know, you'll see that, you know, it flattens out a little bit. Also, you know, if you look at sort of pure mergers, that'll flatten it out a little bit, you know, because companies are getting bigger.

But that's an artifact of the fact that we've made it more expensive to be a public company. The break-even point below which you just don't want to be public because it's too costly to comply, has gone way up. So we've added a number

of complaints, burdens on public companies that we don't apply to private companies – everything from Sarbanes-Oxley to conflict minerals and all that. And the – so the cost of all that compliance means, you know, you've got to be much bigger than before, before it makes sense to access the public capital markets. That's one of the key drivers.

You know, the litigation mess that companies face – as one CEO told me, he said, hey, if I go public, I get sued – end of the story. But also the market structure changes that we've made – there's no one simple cause; there's no one silver bullet. What I think we need to reverse this trend is an atmosphere of innovation. You know, we need to have a regulatory structure which say, hey, it's OK to try new things. And indeed, Congress tried this with the JOBS Act, but the SEC has been very slow in its implementation of it. And they don't seem to be very innovative in their thinking. You know, yet, meanwhile, our markets keep shrinking.

MR. JIM KESSLER: Any other questions? I want to thank Jim for doing this and being flexible with – rolling with the punches with the security problems here. And I want to thank everybody for coming because I know there was security issues getting in here. And it was a great turn out. And, Lauren, who do we have next? What's that?

MS. LAUREN OPPENHEIMER: Well, our next – our next session is on May 10th with Peter Matheson from the British embassy. He's going talk about the British response to the plan. (Inaudible) – you all here – (inaudible) – on the other side.

MR. ANGEL: Oh, cool. Can I come to that one?

MR. JIM KESSLER: You can come.

MS. LAUREN OPPENHEIMER: You certainly can.

MR. JIM KESSLER: Yes.

MR. ANGEL: All right. And by the way, if you have any questions about this, my contact information is in the handout. The – and so feel free to drop me an email or give

me call. As you can see, I just love talking about this stuff. So if you have any questions, give me a call. Thank you.

MR. JIM KESSLER: Thank you. Thanks a lot. (Applause.)

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