Multiplex network analysis of the UK OTC derivatives market by Bardoscia, Bianconi & Ferrara Discussion by

Iñaki Aldasoro¹

¹Bank for International Settlements

November 16, 2018

Economics of Payments IX, Basel

Disclaimer: The views presented are mine and do not necessarily represent those of the Bank for International Settlements

- [1] Data Put together very granular data for the three largest derivatives markets (IRS, CDS, FX); study the properties of the resulting network/s
 - Financial multiplex networks (Poledna et al '15; Bargigli et al '15; Aldasoro & Alves '18; Montagna & Kok '18)
 - Trade repository data (Abad et al '16; El Omari et al '18)
- [2] Centrality Extend the lacovacci et al '16 centrality measure to weighted networks (Functional Multiplex PageRank) and compare it to a competing measure
- [3] Contagion Extend the contagion mechanism of Paddrick et al '16 to study liquidity contagion after VM shocks (Eisenberg & Noe '01; Heath et al '16)

- [1] Data Put together very granular data for the three largest derivatives markets (IRS, CDS, FX); study the properties of the resulting network/s
 - Financial multiplex networks (Poledna et al '15; Bargigli et al '15; Aldasoro & Alves '18; Montagna & Kok '18)

Trade repository data (Abad et al '16; El Omari et al '18)

- [2] Centrality Extend the lacovacci et al '16 centrality measure to weighted networks (Functional Multiplex PageRank) and compare it to a competing measure
- [3] Contagion Extend the contagion mechanism of Paddrick et al '16 to study liquidity contagion after VM shocks (Eisenberg & Noe '01; Heath et al '16)

- [1] Data Put together very granular data for the three largest derivatives markets (IRS, CDS, FX); study the properties of the resulting network/s
 - Financial multiplex networks (Poledna et al '15; Bargigli et al '15; Aldasoro & Alves '18; Montagna & Kok '18)
 - Trade repository data (Abad et al '16; El Omari et al '18)
- [2] Centrality Extend the lacovacci et al '16 centrality measure to weighted networks (Functional Multiplex PageRank) and compare it to a competing measure
- [3] Contagion Extend the contagion mechanism of Paddrick et al '16 to study liquidity contagion after VM shocks (Eisenberg & Noe '01; Heath et al '16)

- [1] Data Put together very granular data for the three largest derivatives markets (IRS, CDS, FX); study the properties of the resulting network/s
 - Financial multiplex networks (Poledna et al '15; Bargigli et al '15; Aldasoro & Alves '18; Montagna & Kok '18)
 - Trade repository data (Abad et al '16; El Omari et al '18)
- [2] Centrality Extend the lacovacci et al '16 centrality measure to weighted networks (Functional Multiplex PageRank) and compare it to a competing measure
- [3] Contagion Extend the contagion mechanism of Paddrick et al '16 to study liquidity contagion after VM shocks (Eisenberg & Noe '01; Heath et al '16)

- [1] Data Put together very granular data for the three largest derivatives markets (IRS, CDS, FX); study the properties of the resulting network/s
 - Financial multiplex networks (Poledna et al '15; Bargigli et al '15; Aldasoro & Alves '18; Montagna & Kok '18)
 - Trade repository data (Abad et al '16; El Omari et al '18)
- [2] Centrality Extend the lacovacci et al '16 centrality measure to weighted networks (Functional Multiplex PageRank) and compare it to a competing measure
- [3] Contagion Extend the contagion mechanism of Paddrick et al '16 to study liquidity contagion after VM shocks (Eisenberg & Noe '01; Heath et al '16)

- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- ▶ But ...

- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- ▶ But ...

- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- ▶ But ...

- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- But ...

- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- ► But ...



- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- ► But ...





Data

- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- ► But ...



Data Centrality

- Breadth of the paper impressive (data, centrality, contagion)
- Well written, careful analysis
- Work with TR data: hats off!
- ► But ...



Data Centrality Contagion

- TR data are a *diamond in the rough* Unless you polish it (and document the polishing!) people might see a *stone* rather than a *jewel*
- How much of the raw data you have to discard and why?
- Quality issues? Quality checks using double reporting obligation for UK counterparties?
- Matching between TRs (critical for IRS, ie LCH)?
- Unit of observation: LEIs? Analysis at entity level or some consolidation done? Why/why not?

I was expecting much more detail on the data

TR data are a diamond in the rough

 \Rightarrow Unless you polish it (and document the polishing!) people might see a *stone* rather than a *jewel*

- How much of the raw data you have to discard and why?
- Quality issues? Quality checks using double reporting obligation for UK counterparties?
- Matching between TRs (critical for IRS, ie LCH)?
- Unit of observation: LEIs? Analysis at entity level or some consolidation done? Why/why not?

- ► TR data are a *diamond in the rough* ⇒ Unless you polish it (and document the polishing!) people might see a *stone* rather than a *jewel*
- How much of the raw data you have to discard and why?
- Quality issues? Quality checks using double reporting obligation for UK counterparties?
- Matching between TRs (critical for IRS, ie LCH)?
- Unit of observation: LEIs? Analysis at entity level or some consolidation done? Why/why not?

I was expecting much more detail on the data

► TR data are a *diamond in the rough* ⇒ Unless you polish it (and document the polishing!) people might see a *stone* rather than a *jewel*

How much of the raw data you have to discard and why?

- Quality issues? Quality checks using double reporting obligation for UK counterparties?
- Matching between TRs (critical for IRS, ie LCH)?
- Unit of observation: LEIs? Analysis at entity level or some consolidation done? Why/why not?

- ► TR data are a *diamond in the rough* ⇒ Unless you polish it (and document the polishing!) people might see a *stone* rather than a *jewel*
- How much of the raw data you have to discard and why?
- Quality issues? Quality checks using double reporting obligation for UK counterparties?
- Matching between TRs (critical for IRS, ie LCH)?
- Unit of observation: LEIs? Analysis at entity level or some consolidation done? Why/why not?

- ► TR data are a *diamond in the rough* ⇒ Unless you polish it (and document the polishing!) people might see a *stone* rather than a *jewel*
- How much of the raw data you have to discard and why?
- Quality issues? Quality checks using double reporting obligation for UK counterparties?
- Matching between TRs (critical for IRS, ie LCH)?
- Unit of observation: LEIs? Analysis at entity level or some consolidation done? Why/why not?

- ► TR data are a *diamond in the rough* ⇒ Unless you polish it (and document the polishing!) people might see a *stone* rather than a *jewel*
- How much of the raw data you have to discard and why?
- Quality issues? Quality checks using double reporting obligation for UK counterparties?
- Matching between TRs (critical for IRS, ie LCH)?
- Unit of observation: LEIs? Analysis at entity level or some consolidation done? Why/why not?

- Not entirely clear how networks are constructed
- "aggregate net mark-to-market value of the outstanding contracts"
 - I have no reason to believe that you construct MTM yourself as Paddrick et al '16 do
 - How confident are you in the quality of data on MTM? ⇒ In Abad et al (2016), using a superset of your data as of Nov15, we find that about 20% of raw data useless on account of MTM alone
 - Net of what? Collateral? (if so big red flag; netting sets, quality of data especially before RTS/ITS in Nov17)
 - If position between i and j is ITM for i then it is OTM for j, so matrices built from this are antisymmetric (against claim of directionality in the paper)
 - My guess: entry (i, j) of any given matrix is given by max {0, MTM_{ij}} (this also goes against directionality, and most importantly, the reader should not have to guess this!)

- Not entirely clear how networks are constructed
- "aggregate net mark-to-market value of the outstanding contracts"
 - I have no reason to believe that you construct MTM yourself as Paddrick et al '16 do
 - ► How confident are you in the quality of data on MTM? ⇒ In Abad et al (2016), using a superset of your data as of Nov15, we find that about 20% of raw data useless on account of MTM *alone*
 - Net of what? Collateral? (if so big red flag; netting sets, quality of data especially before RTS/ITS in Nov17)
 - If position between i and j is ITM for i then it is OTM for j, so matrices built from this are antisymmetric (against claim of directionality in the paper)
 - My guess: entry (i, j) of any given matrix is given by max{0, MTM_{ij}} (this also goes against directionality, and most importantly, the reader should not have to guess this!)

- Not entirely clear how networks are constructed
- "aggregate net mark-to-market value of the outstanding contracts"
 - I have no reason to believe that you construct MTM yourself as Paddrick et al '16 do
 - ► How confident are you in the quality of data on MTM? ⇒ In Abad et al (2016), using a superset of your data as of Nov15, we find that about 20% of raw data useless on account of MTM *alone*
 - Net of what? Collateral? (if so big red flag; netting sets, quality of data especially before RTS/ITS in Nov17)
 - If position between i and j is ITM for i then it is OTM for j, so matrices built from this are antisymmetric (against claim of directionality in the paper)
 - My guess: entry (i, j) of any given matrix is given by max{0, MTM_{ij}} (this also goes against directionality, and most importantly, the reader should not have to guess this!)

- Not entirely clear how networks are constructed
- "aggregate net mark-to-market value of the outstanding contracts"
 - I have no reason to believe that you construct MTM yourself as Paddrick et al '16 do
 - ► How confident are you in the quality of data on MTM? ⇒ In Abad et al (2016), using a superset of your data as of Nov15, we find that about 20% of raw data useless on account of MTM *alone*
 - Net of what? Collateral? (if so big red flag; netting sets, quality of data especially before RTS/ITS in Nov17)
 - If position between i and j is ITM for i then it is OTM for j, so matrices built from this are antisymmetric (against claim of directionality in the paper)
 - My guess: entry (i, j) of any given matrix is given by max{0, MTM_{ij}} (this also goes against directionality, and most importantly, the reader should not have to guess this!)

- Not entirely clear how networks are constructed
- "aggregate net mark-to-market value of the outstanding contracts"
 - I have no reason to believe that you construct MTM yourself as Paddrick et al '16 do
 - ► How confident are you in the quality of data on MTM? ⇒ In Abad et al (2016), using a superset of your data as of Nov15, we find that about 20% of raw data useless on account of MTM *alone*
 - Net of what? Collateral? (if so big red flag; netting sets, quality of data especially before RTS/ITS in Nov17)
 - If position between i and j is ITM for i then it is OTM for j, so matrices built from this are antisymmetric (against claim of directionality in the paper)
 - My guess: entry (i, j) of any given matrix is given by max{0, MTM_{ij}} (this also goes against directionality, and most importantly, the reader should not have to guess this!)

- Not entirely clear how networks are constructed
- "aggregate net mark-to-market value of the outstanding contracts"
 - I have no reason to believe that you construct MTM yourself as Paddrick et al '16 do
 - ► How confident are you in the quality of data on MTM? ⇒ In Abad et al (2016), using a superset of your data as of Nov15, we find that about 20% of raw data useless on account of MTM *alone*
 - Net of what? Collateral? (if so big red flag; netting sets, quality of data especially before RTS/ITS in Nov17)
 - If position between i and j is ITM for i then it is OTM for j, so matrices built from this are antisymmetric (against claim of directionality in the paper)
 - My guess: entry (i, j) of any given matrix is given by max{0, MTM_{ij}} (this also goes against directionality, and most importantly, the reader should not have to guess this!)

- Not entirely clear how networks are constructed
- "aggregate net mark-to-market value of the outstanding contracts"
 - I have no reason to believe that you construct MTM yourself as Paddrick et al '16 do
 - ► How confident are you in the quality of data on MTM? ⇒ In Abad et al (2016), using a superset of your data as of Nov15, we find that about 20% of raw data useless on account of MTM *alone*
 - Net of what? Collateral? (if so big red flag; netting sets, quality of data especially before RTS/ITS in Nov17)
 - If position between i and j is ITM for i then it is OTM for j, so matrices built from this are antisymmetric (against claim of directionality in the paper)
 - My guess: entry (i, j) of any given matrix is given by max{0, MTM_{ij}} (this also goes against directionality, and most importantly, the reader should not have to guess this!)

Low clearing in CDS makes me suspicious (Aldasoro & Ehlers '18)

- Suggest to look at number rather than % of institutions active in 1/2/3 layers (Table 3; role of dealers and CM)
- Which type of institutions?

Low clearing in CDS makes me suspicious (Aldasoro & Ehlers '18)

	Centrally cleared	Non-centrally cleared
IR CD	68.69% 8.47%	31.31% 91.53%
FX	0.92%	99.08%







- Suggest to look at number rather than % of institutions active in 1/2/3 layers (Table 3; role of dealers and CM)
- Which type of institutions?

Low clearing in CDS makes me suspicious (Aldasoro & Ehlers '18)

	Centrally cleared	Non-centrally cleared
IR CD	68.69% 8.47%	31.31% 91.53%
FX	0.92%	99.08%



Source: BIS derivatives statistics.



Suggest to look at number rather than % of institutions active in 1/2/3 layers (Table 3; role of dealers and CM)
 Which type of institutions?

Low clearing in CDS makes me suspicious (Aldasoro & Ehlers '18)

	Centrally cleared	Non-centrally cleared
IR CD	68.69% 8.47%	31.31% 91.53%
FX	0.92%	99.08%

Clearing rates on the rise, regardless of the measure used



Jource: bis dermatives statistics.

- Suggest to look at number rather than % of institutions active in 1/2/3 layers (Table 3; role of dealers and CM)
- Which type of institutions?

Extends Functional Multiplex PageRank to weighted networks

- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - How is one to economically interpret the "influences" z?

- Extends Functional Multiplex PageRank to weighted networks
- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - How is one to economically interpret the "influences" z?

- Extends Functional Multiplex PageRank to weighted networks
- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - ► How is one to economically interpret the "influences" **z**?

- Extends Functional Multiplex PageRank to weighted networks
- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - ► How is one to economically interpret the "influences" z?

- Extends Functional Multiplex PageRank to weighted networks
- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - ► How is one to economically interpret the "influences" z?

- Extends Functional Multiplex PageRank to weighted networks
- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - How is one to economically interpret the "influences" z?

- Extends Functional Multiplex PageRank to weighted networks
- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - How is one to economically interpret the "influences" z?

- Extends Functional Multiplex PageRank to weighted networks
- Shorten the discussion of eigenvector versus PR centrality (made extensively before)
- Suggest to \uparrow the economics and \downarrow the technicality
 - What makes FMP suitable in economics terms? Centrality usually reflects a process in the network; how does your measure reflect a meaningful economic process?
 - In other words, starting point should be: what is it that you want to capture that made you develop the measure? and, how well does the measure capture this?
 - How does interaction between PR in single layers, aggregated layer and "full multilink" layer add to our understanding?
 - How is one to economically interpret the "influences" z?

Extension of Paddrick et al '16 (Eisenberg & Noe '01)

- VM shocks drawn from N distribution (Heath et al '16)
- Pre-default analysis (no waterfall)
- But, ideally, include IM as in Paddrick et al '16
- Why consider only network of CCPs and CM?
 ⇒ Key finding of Paddrick et al '16 is most problematic players are non-CM with highly unbalanced positions
- Model seems designed for one CCP; how many do you have? how do you map model and data in this regard?

- Extension of Paddrick et al '16 (Eisenberg & Noe '01)
- ▶ VM shocks drawn from N distribution (Heath et al '16)
- Pre-default analysis (no waterfall)
- But, ideally, include IM as in Paddrick et al '16
- ▶ Why consider only network of CCPs and CM? ⇒ Key finding of Paddrick et al '16 is most problematic players are non-CM with highly unbalanced positions
- Model seems designed for one CCP; how many do you have? how do you map model and data in this regard?

- Extension of Paddrick et al '16 (Eisenberg & Noe '01)
- ▶ VM shocks drawn from N distribution (Heath et al '16)
- Pre-default analysis (no waterfall)
- But, ideally, include IM as in Paddrick et al '16
- ▶ Why consider only network of CCPs and CM? ⇒ Key finding of Paddrick et al '16 is most problematic players are non-CM with highly unbalanced positions
- Model seems designed for one CCP; how many do you have? how do you map model and data in this regard?

- Extension of Paddrick et al '16 (Eisenberg & Noe '01)
- ▶ VM shocks drawn from N distribution (Heath et al '16)
- Pre-default analysis (no waterfall)
- But, ideally, include IM as in Paddrick et al '16
- ▶ Why consider only network of CCPs and CM? ⇒ Key finding of Paddrick et al '16 is most problematic players are non-CM with highly unbalanced positions
- Model seems designed for one CCP; how many do you have? how do you map model and data in this regard?

- Extension of Paddrick et al '16 (Eisenberg & Noe '01)
- VM shocks drawn from N distribution (Heath et al '16)
- Pre-default analysis (no waterfall)
- But, ideally, include IM as in Paddrick et al '16
- ► Why consider only network of CCPs and CM? ⇒ Key finding of Paddrick et al '16 is most problematic players are non-CM with highly unbalanced positions
- Model seems designed for one CCP; how many do you have? how do you map model and data in this regard?

- Extension of Paddrick et al '16 (Eisenberg & Noe '01)
- VM shocks drawn from N distribution (Heath et al '16)
- Pre-default analysis (no waterfall)
- But, ideally, include IM as in Paddrick et al '16
- ► Why consider only network of CCPs and CM? ⇒ Key finding of Paddrick et al '16 is most problematic players are non-CM with highly unbalanced positions
- Model seems designed for one CCP; how many do you have? how do you map model and data in this regard?

- Systemic players as those that are key to this propagation?
- Shock one layer at a time?
- Insights additional to market size? (deficiencies by market seem proportional to size, Fig8)
- *•* "it is possible to show that (18) leads to the same aggregate payments that we would get if we aggregate all the VM payments across all layers from the start"
 → Value added of multiplex analysis?
 - \rightarrow Any non-linearities in aggregation of stress?

- Systemic players as those that are key to this propagation?
- Shock one layer at a time?
- Insights additional to market size? (deficiencies by market seem proportional to size, Fig8)
- *•* "it is possible to show that (18) leads to the same aggregate payments that we would get if we aggregate all the VM payments across all layers from the start"
 → Value added of multiplex analysis?
 - \rightarrow Any non-linearities in aggregation of stress?

- Systemic players as those that are key to this propagation?
- Shock one layer at a time?
- Insights additional to market size? (deficiencies by market seem proportional to size, Fig8)
- *•* "it is possible to show that (18) leads to the same aggregate payments that we would get if we aggregate all the VM payments across all layers from the start"
 → Value added of multiplex analysis?
 - → Any non-linearities in aggregation of stress?

- Systemic players as those that are key to this propagation?
- Shock one layer at a time?
- Insights additional to market size? (deficiencies by market seem proportional to size, Fig8)
- *•* "it is possible to show that (18) leads to the same aggregate payments that we would get if we aggregate all the VM payments across all layers from the start"
 → Value added of multiplex analysis?
 → Any population of stress?

- Systemic players as those that are key to this propagation?
- Shock one layer at a time?
- Insights additional to market size? (deficiencies by market seem proportional to size, Fig8)
- "it is possible to show that (18) leads to the same aggregate payments that we would get if we aggregate all the VM payments across all layers from the start"
 - \rightarrow Value added of multiplex analysis?
 - \rightarrow Any non-linearities in aggregation of stress?

THANK YOU FOR YOUR ATTENTION!

 \bowtie inaki.aldasoro@bis.org