

Global Pharmaceuticals

Insights on US Plasma Donations & Updates on Plasma Derived Therapies for COVID-19

Major Pharmaceuticals | Connections Series

In this connection series note, we provide insights on the current state of plasma collection in the US, and an update on the latest development for plasma derived therapies against COVID-19 as it relates to the three largest players in plasma derived therapeutics: Grifols (EU pharma team), CSL (Gretel Janu, Australian equities) and Takeda (Sakai-san, Japanese Pharma). We also highlight coverage of CBPO ([FY 19 results comment](#)) where our team noted a 1 month plasma collection suspension in China and slow recovery.

- **Limited disruption to US Plasma collection observed so far**, but may follow in near term as COVID-19 outbreak continues to grow in US. (Most 1Q impact felt by Grifols likely to be in Germany, given the need for an onsite doctor). Most investor focus has been on the Mexico border, although this is still open to plasma donors who are deemed essential. For Grifols CS est. c.5% of sites c.8% of global capacity. A move of COVID-19 hot spots to the next 5 states as predicted by the Whitehouse Task Force could impact donations more. Exposure to centres here ranges from 37% TAK, 48% GRLS, & 56% CSL.
- **US rising unemployment rates may increase mid term donation volumes** and Grifols & CSL have the highest centre exposure to states with most jobless claims thus far (c 40%) vs Takeda (c 20%). We reflect this with higher mid term growth in our models.
- **CSL is seeing “lumpy” plasma supply, but demand remains strong:** In March, CSL saw its US plasma collections soften but remain above the prior year’s level. However, in the last few weeks, CSL did see volumes dip further, with collections falling below the levels achieved in prior periods ([CSL research note](#)). We forecast CSL’s FY20 plasma collections down 8%vs pre-COVID-19 estimates, and forecast 13% IG revenue growth (previously 17%). We’ve reduced our FY21 EPS estimates a total of 8% as a result of COVID-19 disruption to CSL’s plasma supply.
- **In a companion [note](#) we have cut our Grifols FY20 EPS by 2%, FY21 by 6% and raised FY22 by 6%.** This reflects 2% lower plasma collection volume in 1Q’20, -15% in 2Q, and -3% in 3Q with a rebound of +6% in 4Q20. The EPS hit comes with a 6-9month lag to from collection to sales. Our change in collection growth broadly matches our CSL assumptions on donation volumes, but are less marked overall, reflecting the limited expectation of new openings for Grifols vs expectations for both CSL and Takeda.
- **Hyperimmune immunoglobulin (H-IG) to be available for testing in COVID-19 patients as early as July.** Grifols may be first to patients with its H-IG, in collaboration with FDA/BARDA (where it can utilise a dedicated fractionation plant). CSL and Takeda have simultaneously formed an alliance with additional companies to accelerate development of an unbranded H-IG therapy, however, timelines have not been disclosed. We estimate c75 donors’ plasma will produce therapy to treat 3-4 patients.
- **Convalescent plasma already being utilized in small patient numbers** following the FDA authorizing its emergency use. Collection of plasma from recovered COVID-19 patients has begun primarily in the hospital setting.

Research Analysts

European Pharma Team

44 207 888 0304
creditsuisse.pharmateam@credit-suisse.com

Gretel Janu

61 2 8205 4028
gretel.janu@credit-suisse.com

Fumiyoshi Sakai

81 3 4550 9737
fumiyoshi.sakai@credit-suisse.com

Jason Liu

852 2101 6465
jason.j.liu@credit-suisse.com

Executive Summary

There are 4 key plasma manufacturers under Credit Suisse coverage, CSL, Grifols, Takeda (who acquired Shire) and China Biological Products. Collectively we estimate sales of plasma derived products/therapies of c USD \$15 billion in 2019, and expect this to grow to c\$21 billion by 2023 (see Figure 1). Of these total sales estimates, c60% of revenues come from immunoglobulin products, c15% from albumin and the remaining 25% comes from other proteins.

In this report, we present insights on the initial impact felt from COVID-19 on plasma collection, and provide sensitivity analysis for three key players and give an update on the latest development on plasma derived COVID-19 therapies.

CSL

- CSL updated the market on 9th April on how it has been impacted by COVID-19 ([CSL research note](#))
- Plasma collections: In March, CSL did see collections soften but remain above the prior year's level. In the last few weeks, CSL did see collections dip further, with collections falling below the levels achieved in the pcp. Collections in the various centres are mixed and lumpy. Some centres are achieving collections above budget, other centres have seen a material slowdown.
- Centres along the US/Mexico border have been impacted by the border closure. Mexicans are still allowed to donate, but the greater restrictions in crossing the border have created some slowdown. CSL has ~4% exposure to US/Mexico border.
- CSL is still expecting to open 40 new collection centres in FY20 (currently have opened 32 centres). New donors are expected to arise following the economic downturn, but CSL will likely have to increase advertising to get access to new donors.
- Strong demand for products remains as they are life -saving & life -extending and usually non-discretionary. In particular, CSL has seen increased demand for IVIG from hospitals.
- Despite CSL remaining positive that it will be able to open the remaining 8 collection centres in FY20, we prefer to remain conservative. We forecast no further plasma centre openings in FY20 (a total of 32 centres in FY20). We assume total plasma collected in FY20 is 17mn litres (down 8% from prior estimate of 18.3mn L). This implies that the plasma collected between April-June is ~16% below the monthly average seen in 1H20 and January & February 2020. We continue to believe that as soon as the US economy begins to open following peak infections we will see a sharp increase in plasma collections due to the rising unemployment rate.
- We assume IG revenue growth of 13% in FY21, following 21% IG revenue growth in FY20. We forecast 50bp gross margin contraction in CSL Behring in FY21 due to added collection costs associated with COVID -19.

Grifols

- Primary research insights from 6 Grifols collection centres shows some initial signs of disruption from COVID-19, with centres working under reduced capacity, due to social distancing requirements and staffing shortages.
- We see Grifols as having the highest exposure to the temporary closure of the US-Mexico border, where it has c5% of its sites (which we estimate contribute c8% of its plasma volumes). We understand donors can still cross the border, as are deemed essential, but in our view we estimate there may still be negative impact in the near term.
- Grifols sits between peers in terms of % of sites exposed to US states with the highest rates of confirm COVID-19 infections. We see this as a potential risk to near term donation volumes. However we see Grifols as well positioned in US states with the highest rates of

new unemployment filings thus far, where it could see an uplift in new donors in months to come.

- In a companion note we have updated our Grifols model assuming 15% lower plasma collection in 2Q, and 3% in 3Q with a rebound of +6% in 4Q, driven by new donors likely to be attracted by the donor fee with higher levels of unemployment. With a 6-9 month lag to sales, and a 70% contribution margin this would suggest a -2% impact on 2020 EPS and 6% on FY2021 EPS but an increase of 6% in 2022 EPS with higher long term donations. Grifols has seen a strong increase in number of collection centres up from 190 at the end of 2017 to 295 at the end of 2019 and we assume only c 7 new openings in 2020. Grifols is also able to access more plasma from acquired sites which are winding their third party sales, making more available to Grifols. This potentially puts Grifols in a better position than peers who need to both drive up donations per site and open new sites which may be challenging. This analysis does not take into account any ability to supply more albumin to China in 2H2020 if local players who have also had temporary collection issues find themselves short of inventory in 2H2020/early 2021. We understand that Grifols current inventories are at least 6 months giving them some likely flexibility to take advantage of any market shortages. Neither does it reflect higher prices likely during market shortages or potentially lower donor fees possible if economic pressures increase the number of donors
- The company is actively working with the FDA/BARDA on the development of both a hyper-immune immunoglobulin (H-IG) product to treat COVID-19 as well as convalescent plasma, where it has the possibility to be first to patients with the former. Grifols is aiming to have its H-IG available by July, and convalescent plasma ready for use in 2-3 weeks time.

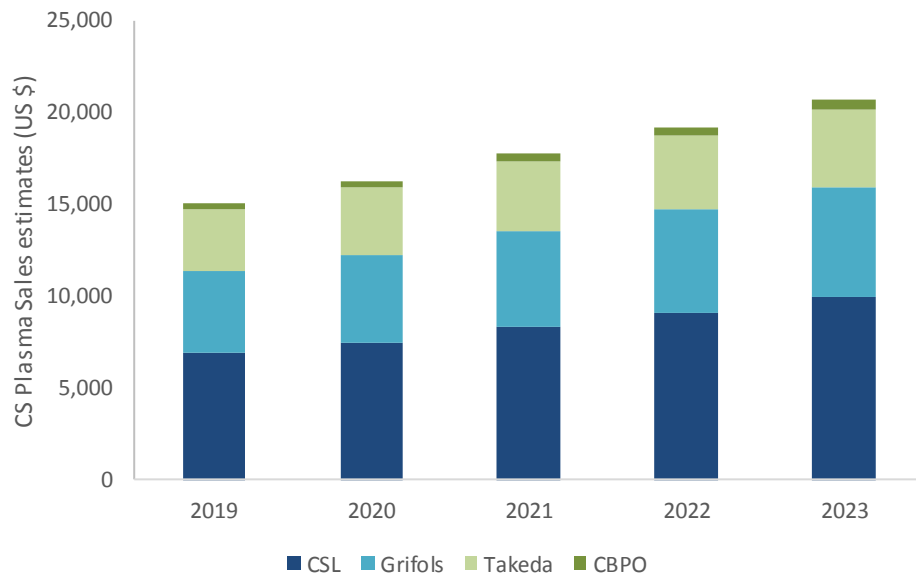
Takeda

- Takeda acquired Shire within which lies the old Baxalta plasma unit. Under the direction of Julie Kim who joined with Shire, Takeda is looking to expand its plasma collection centers but has noted that low site numbers relative to sales correctly suggests high efficiency and larger average sites today. A sensitivity discussed later in the report that matches the Grifols assumptions would result in a -2% for EPS for Fiscal FY21 and +2% in Fiscal 22. This assumes a 70% contribution margin on lost / gained sales and a 15% tax rate. This sensitivity ignores any pricing impact from shortages, or material additional demand from COVID related hyper immune or convalescent plasma sales. For our analysis Takeda has the lowest exposure of the majors to sites near the Mexican border, and the lowest exposure the next 5 states hightailed as likely to be next hot spots in the US by the White House task force.

CBPO

- COVID-19 brings uncertainty to 2020E. Plasma collection was suspended for more than one month and just resumed starting in early March, but the recovery speed is low. CBPO postponed giving 2020 guidance. We expect 2020 top line/bottom line to grow at ~10%. CBPO has several months of plasma inventory to maintain production.
- On a China wide industry-level, blood products, especially IVIG usage, during COVID-19 increased, and our team assumes that at some point imported human albumin supply might be reduced by the COVID-19 outbreak in EU/US. As a result, our team expects both human albumin and IVIG supply to be constrained and prices to increase in 2020.

Figure 1: CS Plasma sales forecasts for 4 key players, 2019-2023e



Source: Company data, Credit Suisse estimates

Current status of US Plasma Collection

The US is the largest market for plasma collection, with >700 plasma donation centres spread across the country, making up the majority of worldwide plasma collections in volume. Of those centres, 246 belong to CSL, 250 are Grifols' and 126 are owned by Takeda (Biolife). For Grifols, we estimate >70% of its supply is sourced in the US, and understand that 85-90% of which is collected directly by Grifols (the remaining is bought in from third parties). CSL sources the vast majority of plasma (~95%) from its US collection centres.

The US plasma market is also unusual in that it compensates its donors, paying them somewhere between c\$45-70/donor (depending on volume given/weight of donor and company paying). We estimate a typical US donor fee of \$50/donation (based on our CSL discussions, but note that Grifols has suggested a slightly lower effective figure in the range of \$45-50/litre. We estimate average donation volume is 0.8L.

Given the US is swiftly becoming the epicenter of the coronavirus outbreak (c>400,000 cases of global c1.4m cases), we conducted primary research through talking to donation centres and looked at the relative exposure to the three companies under our coverage by regions most heavily affected by the virus. We have also conducted a sensitivity analysis for Grifols, Takeda and previously published one for CSL ([link](#)) on the potential impact of COVID-19 to supply and costs.

Donors may use plasma donation as an additional source of monthly income, so we see this as a potentially attractive earning opportunity to some in the US, given the rising rates of individuals filing for unemployment benefits. Latest data from the US Department of Labor has [reported](#) c6.4million seasonally adjusted initial claims for unemployment made as of 2nd April 2020, up from the previous week's level of c3.3million

Primary research from US collection centres shows initial signs of disruption due to COVID-19

We recently contacted 21 US donation centres and spoke with 18 of them, 6 from each company (CSL, Grifols, Takeda), across the following states Texas, Arizona, Washington, California, New Jersey and Colorado.

- **Reduced capacity due to CDC guidelines/social distancing.** Most centres appear to remain open at this time. Both Grifols and Takeda centres explicitly indicated they are operating under reduced capacity, due to social distancing measures and recently updated CDC guidelines for blood/plasma collection ([link](#)), which advises centres to have at least 6 feet between donor chairs. They did not quantify the level of restriction.
- **Restricted hours due to capacity.** Some centres noted they are open for restricted hours (e.g. only open until 2pm vs usually open until 8pm) due to staff shortages (partially due to self-quarantining).
- **Less appointment availability in hotspots.** Centres closer to COVID-19 hotspots, such as Washington state or New Jersey appeared to have less availability for appointments for new donors and are operating under restricted hours.
- **Minimal centre closures to date.** Some centers we tried to reach were closed. We understand Grifols may be temporarily closing some centres if there are issues and may at some point have to shut down a handful of centres due to COVID-19, however we view these as only temporary closures. We understand CSL had to temporarily close a centre in Florida after one of the staff members contracted COVID-19. Yet CSL was able to re-open the centre in just a few days.

We understand that Grifols and CSL have both started to see a reduction in capacity (due to social distancing measures/reduced hours) but that this can be partially offset through better management of its network, booking donors appointments in advance and increasing operation hours (i.e. more donors coming early mornings/late in the evenings).

US state by state analysis shows CSL with the greatest exposure to the COVID-19 “hot spots”

As of April 9th, John Hopkins data indicate there are c. 432,000 confirmed coronavirus cases in the United States. Of those cases, the majority are within top ten states, New York, New Jersey, Michigan, California, Louisiana, Florida, Massachusetts, Illinois, Pennsylvania and Washington.

Bloomberg has reported that the White House task-force coordinator Deborah Birx has indicated that the rate of positive coronavirus tests suggest the next “hot spots” in the US could include Michigan, Connecticut, Indiana, Georgia and Illinois. We would expect these hot spots may cause greater short term disruption to plasma collection, potentially reducing short term donation volumes.

Based upon this, we present the relative exposure of collection centres in the top 15 affected states by company (see Figure 2) CSL appear to have the greatest exposure overall to the top 15 states and has the largest number of sites in the expected upcoming “hot spot” states.

Figure 2: Number of company collection centres in 15 US states with highest rates of COVID-19 confirmed cases

	CSL	Grifols	Takeda
1 New York	10	0	0
2 New Jersey	4	0	0
3 Michigan	19	10	5
4 California	0	11	0
5 Louisiana	3	7	0
6 Florida	17	16	4
7 Massachusetts	0	0	0
8 Illinois	10	8	4
9 Pennsylvania	10	7	1
10 Washington	5	4	3
11 Georgia	9	11	7
12 Texas	32	33	10
13 Connecticut	0	0	0
14 Colorado	7	7	3
15 Indiana	11	7	7
Total	137	121	44
% of Total US sites	56%	48%	37%

Source: Company data, Credit Suisse estimates, John's Hopkins

US-Mexico Border restrictions most likely to cause short-term disruption to Grifols US plasma collection

Whilst not disclosed by the companies, we estimate somewhere between 40-80% of donors at plasma collection sites close to/on the US-Mexico border, have crossed over from Mexico on a temporary visa to donate plasma. As of March 20th, the US [enforced](#) travel restrictions on the Mexico border, limiting travel of individuals to essential travel only until April 20th at this time, but we could expect the restrictions could be in place longer given the acceleration of new coronavirus cases being seen in the US. This news has attracted investor attention, as both CSL and Grifols have a number of plasma donation centres which sit very close to the Mexico border, across multiple states (California, Arizona and Texas). Whereas Takeda does not have any sites in these locations.

- **Grifols has the largest exposure to potential impact from these travel restrictions on the border**, with 16 of its US centres in the affected location (representing c5% of its global sites, and we estimate c8% of global volume). We estimate CSL has ~5% exposure to the border. We understand that US homeland security have classified plasma donors as essential travelers so are still allowed to cross the border but expect travelling/entry into the US to be more challenging for donors and so these donor sites may see less donors in the near term. We understand that Grifols have seen a reduction in collection volumes in March compared with Jan/Feb at these sites, however view it as too early to confirm the level of this decline or how long it will last.
- **Primary research suggests more openings for new donor appointments at these sites.** At the end of last week, we spoke with a handful of Grifols and CSL centres that are located near the border, who confirmed their sites are remaining open as usual for collection at this time. We note that these sites had appointment availability for new donors within 24-72 hours of the phone call, which contrasts sites we spoke to elsewhere in the US which had much less availability. We highlight that Grifols collection centres close to the border produce greater than average volumes of plasma, so we estimate them to have an overall larger capacity for number of donors. This may in part account for the near term availability of appointments at the sites we spoke with.

Figure 3: Number of US plasma collection sites closest to Mexican border by company

Company	Total US centres	Sites close to Mexican border
CSL	246	11 (4%)
Grifols	250	16 (5%)
Takeda	120	0 (0%)

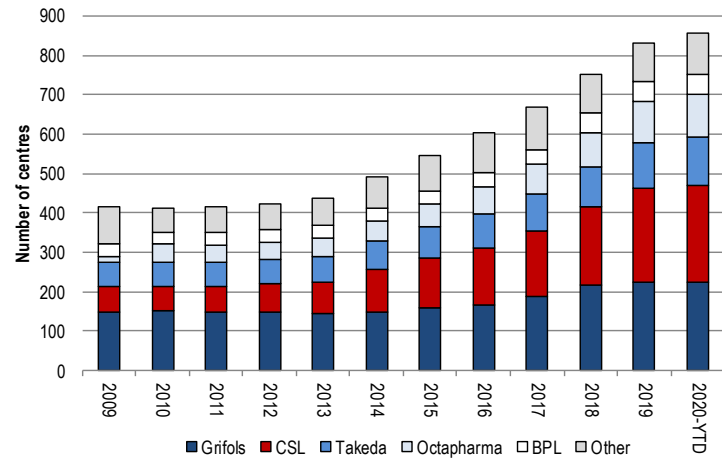
Source: Company data, Credit Suisse estimates

New centre openings likely to stall for all three players

As a result of COVID-19 lockdowns, we expect new centre openings to stall. CSL is targeting the largest number of new collection centre openings in FY20, with 40 new collection centre planned. We estimate that Grifols could open c 7-10 new centres within 2020 (based on Grifols target of reaching 321 centres by 2022). Takeda opened 19 new collection centres in 2019, and we expect the same level of investment in 2020 and beyond, in order to catch up on demand. (Takeda is investing to grow its plasma collection capacity by >65% over the next 5 years).

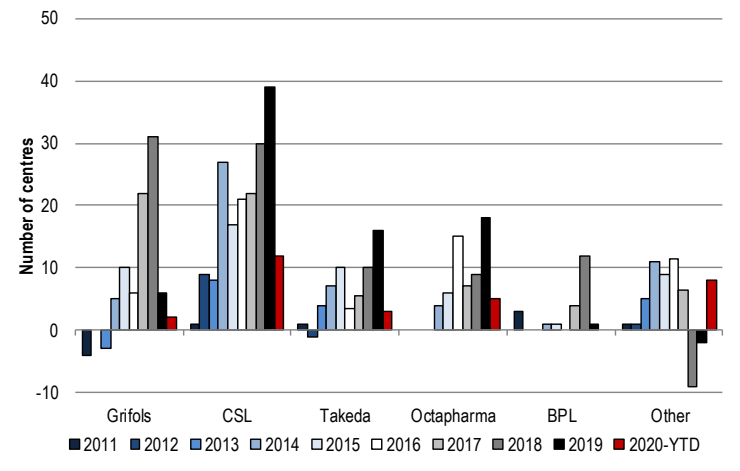
In 2020 YTD, CSL has opened 12 centres vs Grifols and Takeda opening 2 and 3 centres each, respectively, according to the FDA. Relative to the other players, opening new plasma centres has been a core strategy for CSL in growing its plasma supply. A potential 3-6 month delay to openings could have greater implications for its growth potential over the short-medium term (Figure 4 and Figure 5).

Figure 4: US plasma collection centres



Source: FDA, Company data, Credit Suisse estimates

Figure 5: Number of US plasma collection centres added



Source: FDA, Company data, Credit Suisse estimates

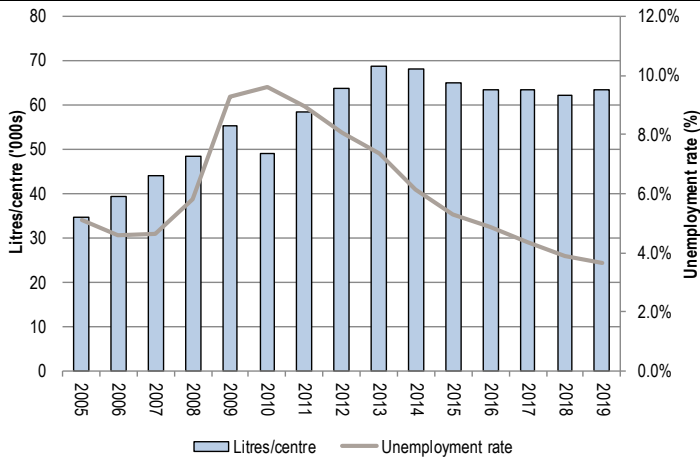
Rising unemployment rates in the US; CSL and Grifols positioned for an uplift in new donors

Whilst we see a risk to short term plasma collection volumes due to COVID-19 disruption to normal day-to-day business and operations, rising unemployment rates may lead to increased supply later in the year, since plasma donors can be financially compensated.

Following the global financial crisis, when rates of US unemployment rose rapidly in the US, we saw average litres collected/centre also grew (+14% in 2009), according to the PPTA. 2010 saw a decline due to increased supply, yet this was quickly reversed with collections/centre rising up to ~70k L/centre in 2013 normalizing back to ~62k L/centre as the unemployment rate fell from 6% to <4% between 2014-19. Given the strength in demand, where demand continues to exceed supply, we do not believe we will get into a situation similar to 2010 where there was excess supply in the market.

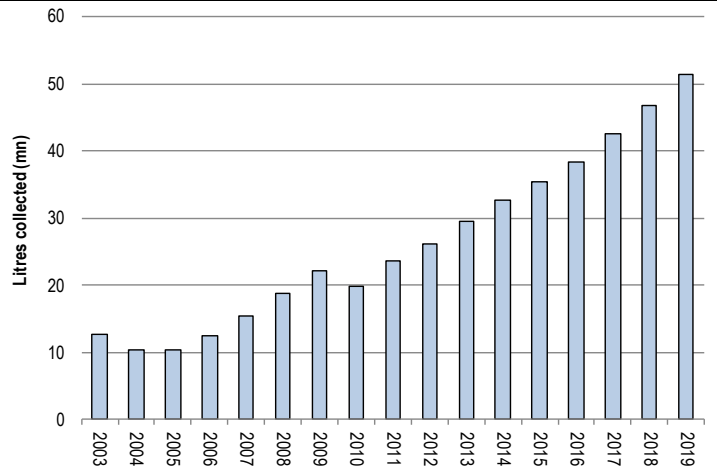
In the last two weeks of March, we have seen a spike in the number of Americans who have filed for unemployment benefits (see Figure 6) and could expect these numbers to continue to grow. In the 10 states that have recorded the largest number of initial jobless claims so far, CSL and Grifols have similarly high exposure (see Figure 9). Based upon this analysis, we see both CSL and Grifols as relatively best positioned to maintain a growing raw material supply from potential new donors in the US.

Figure 6: Litres/centre rise as unemployment rates increases



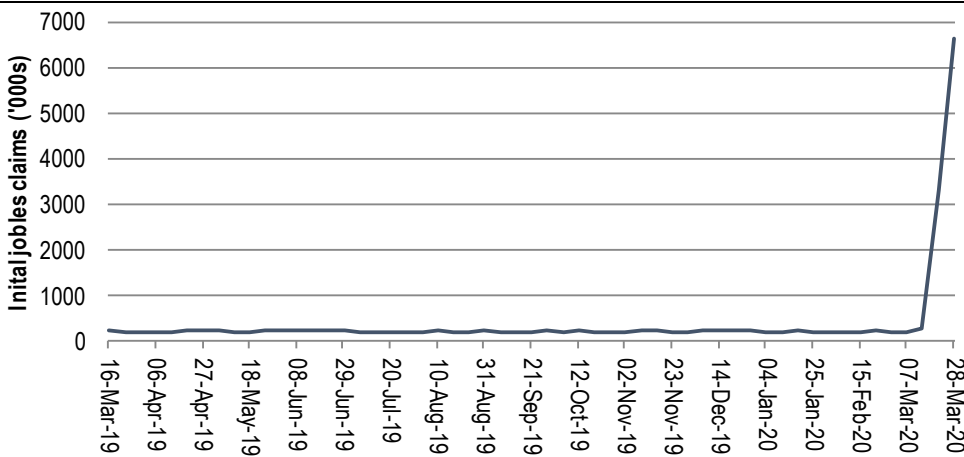
Source: US Department of Labour, PPTA, Credit Suisse Estimates

Figure 7: US plasma litres collected



Source: PPTA, Credit Suisse Estimates

Figure 8: US initial jobless claims (weekly data)



Source: Company data, Credit Suisse estimates

Figure 9: US plasma collection sites by company in 10 US states with highest unemployment filings to date

	Unemployment filings		
	last 2 weeks of March	CSL	Grifols Takeda
1 California	1,065,536	0%	5% 0%
2 Pennsylvania	784,788	4%	3% 1%
3 Ohio	459,913	7%	5% 3%
4 New Hampshire	446,737	0%	0% 0%
5 Michigan	440,384	8%	4% 4%
6 Texas	431,254	12%	15% 8%
7 New Mexico	360,969	1%	0% 0%
8 Massachusetts	329,057	0%	0% 0%
9 Washington	320,979	2%	2% 3%
10 Florida	301,021	7%	7% 3%
Total	4,940,638	41%	41% 22%

Source: Company data, Credit Suisse estimates, US Department of Labor

CSL sensitivity analysis

We recently downgraded our CSL forecasts assuming modest plasma supply risk due to COVID-19 (see notes [CSL: Rising unemployment tempers plasma supply risk](#) & [CSL: COVID-19 creates lumpy plasma supply, but demand remains strong](#)). We retain an OUTPERFORM rating on the stock.

Lower collections over the next 3-6 months will affect FY21 earnings, given the ~9month production time line. We assume CSL collects 17mL of plasma in FY20 (down 8% from prior estimate) and lowered our IG sales growth assumption to 13% in FY21. We forecast 50bp gross margin contraction in CSL Behring in FY21 due to added collection costs associated with COVID-19 and given we estimate ~20-25% of collection & fractionation costs are fixed.

We highlight the sensitivity to IG revenue growth in FY21 if:

- Collections per centre are more volatile.
- CSL is forced to close centres for up to 6 months due to COVID-19

In performing this sensitivity, we assume CSL does not open any further collection centres for the remainder of FY20 (currently has 32 centres). We estimate that for every 5 ppt decrease in collections per centre, IG revenue growth in FY21 is lowered by 100 bps. For every 5 centres that CSL closes for 6 months, we estimate this reduces IG revenue growth in FY21 by 40bps.

Figure 10: IG revenue growth sensitivity to collection centre closures and collections/centre

IG revenue growth in FY21	Collections/centre (vs FY19)						
	-20%	-15%	-10%	-5%	Steady	5%	
Collection centre closures & no more openings	0	11.9%	12.9%	13.9%	14.9%	15.8%	16.7%
	5	11.6%	12.6%	13.5%	14.5%	15.4%	16.3%
	10	11.2%	12.2%	13.1%	14.1%	15.0%	16.0%
	15	10.8%	11.8%	12.8%	13.7%	14.7%	15.6%

Source: Company data, Credit Suisse estimates

Grifols EPS cut -2% FY20,-6%FT21,+6% FY22

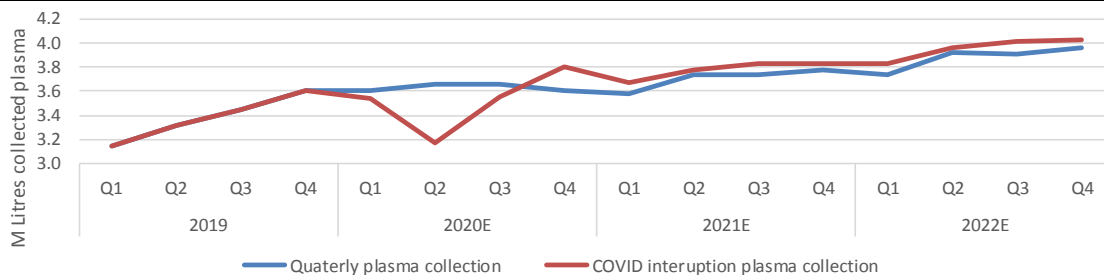
In Figure 11: we show how we model plasma collection for Grifols. Historic growth has been based largely on increased collection sites with a c 13% increase in volume of plasma obtained in 2019 over 2018 coming with a 24% increase in sites (some of which aren't yet fully supplying Grifols with plasma). We have seen a 13% increase in donations, matching the volume growth. Our forecasts assume a gradual increase in effective plasma collected per site as more sites rollover to supply Grifols and as newer sites mature. In response to the current COVID situation we have updated our current assumptions cutting our assumed 1Q'20 collection volumes by 2% to reflect an impact in Germany where the need for on-site doctors may have reduced effective capacity. We have assumed a 15% drop in 2Q and a further 3% drop in 3Q which we would assume would reflect some states continuing to have issues of restricted capacity, but also some rebound especially in areas of growing unemployment. With lower economic growth we flex our numbers to show overall slightly higher volumes from 2021.

In Figure 12 we translate this to sales. We assume a 6-9 month lag between collection and the sale of the fractionated final products (IG, albumin, factor 8 alpha anti trypsin etc). At the profit level we assume a 70% contribution margin on gained /lost sales. This results in a 2% reduction in FY2020, a 6% reduction in 2021 and a 6% increase in 2022 for EPS.

For CSL CS assume an overall 8% decline in collection volumes for fiscal'20, with 1Hfiscal 2020 largely unaffected we are assuming essentially -16% in 2H, (crudely -10% in Cal 1Q and -22% in 2Q). For 1H fiscal '21 for CSL CS has assumed a 5% rebound this is slight more optimistic than the - 3% and +6% for Cal 3Q and 4Q 2020 we assume for Grifols. A major pater of the CSL assumption changes comes from reduced new site opening and the fact that CSL has not yet collected plasma from any of the 32 sites so far opening in fiscal 2020

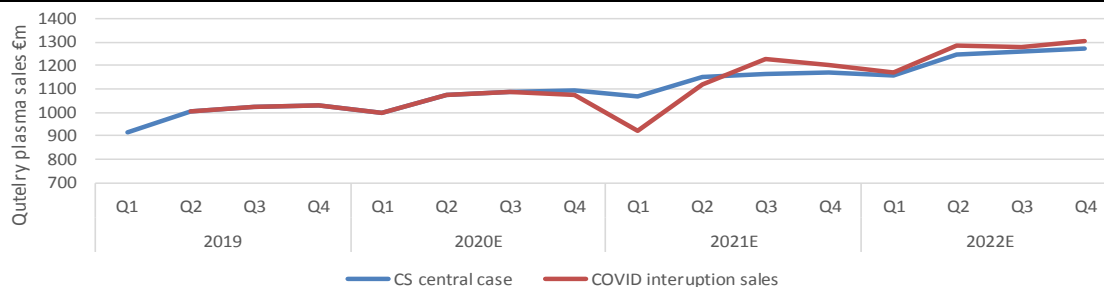
We make no assumptions on any possible increased sales into China of albumin in 2H2020 which may occur if local suppliers have been unable to sustain local donations and no assumption of any price rises that might offset some volume loss with tight market supply which will impact all of the major players. We have not assumed lower prices from broadly increased supply post 2021 if economic conditions result in a significant increase in donors, or accounted for possibly lower donor fees that might need to be paid if donor numbers increase rapidly.

Figure 11: CS estimates of collection volumes of plasma for Grifols , and flexed assumptions for possible COVID impact



Source: Company data, Credit Suisse estimates

Figure 12: CS estimates of plasma sales for Grifols , and flexed assumptions for possible COVID impact



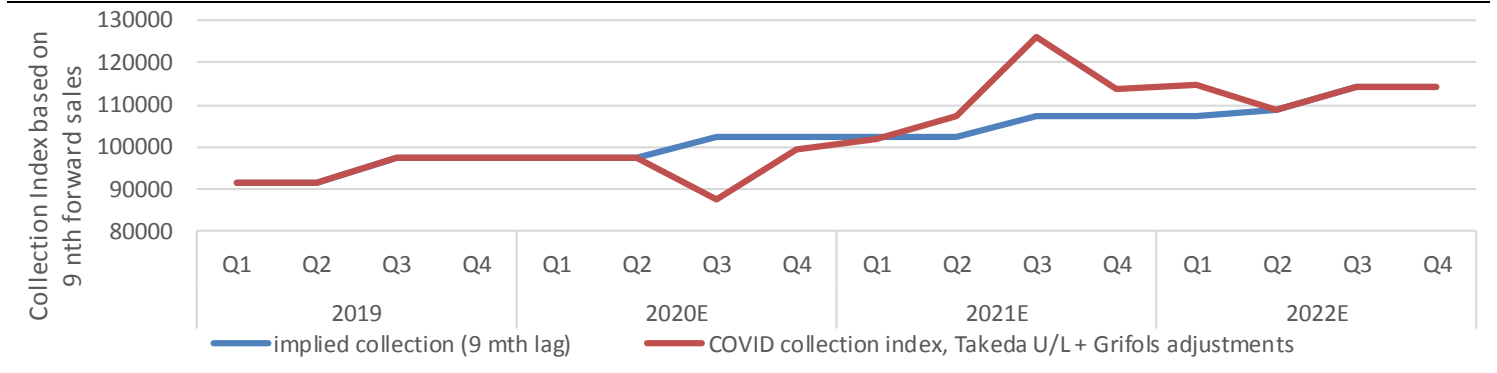
Source: Company data, Credit Suisse estimates

Takeda sensitivity: EPS -2% FY21, +2% FY22

For this sensitivity exercise we replicated the change in assumed growth in collection volumes we have applied to Grifols to Takeda. We have based this on the same calendar quarters and then adjusted to show the relevant quarters that are within the March year end for Takeda. We do not have the same granularity of centre numbers and donation volumes we have with Grifols and so we have simplified the analysis. We have derived an implied collection volume with a 9 month lag based on current and projected plasma sales. We have then adjusted this base line index of volume by the same adjustment factors we have used for Grifols, excluding the Cal 1Q20 adjustment for Germany, as we assume the majority of Takeda collection from the US where we see only a limited 1Q sales impact. Given that plasma products only accounts for around 11% of Takeda group growth the EPS impact of changes in revenues even allowing for a 70% contribution on sales is small. However cash flow could be an important factor to consider. Takeda must manage the situation well in order to gain credibility. There is also a greater capture of both short term negative and mid-term positives within one fiscal year for Takeda.

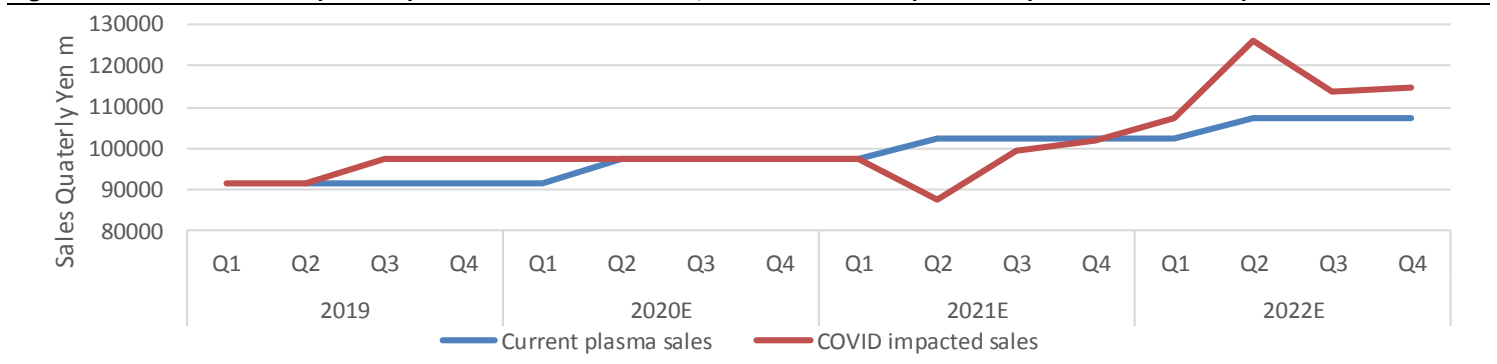
In our CSL analysis we have flexed both donations per centre and center numbers separately. We have not done this for Takeda, and yet for Takeda increased centre numbers are implicit in our underlying growth expectations as their recent expansion has lagged peers.

Figure 13: CS estimates of collection volumes of plasma for Takeda , and flexed assumptions for possible COVID impact



Source: Company data, Calendar year data Credit Suisse estimates

Figure 14: CS estimates of plasma product sales for Takeda , and flexed assumptions for possible COVID impact



Source: Company data, Calendar year data Credit Suisse estimates

Progress on COVID-19 Plasma therapeutics

In our recently published COVID-19 therapeutics [tear sheet](#), we introduced the concepts of both regular plasma and convalescent plasma (from recovered COVID-19 patients) as potential treatment options to help boost immune systems in sick patients. Recall, plasma is the yellow liquid component of your blood once you filter out red blood cells, white blood cells and platelets. Plasma derived products, such as intravenous/subcutaneous immunoglobulin (IVIg/SCIg) are frequently used to help boost immunity in immune deficient patients, and so will likely to be used to help patients recover from COVID-19.

Beyond the standard IG, companies that specialize in plasma derived therapeutics are also developing hyper immune immunoglobulin (H-IG, fractionated plasma with large titres of COVID-19 antibodies) and convalescent plasma (whole plasma taken from patients who have recovered from COVID-19). Both of these therapies require plasma donations from recovered COVID-19 patients. According to data from John Hopkins university, there are c330,000 individuals that have recovered from COVID-19 around the globe (as of April 9th), with the largest proportion of these residing in China.

We understand at this time, collection of plasma from these recovered patients has begun around the world, pre-dominantly in the hospital setting. We expect collection will soon roll out to the plasma collection centres, particularly in the US, as the flow of eligible donors increases and formal collection protocols (testing etc.) are put in place.

Hyper-immune Immunoglobulin (H-IG)

Hyper-immune immunoglobulin is concentrated fractionated plasma product derived from plasma donations from donors that have recovered from the COVID-19 virus. The end product has a high titre of COVID-19 antibodies and will require clinical trials before use. To create it, we estimate c75 patients worth of plasma will produce enough for a 5 day treatment for c 3-4 patients. We understand that lower volumes of plasma from these donors is required (c500ml vs an 800ml average donation).

- **Grifols & FDA collaboration.** Grifols is also working on an H-IG in collaboration with BARDA and the FDA. We understand that the company is targeting having its product available by July (in 3 months), and may be first to produce the product (with a rapid 6 week production process). Similar to Takeda, collection of plasma has already begun in the US, primarily in the hospital setting. The company may benefit from the collaboration with the FDA and CDC in identifying eligible donors, to speed up development vs peers. Fractionation is expected to take place at Grifol's Clayton (North Carolina) facility, in small batches.
- **CSL & Takeda Alliance.** This week, the companies announced they are forming an alliance with 4 additional companies (Biotest, BPL, LFB, and Octapharma) to accelerate the development of an unbranded hyperimmune plasma for COVID-19. The alliance is actively encouraging others to join. We understand that Grifols will be contributing its expertise, but will not be a key driving force behind the project due to the simultaneous efforts ongoing in partnership with FDA. No development timelines for this product were shared in the press release. At this stage, the economics for this product in relation to Takeda and CSL remain unknown, but given its unbranded nature, we could expect this therapy could be donated, rather than sold.
- **Takeda (TAK-888).** Takeda was the first to announce its pre-clinical development for H-IG, TAK-888, an anti COVID polyclonal H-IG but has since terminated sole development. The company stated at its recent investor event that it has begun collecting plasma from patients in Australia and the US and Takeda expects it will take between 9 and 18 months to complete clinical studies. However following the announcement of the CSL alliance, Takeda is re-focusing its efforts away from TAK-888 and on to developing an unbranded product.

Convalescent plasma

Convalescent plasma is where the whole plasma taken from a recovered patient is infused into the sick patients, with filtering but limited processing. Given this, processing time is typically faster versus H-IG and smaller volumes of plasma are required for treatment (we understand donations from two separate donors is sufficient to treat 1 patient). The FDA has also [authorised](#) the emergency use of convalescent plasma in the US, so physicians today are able to gain emergency IND to administer convalescent plasma for specific patients. We have already seen anecdotal evidence of this approach being used, first in China and more recently in the US, with success but in very small patient numbers.

- **Collection limited to hospital setting.** No centres we spoke to during our research on CSL, Grifols and Takeda stated they were ready to take collections from COVID-19 survivors at their respective collection centres. The FDA has announced it is working on master protocols for collection in partnership with NIH and CDC, which we expect will be available imminently. We also note AABB (a non-profit agency focused on transfusion medicine) put out new [guidelines](#) on convalescent plasma last week. We expect the publication of these protocol/guidelines will accelerate collection and help advance it away from hospitals and into local collection centres. Increased availability of COVID-19 testing will also help speed up this process.
- **Grifols & FDA collaboration.** In addition to developing a hyperimmune product, Grifols is also providing resources for the production of convalescent plasma, as part of its agreement with the FDA. We understand the company is targeting to have plasma available to treat patients as early as the end of April (2-3 weeks time). We would not expect this plasma product to be studied in clinical trials given the FDA emergency authorization, but may be used to help treat patients in interim period before its H-IG product becomes available.
- **We believe that Grifols is particularly well positioned** here with a dedicated fractionation facility available (certified for this sort of use during the Ebola crisis).
- **Academic alliances also forming for convalescent plasma.** We highlight a new self-organised US National COVID-19 convalescent plasma project ([link](#)) has recently formed. The group consists of physicians from 34 institutions in 17 states who are investigating use of convalescent plasma, without apparent industry partnerships. The group is providing trial protocols and guidance for healthcare providers looking to utilize convalescent plasma, as well as encouraging plasma donations at local blood banks and the Red Cross.

Appendix

Figure 15: CSL Plasma centre locations



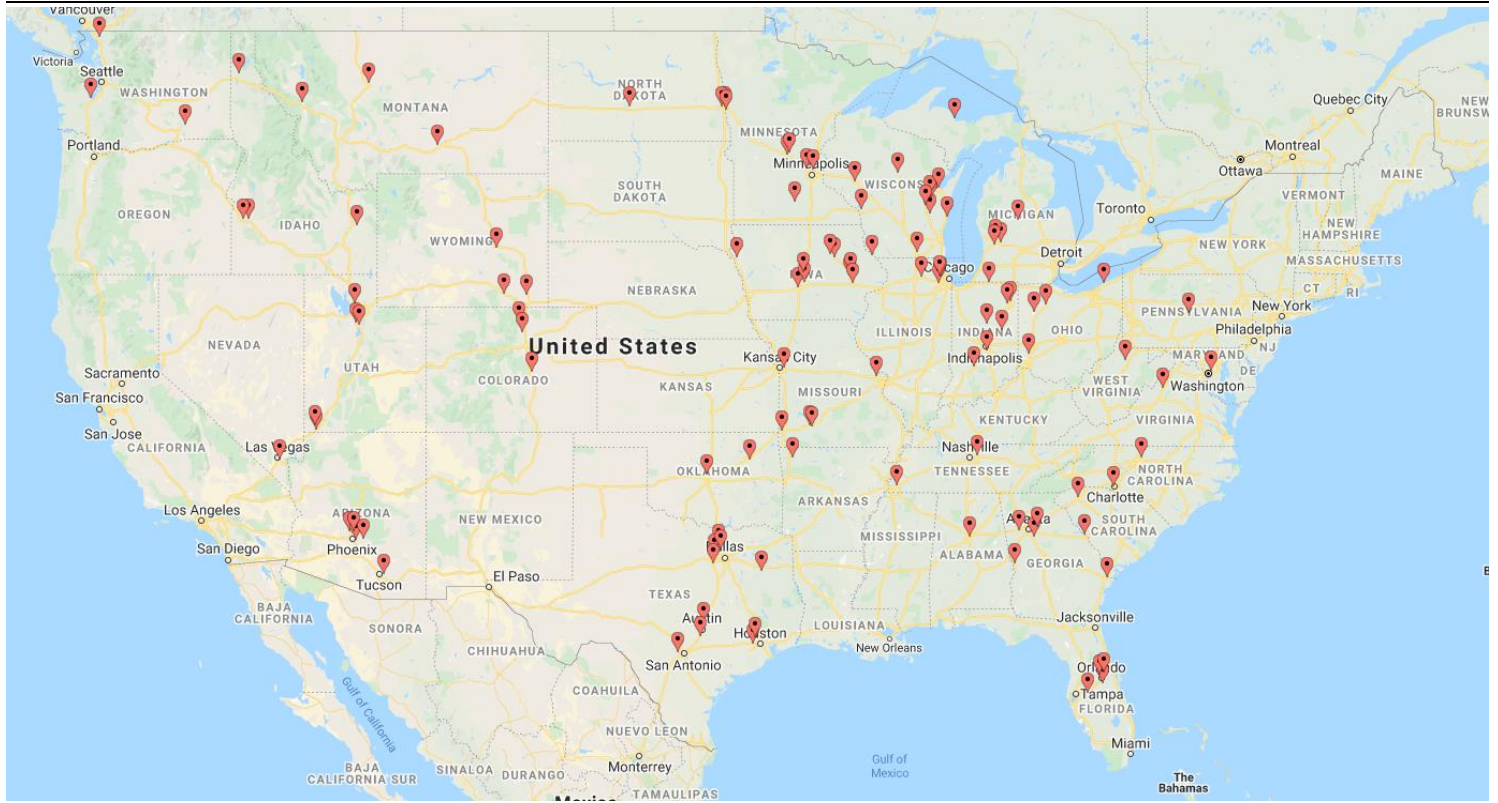
Source: FDA, Company data, Credit Suisse estimates

Figure 16: Grifols plasma centre locations



Source: FDA, Company data, Credit Suisse estimates

Figure 17: Takeda plasma centre locations



Source: FDA, Company data, Credit Suisse estimates

Companies Mentioned (Price as of 09-Apr-2020)**Biotech** (BIOG.DE, €22.8)**CSL Ltd** (CSL.AX, A\$329.0)**China Biologic Products, Inc.** (CBPO.OQ, \$106.7)**Grifols** (GRLS.MC, €29.49)**Takeda Pharmaceutical** (4502.T, ¥3,480)

Disclosure Appendix

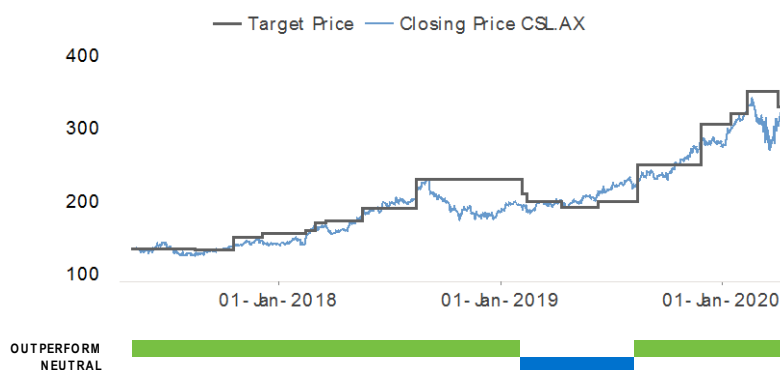
Analyst Certification

Fumiyoshi Sakai, Jo Walton, Gretel Janu and Jason Liu each certify, with respect to the companies or securities that the individual analyzes, that (1) the views expressed in this report accurately reflect his or her personal views about all of the subject companies and securities and (2) no part of his or her compensation was, is or will be directly or indirectly related to the specific recommendations or views expressed in this report.

3-Year Price and Rating History for CSL Ltd (CSL.AX)

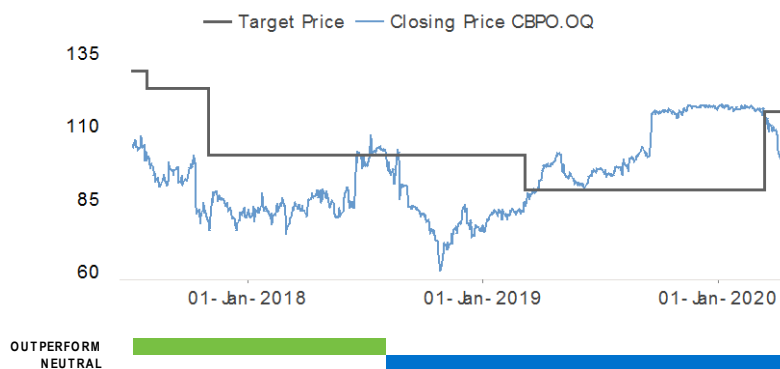
CSL.AX	Closing Price	Target Price	
Date	(A\$)	(A\$)	Rating
05-May-17	133.62	134.00	O
16-Aug-17	125.27	133.00	
18-Oct-17	141.45	150.00	
04-Dec-17	145.31	155.00	*
14-Feb-18	149.29	160.00	
02-Mar-18	160.05	170.00	
19-Mar-18	166.59	173.00	
18-May-18	182.95	190.00	
15-Aug-18	214.58	230.00	
05-Feb-19	193.03	210.00	N
13-Feb-19	186.09	200.00	
12-Apr-19	197.86	192.00	
11-Jun-19	212.50	199.00	
14-Aug-19	234.00	249.00	O
28-Nov-19	282.99	305.00	
15-Jan-20	297.74	320.00	
12-Feb-20	328.25	350.00	
03-Apr-20	304.11	329.00	

* Asterisk signifies initiation or assumption of coverage.

**3-Year Price and Rating History for China Biologic Products, Inc. (CBPO.OQ)**

CBPO.OQ	Closing Price	Target Price	
Date	(US\$)	(US\$)	Rating
06-Jul-17	102.78	129.00	O
28-Jul-17	98.42	123.00	
31-Oct-17	77.71	100.00	*
06-Aug-18	94.86	100.00	N
07-Mar-19	83.61	88.00	
13-Mar-20	114.78	115.00	*

* Asterisk signifies initiation or assumption of coverage.



3-Year Price and Rating History for Grifols (GRLS.MC)

GRLS.MC	Closing Price	Target Price	
Date	(€)	(€)	Rating
08-Dec-17	24.08	26.00	N *
02-Aug-19	28.92	27.00	
16-Jan-20	31.89	32.00	

* Asterisk signifies initiation or assumption of coverage.



3-Year Price and Rating History for Takeda Pharmaceutical (4502.T)

4502.T	Closing Price	Target Price	
Date	(¥)	(¥)	Rating
10-May-17	5,489	5,400	N
01-Jun-17	5,735	5,900	
14-Nov-17	6,393	6,400	
07-May-18	4,460	6,000	O
24-May-18	4,499	6,100	

* Asterisk signifies initiation or assumption of coverage.



As of December 10, 2012 Analysts' stock rating are defined as follows:

Outperform (O) : The stock's total return is expected to outperform the relevant benchmark* over the next 12 months.

Neutral (N) : The stock's total return is expected to be in line with the relevant benchmark* over the next 12 months.

Underperform (U) : The stock's total return is expected to underperform the relevant benchmark* over the next 12 months.

*Relevant benchmark by region: As of 10th December 2012, Japanese ratings are based on a stock's total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. As of 2nd October 2012, U.S. and Canadian as well as European (excluding Turkey) ratings are based on a stock's total return relative to the analyst's coverage universe which consists of all companies covered by the analyst within the relevant sector, with Outperforms representing the most attractive, Neutrals the less attractive, and Underperforms the least attractive investment opportunities. For Latin America, Turkey and Asia (excluding Japan and Australia), stock ratings are based on a stock's total return relative to the average total return of the relevant country or regional benchmark (India - S&P BSE Sensex Index); prior to 2nd October 2012 U.S. and Canadian ratings were based on (1) a stock's absolute total return potential to its current share price and (2) the relative attractiveness of a stock's total return potential within an analyst's coverage universe. For Australian and New Zealand stocks, the expected total return (ETR) calculation includes 12-month rolling dividend yield. An Outperform rating is assigned where an ETR is greater than or equal to 7.5%; Underperform where an ETR less than or equal to 5%. A Neutral may be assigned where the ETR is between -5% and 15%. The overlapping rating range allows analysts to assign a rating that puts ETR in the context of associated risks. Prior to 18 May 2015, ETR ranges for Outperform and Underperform ratings did not overlap with Neutral thresholds between 15% and 7.5%, which was in operation from 7 July 2011.

Restricted (R) : In certain circumstances, Credit Suisse policy and/or applicable law and regulations preclude certain types of communications, including an investment recommendation, during the course of Credit Suisse's engagement in an investment banking transaction and in certain other circumstances.

Not Rated (NR) : Credit Suisse Equity Research does not have an investment rating or view on the stock or any other securities related to the company at this time.

Not Covered (NC) : Credit Suisse Equity Research does not provide ongoing coverage of the company or offer an investment rating or investment view on the equity security of the company or related products.

Volatility Indicator [V] : A stock is defined as volatile if the stock price has moved up or down by 20% or more in a month in at least 8 of the past 24 months or the analyst expects significant volatility going forward.

Analysts' sector weightings are distinct from analysts' stock ratings and are based on the analyst's expectations for the fundamentals and/or valuation of the sector* relative to the group's historic fundamentals and/or valuation:

Overweight : The analyst's expectation for the sector's fundamentals and/or valuation is favorable over the next 12 months.

Market Weight : The analyst's expectation for the sector's fundamentals and/or valuation is neutral over the next 12 months.

Underweight : The analyst's expectation for the sector's fundamentals and/or valuation is cautious over the next 12 months.

*An analyst's coverage sector consists of all companies covered by the analyst within the relevant sector. An analyst may cover multiple sectors.

Credit Suisse's distribution of stock ratings (and banking clients) is:

Global Ratings Distribution

Rating	Versus universe (%)	Of which banking clients (%)
Outperform/Buy*	49%	(33% banking clients)
Neutral/Hold*	38%	(26% banking clients)
Underperform/Sell*	12%	(22% banking clients)
Restricted	2%	

*For purposes of the NYSE and FINRA ratings distribution disclosure requirements, our stock ratings of Outperform, Neutral, and Underperform most closely correspond to Buy, Hold, and Sell, respectively; however, the meanings are not the same, as our stock ratings are determined on a relative basis. (Please refer to definitions above.) An investor's decision to buy or sell a security should be based on investment objectives, current holdings, and other individual factors.

Important Global Disclosures

Credit Suisse's research reports are made available to clients through our proprietary research portal on CS PLUS. Credit Suisse research products may also be made available through third-party vendors or alternate electronic means as a convenience. Certain research products are only made available through CS PLUS. The services provided by Credit Suisse's analysts to clients may depend on a specific client's preferences regarding the frequency and manner of receiving communications, the client's risk profile and investment, the size and scope of the overall client relationship with the Firm, as well as legal and regulatory constraints. To access all of Credit Suisse's research that you are entitled to receive in the most timely manner, please contact your sales representative or go to <https://plus.credit-suisse.com>.

Credit Suisse's policy is to update research reports as it deems appropriate, based on developments with the subject company, the sector or the market that may have a material impact on the research views or opinions stated herein.

Credit Suisse's policy is only to publish investment research that is impartial, independent, clear, fair and not misleading. For more detail please refer to Credit Suisse's Policies for Managing Conflicts of Interest in connection with Investment Research: <https://www.credit-suisse.com/sites/disclaimers-ib/en/managing-conflicts.html>.

Any information relating to the tax status of financial instruments discussed herein is not intended to provide tax advice or to be used by anyone to provide tax advice. Investors are urged to seek tax advice based on their particular circumstances from an independent tax professional.

Credit Suisse has decided not to enter into business relationships with companies that Credit Suisse has determined to be involved in the development, manufacture, or acquisition of anti-personnel mines and cluster munitions. For Credit Suisse's position on the issue, please see <https://www.credit-suisse.com/media/assets/corporate/docs/about-us/responsibility/banking/policy-summaries-en.pdf>.

The analyst(s) responsible for preparing this research report received compensation that is based upon various factors including Credit Suisse's total revenues, a portion of which are generated by Credit Suisse's investment banking activities

See the Companies Mentioned section for full company names

Credit Suisse expects to receive or intends to seek investment banking related compensation from the subject company (CBPO.OQ, GRLS.MC) within the next 3 months.

Credit Suisse or a member of the Credit Suisse Group is a market maker or liquidity provider in the securities of the following subject issuer(s): CSL.AX, CBPO.OQ, GRLS.MC, 4502.T

As of the date of this report, Credit Suisse beneficially own 1% or more of a class of common equity securities of (GRLS.MC).

For date and time of production, dissemination and history of recommendation for the subject company(ies) featured in this report, disseminated within the past 12 months, please refer to the link: <https://rave.credit-suisse.com/disclosures/view/report?i=507721&v=1gxka0il6dq5y5nysw623hco2>.

Important Regional Disclosures

Singapore recipients should contact Credit Suisse AG, Singapore Branch for any matters arising from this research report.

The analyst(s) involved in the preparation of this report may participate in events hosted by the subject company, including site visits. Credit Suisse does not accept or permit analysts to accept payment or reimbursement for travel expenses associated with these events.

For Credit Suisse Securities (Canada), Inc.'s policies and procedures regarding the dissemination of equity research, please visit <https://www.credit-suisse.com/sites/disclaimers-ib/en/canada-research-policy.html>.

Investors should note that income from such securities and other financial instruments, if any, may fluctuate and that price or value of such securities and instruments may rise or fall and, in some cases, investors may lose their entire principal investment.

Credit Suisse Equity Research may make decisions about new and ongoing listed company coverage, including initiation, assumption or termination of coverage, based on various factors including: market capitalisation, trading volume, relevance to our institutional investor-clients, availability of information allowing formation and maintenance of a reasonable investment view, internal resourcing and availability of suitable analysts, or other factors of a regulatory nature as may be encountered from time to time.

In the preparation of Credit Suisse's research reports, Credit Suisse may have had assistance from the company (including but not limited to discussions with management of the company and visits to certain sites of the company).

This research report is authored by:

Credit Suisse (Hong Kong) Limited Jason Liu
Credit Suisse Equities (Australia) Limited Gretel Janu
Credit Suisse Securities (Japan) Limited Fumiyoshi Sakai
Credit Suisse International European Pharma Team ; Jo Walton

To the extent this is a report authored in whole or in part by a non-U.S. analyst and is made available in the U.S., the following are important disclosures regarding any non-U.S. analyst contributors: The non-U.S. research analysts listed below (if any) are not registered/qualified as research analysts with FINRA. The non-U.S. research analysts listed below may not be associated persons of CSSU and therefore may not be

subject to the FINRA 2241 and NYSE Rule 472 restrictions on communications with a subject company, public appearances and trading securities held by a research analyst account.

Credit Suisse (Hong Kong) Limited Jason Liu
Credit Suisse Equities (Australia) Limited Gretel Janu
Credit Suisse Securities (Japan) Limited Fumiyoshi Sakai
Credit Suisse International European Pharma Team ; Jo Walton

Important disclosures regarding companies that are the subject of this report are available by calling +1 (877) 291-2683. The same important disclosures, with the exception of valuation methodology and risk discussions, are also available on Credit Suisse's disclosure website at <https://rave.credit-suisse.com/disclosures>. For valuation methodology and risks associated with any recommendation, price target, or rating referenced in this report, please refer to the disclosures section of the most recent report regarding the subject company.

This report is produced by subsidiaries and affiliates of Credit Suisse operating under its Global Markets Division. For more information on our structure, please use the following link: <https://www.credit-suisse.com/who-we-are>. This report may contain material that is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any locality, state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation or which would subject Credit Suisse or its affiliates ("CS") to any registration or licensing requirement within such jurisdiction. All material presented in this report, unless specifically indicated otherwise, is under copyright to CS. None of the material, nor its content, nor any copy of it, may be altered in any way, transmitted to, copied or distributed to any other party, without the prior express written permission of CS. All trademarks, service marks and logos used in this report are trademarks or service marks or registered trademarks or service marks of CS or its affiliates. The information, tools and material presented in this report are provided to you for information purposes only and are not to be used or considered as an offer or the solicitation of an offer to sell or to buy or subscribe for securities or other financial instruments. CS may not have taken any steps to ensure that the securities referred to in this report are suitable for any particular investor. CS will not treat recipients of this report as its customers by virtue of their receiving this report. The investments and services contained or referred to in this report may not be suitable for you and it is recommended that you consult an independent investment advisor if you are in doubt about such investments or investment services. Nothing in this report constitutes investment, legal, accounting or tax advice, or a representation that any investment or strategy is suitable or appropriate to your individual circumstances, or otherwise constitutes a personal recommendation to you. Please note in particular that the bases and levels of taxation may change. Information and opinions presented in this report have been obtained or derived from sources believed by CS to be reliable, but CS makes no representation as to their accuracy or completeness. CS accepts no liability for loss arising from the use of the material presented in this report, except that this exclusion of liability does not apply to the extent that such liability arises under specific statutes or regulations applicable to CS. This report is not to be relied upon in substitution for the exercise of independent judgment. CS may have issued, and may in the future issue, other communications that are inconsistent with, and reach different conclusions from, the information presented in this report. Those communications reflect the different assumptions, views and analytical methods of the analysts who prepared them and CS is under no obligation to ensure that such other communications are brought to the attention of any recipient of this report. Some investments referred to in this report will be offered solely by a single entity and in the case of some investments solely by CS, or an associate of CS or CS may be the only market maker in such investments. Past performance should not be taken as an indication or guarantee of future performance, and no representation or warranty, express or implied, is made regarding future performance. Information, opinions and estimates contained in this report reflect a judgment at its original date of publication by CS and are subject to change without notice. The price, value of and income from any of the securities or financial instruments mentioned in this report can fall as well as rise. The value of securities and financial instruments is subject to exchange rate fluctuation that may have a positive or adverse effect on the price or income of such securities or financial instruments. Investors in securities such as ADRs, the values of which are influenced by currency volatility, effectively assume this risk. Structured securities are complex instruments, typically involve a high degree of risk and are intended for sale only to sophisticated investors who are capable of understanding and assuming the risks involved. The market value of any structured security may be affected by changes in economic, financial and political factors (including, but not limited to, spot and forward interest and exchange rates), time to maturity, market conditions and volatility, and the credit quality of any issuer or reference issuer. Any investor interested in purchasing a structured product should conduct their own investigation and analysis of the product and consult with their own professional advisers as to the risks involved in making such a purchase. Some investments discussed in this report may have a high level of volatility. High volatility investments may experience sudden and large falls in their value causing losses when that investment is realised. Those losses may equal your original investment. Indeed, in the case of some investments the potential losses may exceed the amount of initial investment and, in such circumstances, you may be required to pay more money to support those losses. Income yields from investments may fluctuate and, in consequence, initial capital paid to make the investment may be used as part of that income yield. Some investments may not be readily realisable and it may be difficult to sell or realise those investments, similarly it may prove difficult for you to obtain reliable information about the value, or risks, to which such an investment is exposed. This report may provide the addresses of, or contain hyperlinks to, websites. Except to the extent to which the report refers to website material of CS, CS has not reviewed any such site and takes no responsibility for the content contained therein. Such address or hyperlink (including addresses or hyperlinks to CS's own website material) is provided solely for your convenience and information and the content of any such website does not in any way form part of this document. Accessing such website or following such link through this report or CS's website shall be at your own risk.

This report is issued and distributed in **European Union (except Germany and Spain)**: by Credit Suisse Securities (Europe) Limited, One Cabot Square, London E14 4QJ, England, which is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority; **Spain**: Credit Suisse Securities, Sociedad de Valores, S.A. ("CSSSV") regulated by the Comisión Nacional del Mercado de Valores; **Germany**: Credit Suisse (Deutschland) Aktiengesellschaft regulated by the Bundesanstalt fuer Finanzdienstleistungsaufsicht ("BaFin"); **United States and Canada**: Credit Suisse Securities (USA) LLC; **Switzerland**: Credit Suisse AG; **Brazil**: Banco de Investimentos Credit Suisse (Brasil) SA or its affiliates; **Mexico**: Banco Credit Suisse (México), S.A., Institución de Banca Múltiple, Grupo Financiero Credit Suisse (México) and Casa de Bolsa Credit Suisse (México), S.A. de C.V., Grupo Financiero Credit Suisse (México) ("Credit Suisse Mexico"). This document has been prepared for information purposes only and is exclusively distributed in Mexico to Institutional Investors. Credit Suisse Mexico is not responsible for any onward distribution of this report to non-institutional investors by any third party. The authors of this report have not received payment or compensation from any entity or company other than from the relevant Credit Suisse Group company employing them; **Japan**: by Credit Suisse Securities (Japan) Limited, Financial Instruments Firm, Director-General of Kanto Local Finance Bureau (*Kinsho*) No. 66, a member of Japan Securities Dealers Association, The Financial Futures Association of Japan, Japan Investment Advisers Association, Type II Financial Instruments Firms Association; **Hong Kong**: Credit Suisse (Hong Kong) Limited; **Australia**: Credit Suisse Equities (Australia) Limited; **Thailand**: Credit Suisse Securities (Thailand) Limited, regulated by the Office of the Securities and Exchange Commission, Thailand, having registered address at 990 Abdulrahim Place, 27th Floor, Unit 2701, Rama IV Road, Slom, Bangkok, Bangkok10500, Thailand, Tel. +66 2614 6000; **Malaysia**: Credit Suisse Securities (Malaysia) Sdn Bhd; **Singapore**: Credit Suisse AG, Singapore Branch; **India**: Credit Suisse Securities (India) Private Limited (CIN no.U67120MH1996PTC104392) regulated by the Securities and Exchange Board of India as Research Analyst (registration no. INH 000001030) and as Stock Broker (registration no. INZ000248233), having registered address at 9th Floor, Ceejay House, Dr.A.B. Road, Worli, Mumbai - 18, India, T- +91-22 6777 3777; **South Korea**: Credit Suisse Securities (Europe) Limited, Seoul Branch; **Taiwan**: Credit Suisse AG Taipei Securities Branch; **Indonesia**: PT Credit Suisse Sekuritas Indonesia; **Philippines**: Credit Suisse Securities (Philippines) Inc., and elsewhere in the world by the relevant authorised affiliate of the above.

Additional Regional Disclaimers

Australia: Credit Suisse Securities (Europe) Limited ("CSSEL") and Credit Suisse International ("CSI") are authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority ("FCA") and the Prudential Regulation Authority under UK laws, which differ from Australian Laws. CSSEL and CSI do not hold an Australian Financial Services Licence ("AFSL") and are exempt from the requirement to hold an AFSL under the Corporations Act (Cth) 2001 ("Corporations Act") in respect of the financial services provided to Australian wholesale clients (within the meaning of section 761G of the Corporations Act) (hereinafter referred to as "Financial Services"). This material is not for distribution to retail clients and is directed exclusively at Credit Suisse's professional clients and eligible counterparties as defined by the FCA, and wholesale clients as defined under section 761G of the Corporations Act. Credit Suisse (Hong Kong) Limited ("CSHK") is licensed and regulated by the Securities and Futures Commission of Hong Kong under the laws of Hong Kong, which differ from Australian laws. CSHK does not hold an AFSL and is exempt from the requirement to hold an AFSL under the Corporations Act in respect of providing Financial Services. Investment banking services in the United States are provided by Credit Suisse Securities (USA) LLC, an affiliate of Credit Suisse Group. CSSU is regulated by the United States Securities and Exchange Commission under United States laws, which differ from Australian laws. CSSU does not hold an AFSL and is exempt from the requirement to hold an AFSL under the Corporations Act in respect of providing Financial Services. Credit Suisse Asset Management LLC (CSAM) is authorised by the Securities and Exchange Commission under US laws, which differ from Australian laws. CSAM does not hold an AFSL and is exempt from the requirement to hold an AFSL under the Corporations Act in respect of providing Financial Services. This material is provided solely to Institutional Accounts (as defined in the FINRA rules) who are Eligible Contract Participants (as defined in the US Commodity Exchange Act). Credit Suisse Equities (Australia) Limited (ABN 35 068 232 708) ("CSEAL") is an AFSL holder in Australia (AFSL 237237).

Malaysia: Research provided to residents of Malaysia is authorised by the Head of Research for Credit Suisse Securities (Malaysia) Sdn Bhd, to whom they should direct any queries on +603 2723 2020.

Singapore: This report has been prepared and issued for distribution in Singapore to institutional investors, accredited investors and expert investors (each as defined under the Financial Advisers Regulations) only, and is also distributed by Credit Suisse AG, Singapore Branch to overseas investors (as defined under the Financial Advisers Regulations). Credit Suisse AG, Singapore Branch may distribute reports produced by its foreign entities or affiliates pursuant to an arrangement under Regulation 32C of the Financial Advisers Regulations. Singapore recipients should contact Credit Suisse AG, Singapore Branch at +65-6212-2000 for matters arising from, or in connection with, this report. By virtue of your status as an institutional investor, accredited investor, expert investor or overseas investor, Credit Suisse AG, Singapore Branch is exempted from complying with certain compliance requirements under the Financial Advisers Act, Chapter 110 of Singapore (the "FAA"), the Financial Advisers Regulations and the relevant Notices and Guidelines issued thereunder, in respect of any financial advisory service which Credit Suisse AG, Singapore Branch may provide to you.

EU: This report has been produced by subsidiaries and affiliates of Credit Suisse operating under its Global Markets Division

In jurisdictions where CS is not already registered or licensed to trade in securities, transactions will only be effected in accordance with applicable securities legislation, which will vary from jurisdiction to jurisdiction and may require that the trade be made in accordance with applicable exemptions from registration or licensing requirements.

This material is issued and distributed in the U.S. by CSSU, a member of NYSE, FINRA, SIPC and the NFA, and CSSU accepts responsibility for its contents. Clients should contact analysts and execute transactions through a Credit Suisse subsidiary or affiliate in their home jurisdiction unless governing law permits otherwise.

CS may provide various services to US municipal entities or obligated persons ("municipalities"), including suggesting individual transactions or trades and entering into such transactions. Any services CS provides to municipalities are not viewed as "advice" within the meaning of Section 975 of the Dodd-Frank Wall Street Reform and Consumer Protection Act. CS is providing any such services and related information solely on an arm's length basis and not as an advisor or fiduciary to the municipality. In connection with the provision of the any such services, there is no agreement, direct or indirect, between any municipality (including the officials, management, employees or agents thereof) and CS for CS to provide advice to the municipality. Municipalities should consult with their financial, accounting and legal advisors regarding any such services provided by CS. In addition, CS is not acting for direct or indirect compensation to solicit the municipality on behalf of an unaffiliated broker, dealer, municipal securities dealer, municipal advisor, or investment adviser for the purpose of obtaining or retaining an engagement by the municipality for or in connection with Municipal Financial Products, the issuance of municipal securities, or of an investment adviser to provide investment advisory services to or on behalf of the municipality. If this report is being distributed by a financial institution other than Credit Suisse AG, or its affiliates, that financial institution is solely responsible for distribution. Clients of that institution should contact that institution to effect a transaction in the securities mentioned in this report or require further information. This report does not constitute investment advice by Credit Suisse to the clients of the distributing financial institution, and neither Credit Suisse AG, its affiliates, and their respective officers, directors and employees accept any liability whatsoever for any direct or consequential loss arising from their use of this report or its content. No information or communication provided herein or otherwise is intended to be, or should be construed as, a recommendation within the meaning of the US Department of Labor's final regulation defining "investment advice" for purposes of the Employee Retirement Income Security Act of 1974, as amended and Section 4975 of the Internal Revenue Code of 1986, as amended, and the information provided herein is intended to be general information, and should not be construed as, providing investment advice (impartial or otherwise).

Copyright © 2020 CREDIT SUISSE AG and/or its affiliates. All rights reserved.

When you purchase non-listed Japanese fixed income securities (Japanese government bonds, Japanese municipal bonds, Japanese government guaranteed bonds, Japanese corporate bonds) from CS as a seller, you will be requested to pay the purchase price only.