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# Argentina GDP Warrants

## A US\$6.4bn deal sweetener?

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- In his May 31st presentation, Argentine Economy Minister Lavagna indicated that the proposed GDP-linked structure included in Argentina's debt restructuring proposal would be worth \$6.4bn in NPV terms. This would represent almost 8 points in the price of the defaulted debt.
- We find it highly unlikely that a structure such as that described by Minister Lavagna could be worth as much. Our analysis suggests a value of \$1.36bn or 1.7 points on the value of the defaulted debt. We are using an exit yield of 12%. At a 14% rate, the warrant value falls to 1.4 points.
- We assume trend growth of 3% (real) and growth volatility of 4%. In addition, we assume that the peso continues to appreciate in real terms, reaching an equilibrium level in 2008 of 1.35 (relative to 1.74 at end-03 and 1.00 at the end of convertibility). We also assume a discount rate of 12%.
- Taking our warrant valuation into consideration, we find the total value of the restructuring proposal to be \$18.4 at a yield of 14% and \$22.9 at a yield of 12%. The government will most likely need to change the terms of the proposal to reach levels closer to current market prices.
- We are also releasing our *GDP Warrant simulation and valuation* interactive model. This model allows investors to input their own assumptions for GDP growth and growth volatility and determine the value of the warrant. The model also allows the user to specify the structure of the warrant pay-off in a very flexible form.

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### Aggressive assumptions needed for warrant to be worth more than US\$2

#### Warrant value in terms of defaulted debt price

		Growth volatility				
		3.0%	3.5%	4.0%	4.5%	5.0%
Real growth	1.0%	0.4	0.5	0.7	0.8	1.0
	2.0%	0.7	0.9	1.1	1.3	1.5
	2.5%	1.0	1.2	1.4	1.6	1.8
	3.0%	1.3	1.5	1.7	1.9	2.1
	3.5%	1.6	1.8	2.0	2.3	2.5
	4.0%	2.1	2.3	2.5	2.7	2.9
	5.0%	3.2	3.4	3.6	3.8	4.1

Source: Deutsche Bank

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## Determining the value of the GDP Warrants

### What is the proposed structure?

Minister Lavagna indicated last Tuesday that the GDP-linked structure would have a pay-off triggered when GDP growth exceeds 3%. In that event, the amount of the pay-off would be 5% of the excess growth. Although it was unspecified, we assume that the 3% trigger will be based on real GDP growth. In addition, it is unclear whether the excess growth is simply the excess growth for the given year or whether it is the cumulative excess growth – i.e., the growth above the trend rate, or whether it is in real or nominal terms.

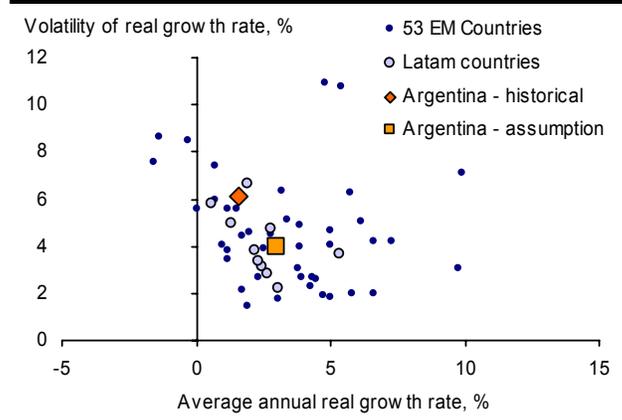
### Valuing the structure using Monte Carlo simulation

Given the degree of uncertainty and potential complexity of the proposed structure, we have used a Monte Carlo simulation approach to value the structure. First, we create 100 simulated paths of real and nominal GDP based on a set of assumptions of trend growth, growth volatility, US inflation and a path of the REER. Once we have the simulated paths, it is simply a matter of determining the annual pay-off under each path, based on the assumed pay-off formula. We then NPV the pay-off of each of the 100 paths at a fixed discount rate. The value of the structure is then simply the average value of the 100 paths.

### Growth assumptions

For trend growth, we assume 3% annual real growth. This is the baseline growth assumption in both our own, and the government's debt sustainability analysis. In addition, the fact that this is also the trigger level on the warrant makes this assumption for trend growth the most value-neutral assumption. We will later examine the sensitivity of the valuation to this and to other assumptions. In order to determine an appropriate assumption for growth volatility, we have examined historical real growth and growth volatility across a wide range of EM countries over the past 20 years. Over this time frame, Argentina has grown at an average rate of 1.6% per year with a volatility of 6.1%. However, this period included the decade of the convertibility regime,

**Historical GDP growth and growth volatility across emerging markets (past 20 years)**



Source: IIF, DB Global Markets Research

during which the volatility of real GDP was likely higher than it would have been under a freely floating FX regime, the regime one would expect looking forward. Looking across the history of EM countries (above), we believe that given an assumed trend growth of 3%, a growth volatility assumption of 4% appears to be a reasonable choice.

In addition to assumptions that drive the process of real GDP, we also make assumptions for US inflation and the path of the real effective exchange rate (REER), allowing us to determine a path for nominal GDP (upon which the warrant pay-off may be based). For US inflation, we assume a constant 1.5%. For the real effective exchange rate, we assume that the peso appreciates from the current level, to a level of 1.35 (relative to

convertibility) and that it reaches this equilibrium level at the end of 2008. This represents a real appreciation of approximately 20% relative to the levels of the end of 2003.

### Warrant pay-off

The GDP-linked warrant as described by Minister Lavagna (and understood by us) implied that the trigger is based on 3% real growth and that the pay-off is based solely on the excess growth in the previous year. Based on these assumptions, we can describe the pay-off by the following formula:

$$Pay-off_{g>3\%} = \text{Max}\left(0, \frac{Y}{g+1} \times (g-3\%) \right) \times 5\%$$

$$Pay-off_{g<3\%} = 0$$

Real excess growth above 3%

Where:

- $g$  - Annual real GDP growth
- $Y$  - Nominal GDP level

Given this pay-off formula, the GDP process we defined earlier and a discount rate of 12%, we find that the total NPV of the warrant would be US\$1.36bn. Given the total notional amount of defaulted debt (US\$81.2bn), this US\$ market value translates into 1.7 points of value in terms of the price of the defaulted debt.

A more optimistic interpretation we can make of the pay-off structure of the GDP-linked warrant is that the trigger is based on 3% real growth and that the pay-off is based on cumulative excess real growth above a 3% trend level. If the warrant pay-off is based, the warrant formula becomes:

$$Pay-off_{g>3\%} = \text{Max}\left(0, Q - Q_r \times (1+3\%)^{T-T_r} \right) \times 5\%$$

$$Pay-off_{g<3\%} = 0$$

Expected nominal growth, assuming 3% trend growth

Where:

- $g$  - Annual real GDP growth
- $Q$  - Real GDP Level
- $Q_r$  - Reference real GDP level
- $T$  - Year of GDP measurement
- $T_r$  - Reference year

Given this pay-off formula, we find that the total NPV of the warrant would be US\$1.75bn or 2.2 points in terms of the price of the defaulted debt. Under a 14% exit yield, the NPV of the warrant would be USD1.37bn (or 1.7 points of defaulted debt).

### Sensitivity to GDP assumptions

Clearly the assumptions regarding GDP growth have a significant bearing on value of the warrant. The table below demonstrates the effect of changing both the trend growth and growth volatility assumptions:

<b>Sensitivity of warrant valuation to growth assumptions</b>						
<i>NPV of warrant (US\$bn)</i>			<i>Warrant value in terms of defaulted debt price</i>			
	Growth volatility		4.0%	4.5%	5.0%	
	3.0%	3.5%				
Real growth	1.0%	0.32	0.44	0.56	0.69	0.81
	2.0%	0.59	0.74	0.89	1.04	1.19
	2.5%	0.79	0.94	1.10	1.26	1.42
	3.0%	1.02	1.19	1.36	1.53	1.70
	3.5%	1.31	1.49	1.66	1.84	2.01
	4.0%	1.67	1.85	2.02	2.20	2.38
	5.0%	2.58	2.75	2.93	3.11	3.30
Real growth	1.0%	0.4	0.5	0.7	0.8	1.0
	2.0%	0.7	0.9	1.1	1.3	1.5
	2.5%	1.0	1.2	1.4	1.6	1.8
	3.0%	1.3	1.5	1.7	1.9	2.1
	3.5%	1.6	1.8	2.0	2.3	2.5
	4.0%	2.1	2.3	2.5	2.7	2.9
	5.0%	3.2	3.4	3.6	3.8	4.1

*Source: DB Global Markets Research*

### Conclusion

While our analysis suggests that there is certainly some value in the type of GDP-linked structure described by Minister Lavagna, we find it hard to justify how it could have a value of the magnitude suggested in the press conference. To achieve such a value, one would either have to assume an unrealistically high level of trend growth (around 7.5%), or one would have to assume that the structure of the warrant is modified to increase the pay-off (for instance by changing the structure to pay the cumulative growth as opposed to the current growth and increasing the share of excess growth to levels close to 24% from 5%).

Furthermore, we have assumed that the market price of such a warrant would be equal to the theoretical fair price given our baseline assumptions. This is certainly an optimistic assumption. There are many reasons why the market would be likely to attach a significant discount to the value of the warrant. The potential conflict of interest and lack of transparency in the calculation of GDP itself has frequently been cited by investors as a concern. In addition, the lack of instruments to hedge the underlying of the warrant (GDP) will likely cause investors to be conservative in the baseline assumptions that they make to value the warrant.

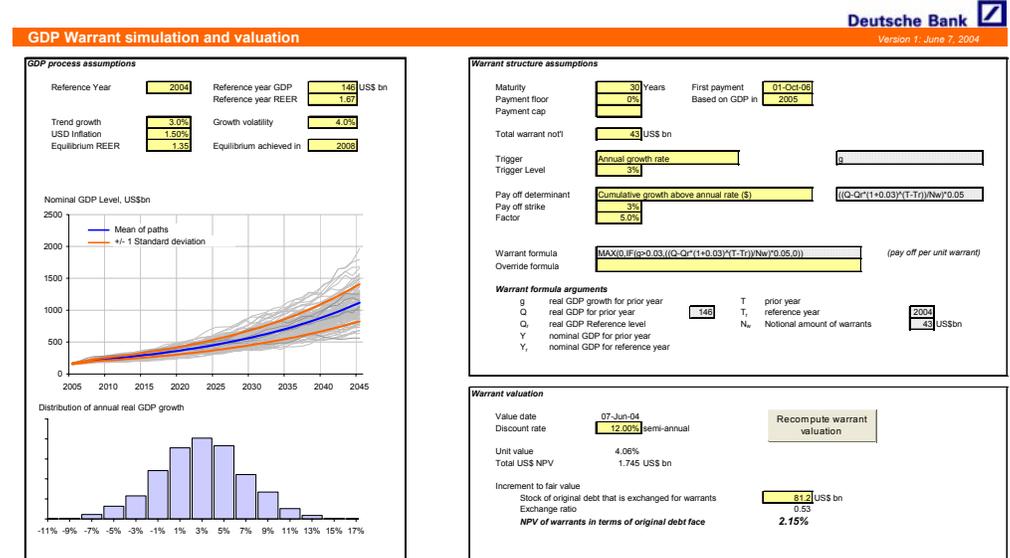
Taking our warrant valuation into consideration when we value the entire debt restructuring proposal, we find the total value to be \$18.4 at a yield of 14% and \$22.9 at a yield of 14%.



## Introducing our GDP warrant simulation and valuation model

Given the potential importance of the GDP warrant to the valuation of the restructuring proposal and also given the substantial uncertainties surrounding the exact nature of the warrant, we are publishing an interactive tool that allows investors to value the warrant based on their own assumptions. This model is available on our web site at: <http://gm.db.com/EM PricingModels>

### DB's GDP Warrant simulation and valuation model



The model is comprised of three elements:

### 1. GDP Process

Annual real GDP growth is assumed to follow a Brownian motion with the given trend and volatility. To express the growth in terms of US\$, a starting GDP level must be supplied. In addition, assumptions for US\$ inflation and a path of real appreciation of the domestic currency can be supplied. These assumptions are used to derive the path of nominal GDP from the real growth assumptions. 100 paths of GDP are generated randomly based on the supplied inputs.

### 2. Warrant structure

The warrant is assumed to pay annually for a given number of years. The pay-off structure of the warrant is defined as a formula with the following optional arguments:

g	real GDP growth for prior year (%)
Q	real GDP for prior year (US\$bn)
Q <sub>r</sub>	real GDP Reference level (US\$bn)
Y	nominal GDP for prior year (US\$bn)
Y <sub>r</sub>	nominal GDP Reference level (US\$bn)
T	prior year
T <sub>r</sub>	reference year
Nw	Notional amount of warrants (US\$bn)

*Examples of warrant pay off formulae:*

- a)  $IF((Q/Q_0) > 125\%, 2\%, 0\%)$  Pays 2% when real GDP exceeds 125% of the GDP in the reference year, 0% otherwise
- b)  $IF((Q/Q_0) > (1+2\%)^{(T-T_0)}, 2\%, 0\%)$  Pays 2% when current GDP exceeds projected level assuming 2% trend from reference level
- c)  $IF((Q/Q_0) > 120\%, MAX(g, 0), 0\%)$  Pays a rate equal to the previous year's growth when GDP exceeds 120% of the reference GDP

The warrant pay off formula can be entered manually, or can be constructed by selecting from predefined inputs:

- a) **Payment floor** - The floor on warrant payments (usually zero).
- b) **Payment cap** - The ceiling on warrant payments (leave blank to ignore).
- c) **Trigger and Trigger Level**  
The variable used to determine when a payment is made. This can be either the annual growth rate (for the previous year), or the cumulative annual growth rate (since the reference year). The *Trigger level* is the level of the *Trigger* above which payments are made.
- d) **Pay off determinant and strike**  
The variable used to determine the value of the payment. This can again be either the growth rate of the previous year or the cumulative annual growth. In addition, the payment can be determined based on the percentage excess growth rate, or in terms of the US\$ value of the excess growth. If the US\$ growth value is chosen, the notional amount of the warrants issued will be included in the formula, so that the unit value of the warrant payment can be determined. The strike (%) is the level of the above variable which is subtracted from the actual growth rate (previous year or cumulative annual).
- e) **Factor** - A final multiplying factor applied to the payoff.

### 3. Warrant valuation

For valuation, we assume a constant (semi-annual, 30/360) discount rate is applied to the simulated payments. The average NPV of all 100 simulations is then taken as the NPV of the warrant. This is expressed relative to a unit warrant and in total US\$ terms.

To determine the impact of the warrant valuation on the fair price of the defaulted debt, we must calculate the exchange ratio implied by the restructuring. Minister Lavagna indicated that all the new bonds would carry the warrants. This would indicate that there would be \$43bn notional of warrants, relative to \$81.2bn notional of defaulted debt – implying an exchange ratio of 0.53. Therefore the unit warrant value must be multiplied by 0.53 to find the value in terms of the price of the defaulted debt. The price of the warrant in terms of the price of defaulted debt is shown highlighted at the bottom right of the model.



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