SSRG International Journal of Economics and Management Studies
ISSN: 2393 – 9125 / https://doi.org/10.14445/23939125/IJEMS-V7I3P117

Volume 7 Issue 3, 115-121, March, 2020

Original Article

How Likely is an Economic Depression?

Camilo Sarmiento

Inter-American Development Bank

Received Date: 23 February 2020
Revised Date: 26 March 2020
Accepted Date: 28 March 2020

Abstract *- This paper uses a panel vector-autoregressive (VAR) process with different distributional assumptions to forecast GDP contraction severities and identify the likelihood of a depression threshold event across main Latin American countries. We compare these results to similar hypothetical events for U.S., U.K., France, and Canada.*

Keywords *- Economic Depression, Latin America, Tail Event, Vector Autoregressive Model.*

I. INTRODUCTION

Recessions relate to normal contractions in output that occur as part of thebusiness cycle.If history is to provide some guidance, after a period of sustained economic growth, economic activity invariably falls into a period of contraction.[1] It is fair to assume that economic cycles tend to last 10-years, and the official definition of a recession is the occurrence of two consecutive quarters of economic contraction.[2] The definition of a depression is avery severe recession that consists of either a decline in real GDP of at least 10 percent from peak to trough, or a recession that lasts 2 years or more.[3]

To conduct an empirical analysis of the likelihood of a depression, we provide a definition of depression that is more specific. This more refined definition makes the empirical analysis more transparent without much loss of generality. For the first definition, we consider a decline in realGDP of at least 10 percent in the span of 12 months. For the second definition, we consider back-to-back years of declines in GDP of at least 0.5%. No major developed country has met either of these two thresholds in the last 40 years.

During the Latin American Debt Crisis in the 1980, Argentina, Chile, Peru, and Venezuela hit both thresholds for a depression event. In the 2010s, Argentina and Brazilonly hit thesecond threshold for a depression, while Venezuela hit both thresholds. Clearly, the first threshold is more severe. We can, therefore, examine the condition of back-to-back years of declines in GDP as the weak condition for a depression, and if the first criterionis met,then the strong condition for a depression is met. So how likely is the event of a depression inLatin American countries, and how does it compare to a developed country?

In this paper, we estimate the likelihood of the weak and strong conditionsfor a depression. This derived condition can be a useful benchmark in the determination of capital requirements that focus on a one-year horizon (e.g., under Basel II), as well as to conduct stress testing for portfolios with Latin American exposures.

To do so, we use a panel vector-autoregressive(VAR) process with different distributional assumptions to forecast GDP contraction severities and identify the likelihood of a depression threshold event across main Latin American countries. We compare these results to similar hypothetical events for U.S., U.K., France, and Canada.

From the VAR model, the likelihood of a depression for a given country depends on the country's GDP growth trend as well as on the historical volatility of GDP growth. In the generation of scenarios, the VAR approach,thus,combines systematic trends with an idiosyncratic shock. The latter shock provides the catalyzer for the depression event. The odds for such catalyzer, however, vary largely across countries. In Latin America, we show that Argentina, Brazil, and Mexico have odds of a depression (the weak version) that are larger than 3 percent. Moreover, these odds triple if these countries were to have current account deficits at levels that tend to precede a balance of payments crisis.

The stress testing further indicates that the probability of a depression event (the weak version) is much smaller for developed counties, and the results of the stress testing are less sensitive to the presence of larger current account deficits observed in Latin American countries. Nonetheless, the observation that developed countries exhibit fat tails in the distribution of GDP growth underscores that the risk of a large recession (such as the Great Recession) is larger for

[1]Goodwin (1948) provides the seminal work for endogenous-cycle models.
[2]The National Bureau of Economic Research has an official definition of recession based on more rigorous analysis that includes other economic indicators such as is the unemployment rate.
[3]https://www.economist.com/finance-and-economics/2008/12/30/diagnosing-depression.

these countries against the assumption of a normal distribution.

II. GDP GROWTH FORECAST

Scenariosthat hit the threshold for a depression aremodelled as an extreme random shock and, therefore, such a state of nature departsfrom a normal contraction. Both shocks in the form of the weak or strong version of a depression are modeled. This scenario is part of the data generating process (DGP) of GDP growth and, for some countries,it constitutes a very rare event.

To capture the aforementioned DGP, we use a panel VAR model that incorporates feedback across the macroeconomic factors that drive the likelihood of an economic crisis in Latin America. Specifically, the macro forecast model is:

$$X_{c,t} = A_c + B\, X_{c,t-1} + \varepsilon_{c,t}$$

where

$$X_{c,t} = \begin{bmatrix} Current\ Account\ Balance\ as\ a\ Share\ of\ GDP_{c,t} \\ Saving\ Rate_{c,t} \\ GDP\ Growth\ Rate_{c,t} \end{bmatrix} = \begin{bmatrix} CA_{c,t} \\ SR_{c,t} \\ GDPG_{c,t} \end{bmatrix}.$$

The sample for the analysis consists of Latin American countries, and the data used in estimation spans from 1980 to 2018. The data source is the World Economic Outlook (WEO).

The choice of factors in the VAR model follows historical data reported in the WEO. The premise for the use of a multivariate model is the presence of a feedback mechanism between the GDP growth, current account balance as a percent of GDP, and the savings rate.

It is important to underscore that our reduced form equation model does not attempt to explain the causes of a depression, but rather determines the probabilistic value of such an event. Kehoe and Prescott(2002) andCole and Ohanian (2007) provide a general equilibrium framework that models the causes and dynamics that underpin large output contractions.Reinhart and Rogoff (2009) explain the depth and duration of recessions in terms of shocks to asset prices and a banking crisis. Aguiar and Gopinath (2006) present evidence that GDP contractions in developing countries (Latin America) are systematic, while GDP contractions in developed countries are highly idiosyncratic. Therefore, in emerging markets where fluctuations in income growth are systematic, it follows that shocks to income rather than the level of outstanding debt are the driver of default.

Table 1 shows the estimates of the vector B in the panel VAR model, and the corresponding p-value for GDP growth. (The Appendixshows the table with all the coefficient estimates that include country-level effects.)

Table 1. VAR model Estimates

Current Account Balance Equation				
Variable	**Estimate**	**SE**	**t-value**	**p-value**
$CA_{c,t-1}$	0.39	0.04	10.45	0.00
$SR_{c,t-1}$	0.13	0.03	3.89	0.00
$GDPG_{c,t-1}$	-0.11	0.04	-2.68	0.01
Saving Rate Equation				
Variable	**Estimate**	**SE**	**t-value**	**p-value**
$CA_{c,t-1}$	0.11	0.03	3.36	0.00
$SR_{c,t-1}$	0.72	0.03	25.27	0.00
$GDPG_{c,t-1}$	0.08	0.04	2.20	0.03
GDP Growth Equation				
Variable	**Estimate**	**SE**	**t-value**	**p-value**
$CA_{c,t-1}$	0.24	0.03	7.39	0.00
$GDPG_{c,t-1}$	0.30	0.04	8.29	0.00

The focus of the analysis is in the GDP growth equation that shows that both previous period GDP growth and previous period current account balance explain the current period GDP growth. From the VAR model, we can determine the likelihood of a depression in relation to a shock to GDP growth. The analysis focuses on the six largest Latin American countries: Argentina, Brazil, Chile, Colombia, Mexico, and Peru.

III. INTRODUCING A SHOCK TO GDP

To determine the likelihood of a depression, we model a shock to the data generating process of GDP through the stochastic component of $\varepsilon_{c,t}$In (1). The model framework thus falls within the impulse-propagation models, in which business cycles result from the response of the economy to exogenous shocks (see Chatterjee, 2000).

The severity of the shock depends on both the distribution of the stochastic process at the tail of the distribution and the extremity of the shock. To determine the shape of the distribution, we use at-distribution, which is a more general representation of the Normal distribution with a kurtosis that is different from three. Table 2 shows the calibration of the distribution of the stochastic component of DGP growth for the six largest Latin American countries.

Table 2. Calibration of t-Distribution for Latin American Countries

Country	Calibrated Degrees of Freedom (t-Distribution)	Gaussian Distribution?
Argentina	>100	YES
Brazil	>100	YES
Chile	3.6	NO
Colombia	5.0	NO
Mexico	3.8	NO
Peru	2.3	NO

Table 3 provides next year's (2020) forecasted scenarios (with 2019 information on the current account balance and the GDP growth rate as the starting point) based on the t-distribution calibrated in Table 2. Table 3 shows the likelihood of the strong condition of a depression for the next year across the six largest Latin American countries.

Table 3. The Likelihood of Depression (Strong Condition) for Latin American Countries

Country	Likelihood of the Strong Condition for a Depression	GDP Growth under a 100-Year Event
Argentina	2%	-11.4%
Brazil	<0.1%	-4.5%
Chile	0.2%	-5.6%
Colombia	<0.1%	-1.7%
Mexico	0.2%	-6.9%
Peru	1%	-11.6%

One nice attribute of the VAR approach is that it combines current trends ($X_{c,t-1}$) and systematic trends (A_c) to an idiosyncratic shock ($\varepsilon_{c,t}$). The current and systematic trends simply indicate that if a country is currently growing at less than one percent, it is more likely to fall into a depression relative to a country that is growing 4 percent. In terms of the idiosyncratic component, there are some economies that are more vulnerable to a larger shock. These economies tend to be the ones that are more vulnerable to external markets and exhibit higher reliance on natural resources to access foreign markets.

In addition to the strong condition for a depression, there is a weaker version. This weaker version provides a broader context to a depression, but it is a more likely event, as illustrated in Table 4. For the weaker version of the depression, we calculate the likelihood of back-to-back shocks to the idiosyncratic component (with 2019 information on the current account balance and the GDP growth rate as the starting point). For example, a 100-year event could correspond to two consecutive 10-year events.

Table 4 shows the likelihood of the weak condition of depression across the six largest Latin American countries.

The effects of both the systematic and idiosyncratic components in the likelihood of depression are elicited in Tables 3 and 4. For example, Table 4 provides a larger weight to the systematic component, while Table 3 provides a larger weight to the idiosyncratic component. Overall, it is apparent that the weaker definition of depression provides thresholds that are more reflective of current conditions.

Table 4. The Likelihood of Depression (Weak Condition) for Latin American Countries

Country	Likelihood of the Weak Condition for a Depression	GDP Growth under a 10-Year Event
Argentina	45%	-6.0%
Brazil	5%	-1.5%
Chile	0.8%	0.1%
Colombia	0.6%	1.0%
Mexico	4%	-1.5%
Peru	1.5%	-0.8%

Further insight can be attained when we compare the likelihood of a depression with that of developed countries. To do so, we use the VAR model structure in (1), but it is estimated for a panel of the U.S., Canada, UK, and France. The period of estimation is also 1980 to 2018.

Table 5 shows the estimates of the vector B in the panel VAR model and the corresponding p-value for GDP growth. (The Appendix shows the table with all the coefficient estimates that include country-level effects.)

Table 5. VAR model Estimates for Developed Countries

GDP Growth Equation				
Variable	**Estimate**	**SE**	**t-value**	**p-value**
$GDPG_{c,t-1}$	0.36	0.08	4.65	0.00

Comparison of Tables 1 and 5 reveals that the diffusion process on current GDP growth on future growth (B) is similar for large Latin American countries versus developed nations. Of course, the systematic trend growth (A_c) is larger for Latin American countries versus developed countries.

Lastly, the feedback mechanism between the external sector and GDP growth in Latin America is not observed for large developed countries in North America and Europe.

As in Table 2, we use at-distribution, which is a more general representation of the Normal distribution with a kurtosis that is different from three, to determine the shape of the distribution for developed countries. Table 6 shows the calibration of the distribution of the stochastic component of DGP growth for the US, Canada, France, and the U.K.

Table 6. Calibration of t-Distribution for Developed Countries

Country	Calibrated Degrees of Freedom (t-Distribution)	Gaussian Distribution?
UK	2.8	NO
France	5.9	NO
Canada	4	NO
U.S.	2.8	NO

Different from the developing world, developed countries (despite the presence of fat-tailed distributions) are not generally vulnerable to an economic depression.

As in Table 2, we provide next year's forecast scenarios based on the distribution in Table 6. Table 7 shows the likelihood of the strong condition of depression for the U.S., Canada, France, and the U.K., while Table 8 shows the likelihood of the weak condition for a depression.

Table 7. The Likelihood of Depression (Strong Condition) for Developed Countries

Country	Likelihood of the Strong Condition for a Depression	GDP Growth under a 100-Year Event
UK	<0.1%	-4.6%
France	<0.1%	-3.2%
Canada	<0.1%	-5.3%
U.S.	<0.1%	-5.1%

Table 8. The Likelihood of Depression (Weak Condition) for Developed Countries

Country	Likelihood of the Weak Condition for a Depression	GDP Growth under a 100-Year Event
UK	0.4%	0.63%
France	0.8%	0.03%
Canada	0.5%	0.37%
The U.S.	0.2%	1.13%

As expected, the results indicate that the event of a depression is a much less likely event in developed countries than in Latin America. This is consistent with the premise that developed countries are more diversified economies with buffers that allow these countries to better withstand a global shock.

However, the presence of a fat tail in the distribution of GDP growth for developed countries in Table 9 indicates that these economies could experience large output contractions under very rare idiosyncratic shocks, and the assumption of a Gaussian distribution underestimates the severities of recession in developed countries. In the context of the real business cycle theory, the normality assumption generates recessionary shocks that are much smaller than under at-distribution. The latter distribution is more consistent with the data generating process of GDP growth for developed countries.

Overall, Tables 6 through 9 suggest that the warnings of a depression as the 2008 financial crisis unfolded may have been overstated during the crisis,[4] and the risk of a Great Recession (as it unfolded) may have been understated due to the assumption of a normal distribution for the distribution of GDP growth.

Table 9. GDP Growth Stress under a Gaussian and a t-Distribution for Developed Countries

Country	GDP Growth under a 100-year Event (t-Distribution)	GDP Growth under a 100-year Event (Gaussian Distribution)
UK	-4.6%	-2.2%
France	-3.2%	-2.3%
Canada	-5.3%	-3.2%
The U.S.	-5.1%	-2.4%

IV. SENSITIVITY ANALYSIS

The VAR model for Latin America showed that there is a feedback between the current account balance and the GDP growth rate. This feedback can be further illustrated with a sensitivity analysis. To that end, we examine the likelihood of a depression (the weaker version) to the presence of a current account deficit of 6%. This level is generally associated with a sovereign tilting toward a balance of payments crisis.

[4]In the midst of the Great Recession, the Economist (Dec 30th, 2008 Edition) questioned the notion that a depression in the U.S. was a very remote possibility.

Table 10 shows the outcome from applying a shock to the GDP growth through the idiosyncratic component as in Table 4, while assuming a current account deficit of 6% in the VAR model (the systematic component.) The outcome is striking, showing that Latin American countries with a large current account deficit tend to be 3 times more likely to suffer a depression. In contrast, developed countries show little sensitivity to the odds of a depression relative to the current account deficit level.

Note that the likelihood of a depression for a country such as Colombia may be underestimated based on historical data. This is the case since Colombia's external sector has become increasingly intertwined with the price of oil.

Table 10: Sensitivity of the Odds of Depression to a Large Current Account Deficits

Country	Likelihood of the Weak Condition for a Depression (2019 Current Account)	Likelihood of the Weak Condition for a Depression (Current Account Deficit 6%)
Argentina	45%	>50%
Brazil	5%	16%
Chile	0.8%	2%
Colombia	0.6%	1%
Mexico	4%	12%
Peru	1%	4%

V. CONCLUSION AND LIMITATIONS OF THE ANALYSIS

This paper estimated a VAR process with different distributional assumptions to forecast GDP contraction severities and identify the likelihood of a depression event across main Latin American countries. We compared these results to the likelihood of similar events for the U.S., U.K., France, and Canada.

From the VAR model, the likelihood of a depression for a given country depends on the country's GDP growth trend as well as on the historical volatility of GDP growth. In the generation of scenarios, the VAR approach thus combines systematic trends with an idiosyncratic shock. The latter shock provides the catalyzer for the depression event. The odds for such catalyzer, however, vary largely across countries. In Latin America, we show that Argentina, Brazil, and Mexico have odds of a depression (the weak version) that are larger than 3 percent. Moreover, these odds triple if these countries were to have current account deficits at levels that tend to precede a balance of payments crisis.

The stress testing further indicated that the probability of a depression event (the weak version) is much smaller for developed counties, and the results of the stress testing are less sensitive to the presence of larger current account deficits observed in Latin American countries. Nonetheless, the observation that developed countries exhibit fat tails in the distribution of GDP growth underscores that the risk of a large recession (such as the Great Recession) is larger for these countries against the assumption of normal distribution.

The testing also indicates that the odds of a strong version of a depression are quite low for large Latin American countries (with the exception of Argentina). These odds are, however, calculated based on the 2020 forecast provided by the VAR model.

In terms of capital requirements, these odds of depression are closely linked to the likelihood of a sovereign default. Worsening odds of a depression should result in higher capital requirements for sovereign exposures.

Lastly, the use of the VAR model provides a dynamic view to the stress testing that tracks how the vulnerabilities of each Latin American country to a large loss of income change as current economic conditions either improve or worsen.

An important consideration is a period used in the estimation of the VAR model that started in the 1980s in accordance withthe World Economic Outlook database. The data encompasses the debt crisis of the 1980s, the Tequila Crisis, the burst of the internet bubble (with equity price drops of 50%), and the Great Depression (with annual home price declines of 20 percent in the U.S. in 2008 and 2009). Our view is that the chosen period incorporates volatilities, institutions, and economic interactions across countries that are more representative of the current period for both developed and developing countries (see Caprio et al., 2005; Calomiris and Gorton, 1991). The dataset also provides a more representative notion of conditions that underpin the functioning of a developed country (post-Great Depression and WWII period) that more closely resembles the current conditions in Canada, France, the US, and the UK.

Some caveats from the analysis are that structural changes in developed countries in terms of vulnerability to a depression event may occur if debt levels in both the public and private sectors become unsustainable. The robustness of developed countries to a depression event should thus not be taken for granted. The wrong policies can lead to a shift from history.

VI. REFERENCES

[1] Aguiar, M , G. Gopinath.,Defaultable Debt, Interest Rates, and the Current Account.Journal of International Economics, 69(2006) 64-83.

[2] Calomiris, C.W., G. Gorton.,The Origins of Banking Panics: Models, Facts, and Bank Regulation." In Financial Markets and Financial Crises, edited by R. Glenn Hubbard, Chicago: University of Chicago Press,(1991)109–73.

[3] Caprio, G., D. Klingebiel, L. Laeven, and G. Noguera Banking Crisis Database.In Systemic Financial Crises: Containment and Resolution, edited by Patrick Honohan and Luc Laeven, Cambridge: Cambridge University Press(2005)307– 40.

[4] Chatterjee, S.From Cycles to Shocks: Progress in Business-Cycle Theory.Federal Reserve Bank of Philadelphia Business Review, (2000) 27-37.

[5] Cole, H.L., and L.E. Ohanian A Second Look at the U.S. Great Depression from a Neoclassical Perspective. In Timothy J. Kehoe and Edward C. Prescott, editors, Great depressions of the twentieth century. Federal Reserve Bank of Minneapolis, (2007)21–58.

[6] Conesa, J.C., T.J., Kehoe, K. Ruhl Modeling Great Depressions: The Depression in Finland in the 1990s NBER Working Paper No. 13591(2007).

[7] Goodwin, R.M., Secular and Cyclical Aspects of the Multiplier and the Accelerator. In Income, Employment and Public Policy: Essays in Honor of Alvin H. Hansen. New York: W. W. Norton & Co(1948).

[8] Kehoe, T.J., and E.C. Prescott Great Depressions of the Twentieth Century. Review of Economic Dynamics, 5(2002) 1–18

[9] Reinhart, C.M. , K. S. Rogoff The Aftermath of Financial Crises.American Economic Review, 99(2009) 466-472.

APPENDIX

Table 11. VAR Model Estimates for Latin America

Current Account Balance Equation				
Country	**Estimate**	**SE**	**t-value**	**p-value**
Argentina	-2.57	0.86	-3.00	0.00
Bolivia	-2.62	0.80	-3.25	0.00
Brazil	-3.02	0.88	-3.43	0.00
Chile	-3.42	0.92	-3.74	0.00
Colombia	-3.17	0.86	-3.66	0.00
Costa Rica	-4.54	0.89	-5.10	0.00
Dominican Republic	-3.47	0.90	-3.86	0.00
Ecuador	-3.10	0.91	-3.42	0.00
El Salvador	-3.28	0.81	-4.04	0.00
Guatemala	-3.52	0.79	-4.43	0.00
Honduras	-4.88	0.91	-5.37	0.00
Mexico	-3.23	0.93	-3.46	0.00
Nicaragua	-11.14	1.05	-10.62	0.00
Panama	-4.30	0.94	-4.57	0.00
Paraguay	-2.63	0.93	-2.82	0.00
Peru	-4.21	0.93	-4.53	0.00
Venezuela	-0.79	1.03	-0.77	0.44
$CA_{c,t-1}$	0.39	0.04	10.45	0.00
$SR_{c,t-1}$	0.13	0.03	3.89	0.00
$GDPG_{c,t-1}$	-0.11	0.04	-2.68	0.01
Saving Rate Equation				
Country	**Estimate**	**SE**	**t-value**	**p-value**
Argentina	4.68	0.76	6.17	0.00
Bolivia	3.96	0.71	5.57	0.00
Brazil	4.92	0.78	6.34	0.00
Chile	5.55	0.81	6.87	0.00
Colombia	4.78	0.76	6.26	0.00
Costa Rica	4.93	0.79	6.28	0.00
Dominican Republic	5.46	0.79	6.88	0.00
Ecuador	5.58	0.80	6.97	0.00
El Salvador	4.20	0.72	5.86	0.00
Guatemala	3.60	0.70	5.14	0.00
Honduras	5.51	0.80	6.87	0.00
Mexico	5.67	0.83	6.86	0.00
Nicaragua	5.35	0.93	5.78	0.00
Panama	6.23	0.83	7.49	0.00
Paraguay	5.58	0.82	6.77	0.00

Peru	5.26	0.82	6.41	0.00
Venezuela	6.16	0.91	6.76	0.00
$CA_{c,t-1}$	0.11	0.03	3.36	0.00
$SR_{c,t-1}$	0.72	0.03	25.27	0.00
$GDPG_{c,t-1}$	0.08	0.04	2.20	0.03
GDP Growth Equation				
Country	**Estimate**	**SE**	**t-value**	**p-value**
Argentina	1.70	0.78	2.17	0.03
Bolivia	2.57	0.73	3.50	0.00
Brazil	1.98	0.80	2.47	0.01
Chile	3.61	0.83	4.32	0.00
Colombia	2.95	0.79	3.74	0.00
Costa Rica	3.99	0.81	4.92	0.00
Dominican Republic	3.89	0.82	4.75	0.00
Ecuador	2.49	0.83	3.02	0.00
El Salvador	2.00	0.74	2.70	0.01
Guatemala	2.91	0.72	4.03	0.00
Honduras	3.74	0.83	4.51	0.00
Mexico	2.05	0.85	2.41	0.02
Nicaragua	5.88	0.96	6.14	0.00
Panama	4.37	0.86	5.09	0.00
Paraguay	2.48	0.85	2.91	0.00
Peru	3.13	0.85	3.68	0.00
Venezuela	-0.40	0.94	-0.42	0.67
$CA_{c,t-1}$	0.24	0.03	7.02	0.00
$SR_{c,t-1}$	0.00	0.03	-0.03	0.97
$GDPG_{c,t-1}$	0.30	0.04	7.95	0.00

Table 12. VAR Model Estimates for Developed Countries

GDP Growth Equation				
Country	**Estimate**	**SE**	**t-value**	**p-value**
The U.K.	1.66	0.35	4.70	0.00
France	1.15	0.31	3.69	0.00
Canada	1.77	0.41	4.33	0.00
The U.S.	1.95	0.39	4.96	0.00
$CA_{c,t-1}$	0.09	0.08	1.06	0.29
$GDPG_{c,t-1}$	0.36	0.08	4.65	0.00