Box 1.3. Are Equity Price Drops Harbingers of Recession?

The recent sharp drop in equity prices around the world has raised concerns about the possibility of a double-dip recession in a number of advanced economies. Several factors may have played a role in this fall in equity prices: the sovereign debt problems in the euro area; a downgrade of U.S. federal government debt; and the limited room for policy maneuver by advanced economies that are facing a weaker-than-expected economic recovery. To the extent that such factors simultaneously affect confidence and equity prices, an equity price drop can be indicative of a greater risk of recession, reflecting falling earnings expectations. In their own right, weak or falling equity prices can be a drag on consumption and investment through their effects on private sector wealth and borrowing constraints. Accordingly, many think that a double-dip recession in the United States and other advanced economies has become more likely. However, others have noted that equity price drops have not always been good predictors of recessions. As Paul Samuelson (1966) famously remarked, "The stock market has forecast nine of the last five recessions."

This box examines the performance of equity prices as coincident predictors of a new recession in France, Japan, the United Kingdom, and the United States.[1] Table 1.3.1 displays summary statistics on quarterly real equity price changes for these countries from the first quarter of 1970 through the first half of 2011. We find that real equity prices in these economies are useful predictors of recessions. However, in contrast with the existing literature, there is some evidence of important nonlinearities in the relationship between equity prices and recessions among those economies for which equity prices had predictive power. Equity price drops, defined as a quarterly decline in average

Table 1.3.1. Summary Statistics for Real Equity Price Growth
(Quarter-over-quarter, seasonally adjusted)

Statistic	France	Japan	United Kingdom	United States
Mean	1.1	0.8	1.2	1.4
Standard deviation	8.0	7.7	6.7	5.0
Median	1.5	1.5	1.8	1.9
10th Percentile	−10.0	−9.5	−7.1	−4.6
25th Percentile	−4.1	−3.1	−2.2	−1.4
75th Percentile	5.6	5.1	5.4	4.4
90th Percentile	10.6	9.2	8.7	8.4
Minimum	−22.2	−17.9	−23.1	−18.3
Maximum	25.4	27.1	18.8	14.0
Number of observations	138	141	135	132

Sources: Datastream; Haver Analytics; *IMF, International Financial Statistics;* and IMF staff calculations.

Note: The average nominal equity price index for each economy is converted to real terms using the respective consumer price index. The resulting average real equity price indices are then seasonally adjusted using the X12-ARIMA procedure.

real equity prices of 5 percent or more, significantly improve the accuracy of recession predictions for the United Kingdom and the United States but not for France and Japan.[2]

We also investigate whether the predictive power of equity prices in our simple probability model is materially changed by the addition of other financial variables, including a measure of spillovers from equity markets elsewhere, the term spread, real house price growth, real credit growth, or real oil price peaks. For Japan, the United Kingdom, and the United States, real equity prices remain an important and statistically significant coincident predictor of a new recession across all checks. This may be a reflection of the fact that these economies are home to the largest equity markets in the world. Apart from the case in which a measure of international equity prices is included, domestic equity prices are also an important predictor of a new recession in France.

Finally, we look at the predictive power of real equity price declines in the three other G7 economies. For Canada and Germany, there is no evidence

The main authors of this box are John C. Bluedorn, Jörg Decressin, and Marco E. Terrones.

[1]The beginnings of new recessions are defined according to the method of Harding and Pagan (2002), as implemented by Claessens, Kose, and Terrones (2011c). A cyclical peak or start of a new recession is defined to occur in a quarter if the level of real GDP is higher than during both the prior two quarters and the subsequent two quarters. For the United States, the Harding and Pagan–identified peaks exactly coincide with the NBER-identified peaks in four cases and precede the NBER peak by one quarter in the other two cases.

[2]The choice of 5 percent as the threshold is based on the evidence presented in Claessens, Kose, and Terrones (2011c) that equity price busts (the bottom quartile of periods characterized by equity price falls) have a median decline of about 5½ percent a quarter (Table 4, column 4).

Box 1.3 *(continued)*

that equity prices aid in predicting recessions, whereas for Italy, their predictive power is consistently superseded by the inclusion of additional financial market variables. Consequently, the remainder of the box focuses on the evidence for France, Japan, the United Kingdom, and the United States.[3]

Recession Forecasting

Real-time recession prediction remains an elusive endeavor (Hamilton, 2010). Forecasters are confronted with data limitations, changing economic relationships, and sometimes perverse incentive schemes (Loungani and Trehan, 2002). Although some leading indicator models find that equity prices help improve output growth forecasts for the United States, these models have failed to predict recent recessions (Stock and Watson, 2003).

More recent efforts to forecast the onset of a recession have used straightforward probabilistic models, such as logit or probit. These models take advantage of the fact that cyclical peaks can be modeled as binary indicators (with a value of 1 when the economy has reached its peak and zero otherwise). The most important finding of this literature is that the term spread (the difference between the long-term interest rate and the short-term interest rate) is an important predictor of recessions in the euro area (Moneta, 2003) and the United States (Estrella and Mishkin, 1998; Estrella, 2005; Wright, 2006; and Nyberg, 2010). A number of these studies also find that domestic equity prices can be useful in predicting recessions (Estrella and Mishkin, 1998; and Nyberg, 2010). This literature, however, does not examine in detail the role that other financial variables, such as international equity prices, house prices, and credit, play in forecasting recessions. Recent research indicates that developments in these markets are associated with the characteristics of recessions and recoveries (Claessens, Kose, and Terrones, 2011c).

Predicting the Probability of a New Recession

To explore how a particular variable helps predict new recessions in France, Japan, the United

[3]The results for Canada, Germany, and Italy are available at www.imf.org/weoforum.

Kingdom, and the United States, we use a simple probabilistic model for each economy. The explanatory variables included in our baseline logit model are the contemporaneous quarterly growth rate of the economy's average real equity price index, an indicator variable for whether the real equity price index dropped quarter-over-quarter by 5 percent or more, and the interaction (product) of these two variables. This model allows us to explore the relevance of nonlinearities in the information conveyed by equity price changes about the likelihood of a recession. In particular, sharp drops in equity prices are more likely to be followed by a new recession, reflecting both the destruction of private sector wealth and possible underlying weaknesses in the macroeconomy.

The following findings stand out (Table 1.3.2):

- In the United Kingdom and the United States, there is evidence of important nonlinearities in the information that equity prices convey about the probability of a new recession. This is shown in the statistical significance of equity price growth, the equity price drop indicator, and their interaction as predictors of a new recession. The in-sample performance of the baseline model for these economies is very strong, as reflected by AUC statistics of 0.85 and 0.90, respectively.[4] As seen in Table 1.3.2, column 3, the average probability of a new recession occurring in any quarter, conditional upon observing a drop in equity prices of 5 percent or more, is around 20 percent. By contrast, if no equity price drop is observed, the estimated average probability is insignificantly different from zero. To get a sense for how equity price growth, which is continuous, affects the probability of a new recession, we calculate the marginal effect on the average recession probability of a 1 percent fall in equity prices. As shown in Table 1.3.2, column 1, if only equity price growth is included, the marginal effect of

[4]The AUC statistic is the area under the receiver operating characteristic, which is described in Box 1.2. It is indicative of how well the model classifies the start of a recession versus the absence of recession observations in-sample, relative to a fair coin toss (which would have a 50 percent chance of correctly classifying the situation). A perfect classifier would have an AUC statistic of 1.

Box 1.3 *(continued)*

Table 1.3.2. Predicting New Recessions with Financial Market Variables
(Logit model, dependant variable—New recession starts with quarter t [1 if true and zero if false])

Explanatory Variable	France (1)	France (2)	France (3)	Japan (1)	Japan (2)	Japan (3)	United Kingdom (1)	United Kingdom (2)	United Kingdom (3)	United States (1)	United States (2)	United States (3)
Equity Price Change in Quarter t (Change in quarterly average equity price index)	−0.174** (0.0746)		−0.0984*** (0.024)	−0.258** (0.108)		−0.304*** (0.0444)	−0.153 (0.0598)		0.173*** (0.0367)	−0.181*** (0.0689)		−0.280* (0.169)
Equity Price Drop > 5% (Indicator is 1 if true and zero if false)		1.970** (0.945)	−3.014 (2.703)		2.648** (1.181)	−3.128 (2.722)		3.350*** (1.154)	3.767** (1.803)		2.691*** (0.898)	4.566** (1.78)
Interaction of Equity Drop and Equity Price Change			−0.265 (0.211)			−0.145 (0.197)			−0.220* (0.13)			0.546** (0.268)
Constant	−3.970*** (0.801)	−4.007*** (0.716)	−3.766*** (0.723)	−4.967*** (1.269)	−4.727*** (1.008)	−4.525*** (1.011)	−3.624*** (0.616)	−4.736*** (1.008)	−5.644*** (1.004)	−3.186*** (0.431)	−3.672*** (0.587)	−3.529*** (0.616)
Number of Observations	138	138	138	141	141	141	135	135	135	132	132	132
Pseudo R^2	0.209	0.101	0.251	0.303	0.167	0.33	0.163	0.264	0.287	0.124	0.16	0.233
Log Likelihood	−17	−19.33	−16.1	−12.69	−15.15	−12.18	−17.89	−15.75	−15.25	−21.39	−20.5	−18.71
AUC	0.8	0.71	0.824	0.902	0.788	0.911	0.773	0.835	0.892	0.829	0.715	0.84
Average Predicted Probabilities and Marginal Effects												
Average Predicted Probability if *No* Equity Price Drop > 5%		0.0179 (0.0126)	0.0156 (0.011)		0.00877 (0.00876)	0.00368 (0.00367)		0.0087 (0.00869)	0.00608 (0.00606)		0.0248* (0.0142)	0.0152 (0.0121)
Average Predicted Probability if Equity Price Drop > 5%		0.115* (0.0629)	0.0544 (0.0342)		0.111* (0.067)	0.0539 (0.0405)		0.200** (0.0898)	0.197* (0.0911)		0.273** (0.135)	0.228* (0.133)
Marginal Effect if Equity Price Rise of 1%	−0.00538** (0.00262)		−0.00614** (0.00309)	−0.00606** (0.00304)		−0.00869** (0.00405)	−0.00491** (0.00226)		0.000157 (0.00315)	−0.00722* (0.00378)		−0.002 (0.00587)

Sources: Datastream; Haver Analytics; IMF, *International Financial Statistics*; Claessens, Kose, and Terrones (2011c); and IMF staff calculations.

Note: Robust standard errors are in parentheses underneath the estimates. *, **, and *** denote significance at the 10, 5, and 1 percent level, respectively.
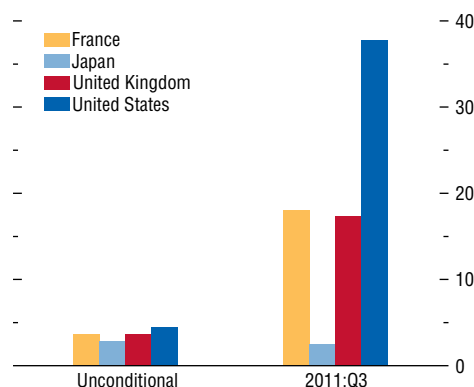
Box 1.3 *(continued)*

a 1 percent fall is a rise in the estimated probability of a new recession by around 0.7 percent for the United States and around 0.5 percent for the United Kingdom. If the equity price drop indicator and its interaction with equity price growth are included, the marginal effect of equity price growth alone is tiny and no longer statistically significant in helping to predict a recession, revealing the importance of nonlinearities in the form of large equity price drops.

- Interestingly, this nonlinearity in the predictive power of equity prices is not evident for France and Japan. Instead, there appears to be a robust, linear relationship between equity price growth and the likelihood of a new recession—large equity price drops do not appear to convey any more information than small drops. The in-sample performance of this model is also strong, as reflected in an AUC of 0.82 for France and 0.91 for Japan. The marginal effect of a 1 percent fall in equity prices is associated with a rise in the probability of a new recession of between 0.5 and 0.6 percent for France and 0.6 and 0.9 percent for Japan.

As noted earlier, we also investigate whether the predictive power of equity prices is materially changed by the addition of other financial variables (such as the term spread, real house prices, and real credit) and real oil prices. Apart from one instance in the case of France, equity prices remain important, coincident predictors of new recessions. The additional financial variables that improve recession prediction differed across these economies. For the United States, a measure of spillovers from equity price movements in the G7, the term spread, and the change in real house prices are all significant predictors of new recessions.[5] For the United Kingdom,

Figure 1.3.1. Predicted Probability of a New Recession in a Quarter

Sources: Claessens, Kose, and Terrones (2011c); Haver Analytics; and IMF Staff Calculations.
Note: The equity price indices used in the estimation are: S&P 500 for the United States, FTSE All Shares for the United Kingdom, CAC All-Tradable for France, and the Nikkei 225 for Japan. The Claessens, Kose, and Terrones (2011c) recession indicator is used for the starts of recessions. Probability estimates are derived from a simple logit model for the recession indicator over the period 1970:Q1 to 2011:Q2, excluding periods during which the economy is already in recession and the quarter just after a recession concludes. The logit model takes as arguments the real equity price change, a dummy for large drops (> 5%) and their interaction. To calculate the average for 2011:Q3, we assume that the last, daily equity price index extends to the end of the quarter. We then calculate the quarterly average level for 2011:Q3 over these daily observations. Latest data are for August 24, 2011.

commodity prices appear to be important, with the peak real oil price growth serving as a significant predictor, while the measure of equity spillovers, the term spread, and real house prices do not.[6] For France, the measure of equity spillovers and the term spread are important predictors. In the model that includes the equity spillover measure, the domestic equity price variables are not statistically significant. For Japan, none of the additional financial variables are important—equity prices alone appear to convey information on the likelihood of a recession.

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[5]The measure of spillovers from equity price movements is defined as the weighted average of quarter-over-quarter, real equity price growth in the G7 economies, with the weight being nominal GDP in U.S. dollars. The term spread is defined to be the difference between the interest rate on a 10-year government bond and that on a three-month Treasury bill. Real house price changes are calculated from real house price data supplied by the Organization for Economic Cooperation and Development. Real credit growth is calculated from the CPI-deflated credit (line 22d) in the IMF's *International Financial Statistics*. Peak real oil price growth is

calculated from the seasonally adjusted (X-12 ARIMA), U.S. CPI-deflated oil price index in the *World Economic Outlook*.

[6]The peak real oil price growth is defined according to Hamilton (2003). It is the maximum of either zero or the log difference between the current real oil price and the peak real oil price over the previous three years.

Box 1.3 *(continued)*

Despite the statistical significance of some of the additional financial variables, the in-sample performance (as measured by the AUC statistic) is not statistically significantly different from the baseline model (column 3 of Table 1.3.2) for any of the four economies.

What Does This Say about the Future?

This box examines the performance of sharp drops in equity prices in predicting new recessions in France, Japan, the United Kingdom, and the United States. The findings suggest that allowing for nonlinearities in the effects of equity prices can be useful in predicting recessions in the United Kingdom and the United States. Although there is no evidence of such nonlinearities in France and Japan, equity price changes still show up as useful coincident predictors of new recessions. These findings suggest that policymakers should be mindful of sharp drops in equity prices because they are associated with an increased risk of a new recession.

An application of the baseline model paints a sobering picture about the likelihood of a double-dip recession in France, the United Kingdom, and the United States in light of the recent sharp drop in equity prices. As seen in Figure 1.3.1, the historical or unconditional probabilities of a new recession starting in the third quarter of 2011 are about 3½ percent for France and the United Kingdom and about 4½ percent for the United States. Assuming that the recent behavior of the equity markets in these economies during the third quarter of 2011 continues, the predicted likelihood of a new recession rises about fivefold for France and the United Kingdom (to about 18 percent and 17 percent, respectively) and eightfold for the United States (to about 38 percent). By contrast, the model for Japan indicates that there has been essentially no change in the likelihood of a new recession there.