IMF Staff Papers
Vol. 49, Special Issue

How Do Large Depreciations Affect Firm Performance?

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This paper examines how 12 "major depreciations" between 1997 and 2000 affected different measures of firm performance in a sample of over 13,500 companies from around the world. Results suggest that in the year after depreciations, firms have significantly higher growth in market capitalization, but significantly lower growth in net income (when measured in local currency). Firms with greater foreign sales exposure have significantly better performance after depreciations, according to a range of indicators. Firms with higher debt ratios tend to have lower net income growth, but there is no robust relationship between debt exposure and the other performance variables. Larger firms frequently have worse performance than smaller firms, although the significance and robustness of this result fluctuates across specifications. [JEL F1, F2, F3]

In the later half of the 1990's, a number of countries experienced substantial currency depreciations. These depreciations include not only the well-known currency crises where countries abandoned pegged exchange rates, such as in Thailand and Korea in 1997, but also less well-documented examples where countries with more flexible exchange rates experienced unusually large depreciations, such as in Mexico and South Africa in 1998. In some cases, these depreciations were followed by a surge in production and improvement in economic growth, while in other cases the depreciations were followed by a decline in output and severe recession.

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Table 1. Firm Performance After Recent Depreciations

	Median Growth in Year of Depreciation[1]		Median Growth in Year After Depreciation[1]	
	Sales	Net Income	Sales	Net Income
Brazil (1999)	–17.6	–56.1	—	—
Czech Republic (1998)	18.3	14.5	–16.5	–18.6
Greece (1998)	20.1	18.3	6.1	28.5
Indonesia (1997)	–35.0	–94.2	–19.5	–33.4
Israel (1998)	–2.5	–13.9	11.8	32.8
Malaysia (1997)	–9.1	–28.4	–24.9	–74.9
Mexico (1998)	6.2	–36.6	18.5	23.9
Pakistan (1998)	–6.8	–13.3	–3.1	–5.8
Philippines (1997)	–19.7	–34.6	–1.1	–32.7
South Africa (1998)	–9.1	–15.0	9.8	3.4
South Korea (1997)	–42.1	–69.0	34.7	19.3
Thailand (1997)	–43.3	–124.2	28.0	–91.4
Average	*–11.7*	*–37.7*	*4.0*	*–13.5*

Notes: Sales and net income measured in U.S. dollars; statistics are median values for all firms in the given country in the given year; dataset is discussed in detail in Section I.

[1]Depreciations defined as a 10 percent or greater increase in a country's U.S. dollar exchange rate in any 4-week period. See Table 2 for additional information and exact dates.

Why are some depreciations expansionary and others contractionary? This paper partially addresses this question by focusing on one specific aspect of depreciations—how they affect firm performance. Depreciations could affect firm performance through a number of channels, such as raising the cost of imported inputs relative to other factors of production, providing exporters with a relative cost advantage relative to foreign competitors, or generating higher borrowing costs and a contraction in lending. Although the impact of depreciations on firm performance is only one component determining how depreciations affect aggregate economic growth, it can be an important and significant determinant of why some depreciations are expansionary and others are contractionary. Moreover, the firm-level impact of depreciations has not been well examined in previous work, and the basic stylized facts have not yet been documented.

Table 1 shows the diverse impact that 12 recent depreciations have had on firm sales growth and net income growth.[1] There is a remarkable difference in firm performance across different countries, even during the same crisis periods. For example, during the Asian crisis and corresponding depreciations in 1997, the median growth rates in sales and net income for South Korean firms were –42 percent and –69 percent, respectively, while the comparable growth rates for Malaysian firms were –9 percent and –28 percent. In 1998, however, the relative performance of firms in Malaysia and Korea reversed. Firms in Korea quickly recovered from the crisis and appeared to benefit from the depreciations, with median

[1]Exact definitions and the dataset are discussed in more detail in Section I.

growth in sales and net income of +35 percent and +19 percent, respectively. The performance of Malaysian firms continued to deteriorate, with median growth in sales and net income of –25 percent and –75 percent. Moreover, the experiences of firms in the Czech Republic, Greece, and Mexico suggest that firms do not necessarily exhibit negative performance after depreciations. For example, median sales growth for firms in all three countries was positive after their depreciations in 1998.

This paper attempts to better understand these patterns by examining how recent depreciations affected different measures of firm performance. More specifically, the paper uses a sample of over 13,500 firms from 42 countries to examine the impact of 12 "major depreciations" between 1997 and 2000. It evaluates firm performance based on the immediate impact of depreciations on sales and net income, as well as the expected longer-term impact as measured by changes in market capitalization and asset value. The paper also analyzes how individual firm characteristics, such as output type, foreign sales exposure, production structure, debt outstanding, size, and profitability determine the impact of depreciations on performance.

Results suggest that in the year after depreciations, firms have significantly higher growth in market capitalization (when measured in local currency or U.S. dollars), but significantly lower growth in net income (when measured in local currency). Firms with greater foreign sales exposure have significantly better performance, according to a range of performance variables. Firms with higher debt ratios tend to have lower net income growth after depreciations, but there is no robust relationship between debt levels and the other performance variables. Larger firms often have worse performance than smaller firms, although the significance and robustness of this result fluctuates across specifications. There appears to be no consistent relationship between a firm's profitability or capital/asset ratio and the impact of depreciations on firm performance.

This paper is related to four diverse branches of literature: the impact of devaluations on exports; the effect of financial crises on macroeconomic variables; the importance of exchange-rate exposure to stock returns; and the extent of pass-through from currency movements to goods' prices. Each of these literatures is so extensive that this paper does not attempt to summarize the relevant papers, but Forbes (2002b) provides a short overview and list of related references. Moreover, despite the range of topics and frameworks in these four branches of literature, none of this work explicitly addresses the key question explored in this paper: how do depreciations affect firm performance? The first two branches of literature focus on macroeconomic relationships and country-level evidence. The last two branches use firm-level models and data, but only consider how exchange-rate movements affect stock returns or product prices.

There is one paper, however, that does not fall into any of the four categories discussed above and that is closely related to this paper. Forbes (2002a) examines how a series of major devaluations affected commodity firms in the "crisis" country as well as competitors in the rest of the world. It focuses on one particular aspect of devaluations—how they affect the relative cost of labor and capital and, therefore, influence firm production levels, profitability, investment decisions, and stock returns. The paper develops these ideas in a small, open-economy model and then performs a series of empirical tests using information for about 1,100 firms

in 10 commodity industries. The empirical tests support the model's main prediction that immediately after devaluations, firms in the crisis country have higher growth rates for output and operating profits than competitors in other countries. Results also support the prediction that the effect of devaluations on capital investment and stock returns (and therefore expected long-run output and profits) is determined by capital/labor ratios and changes in the cost of capital.

This paper builds on the framework in Forbes (2002a) in several ways. First, instead of focusing solely on commodity firms, it examines the impact of depreciations on a much larger set of companies from a range of industries. Second, this paper considers a wider range of effects of depreciations on firm performance. Instead of focusing mainly on how capital/labor ratios determine the impact of depreciations, it also considers the importance of output characteristics, foreign sales exposure, debt outstanding, firm size, and profitability. Finally, instead of focusing solely on "devaluation events" (when countries suddenly abandon rigid exchange rate regimes), this paper also considers "depreciation events" (when countries with more flexible exchange rate regimes experienced unusually rapid losses in their currency's value).

I. Depreciation Events and Dataset

The following analysis defines "depreciation events" as any 4-week period when a country's U.S. dollar exchange rate depreciated by 10 percent or more.[2] In order to correspond to the firm-level dataset, the period considered is January 1, 1997 through December 31, 1999. Also, it only includes countries with information for at least 50 firms during this period. Table 2 lists the resulting 12 depreciation events in chronological order, as well as the months when the depreciations occurred. This list of depreciation events includes the well-known currency crises, such as the series of devaluations in Asia in the later half of 1997 and the Brazilian devaluation in early 1999. It also includes a series of depreciations that were not standard currency crises, but involved the adjustment of more flexible exchange rate regimes (such as Mexico and Israel in 1998).[3]

The firm-level dataset is compiled from the *Worldscope March 2001 CD-ROM* published by Primark. This Worldscope database contains balance sheet, income statement, cash flow, and general company information for firms from 51 countries, representing about 90 percent of global market capitalization (according to their literature).[4] The dataset includes historical information on firms that

[2]The exchange-rate data is from *Datastream*. After a depreciation event, the next year is excluded so that there can be, at most, one depreciation event within any 12-month period.

[3]Some well-known currency crises (such as the devaluations in Russia in 1998 and Ecuador in 1999) are not included since there is insufficient firm-level data for these countries.

[4]There are several limitations with this data. First, since Worldscope only reports information that is publicly available, virtually all of the sample consists of publicly traded companies. Most private and government-owned companies are not included. Second, although Worldscope attempts to correct for major differences in cross-country accounting standards, significant differences may still exist for certain variables. The analysis below addresses this problem by using a range of statistics to test each hypothesis and by examining the impact of country-specific effects on the results. Third, there are a number of extreme and unrealistic outliers that undoubtedly represent reporting errors. The analysis below addresses this problem by performing an extensive set of sensitivity tests that includes removing outliers.

Table 2. Depreciation Events

	Depreciation Date
Thailand	July 1997
Philippines	July 1997
Indonesia	August 1997, January 1999
Malaysia	September 1997
South Korea	November 1997
Czech Republic	February 1998
Greece	March 1998
South Africa	June 1998
Mexico	August 1998
Pakistan	August 1998
Israel	October 1998
Brazil	January 1999

Notes: "Depreciation event" defined as a 10 percent or greater increase in a country's exchange rate versus the U.S. dollar in any 4-week period between January 1, 1997 and December 31, 1999; after a depreciation event, the next year is excluded so that there can be, at most, one depreciation event within any 12-month period; countries with information for less than 50 firms (such as Russia) are excluded; the exchange-rate data is from *Datastream*.

became inactive due to a merger, bankruptcy, or any other reason. For this analysis, I include companies that were active for at least 1 year during the period from 1997 through 2000, and only include countries that have information for at least 50 firms during this period. I also exclude all financial firms (SIC codes 60-69), since the analysis of how depreciations affect sales, net income, and assets is not directly relevant. The Worldscope database is augmented with macroeconomic statistics from the International Monetary Fund's *International Financial Statistics CD-ROM* (from March 2001).

The resulting firm-level dataset includes information for over 13,500 firms in 42 countries. Table 3 shows the distribution of firms by country, as well as median sales (in U.S. dollars). The appendix lists the statistics for each firm used in the following analysis and includes detailed information on how each variable is defined and/or calculated.

This dataset includes the 12 countries that experienced depreciation events (as listed in Table 2), as well as 30 countries that did not experience substantial depreciations between 1997 and 2000. The full sample of firms is necessary to compare the performance of firms in depreciating countries versus firms in the rest of the world, as well as to control for any global industry and/or time trends.[5] As shown at the bottom of Table 3, firms in depreciating countries comprise about 20 percent of the sample and tend to have smaller sales. This partially reflects the fact that firms in emerging markets, which have a higher incidence of major depreciations,

[5]Kamin (1988) shows the importance of controlling for the performance of a "comparison group" to adjust for global industry trends when measuring the impact of devaluations.

Table 3. Firm Sample Information

Region	Country	# Firms	Median Sales[1]
Countries *with* Depreciation Events			
	Brazil	303	167.5
	Czech Republic	58	160.5
	Greece	179	49.7
	Indonesia	127	73.7
	Israel	44	215.6
	Malaysia	332	60.0
	Mexico	127	286.8
	Pakistan	82	28.0
	Philippines	70	60.3
	South Africa	460	49.9
	South Korea	570	131.9
	Thailand	202	58.6
Countries *without* Depreciation Events			
Americas	Argentina	51	258.4
	Canada	613	158.1
	Chile	77	159.7
	United States[2]	411	4,700.2
Asia	Australia	285	191.4
	China, People's Republic of	110	88.3
	Hong Kong, SAR	302	145.9
	India	323	81.6
	Japan	3,160	286.9
	New Zealand	55	157.2
	Singapore	204	105.2
	Taiwan	218	225.6
Europe	Austria	94	151.1
	Belgium	125	153.8
	Denmark	169	117.9
	Finland	138	144.4
	France	783	80.6
	Germany	820	122.0
	Hungary	39	89.2
	Ireland	71	113.0
	Italy	191	259.3
	Netherlands	226	292.2
	Norway	181	84.7
	Poland	53	87.5
	Portugal	81	68.6
	Spain	142	271.6
	Sweden	285	117.3
	Switzerland	182	283.2
	Turkey	71	118.6
	United Kingdom	1,640	87.6
Countries with Depreciations		2,554	86.6
Countries without Depreciations		11,100	182.2
Total Sample		13,654	157.9

[1]Total sales measured in millions of U.S. dollars in 2000 (or the closest year available).
[2]The *Worldscope 2001 CD-ROM* only includes information for S&P500 countries for the United States.

tend to be smaller than in wealthier countries. This also captures the fact that depreciations in the local currency/U.S. dollar exchange rate will, by definition, reduce the dollar value of firm statistics. Finally, this trend could also indicate that after depreciations, firms tend to decrease investment (thereby reducing potential output) and/or have lower sales. The empirical analysis in the next section formally tests this hypothesis.

II. General Analysis: The Impact of Depreciations on Firm Performance

This section uses the dataset described in Section I to compare firm performance in countries with depreciation events to countries without depreciation events. More specifically, it examines the impact of depreciations on the growth of firm sales, net income, market capitalization, and asset value. These results provide the basis for the more detailed analysis in Section III, which examines how different firm characteristics affect how depreciations impact firm performance.

The central model for the analysis is:

$$Performance_{i,k,c,t} = \alpha_k + \beta_1 Depreciation_{c,t+1} + \beta_2 Depreciation_{c,t} + \beta_3 Depreciation_{c,t-1} + \beta_4 Inflation_{c,t} + \beta_5 \mathbf{Period}_t + \xi_{i,k,c,t}, \quad (1)$$

where i is each firm, k is each industry, c is each country, and t is each period (denominated in years). *Performance* is a measure of firm performance (discussed in more detail below). Any time-invariant, industry-specific effects on firm performance are captured by α_k, which is calculated based on 2-digit SIC codes.[6] *Depreciation* is a dummy variable equal to 1 if the country c where firm i is located experienced a depreciation event (as defined in Table 2) in the given period. More specifically, $Depreciation_{c,t+1}$ is equal to 1 if country c had a devaluation in the following year (t+1); $Depreciation_{c,t}$ is equal to 1 if country c had a devaluation in the current year (t); and $Depreciation_{c,t-1}$ is equal to 1 if country c had a devaluation in the previous year (t–1). $Inflation_{c,t}$ measures the rate of inflation in country c in period t. $\mathbf{Period}_t$ is a vector of period dummy variables for 1997 through 2000 (with 1996 as the excluded year) and is included to control for any annual global shocks to firm performance.

Firm performance (*Performance*) is measured by changes in four variables: sales, net income, market capitalization, and assets.[7] Although a single measure of performance would be more straightforward to interpret, each of the four measures is useful in order to capture different aspects of depreciations. For example, an exporter could respond to the relative cost advantage provided by a depreciation by keeping local currency prices constant and lowering foreign currency prices,

[6]The sensitivity analysis tests for the impact of including firm or country effects instead of industry effects. The base analysis focuses on industry-specific effects, however, since recent empirical analysis has shown that during this period, sectoral shocks have been large and significant, and even more important than global and country-specific shocks (Brooks and Del Negro, 2002).

[7]The firm performance variables are calculated as changes using the equation: $(x_t - x_{t-1})/x_{t-1}$.

hoping to generate an increase in sales volume. On the other hand, another firm could respond by keeping foreign currency prices constant and raising local currency prices, so that export sales remained fairly constant but net income increased.[8] Therefore, the impact of the depreciation on firm performance could be reflected mainly by an increase in sales or an increase in income (or some combination of the two), and it is necessary to examine changes in both measures to fully capture the impact of depreciations on firm performance.

Moreover, while changes in sales and net income should capture the short-run impact of depreciations on firm performance, changes in market capitalization and asset value are more likely to capture the longer-term impact. Changes in market capitalization should reflect changes in the discounted value of expected future profits, so that an increase in a firm's market capitalization after depreciations should reflect expected improvements in the firm's longer-term performance. This measure could be particularly important for firms that respond to depreciations with additional investment (such as planting crops or digging mines) that may not increase sales or income for several years. One problem with using market capitalization as a measure of long-term performance, however, is that it assumes markets efficiently reflect new information from the depreciation. This assumption may not be fully satisfied, especially during crises or in less liquid emerging markets. Therefore, changes in firm asset value can provide additional information on the expected longer-term impact of depreciations on firm performance. Firms that are expected to benefit from depreciations in the long run are more likely to increase assets (such as purchasing additional machines or even additional plants). Therefore, all four measures of firm performance are useful in capturing slightly different aspects of how depreciations affect firms in the short and long run.

Finally, it is useful to compare how depreciations affect both local currency statistics as well as U.S. dollar statistics, since exchange rate movements could have different effects on pricing, and therefore various performance measures, for different types of goods. For example, if a firm produces a non-traded good using only domestic inputs, and holding everything else constant, a depreciation would have no direct effect on the local currency values of sales, net income, market capitalization, and assets, while the depreciation would cause an immediate decrease in the U.S. dollar values of the same performance measures. In other words, sales volume and the local currency value of sales would remain constant, while the U.S. dollar value of sales would decrease. On the other hand, if a firm produces an export good (such as oil) that is traditionally priced in U.S. dollars, the same depreciation (again holding everything else constant) would have no direct effect on the U.S. dollar value of sales (and possibly the other performance measures), while it would cause an immediate increase in the local currency value of sales (and possibly the other performance measures). For most goods, depreciations will have an intermediate effect between these two extreme cases, so it is necessary to consider how depreciations affect both local currency and U.S. dollar measures of performance.

[8]See Clarida (1997) for an empirical analysis of how U.S. firms balanced these two possible responses to exchange rate movements in the 1980s.

Table 4 reports random-effects estimates of equation (1) for the four performance measures in local currency and U.S. dollars. The top section of the table reports coefficient estimates, and the lower section reports χ^2 test statistics for the joint significance of the period dummy variables and the industry random effects.

These estimates suggest several key results. First, in the year before a major depreciation, there is no significant difference between firms in depreciating countries and non-depreciating countries for any of the 8 measures of firm performance. Second, when performance is measured in local currency, firms in depreciating countries tend to have slightly worse performance during the year of the depreciation than firms in non-depreciating countries, but this difference is usually insignificant. More specifically, the estimated coefficient on $Depreciation_t$ is negative when performance is measured by growth in local currency sales, market capitalization, or assets, but is only significant at the 10 percent level for the first variable, and as discussed below, small changes in model specification often render this coefficient insignificant. Moreover, the magnitude of the estimated coefficients is fairly small. For example, the –0.10 in column 1 indicates that firm sales growth (measured in local currency) during the year of a depreciation was only 10 percent lower in depreciating countries than in non-depreciating countries.

Third, and in contrast to the above results, firms in depreciating countries appear to have substantially worse performance during the year of the depreciation when performance is measured in U.S. dollars. The coefficient on $Depreciation_t$ is negative and highly significant for all four U.S. dollar measures of performance. This difference with the results when performance is measured in local currency terms, however, undoubtedly reflects the fact that even if real performance remained constant, the exchange-rate adjustment would generate negative growth in U.S. dollar terms. For example, the –0.27 coefficient on $Depreciation_t$ in column 5 suggests that firms in depreciating countries experienced sales growth 27 percent less than firms in non-depreciating countries. If the U.S. dollar exchange rate had remained constant, this could reflect a 27 percent decline in sales volume. On the other hand, this could also reflect constant sales volume, constant local currency output prices, and a 27 percent depreciation in the U.S. dollar exchange rate. Moreover, in the 12-month period after the initial depreciation event, the average currency movement for the 12 countries in Table 2 was a 32 percent depreciation. Although currency movements cannot be directly mapped into changes in U.S. dollar performance measures, these estimates suggest that the apparent negative impact of depreciations on U.S. dollar measures could largely reflect nominal movements and not fundamental changes in real performance.

A fourth result from Table 4 is that in the year after depreciation events, the impact on firm performance is mixed. Firms in depreciating countries have significantly lower net income growth when measured in local currency. Firms may also have lower asset growth when measured in local currency, although the relevant coefficient is only significant at the 10 percent level (and as discussed below this result is not robust). On the other hand, firms in depreciating countries have significantly higher growth in market capitalization, whether measured in local

Table 4. Regression Results: Impact of Depreciations on Firm Performance

	Growth in Local Currency Values				Growth in U.S. Dollar Values			
	Sales (1)	Net Income (2)	Market Capitalization (3)	Assets (4)	Sales (5)	Net Income (6)	Market Capitalization (7)	Assets (8)
Depreciation$_{t+1}$	–0.028	–0.367	–0.032	–0.164	0.041	–0.342	0.021	–0.081
	(0.086)	(0.308)	(0.116)	(0.085)	(0.079)	(0.297)	(0.096)	(0.072)
Depreciation$_{t}$	–0.101*	0.018	–0.069	–0.029	–0.269**	–1.019**	–0.196**	–0.214**
	(0.055)	(0.209)	(0.078)	(0.054)	(0.049)	(0.186)	(0.059)	(0.045)
Depreciation$_{t-1}$	–0.012	–0.637**	0.525**	–0.091*	0.032	0.127	0.640**	–0.034
	(0.055)	(0.211)	(0.077)	(0.054)	(0.050)	(0.186)	(0.059)	(0.045)
Inflation$_{t}$	0.006**	0.021	–0.010	0.004*	–0.001	0.003	0.005**	–0.002
	(0.002)	(0.016)	(0.006)	(0.002)	(0.002)	(0.006)	(0.002)	(0.001)
χ^2 Test Statistics for Significance of:								
Period Dummies[1]	*13.8***	*11.4***	*245.9***	*12.0***	*12.0***	*1.3*	*453.1***	*82.1***
Industry Effects[2]	*2,481.9***	*19.2***	*2,644.1***	*28,878.1***	*2,546.3***	*21.3***	*3,224.2***	*34,489.4***
N	*27,325*	*30,567*	*21,185*	*27,255*	*33,247*	*33,924*	*30,151*	*33,207*

Notes: regression includes random industry effects based on 2-digit SIC industries; data described in Table 3 and the appendix; standard errors in parentheses; * is significant at the 10 percent level and ** is significant at the 5 percent level.

[1] $\chi^2(5)$ test statistic for an *F*-test of the joint significance of the period dummy variables.

[2] $\chi^2(1)$ test statistic for the Breusch and Pagan Lagrangian multiplier test for the joint significance of the industry random effects.

currency or U.S. dollars. If changes in market capitalization are interpreted as changes in the discounted value of future expected profits, this could suggest that depreciations improve firms' expected longer-term profitability. Moreover, the magnitude of the coefficient estimates suggests that this effect could be economically important. For example, the estimates in column 3 suggest that in the year after depreciations, market capitalization increased by 53 percent more for firms in depreciating countries than in non-depreciating countries.

The final noteworthy result from Table 4 is the significance of the coefficients other than the depreciation dummies. The magnitude and significance of the inflation coefficients fluctuate across specifications. On the other hand, the period dummy variables are jointly highly significant (in 7 of the 8 specifications) and the industry effects are jointly highly significant in each of the 8 specifications. These results suggest that period- and industry-specific shocks are important determinants of firm performance.

Next, I estimate a number of variations to the model specified in equation (1) in order to test for the sensitivity of these results to model specification and outliers. First, I estimate the model substituting firm effects (α_i) for the industry effects (α_k). Second, I estimate the model substituting country effects (α_c) instead of the industry effects. Third, I estimate the original model with industry effects, except use fixed effects instead of random effects to focus on changes in firm performance within each industry. Fourth, I estimate the model after removing the 10 outliers for each of the performance measures. Fifth and finally, I remove each country from the sample and reestimate the base model.

Although the coefficient estimates fluctuate in each of these variations, the central results do not change.[9] In each of these sensitivity tests, the only coefficients on the depreciation variables that are consistently positive and significant are when performance is measured by growth in market capitalization (measured in either currency) in the year after depreciations. The only coefficients that are consistently negative and significant are those when performance is measured by net income growth (in local currency) in the year after depreciations, and those for each of the four U.S. dollar performance measures in the year of depreciations. The significance of the other coefficients fluctuates based on model specification and sample selection. (For example, when performance is measured by asset growth in local currency, the coefficient on $Depreciation_{t-1}$ is insignificant at the 10 percent level in over 1/3 of the tests.)

To conclude, this analysis has documented several consistent patterns of how depreciations tend to affect average firm performance. In the year after depreciations, firms in the depreciating country tend to have significantly higher growth in market capitalization. On the other hand, firms in depreciating countries tend to have significantly lower growth in net income (when measured in local currency). Firms in depreciating countries also tend to display worse performance during the year of the depreciation when performance is measured in U.S. dollars, but this could largely reflect changes in relative currency values and not significant changes in actual performance.

[9]Results are not reported since they are so similar to the base results in Table 4.

III. The Impact of Depreciations on Performance in Different Types of Firms

The general patterns reported in the last section on how depreciations affect average firm performance may mask important differences across individual companies. For example, depreciations may significantly improve the performance of exporters, but negatively impact the performance of firms using a high share of imported inputs. These different effects could counteract each other when calculating the average impact of depreciations on firms in general. Therefore, this section examines which firm characteristics determine the impact of depreciations on firm performance. More specifically, it considers whether output characteristics, foreign sales exposure, production structure, debt ratios, size, and/or profitability determine the impact of depreciations on different types of firms.

The empirical specification is an extension of the framework used for the more general tests in Section II. More specifically, the estimating equation is the same as equation (1), plus the relevant test variables (i.e., firm characteristics) interacted with dummy variables indicating whether there was a depreciation in the current year or previous year:

$$\begin{aligned} Performance_{i,k,c,t} = {} & \alpha_k + \beta_1 Depreciation_{c,t+1} + \beta_2 Depreciation_{c,t} + \beta_3 Depreciation_{c,t-1} \\ & + \beta_4 Inflation_{c,t} + \beta_5 \mathbf{Period}_t + \beta_6 Depreciation_{c,t} * \mathbf{Test}_{i,t-1} \\ & + \beta_7 Depreciation_{c,t-1} * \mathbf{Test}_{i,t-1} + \xi_{i,k,c,t}, \end{aligned} \tag{2}$$

All variables are defined as in equation (1) except $\mathbf{Test}_{i,t-1}$, which is a vector of characteristics for firm *i* from the previous period. $\mathbf{Test}_{i,t-1}$ is lagged in order to avoid capturing any impact of the depreciation on the relevant firm characteristic. These interactive terms are included to test which firm characteristics determine how depreciations impact firm performance. For example, if one variable in $\mathbf{Test}_i$ is a measure of firm size (such as total assets), then the relevant coefficient estimates in β_6 and β_7 would capture any additional impact of depreciations on larger firms.

There are a number of firm characteristics that could determine how depreciations affect firm performance and which should therefore be included in $\mathbf{Test}_i$. The base analysis focuses on 6 different variables:

1. Output Characteristics. Theoretical models suggest that one important factor determining the impact of depreciations is whether a firm produces non-traded goods that only compete with other domestic producers, or traded goods that compete with foreign producers (either in domestic markets through competition with imports and/or in foreign markets through competition as exports). Depreciations should reduce the cost of production for goods in the depreciating country relative to identical goods produced in non-depreciating countries. This should give a relative cost advantage to firms that produce traded goods, but no relative cost advantage to non-traded goods. As a result, depreciations should improve the performance of firms that produce traded goods relative to firms that produce non-traded goods.[10]

[10]For a model and detailed discussion of these effects, see Agénor and Montiel (1996). Also see Ghei and Pritchett (1999) for a discussion of factors that could reduce any positive impact of depreciations on traded goods, especially in developing countries.

2. Foreign Exposure. Closely related to the impact of depreciations on traded versus non-traded goods is whether firms had foreign sales before the depreciation. Firms with export experience are better positioned to benefit from the relative cost advantage of depreciations. Granted, firms that do not have foreign sales exposure before depreciations could begin operating abroad after depreciations, but developing international operations can involve substantial time lags. Therefore, firms with foreign sales would be expected to exhibit better performance directly after depreciations than firms without foreign exposure.

3. Production Structure. As discussed in the section on traded and non-traded goods, simple models suggest that depreciations can lower the relative cost of production for firms in the depreciating country relative to firms in non-depreciating countries. This reduction in relative production costs will be proportional to the share of domestic inputs (such as labor) in production. If production involves a higher share of imported inputs, then depreciations will have less impact on relative production costs.[11] In most emerging markets a large fraction of capital is imported, so that capital/labor ratios can be used as rough proxies for the share of imported inputs to domestic inputs in production. Therefore, firms with lower capital/labor ratios are expected to have relatively better performance after depreciations than firms with higher capital/labor ratios.

4. Debt Ratios. One feature of recent large depreciations, and especially currency crises, is that they are often accompanied by a contraction in lending and/or increase in interest rates. In some cases, the contraction in lending is a market response to the capital outflows that generated the currency depreciation. In other cases, the increase in interest rates is a policy response by the central bank in order to reduce capital outflows and strengthen the currency's value. Raising interest rates could also be required as part of an IMF program. At the firm level, depreciations can reduce collateral values and therefore raise a company's cost of borrowing.[12] In each of these cases, the contraction in lending and/or higher interest rates after depreciations would disproportionately affect firms with higher outstanding debt burdens, as well as those more reliant on borrowing to finance working capital. Moreover, since many companies borrow in foreign currency, depreciations would have balance-sheet effects and increase the relative burden of repaying existing foreign-currency debt.[13] For all of these reasons, depreciations would be expected to have a more negative impact on the performance of firms with higher outstanding debt ratios.

5. Size. There are a number of channels by which firm size could interact with depreciations to affect firm performance. First, larger firms are more likely to have access to financing during lending contractions, which, as discussed above, have frequently occurred during recent large depreciations. Improved access to financing could occur through informal or formal networks (such as the Korean chaebol), through government pressure on lending institutions, and/or through

[11] See Forbes (2002a) for a model and detailed discussion of these effects.

[12] See Caballero and Krishnamurthy (2000).

[13] See Céspedes, Chang, and Velasco (2000). Unfortunately, the Worldscope database does not have sufficient information on foreign-currency borrowing to test this channel directly.

direct bailouts for firms judged "too big to fail." Second, and possibly counteracting this effect, although larger firms were more likely to benefit from special networks or privileges before depreciations, fiscal pressures (or even stricter monitoring as part of an IMF program) may make it more difficult to benefit from these traditional networks after depreciations. Third, larger firms are more likely to have borrowed in foreign currency and therefore experience negative balance-sheet effects from depreciations. Fourth, and possibly counteracting this effect, larger firms are more likely to have hedged against currency risk. For all of these reasons, larger firms could exhibit better or worse performance than smaller firms after depreciations, but it is difficult to predict which of these effects dominates a priori.

6. Profitability. The relationship between firm profitability and the impact of depreciations on firm performance is also difficult to predict a priori. More profitable firms tend to be operated by more capable managers, who could be better able to adjust production to benefit from depreciations. Closely related, if depreciations are followed by an output contraction, then more profitable firms may be better able to withstand the contraction in demand, while less profitable firms are more likely to go bankrupt. Possibly counteracting this effect, however, more profitable firms may be operating closer to full capacity and therefore have fewer excess resources to reallocate and adjust to the depreciation. As a result, it is difficult to predict whether depreciations will have a positive or negative effect on firms that were more profitable before the depreciation.

There are obviously a number of firm characteristics other than the six discussed above that could determine how depreciations affect firm performance. For example, the extent of hedging against currency risk or the proportion of debt denominated in foreign currency could be critical. Unfortunately, the firm-level data for these additional tests is not available. The tests for this analysis were chosen based on a combination of theoretical motivation, anecdotal evidence, and data availability.

To test for the impact of these six firm characteristics on performance after depreciations, it is necessary to augment the dataset described in Section I. To test for the importance of traded versus non-traded goods, I classify each firm as producing either traded or non-traded goods based on the 2-digit SIC code of their primary output. This classification is then used to create a traded dummy variable that takes a value of 1 if the firm's main output is a traded good.[14] Foreign exposure is measured by the ratio of foreign sales to total sales. Capital/labor ratios are measured by the ratio of total assets (in U.S. dollars) to employees. Outstanding debt is measured by the ratio of total debt to equity. Firm size is measured by total assets, and firm profitability is measured by the return on assets. The appendix provides detailed definitions and summary statistics for each of these variables. The sensitivity analysis at the end of this section shows that using different definitions has minimal impact on the central results.

Table 5 reports regression results based on random effects estimates of equation (2) with the six variables discussed above included in $\mathbf{Test}_i$. When $Test_i$ is measured by the traded dummy, the signs on the coefficient estimates fluctuate and are only

[14] A table listing the specific classifications into traded or non-traded goods for each 2-digit SIC code is included in the working paper version (Forbes, 2002b).

significant when performance is measured by net income growth. Moreover, the significant coefficient estimates are negative, the opposite of the simple model predictions discussed above.[15] When $Test_i$ is measured by foreign sales exposure, however, the results are more consistent across performance measures and agree with the theoretical predictions. The coefficient estimates on these interaction terms are positive in 14 of the 16 cases, and are often highly significant. Moreover, the magnitude of the coefficient estimates suggests that this effect is economically important. Holding everything else constant, if a firm increased its foreign sales (as a ratio to total sales) by 10 percent, it would be predicted to experience growth rates 4 percent higher in sales, 130 percent higher in income, and 3 percent higher in assets (all measured in local currency) in the year of a major depreciation.

The coefficient estimates when $Test_i$ is measured by capital/labor ratios or debt ratios provide a less consistent picture. The signs of the coefficient estimates for both sets of results are fairly evenly split between positive and negative, and the few coefficient estimates that are significant provide mixed support for the theoretical predictions. For example, in the year after depreciations, firms with higher capital/labor ratios have significantly lower growth in U.S. dollar assets (as predicted), but significantly higher growth in local currency sales (the opposite of the predictions). Firms with higher debt ratios tend to have significantly higher asset growth in the year of depreciations (the opposite of the predictions), but significantly lower income growth in the year after depreciations (as predicted). Therefore, this set of results suggests that there is little strong and consistent relationship between firms' capital/labor ratios or debt exposure and the impact of depreciations on firm performance.

When $Test_i$ is measured by firm size, all 8 coefficient estimates are negative for the year of the depreciation, suggesting that larger firms had worse performance in this period. Only 3 of these coefficients are significant at the 10 percent level, however, and some of this negative effect of firm size is reversed in the year after depreciations. Sales growth measured in local currency, however, is significantly lower for larger firms in the year after depreciations. For the final set of coefficient estimates, when $Test_i$ is measured by profitability, there is no clear pattern. More profitable firms have significantly higher growth in local currency sales in the year after depreciations, but this is the only coefficient of the 16 related to the profitability interaction terms that is significant at the 5 percent level. Moreover, the signs of the coefficient estimates are fairly evenly split between positive and negative. Therefore, although larger firms have slightly worse performance than smaller firms after depreciations, profitability appears to have little impact on how depreciations affect performance.

To analyze the robustness of these central results to changes in variable definition, model specification, and sample selection, I estimate a number of sensitivity tests. First, I redefine several different variables: measure foreign exposure using the ratio of foreign assets to total assets or foreign income to total income (instead of foreign sales to total sales); measure debt outstanding using total debt to assets or short-term debt to equity (instead of total debt to equity); measure size using total market capitalization or total income in U.S. dollars (instead of total assets); or

[15] This counterintuitive result is analyzed in more detail in the sensitivity tests below.

Table 5. Regression Results: Firm Characteristics and the Impact of Depreciations

	Growth in Local Currency Values				Growth in U.S. Dollar Values			
	Sales	Net Income	Market Capitalization	Assets	Sales	Net Income	Market Capitalization	Assets
$Depreciation_{t+1}$	0.127	–0.339	–0.160	–0.056	0.053	–0.829	–0.228	–0.117
	(0.114)	(3.347)	(0.418)	(0.084)	(0.092)	(2.941)	(0.291)	(0.076)
$Depreciation_t$	–0.037	10.131*	–1.041	–0.094	–0.331**	7.986	–1.126**	–0.387**
	(0.201)	(5.854)	(0.832)	(0.148)	(0.162)	(5.249)	(0.510)	(0.135)
$Depreciation_{t-1}$	0.197	–0.213	–1.347	0.205*	0.151	–0.064	–0.359	0.115
	(0.156)	(4.786)	(0.865)	(0.115)	(0.126)	(4.006)	(0.395)	(0.106)
$Inflation_t$	0.005	0.087	0.063	0.007	0.006	0.162	0.026*	0.012**
	(0.006)	(0.242)	(0.063)	(0.004)	(0.005)	(0.150)	(0.015)	(0.004)
Test Variables Interacted with Depreciation Dummies								
$Traded_t$	0.005	–11.505**	0.276	0.014	0.042	–8.876**	–0.103	0.023
	(0.136)	(4.258)	(0.571)	(0.100)	(0.109)	(3.777)	(0.346)	(0.093)
$Traded_{t-1}$	–0.121	–3.497	–0.081	–0.044	–0.140	–2.508	–0.132	–0.054
	(0.144)	(4.156)	(0.533)	(0.106)	(0.116)	(3.696)	(0.365)	(0.099)
Foreign $Exposure_t$	0.425**	12.976**	1.211	0.322**	0.435**	7.648	1.604**	0.411**
	(0.198)	(6.336)	(0.871)	(0.146)	(0.160)	(5.110)	(0.506)	(0.134)
Foreign $Exposure_{t-1}$	–0.562	14.155	0.445	0.098	–0.122	8.161	0.621	0.417*
	(0.346)	(10.382)	(1.488)	(0.255)	(0.279)	(8.895)	(0.877)	(0.234)

Table 5. *(concluded)*

	Growth in Local Currency Values				Growth in U.S. Dollar Values			
	Sales	Net Income	Market Capitalization	Assets	Sales	Net Income	Market Capitalization	Assets
Test Variables Interacted with Depreciation Dummies								
K/L_t	–0.012	–8.082	2.052**	–0.123	–0.128	–3.721	0.303	–0.187*
	(0.147)	(4.969)	(0.786)	(0.108)	(0.118)	(3.819)	(0.371)	(0.099)
K/L_{t-1}	1.551**	–2.552	3.149	0.008	0.272	8.441	–0.370	–0.841**
	(0.521)	(22.579)	(3.736)	(0.383)	(0.420)	(13.352)	(1.318)	(0.350)
$Debt_t$	0.108	–1.152	0.857	0.192**	0.102	0.724	0.547*	0.188**
	(0.110)	(3.532)	(0.545)	(0.081)	(0.089)	(2.981)	(0.280)	(0.074)
$Debt_{t-1}$	0.008	–6.546**	–0.025	–0.083	–0.106	–5.789**	–0.375	–0.171**
	(0.108)	(3.238)	(0.442)	(0.079)	(0.087)	(2.762)	(0.272)	(0.072)
$Size_t$	–0.012	–0.014	–0.250	–0.039*	–0.021	–0.392	–0.146**	–0.051**
	(0.027)	(0.868)	(0.242)	(0.020)	(0.022)	(0.732)	(0.069)	(0.018)
$Size_{t-1}$	–0.066**	0.418	–0.399	–0.003	0.010	0.228	0.094	0.051**
	(0.031)	(1.313)	(0.372)	(0.023)	(0.025)	(0.805)	(0.079)	(0.021)
$Profitability_t$	1.233	–34.231	–0.557	0.955*	0.690	–27.222	–0.054	0.509
	(0.784)	(22.847)	(3.443)	(0.577)	(0.632)	(20.587)	(1.998)	(0.530)
$Profitability_{t-1}$	0.619**	–6.443	6.792	–0.206	0.293	–5.069	–1.057	–0.385*
	(0.310)	(8.797)	(5.758)	(0.228)	(0.250)	(7.946)	(0.784)	(0.209)

Notes: Estimates obtained based on equation (2) with random industry effects; period dummies included in analysis (but not reported); standard errors in parentheses; * is significant at the 10 percent level and ** at the 5 percent level.

measure profitability using return on equity or return on invested capital (instead of return on assets). Second, to examine the impact of model specification, I reestimate the model substituting firm effects (α_i) or country effects (α_c) for the industry effects (α_k) in equation (2), or using fixed effects instead of random effects. Then I drop one variable at a time, excluding the inflation and period dummy variables as well as the interactive terms. Third and finally, I test for any impact of outliers by removing the 10 extreme values for each of the variables in $\mathbf{Test}_i$.

Coefficient estimates fluctuate throughout this series of sensitivity tests, but the key findings discussed above are robust. Firms with greater foreign sales exposure tend to have significantly better performance after depreciations (according to most of the performance variables measured in either currency).[16] Firms with higher debt ratios tend to have lower growth in net income (in either currency), but there is no consistent relationship between debt exposure and the other performance variables. Larger firms tend to have worse performance than smaller firms, although the significance of this result fluctuates across performance measures. There appears to be no consistent relationship between a firm's profitability or capital/asset ratio and the impact of depreciations on firm performance. Finally, firms producing traded goods tend to have significantly lower net income growth after depreciations than firms producing non-traded goods, although this result does not apply for the other performance measures.

In an attempt to better understand this last result, which does not support the simple model predictions discussed above, I perform two additional tests. I decompose traded goods into commodities and differentiated goods in order to see if trends in either group are driving the coefficient estimates.[17] Negative shocks to commodity prices that are not captured by the industry effects could be important, especially since commodities are a major export for many of the depreciating countries. Then I reestimate equation (2), replacing the traded dummy variable with dummy variables for commodities and differentiated goods (with non-traded goods continuing to be the excluded variable).

Results are reported in Table 6. The table only reports coefficient estimates for the depreciation variables and commodity and differentiated good interaction terms, since the coefficient estimates for the remaining variables in $\mathbf{Test}_i$ are virtually identical to those reported in Table 5. The results suggest that the negative impact of depreciations on income growth for traded-goods firms occurs in differentiated-goods firms instead of commodity firms. Therefore, the robust finding of a negative impact of depreciations on income growth for traded-goods firms does not appear to be caused by movements in commodity prices.

[16]The one exception to this otherwise robust result is when foreign sales exposure is measured as the ratio of foreign assets to total assets or the ratio of foreign income to total income (instead of using the ratio of foreign sales to total sales). In both of these cases, data availability is much more limited, and the new foreign exposure variable is not consistently positive and significant.

[17]Commodities are defined as goods that are fairly homogenous across countries, so that prices are set in global markets. Differentiated goods, on the other hand, are defined as goods that are more heterogeneous across producers, so that firms have greater power in setting prices. Table 5 in the working paper version (Forbes, 2002b) reports the classification of traded goods as commodities or differentiated goods based on 2-digit SIC codes.

Table 6. Sensitivity Tests: Estimates Decomposing Traded Goods into Commodities and Differentiated Goods

	Growth in Local Currency Values				Growth in U.S. Dollar Values			
	Sales	Net Income	Market Capitalization	Assets	Sales	Net Income	Market Capitalization	Assets
$Depreciation_{t+1}$	0.119	0.043	–0.155	–0.065	0.048	–0.666	–0.238	–0.139*
	(0.115)	(3.328)	(0.425)	(0.083)	(0.093)	(2.947)	(0.295)	(0.072)
$Depreciation_{t}$	–0.071	11.120*	–1.073	–0.108	–0.344**	9.002*	–1.172**	–0.400**
	(0.205)	(5.871)	(0.854)	(0.148)	(0.166)	(5.325)	(0.521)	(0.133)
$Depreciation_{t-1}$	0.198	0.773	–1.392	0.225**	0.158	0.222	–0.366	0.119
	(0.158)	(4.784)	(0.909)	(0.114)	(0.127)	(4.013)	(0.401)	(0.106)
$Commodity_{t}$	–0.106	–7.550	–0.276	–0.019	0.005	–5.726	–0.272	0.058
	(0.176)	(5.170)	(1.336)	(0.127)	(0.142)	(4.628)	(0.446)	(0.118)
$Commodity_{t-1}$	–0.116	3.738	–0.635	0.197	–0.053	1.502	–0.221	0.270*
	(0.221)	(6.691)	(1.068)	(0.160)	(0.178)	(5.618)	(0.561)	(0.148)
Differentiated $Good_{t}$	0.051	–13.427**	0.369	0.023	0.055	–10.474**	–0.027	0.008
	(0.144)	(4.483)	(0.621)	(0.104)	(0.116)	(3.992)	(0.370)	(0.098)
Differentiated $Good_{t-1}$	–0.123	–4.490	–0.062	–0.075	–0.151	–2.946	–0.123	–0.086
	(0.146)	(4.178)	(0.544)	(0.106)	(0.118)	(3.727)	(0.372)	(0.101)

Notes: Regression identical to that reported in Table 5, except the *Traded* dummy variables are replaced with the *Commodity* and *Differentiated Good* dummy variables; standard errors in parentheses; estimates include random industry effects; * is significant at the 10 percent level and ** at the 5 percent level.

There are three possible explanations (at least) for why depreciations appear to have a significant negative impact on income growth for firms producing differentiated goods relative to firms producing other output. First, since many countries in the sample produce similar products and experienced depreciations around the same time, this may have eroded the relative cost advantage traditionally provided to traded goods by depreciations. Duttagupta and Spilimbergo (2000) provide evidence that these "competitive depreciations" were important factors explaining why the depreciations during the Asian crisis only had a minimal impact on export revenues in many Asian countries. Second, the demand for differentiated traded goods tends to be more income elastic than the demand for non-traded goods and commodities. As a result, if depreciations cause a contraction in income, which occurred in many countries in the sample, this could generate a greater reduction in demand for differentiated goods relative to other products.

A final possible explanation is that the positive effect of depreciations on traded goods predicted by the models is captured in the significant positive coefficients on the foreign exposure variables. More specifically, the models predict two main channels by which the relative cost advantage provided to traded goods improves their performance relative to non-traded goods. First, depreciations lower production costs relative to those of competing imports in the domestic market. This effect could be minimal, however, if exporters in other countries respond by lowering prices, and this "pricing to market" is more likely to occur in differentiated goods. Second, depreciations should lower production costs relative to those of competitors in international markets, leading to an increase in export revenues. Previous empirical work has shown that the second effect tends to be more important than the first, but this second effect could already be captured in the regressions by the coefficients on the foreign exposure variables.[18]

To test for this effect, I reestimate the base specification in equation (2), but exclude the foreign exposure variables. Coefficient estimates for the relevant variables are reported in Table 7. The coefficient on $Traded_t$ becomes insignificant when performance is measured by net income growth (in either currency), although the coefficient on $Traded_{t+1}$ becomes negative and significant at the 10 percent level when performance is measured as net income growth in local currency. Moreover, the coefficients on $Traded_t$ and $Traded_{t+1}$ become negative and borderline significant for other performance measures. Therefore, these results suggest that some of the estimated impact of depreciations on traded goods compared to non-traded goods may be captured by the foreign exposure variables in the base specification. When the foreign exposure variables are removed, however, traded goods still do not exhibit superior performance to non-traded goods, as predicted by the models, so other factors (such as "competitive devaluations" or income elasticities of demand) may also be important.

[18]For example, Kamin (1988) finds that most of the impact of devaluations on the trade balance occurs through the expansion of exports rather than the contraction of imports. Ghei and Pritchett (1999) survey the empirical literature and do not find strong evidence of a response of imports to exchange-rate movements in developing countries.

Table 7. Sensitivity Tests: Estimates Excluding the Foreign Exposure Variables

	Growth in Local Currency Values				Growth in U.S. Dollar Values			
	Sales	Net Income	Market Capitalization	Assets	Sales	Net Income	Market Capitalization	Assets
$Depreciation_{t+1}$	0.050	0.142	0.446	0.064	–0.072	–0.476	0.157	–0.031
	(0.050)	(0.929)	(0.356)	(0.047)	(0.048)	(0.931)	(0.216)	(0.046)
$Depreciation_{t}$	0.035	0.399	0.853*	0.116**	–0.357**	–0.938	–0.242	–0.279**
	(0.057)	(1.250)	(0.509)	(0.053)	(0.055)	(1.064)	(0.246)	(0.052)
$Depreciation_{t-1}$	0.054	0.044	1.914**	0.223**	–0.115**	–0.195	0.966**	0.038
	(0.054)	(1.151)	(0.465)	(0.050)	(0.052)	(1.003)	(0.232)	(0.049)
$Traded_{t}$	–0.013	0.224	0.342	0.005	–0.071*	–0.271	0.054	–0.079*
	(0.043)	(0.911)	(0.394)	(0.040)	(0.041)	(0.799)	(0.187)	(0.049)
$Traded_{t-1}$	–0.053	–1.580*	–0.775*	–0.043	0.017	–0.495	–0.279	0.029
	(0.045)	(0.933)	(0.403)	(0.042)	(0.043)	(0.839)	(0.193)	(0.041)

Notes: Regression identical to that reported in Table 5, except the *Foreign Sales* interaction variables are excluded; standard errors in parentheses; estimates include random industry effects; * is significant at the 10 percent level and ** at the 5 percent level.

IV. Conclusions

This paper documents several stylized facts of how recent depreciations affected different measures of firm performance. It uses a sample of over 13,500 firms from 42 countries to examine the impact of 12 "major depreciations" between 1997 and 2000. It evaluates firm performance based on the immediate impact of depreciations on sales and net income, as well as the expected longer-term impact as measured by changes in market capitalization and asset value.

The first part of the analysis focused on how depreciations affect firms on average. It finds that in the year after depreciations, firms have significantly higher growth in market capitalization, suggesting that depreciations increase the present value of firms' expected future profits. On the other hand, firms have significantly lower growth in net income (measured in local currency), suggesting that even if firms benefit from depreciations in the long run, the immediate impact on performance may be negative. Firms also tend to display worse performance after depreciations when performance is measured in U.S. dollars, but this could largely reflect changes in relative currency values and not significant changes in real performance.

The second part of the analysis attempted to identify which firm characteristics determined the impact of depreciations on individual firm performance. The strongest and most robust result is that firms with greater foreign sales exposure have significantly better performance after depreciations (according to most of the performance variables, whether measured in local currency or U.S. dollars). Firms with higher debt ratios tend to have lower growth in net income, and larger firms often have worse performance than smaller firms, although the significance of these results fluctuates across performance measures and model specification. There is no consistent relationship between a firm's profitability or capital/asset ratio and the impact of depreciations on performance. Finally, firms producing traded goods tend to have significantly lower income growth than firms producing non-traded goods, but this result is sensitive to the inclusion of the foreign exposure variables and does not apply for the other performance measures.

Although there are a number of factors other than firm characteristics that determine how depreciations affect a country's macroeconomy, these empirical patterns provide some suggestive evidence of why depreciations can have such varied effects in different countries. The one group of firms that consistently has superior performance after depreciations, whether measured by improvements in sales, net income, market capitalization, or asset value, was firms with greater foreign sales exposure. Therefore, relatively open economies with substantial export experience are more likely to benefit from depreciations, while relatively closed economies with limited export capacity are more likely to experience an economic contraction.

The empirical results, however, did not find evidence of a robust relationship between several other firm characteristics, such as capital/labor ratios, and the impact of depreciations on firm performance. Some of these estimated relationships may be insignificant because it is not only the firm characteristic that

determines the impact of depreciations, but rather the interaction between the firm characteristic and macroeconomic variables (such as inflation, interest rates, government spending, or changes in the composition of aggregate income). For example, a model developed in Forbes (2002a) suggests that for commodity firms, it is not just capital/labor ratios that determine how depreciations affect sales growth, but the interaction between capital/labor ratios and changes in the cost of capital.

Therefore, one promising area for future research is to combine the firm-level evidence on the impact of depreciations in this paper with the more traditional macro-level research in previous work. This could involve aggregating the firm-level effects documented in this paper in order to assess their overall impact at the country level. This could also involve evaluating whether a country's firm and industry characteristics or its macroeconomic characteristics are relatively more important determinants of how depreciations affect aggregate growth. Finally, this research could also investigate how firm-level factors interact with macroeconomic variables to determine why some depreciations are expansionary and others are contractionary.

APPENDIX

Variable Definitions, Sources, and Summary Statistics

Variable	Definition and Source	Mean	Standard Deviation
Assets (Total)	The sum of total current assets, long-term receivables, investment in unconsolidated subsidiaries, other investments, net property, plant and equipment, and other assets. Reported in billions of U.S. dollars. Source: Worldscope.	3.88	25.98
Capital/Labor Ratio	The ratio of total assets (expressed in millions of U.S. dollars and defined above) to total employees. Source: calculated based on Worldscope information.	1.14	9.57
Foreign Assets	The ratio of assets abroad to total assets (defined above). Source: Worldscope.	0.24	0.22
Foreign Income	The ratio of income generated abroad to total net income (defined below). Source: Worldscope.	0.28	0.33
Foreign Sales	The ratio of sales abroad to net sales (defined below). Source: Worldscope.	0.34	0.28
Inflation	Annual percent change in consumer prices for the same annual period as the corresponding firm data. Source: International Financial Statistics, line 64..XZF.	3.11	6.82
Market Capitalization	Product of shares outstanding and market price at fiscal year end. Includes all types of shares. Reported in billions of U.S. dollars. Source: Worldscope.	1.67	10.85
Net Income	Income after all operating and non-operating income, expenses, reserves, income taxes, minority interest, and extraordinary items. Represents income before preferred dividends. Reported in billions of U.S. dollars. Source: Worldscope.	0.05	0.38
Return on Assets	(Net income before preferred dividends + ((interest expense on debt – interest capitalized) * (1 – Tax Rate))) / Last year's total assets. Source: Worldscope.	0.03	0.30
Return on Equity	(Net income before preferred dividends – preferred dividend requirements) / Last year's common equity. Source: Worldscope.	0.03	0.66
Return on Invested Capital	(Net income before preferred dividends + ((Interest expense on debt – interest capitalized) * (1 – Tax Rate))) / (Last year's total capital + last year's short-term debt and current portion of long-term debt). Source: Worldscope.	0.06	0.39
Sales (Net)	Gross sales and other operating revenue less discounts, returns, and allowances. Reported in billions of U.S. dollars. Source: Worldscope.	1.27	5.55
Short-Term Debt to Equity	Ratio of local currency value of short-term debt to equity. Short-term debt is any debt payable within 1 year (including current portion of long-term debt). Equity is common shareholder's investment in a company, including common stock value, retained earnings, capital surplus, capital stock premium, cumulative gain or loss of foreign currency translations, discretionary reserves, and negative goodwill. Source: calculated based on Worldscope.	0.96	3.56
Total Debt to Assets	Ratio of local currency value of total debt to total assets. Total debt is the sum of short-term debt (defined above) plus long-term debt (which is any interest bearing financial obligations, excluding short-term debt and net of premium or discount). Assets defined above. Source: calculated based on Worldscope.	0.36	0.30
Total Debt to Equity	Ratio of local currency value of total debt to equity. Both terms defined above. Source: calculated based on Worldscope.	2.04	5.48

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