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FOREIGN DIRECT INVESTMENT AND THE SUPPLY OF CREDIT IN MEXICO

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Abstract

The document evaluates the importance of foreign capital flows on the supply of credit in Mexico. The analysis shows that, although the flows of foreign direct investment and the supply of credit are positively correlated, the series do not share a common cycle or a common trend and there is no causal relationship in the sense of Granger among them. These results indicate that the assumption that flows of foreign direct investment affect the conditions of the credit market should not be made.

Key words: econometry, correlation, cointegration, flows of foreign direct investment and supply of credit in Mexico.

Clasificación: F21; E51; C12; C13.

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Introduction

Although several studies have shown that the conditions of the credit market affect the behavior of real variables such as consumption and investment, few are the studies that examine the factors that influence this market.[1] In general, studies that analyze the impact of commercial credit on real variables assume that the supply of credit responds to factors such as the availability of funds, issues of moral hazard and adverse selection, prevailing macroeconomic conditions, and flows of foreign capital. For example, Garcés (2001) suggests that the increase in capital inflows to Mexico, consequence of the successful implementation of the1987 financial stabilization program, favored conditions in the credit market during the late 1980's and early 1990's. Interestingly enough, however, we find that in the last two years, although the inflows of foreign capital to Mexico have been significant, the supply of credit has not increased. Is there a causal relationship between the inflows of foreign capital and the conditions of the credit market?

In this paper I examine the impact of the flows of one type of foreign capital, foreign direct investment (FDI), on the supply of credit. Why would FDI influence the behavior of the participants in the credit market? One possibility is that suggested by the theory of foreign capital spillovers. Moran (1998), for instance, notices that before 1979 the FDI-related automotive industry in Mexico had subscale plants producing primarily for the domestic market. But once General Motors established a producing plant, other automotive makers follow. With the establishment of auto producing plants, several other industry-related businesses emerged, including car parts and accessories suppliers. In recent years, another important business associated with the automotive industry, auto financing, has become prominent. Nowadays, the financing options for the consumer

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[1] Exceptions include Copelman (1996) who shows that the remonetization of the economy and the decline of public debt held by banks increased the supply of credit in Mexico during the post 1987 stabilization period. More recently, Gonzalez-Anaya (2002) finds that perverse incentives generated by the implementation of the bank bail out after the 1995 financial crisis are responsible for the incipient supply of credit in recent times.

willing to purchase a vehicle are numberless. This fact might be perceived as evidence that the spillover effect of the FDI in the auto industry has increased the possibilities of auto financing, and hence, has influenced the credit market.[2] However, there is no statistical evidence of the relationship between the flows of foreign capital and the supply of credit documented in the literature.[3]

In the analysis that follows, the short and long-run statistical relationships between the flows of FDI and the supply of credit are determined. In particular, the analysis evaluates whether the variables share a common trend or a common cycle. If the series share a common trend (or a common cycle), and if the FDI variable precedes the credit variable, then, the assumption that the flows of FDI influence the conditions of the credit market would be valid. Otherwise, the assumption should be made with caution. The long-run analysis includes the estimation of a cointegration equation, the short-run analysis is performed following the Beveridge and Nelson (1981) methodology for identifying common cycles.[4] In addition, a vector autoregression (VAR) is estimated to evaluate the response of the supply of credit to shocks to FDI.

The rest of the document is organized as follows: Section I presents the data and a description of its statistical properties. In Section II the econometric exercise is conducted. Section III Concludes.

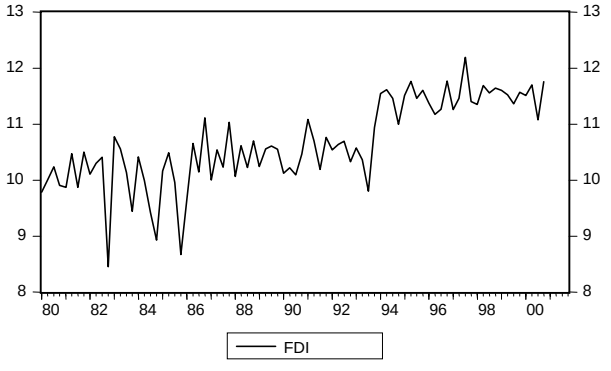
Section I. Data

I.II Statistical Properties

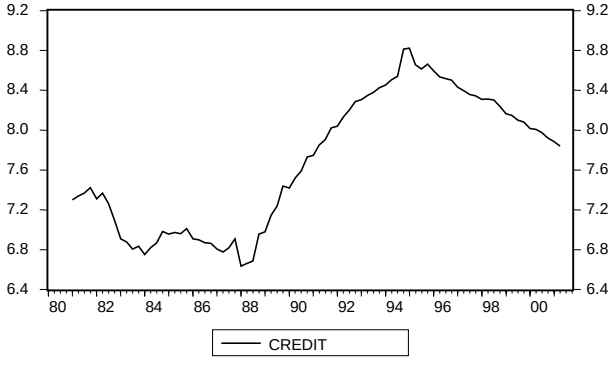
The series considered in this exercise correspond to real FDI measured in Mexican pesos and real credit granted by commercial banks to the private sector for the period 1980:1-2001:3.[5] The data are quarterly and the source of the same is the System of Economic Information of Banco de Mexico (SIE). Unless otherwise indicated, the exercises consider the natural logarithm of the series.

The logarithms of the FDI and CREDIT series are presented in Graph 1 and Graph 2 respectively.

Graph 1



Graph 2



At first sight, the relationship between the variables is not clear, the increase and subsequent fall of the real credit does not necessarily follow movements in the FDI. To examine more precisely their relationship, the correlation between the two variables is estimated. The correlation coefficient for the CREDIT and FDI series

[2] The electronics industry is another example of an industry in which spillover effects of FDI appear to have influenced financing practices.

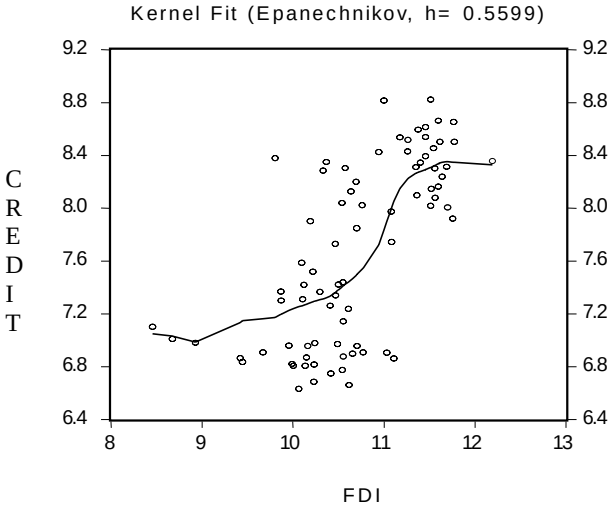
[3] For additional discussion on the possible link between FDI and the supply of credit see Lim (2001).

[4] See also Stock and Watson (1988), Blanchard and Quah (1989), King et al. (1991), and Gonzalo and Ng (2001) for alternative methodologies for identifying common trends and common cycles.

[5] The series were deflated with the consumer price index base 1994 and both are expressed as flows.

is positive and significant, 0.68. A graphic representation of the relationship fitting a nonparametric regression is presented in Graph 3.

Graph 3



The diagram confirms the positive relationship between the flows of FDI and the supply of credit. However, as it is well known, a high correlation between series does not necessarily imply any meaningful economic relationship.

The first formal exercise performed in the analysis to investigate the statistical relationship between the flow of FDI and the supply of credit corresponds to a causality test in the sense of Granger. The estimation considers 5 lags which were determined following the Schwarz criterion. The results are presented in Table 1.

Table 1

Granger Causality Tests

Null Hypothesis	F-Statistic	P-Value
CREDIT does not Granger cause FDI	0.98	0.44
FDI does not granger cause CREDIT	0.68	0.64

The results indicate that there is no causal relationship between the two variables in any direction. That is, although both series exhibit a positive correlation, foreign direct investment does not appear to precede changes in the supply of credit or viceversa.

The next exercise consists on estimating the order of integration of the series. Initially, the autocorrelation and partial correlation series are presented in table 2.

The gradual decay of the autocorrelation series is a behavior often associated with non-stationary series. To confirm this perception, traditional unit root tests are performed. The results of Augmented Dickey Fuller

Table 2

Period	1	2	3	4	5	6	7	8	9	10	11	12	12	14	15
FDI															
Autocorrelation	0.65	0.6	0.59	0.66	0.59	0.55	0.51	0.54	0.46	0.41	0.45	0.43	0.43	0.35	0.32
Partial Correlation	0.65	0.31	0.24	0.33	0.08	0.02	-0	0.06	-0.1	0.1	0.1	0	0.09	-0.1	-0.1
CREDIT															
Autocorrelation	0.99	0.98	0.96	0.93	0.9	0.87	0.84	0.8	0.76	0.72	0.67	0.62	0.57	0.52	0.47
Partial Correlation	0.99	-0.2	-0.2	0.02	-0.4	0.18	-0.1	-0.1	-0.2	0	-0	0.05	-0.1	-0	-0

Table 3

Unit Root Tests*

Serie	Specificaction	ADF t-stat	Critical Value**	PP t-stat	Critical Value***
CREDIT	level	-1.21	-2.90	-0.85	-2.90
CREDIT	1st difference	-2.32	-2.90	-7.12	-2.90
FDI	level	-0.69	-2.90	-3.65	-2.90
FDI	1st difference	-5.21	-2.90	-19.8	-2.90

* The specifications consider 5 lags which were choosen following the Schwarz criterion
** at 5 percent

(ADF) and Phillips-Perron (PP) unit root tests are presented in Table 3.

The results report contradicting evidence, for the credit variable the ADF test indicates that the series is integrated of order 2, in contrast, the PP test suggests an integration of order 1. The ADF test for the FDI series suggests that the series is integrated of order 1, but the PP test indicates integration of order 0. Finding inconclusive results from unit root tests should not be surprising, it is unlikely that a researcher finds robust results when performing these tests.

In the case of the series considered in this analysis, the problem of finding definite results from the unit root tests is accentuated, since there appears to be various structural breaks in the series. Notice, for instance, that the CREDIT series experienced abrupt changes in 1988 and 1994. As Perron (1989) indicates, the results of the conventional unit root tests might be biased in the presence of structural breaks. Hence, a unit root test that allows for the presence of a breaking trend in the series is desirable. The test implemented in this document follows the methodology suggested in Zivot and Andrews (1992).[6] The authors present a procedure whereby a test statistic is estimated for each period in the sample while, simultaneously, allowing for the possibility of a structural break. Specifically, an equation that includes a variable to capture a structural break is estimated in each individual period, a test statistic is obtained (Z_{value}) and then, the most negative Z_{value} is compared with the critical values. The null hypothesis in this test is that the data generating process of the series is characterized by a unit root.

The estimating equation corresponds to equation (3') in Zivot and Andrews (1992) and is defined as follows:[7]

$$y_t = \mu + \theta DU_t(\lambda) + \beta t + \gamma DT_t^*(\lambda) + \alpha y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + \varepsilon_t \qquad (7)$$

where $DU_t(\lambda) = 1$ if $t > T\lambda$, 0 otherwise; $DT_t^*(\lambda) = t - T\lambda$ if $t > T\lambda$, 0 otherwise. $T\lambda$ corresponds to the period for which the hypothesis of a structural break is tested.

The test is implemented by recursively estimating this equation and calculating the Z_{value} for each period in the sample.[8] The critical value for this test at the 5% confidence level is -5.30 and can be found in Table 4 in Zivot and Andrews (1992). For the CREDIT and FDI series the most negative test statistics obtained were

[6] This test allows for endogenously determined structural breaks, it has been shown that this type of tests produce more robust results relative to unit root tests that only consider exogenously determined structural breaks. See Rao (1995), for instance.

[7] The actual estimated equation does not include lagged values since evidence of temporal dependence in the disturbances was not found.

[8] The estimation of the Zvalue for each period is computed with a program developed in the econometric package Eviews. To account for "end of sample" problems, the equation was estimated for the sample period 1981:01-2000:03.

-2.27 and -5.22 respectively. Thus, the hypothesis of non-stationarity cannot be rejected. From these results, those obtained in the conventional unit root tests, the evidence of the autocorrelation series, and results from various other documents, it is concluded that both series are integrated of order[9].

Section II. Long and Short-Run Relationships

II.I Cointegration

To evaluate the existence of a long-run relationship, cointegration, between the supply of real credit and the flow of real foreign direct investment, the Johansen cointegration test is performed. The test considers 5 lags which were chosen following the Schwarz criterion. The results are presented in Table 4.

Table 4

Cointegration Tests

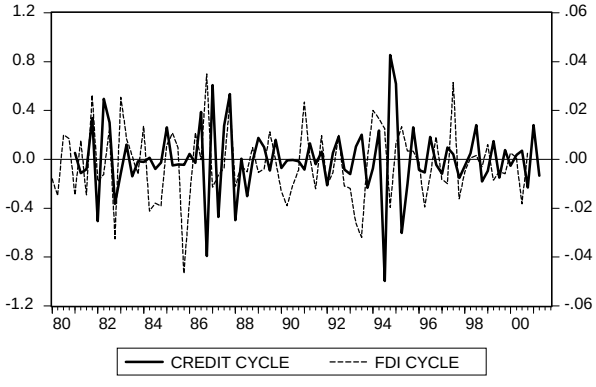
Hypothized No. Of CE(s)	Eigenvalue	Trace Statistic	5 percent Critical Value	1 percent Critical Value
None	0.090	7.58	15.41	20.04
At most one	0.009	0.68	3.76	6.65
Trace test indicates no cointegration at both 5 and 1 percent level				
Hypothized No. Of CE(s)	Max-Eigen Statistic	Trace Statistic	5 percent Critical Value	1 percent Critical Value
None	0.093	6.90	14.07	18.63
Atmost one	0.016	0.68	3.76	6.65
Maxeigen value test indicates no cointegration at both 5 and 1 percent level				

These indicate that there is no cointegration between the two variables.[10] That is, the series do not share a common trend in the long-run.

II. II Common Cycles

The cointegration results from the previous section indicate that the series do not share a common trend, fact that does not imply that the series do not share a common cycle. If the series were cointegrated, the test for common cycles would require the identification of serial canonical correlations, a procedure suggested by Vahid and Engle (1993) and further developed in Issler and Vahid (2001). Since the CREDIT and FDI series are not cointegrated, however, the test for common cycles amounts to identify serial correlation on their cyclical components.

Initially, the series are decomposed into their trend or permanent component and their transitory or cyclical component.[11] The following graph shows the cyclical components of the CREDIT and FDI series.



It is evident that the cyclical components do not overlap, moreover, their turning points generally do not coincide. Hence, the graphical evidence suggests that the CREDIT and FDI series do not share a common cycle.

A test of the correlation between the cycles can provide further evidence of their relationship. That is, if the cyclical series are highly correlated, that might be an indication that the original series share a common cycle. However, in this case the common sample correlation for the cyclical series is –0.06, which is insignificant. A more formal test for the existence of common cycles among time series follows Beveridge and Nelson (1981), who argue that the presence of serial correlation common feature among the first differences of a set of I(1) varia-

[9] See for instance Herrera and Castillo (2003) and Castillo (2001, 2003).

[10] Other cointegration tests including Engle and Granger and an Error Correction Model were also estimated, the results indicate no cointegration.

[11] A Hodrick-Prescott methodology was implemented to obtain the trend-cycle decomposition.

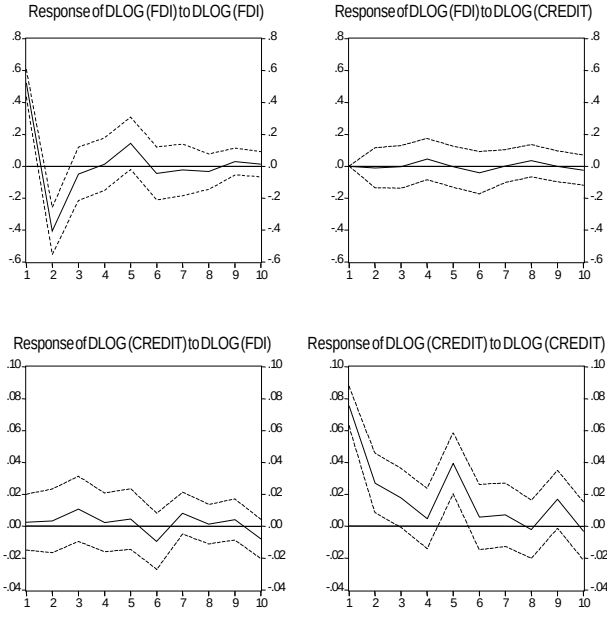
bles imply the existence of a common cycle. The procedure suggested by these authors is implemented, the estimated serial correlation for the first differences of the CREDIT and FDI series is 0.017. Evidently, there is no significant correlation between them. From the evidence presented in this section, it is reasonable to conclude that the FDI and CREDIT series do not share a common cycle, that is, there is no evident short-run relationship between the series.

II. III VAR Estimation

Finally, a VAR is estimated to evaluate the short-run dynamics of the series. Since the purpose of this analysis is to determine the response of the supply of credit to foreign capital flows, the order in the VAR is as follows: D(FDI), D(CREDIT), where D represents the first difference operator. The impulse-response functions from the estimation are presented in Graph 5.

Graph5

Response to Cholesky One S.D. Innovations ± 2 S.E



The response of the supply of credit to innovations in the flow of foreign direct investment is not significant.

The variance decomposition of the VAR is presented in the following table.

Variance Decomposition of ΔFDI				Variance Decomposition of ΔCREDIT			
Period	S.E.	ΔFDI	ΔACREDIT	Period	S.E.	ΔFDI	ΔCREDIT
1	0.52	100.0	0.0	1	0.08	0.11	99.89
2	0.66	100.0	0.0	2	0.08	0.27	99.73
3	0.66	100.0	0.0	3	0.08	1.98	98.02
4	0.67	99.5	0.5	4	0.08	2.05	97.95
5	0.68	99.5	0.5	5	0.09	1.91	98.09
6	0.68	99.2	0.8	6	0.09	2.93	97.07
7	068	99.2	0.8	7	0.09	3.66	96.34
8	0.96	98.9	1.1	8	0.09	3.67	96.33
9	0.69	98.9	1.1	9	0.09	3.74	96.26
10	0.69	98.8	1.2	10	0.10	4.42	95.58

The results from the variance decomposition suggest that the response of the supply of credit to changes in the flow of foreign capital is not significant. That is, variations on the supply of credit are mostly explained by their own past history.

Section III. Conclusions

The analysis in this document shows that, although there is a positive correlation between FDI and the supply of credit, both series do not share a common trend or a common cycle. Moreover, the causality test indicates that there is no causal relationship among them. These results indicate that the argument that suggests that increments (decrements) in the flow of foreign capital, and FDI in particular, affect the supply of credit in Mexico should not be made. More likely, the supply of credit responds to factors that include the discretion of the lenders who take into account issues of adverse selection and moral hazard, macroeconomic conditions and the political environment. Evidently, a more in-depth analysis is needed to formally identify of the factors that influence the behavior of the credit market. Such analysis will be conducted in future research.

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