REASSESSING THE DYNAMIC LINKS BETWEEN TRADE AND GROWTH: NEW EMPIRICAL EVIDENCE FROM INDIA*

1. Introduction and motivation

The relationship between trade and growth is one of the most intensively studied topics in the field of international trade. The nature of the trade-growth nexus has been discussed since the 70's, in the debate between the proponents of export-oriented or import-substituting development strategies (see respectively Bhagwati, 1978 and Prebisch, 1970). The conflicting views expressed in this debate tended, alternatively, to consider trade as an 'engine' of growth (Krueger, 1978) or as a 'handmaiden' of growth (Kravis, 1970). In more recent years, the relationship between trade and growth has received a considerable attention in the field of international trade and in various models of endogenous growth.

The dynamic links outlined in this work may be summarized as follows:

1. a relationship from exports to economic growth;
2. a relationship from economic growth to exports;
3. a simultaneous relationship (i.e. the existence of bi-directional causality) between exports and growth;
4. a relationship from imports to economic growth.

The former causal link corresponds to the well known 'export-led growth hypothesis'. The literature has pointed out various channels which give rise to a positive effect from export to output growth. First, from a standard 'demand side' Keynesian perspective, export growth leads to an overall increase in income and employment through the foreign trade multiplier. Second, export growth may ease the foreign exchange constraint, thus allowing to increase the imports

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of intermediate inputs and capital goods which in turn boost domestic production. This effect is usually referred as the ‘import compression hypothesis’ (Kahn and Knight, 1988). Last but not least, an increase in exports generates a set of positive influences operating through the supply side which include: a better specialization in production through foreign market competition, a more efficient allocation of resources, increased capacity utilization and the exploitation of economies of scale.

The reverse causal relationship, known as the ‘growth-driven exports’ hypothesis, characterizes some trade models where increases in domestic levels of skilled labor induce productivity gains which, in turn, generate a higher export level (see, among others, Findlay, 1984 and Krugman, 1984). The occurrence of a two-way causality between exports and growth, i.e. of a ‘virtuous’ cycle in which an increase in exports generates more output and this in turn stimulates more exports, is instead emphasized both in some standard trade models (Bhagwati, 1988) and in other contributions relying on a north-south approach (Grossman and Helpman, 1991).

Turning to the last relationship, a causal link from imports to economic growth is present in many recent endogenous growth models. These models show how imports represent an important source of long-run growth for developing countries, providing domestic firms with a direct access to technology-intensive factors of production and foreign R&D knowledge (see, among others, Coe and Helpman, 1995 and Mazumdar, 2001).

The variety of potential dynamic links between trade and growth has spurred, since the early 70’s, a large amount of empirical work focusing on many developing countries. A significant part of this research concentrates on India since the period of its independence. This is not surprising because, during this period, this country experienced a radical change in the policies aimed at sustaining long run growth, and represents therefore a particularly attractive case study.

For more than three decades India remained a highly protected economy, characterized by high levels of tariffs and quota walls and by a dominant role of the state in most industrial activities. This policy attitude began to change since the early 90’s, when a progressive trade liberalization was implemented in order to correct a rent-seeking behavior in the public sector and to eliminate price distortions induced by the lack of competitive pressures. Overall, this new outward-oriented strategy significantly increased India’s percentage share in world exports in recent years.

Empirical analyses addressing the experience of India since its independence offer remarkably mixed results. Focusing on earlier work, Xu (1996), Asafu-Adjaye *et al*. (1999), and Anwer and Sampath (2001) reject the 'export-led growth hypothesis', whereas other contributions support this hypothesis either as a short run relationship (Dhawan and Biswal, 1999) or if the export variable is restricted to non-traditional manufactured products (Ghatak and Price, 1997 and Nidugala, 2001). Mallick (1996), on the other hand, reports a reverse causal relationship from income growth to export growth.

Turning to more recent contributions, the main area of disagreement continues to be the validity of the 'export-led growth hypothesis' which is rejected in Sharma and Panagiotidis (2005) and Shirazi and Abdul Manap (2005), while being supported as a short run relationship in Singh (2002) and Love and Chandra (2005). Quite interestingly, some later research documents a bi-directional causality between exports and output (Chandra, 2002 and 2003; Love and Chandra, 2004). This research, however, does not reach uniform conclusions about the short run or long run nature of this relationship.

The mixed results achieved so far may be ascribed to two factors. First, the period examined differs across various contributions. The earlier literature is unable to address to a full extent the experience of the 90's, during which India engaged in a large process of trade liberalization. The latest literature, on the other hand, often neglects the decades immediately following India's independence (Sharma and Panagiotidis, 2005 and Shirazi and Abdul Manap, 2005), during which this country has been described as an "import substituting country par excellence" (Rodrik, 1996).

A further potential source of not homogeneous empirical findings may be ascribed to differences in model's specification. Although most contributions share an approach relying on cointegration and Granger causality tests, some papers (Dhawan and Biswal, 1999; Chandra, 2002; Love and Chandra, 2004 and 2005) do not include imports among the set of variables subject to formal econometric investigation. Yet, as argued in Riezman *et al*. (1996), the omission of imports may lead to misleading results since imports represent an important channel for the transfer of technology to less developed countries.

This paper revisits India's experience since its independence, contributing to the current literature in three main respects.

First, differently from existing contributions, the analysis relies on a larger data sample which covers a significant period of India's post-liberalization phase since 1991. A wider coverage of these years is particularly relevant, since during this period India experienced a notably higher rate of real growth with respect to the first three decades. Moreover, from the perspective of cointegration analysis, the length of the sample period is crucial in order to obtain sensible statistical inferences (Hakkio and Rush, 1991).

A second innovative feature is that the robustness of the empirical findings is assessed through alternative testing procedures, implemented at all stages of the econometric investigation. These robustness checks are particularly relevant in the light of the variegated empirical evidence discussed above.

Third, I try to put the results in perspective, evaluating their policy implications in terms of suitable growth strategies for the future. This issue is only incidentally addressed in the literature, whereas it deserves a careful discussion given the increasing role of India in the global economic scene.

The outline of the paper is as follows. Section 2 describes the data set and investigates the integration and cointegration properties of data. Section 3 contains the main empirical findings. I implement Granger causality tests in the context of a Vector Error Correction Model and assess the robustness of the empirical evidence using an alternative level VAR estimator. Section 4 discusses the policy implications of my results. Section 5 concludes.

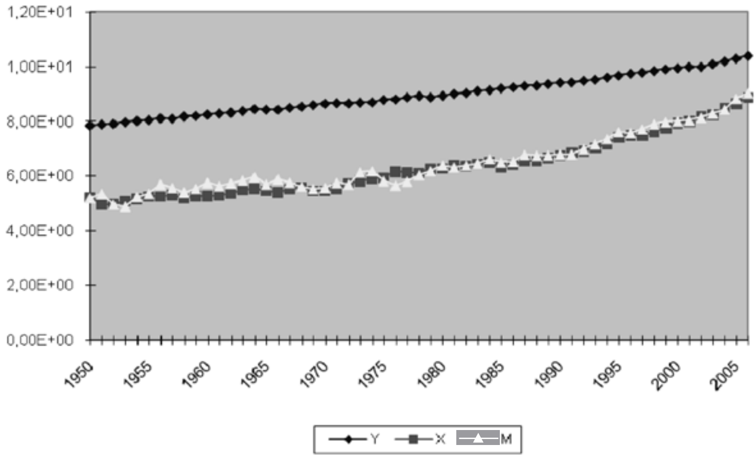
2. Preliminary analyses

2.1 Data Description

I use annual data for the Indian economy drawn from the IFS - National Accounts Tables. The sample covers the period from 1950 to 2006, yielding a total of 57 observations. Data on Gross Domestic Product (GDP) and Exports and Imports of goods and services are originally expressed in Billions of Rupees at current prices. All series were converted in real terms using, respectively, the GDP deflator, the Export price index and the Import price index obtained from the same source. Real series were subsequently expressed in logarithmic form.

Plots of the natural logarithms of real GDP (Y), real exports (X) and real imports (M) are displayed in figure 1. All series exhibit strong upward trends, implying that they might move together in the long run. Moreover, the economic liberalization implemented after the 1991 balance of payments crisis gave a strong impetus to real exports and real imports, which show a significant increase with respect to previous decades.

FIGURE 1 - *India: Real GDP (Y), Real Exports (X), and Real Imports (M), Value in Logs, Annual Data 1950-2006*



2.2 Unit Root Tests

The first step involves the assessment of the stationarity properties of data. To this purpose, the Augmented Dickey Fuller (Dickey and Fuller, 1979) (ADF) and the Phillips Perron (Phillips and Perron, 1988) (PP) tests were applied to the series of real output, real exports and real imports. Since all variables are highly trended, both tests were implemented allowing also for a trend component in the auxiliary equations.

The results displayed in table 1 suggest that the null hypothesis of non stationarity is never rejected for all variables in levels, whereas the null is always strongly rejected when the variables are expressed in first differences. I therefore conclude that all variables included in the data set are integrated of order one (I(1)).

2.3 Cointegration Tests

Cointegration tests are relevant, in the present framework, in order to provide a correct specification for the model underlying Granger causality tests. Following Engle and Granger (1987), the existence of cointegration implies that a Vector Error Correction Model (VECM) is the proper specification to investigate the causality links among variables. On the other hand, in the absence of cointegration, the above model collapses in a standard dynamic VAR specification.

Table 1 - *Unit Root Tests*

VARIABLES	ADF		PP	
	Without Trend	With Trend	Without Trend	With Trend
Y	2.868	0.662	3.289	0.435
ΔY	- 4.580***	- 5.656***	- 6.393***	- 10.96***
X	3.420	0.470	6.752	- 0.352
ΔX	- 4.282***	- 6.058***	- 9.355***	- 14.43***
M	1.390	- 0.735	2.214	- 1.160
ΔM	- 5.382***	- 5.851***	- 9.068***	- 13.90***

Notes: Y, X, M denote, respectively, the logs of real output, real exports, and real imports.
ΔY, ΔX, ΔM denote the first differences of the above variables.
*** denotes statistical significance at the 1% level.
Critical values for these unit root tests are provided in Fuller (1976).

The empirical literature on India reaches mixed conclusions about the existence of a long run relationship between output and trade variables. Focusing on more recent contributions, cointegration is supported in Love and Chandra (2004) and Shirazi and Abdul Manap (2005), whereas Singh (2002), Chandra (2002), Love and Chandra (2005) and Sharma and Panagiotidis (2005) obtain opposite results.

In the light of this controversial empirical evidence, alternative methodologies are implemented in this section. I start applying a residual based approach, using the ADF t ratio test as recommended in Engle and Granger (1987). Cointegrating regressions are alternatively normalized on Y, X, and M, while I allow for the existence of a trend component in the equilibrium relationship. The optimal lag length in auxiliary equations is chosen with the help of standard model selection criteria such as the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC), and ensuring that residuals are white noise.

As shown in table 2, the evidence is highly mixed. Assuming no trend in the cointegrating regression, the null hypothesis of non stationary residuals cannot be rejected in the equation normalized on real output, whereas it is rejected (but only at a 10% level) in

TABLE 2 - *ADF Residual Based Tests for Cointegration*

	Cointegrating Regression normalized on Y	Cointegrating Regression normalized on X	Cointegrating Regression normalized on M
No Trend in the Cointegrating Regression	- 1.73	- 3.50*	- 3.50*
Trend in the Cointegrating Regression	- 3.74	- 2.60	- 4.71***

Notes: * denotes statistical significance at the 10% level; *** denotes statistical significance at the 1% level.
Critical values for the ADF statistics are from Phillips and Ouliaris (1990), tables IIb and IIc.
The critical values for a cointegrating regression with a constant term, no trend, and two explanatory variables are: -3.4494 (10%), -3.7675 (5%), -4.3078 (1%).
The critical values for a cointegrating regression with a constant term, a trend, and two explanatory variables are: -3.8429 (10%), -4.1567 (5%), -4.6451 (1%).

the remaining cases. On the other hand, allowing for a trend in the equilibrium relationship, the null of non stationary residuals is strongly rejected in the equation normalized on real imports, whereas cointegration is not supported in the remaining cases.

On the whole, these results do not allow to reach a definitive conclusion, although there is some evidence pointing to the existence of a long run equilibrium relationship[1].

In order to get further insights, I apply the maximum likelihood

[1] It may be interesting to observe that these results display a close similarity with those recorded applying the Autoregressive Distributed Lag (ARDL) framework developed in Pesaran *et al*. (2001). This alternative procedure assesses the existence of a long run relation specifying a conditional ARDL-ECM equation, and computing an F-statistics for testing the joint significance of the coefficients of the lagged levels of the variables in the above equation. The asymptotic distribution of this F-statistics is not standard, and critical value bounds are provided in Pesaran *et al*. (1996a) for various cases, including the use of either I(1) or I(0) variables. This approach supports the existence of cointegration in the conditional ARDL-ECM normalized on real imports and incorporating a trend component, while rejecting the existence of a long run equilibrium relationship in the other cases. These results are not reported in the present section in order to save space, but are available upon request.

tests for multiple cointegrating vectors developed in Johansen (1988) and Johansen and Juselius (1990). This approach provides better inferences when more than two I(1) variables are involved in the system, since the results from residual based tests may be sensitive to the normalization rule. Table 3 summarizes the results from Johansen cointegration tests.

TABLE 3 - *Johansen Cointegration Tests*

Order of VAR (p = 1)

Null	Alternative	λ -Max Statistics	Critical Values		Trace Statistics	Critical Values	
r = 0	r = 1	18.39	22.60 (10%)	24.35 (5%)	36.52*	36.28 (10%)	39.33 (5%)
r ≤ 1	r = 2	16.58*	16.28 (10%)	18.33 (5%)	18.12	21.23 (10%)	23.83 (5%)
r ≤ 2	r = 3	1.54	9.75 (10%)	11.54 (5%)	1.54	9.75 (10%)	11.54 (5%)

Order of VAR (p = 2)

Null	Alternative	λ -Max Statistics	Critical Values		Trace Statistics	Critical Values	
r = 0	r = 1	26.80**	22.60 (10%)	24.35 (5%)	37.35*	36.28 (10%)	39.33 (5%)
r ≤ 1	r = 2	9.29	16.28 (10%)	18.33 (5%)	10.55	21.23 (10%)	23.83 (5%)
r ≤ 2	r = 3	1.25	9.75 (10%)	11.54 (5%)	1.25	9.75 (10%)	11.54 (5%)

Order of VAR (p = 3)

Null	Alternative	λ -Max Statistics	Critical Values		Trace Statistics	Critical Values	
r = 0	r = 1	21.09	22.60 (10%)	24.35 (5%)	39.93**	36.28 (10%)	39.33 (5%)
r ≤ 1	r = 2	13.88	16.28 (10%)	18.33 (5%)	18.84	21.23 (10%)	23.83 (5%)
r ≤ 2	r = 3	4.95	9.75 (10%)	11.54 (5%)	1.95	9.75 (10%)	11.54 (5%)

Notes: * denotes statistical significance at the 10% level ; ** denotes statistical significance at the 5% level.
Critical values for cointegration tests are from Pesaran *et al.* (1996b).
All test statistics appearing in this table are computed assuming an intercept and a trend in the cointegrating VAR.

Since model selection criteria (AIC, SBC) do not provide uniform guidance, this table reports the results associated with different lag structures (p = 1, 2, 3) in the cointegrating VAR. All equations are submitted to standard mis-specification tests, which allow to exclude the existence of serial correlation and non normality in the residuals.

The Maximum-Eigenvalue test does not provide clear inferences, since the null hypothesis of r = 0 is rejected under one lag structure (p = 2), whereas the absence of cointegration cannot be rejected in the remaining cases. I prefer, however, to place more emphasis on the evidence obtained through the Trace test, as the Monte Carlo experiments performed in Cheung and Lai (1993) suggest that the above test is more robust to both skewness and excess kurtosis in the residuals. Focusing on the more powerful Trace statistics, the null of r = 0 is always rejected, either at a 10% (p = 1, 2) or at a 5% level (p = 3).

Overall, the empirical findings from the Johansen's approach provide more support to the existence of one cointegrating vector between real output, real exports and real imports in the case of India.

Since the evidence achieved in this section suggests that the existence of a long run equilibrium relationship between trade and growth is a reasonable working hypothesis, I start the next section carrying out our Granger causality tests inside a VECM framework. The robustness of these findings is subsequently assessed applying an alternative methodology which does not require the existence of a cointegrating relationship among the variables.

3. Empirical evidence

3.1 Granger Causality Tests in a VECM Framework

In the present trivariate set up, a Vector Error Correction Model (VECM) may be specified as follows:

$$\Delta Y = a_1 + \text{lagged }(\Delta Y, \Delta X, \Delta M) + \lambda_1 EC_{t-1} \quad (1)$$

$$\Delta X = a_2 + \text{lagged }(\Delta Y, \Delta X, \Delta M) + \lambda_2 EC_{t-1} \quad (2)$$

$$\Delta M = a_3 + \text{lagged }(\Delta Y, \Delta X, \Delta M) + \lambda_3 EC_{t-1} \quad (3)$$

where the one period lagged error-correction terms (EC_{t-1}) appearing in the above system of equations are the residuals from the cointegrating equations.

This VECM specification allows to pinpoint both short run and long run causality effects. The former are captured by a significant impact of the lagged variables in the system, while the latter are captured by significant values of the errror-correction parameters (λ's).

A preliminary investigation on the first-differenced system expressed by equations (1)-(2)-(3) pointed out that the null hypothesis of absence of linear trend components cannot be rejected at standard significance levels. Accordingly, this VECM was estimated including a constant term but excluding the presence of a linear trend component in equations (1)-(2)-(3).

As regards the lag structure, we proceeded with a 'simple to general' search as recommended in Engle and Granger (1987). This revealed that a parsimonious structure with p = 1 is sufficient to ensure uncorrelated and Gaussian residuals in all estimated equations. Moreover, a lag structure with p = 1 is fully consistent with standard model selection criteria (AIC, SBC).

TABLE 4 - *Granger Causality Tests in a VECM Framework*

Dependent Variables	Lagged Variables			EC_{t-1}
	ΔY	ΔX	ΔM	
ΔY	-	5.122** [0.028]	0.225 [0.637]	-0.0528* (-1.74)
ΔX	4.996** [0.030]	-	0.666 [0.418]	-0.0756 (-0.76)
ΔM	0.024 [0.876]	2.632 [0.111]	-	-0.412** (-3.21)

Notes: The Vector Error Correction Model includes a constant term and is estimated assuming one lag (p=1).
The statistics appearing in this table are the F-statistics for testing the null of zero or exclusion restrictions on the coefficients of the lagged variables included in the VECM. Marginal significance levels are in square brackets beside these statistics.
The column labelled EC_{t-1} reports the estimates of the lagged error correction terms, with t statistics in round brackets below parameters estimates.
* denotes significance at the 10% level ; ** denotes significance at the 5% level.

The results of Granger causality tests are summarized in table 4.

The most salient feature is the existence of a bi-directional causal relationship between exports and output growth. Focusing on the first row of table 4, we observe that the null hypothesis that lagged variations in exports do not induce output changes is rejected at a 5% confidence level. In a similar way, the null of exclusion restrictions on the lagged coefficients of output growth is rejected at the 5% confidence level in the second row, revealing a significant influence of output on export dynamics.

This empirical evidence is thus consistent with the existence of a 'virtuous cycle' in India along the post-independence period. In this 'virtuous cycle', which has been underlined in some standard trade models and other theoretical contributions (see section 1), an increase in exports generates more output and this in turn stimulates more exports.

According to these results, however, this positive interaction is exclusively a short run phenomenon and does not involve a long run causal relationship among the above variables. This is apparent focusing on the last column of table 4, where the coefficients of the error correction terms are either insignificant (λ_2) or only marginally significant (λ_1). Note moreover that, since we document a weak error correction mechanism in the equation with real output as dependent variable (λ_1 is statistically significant only at a 10% level), our results do not provide a robust support to the export-led growth hypothesis as a long run causal relationship in the case of India.

Turning to the import equation, I find that the null hypothesis of exclusion restrictions for the coefficients of lagged explanatory variables can never be rejected at conventional significance levels, whereas the error correction parameter (λ_3) is highly significant. These results imply that, although output and exports do not Granger cause imports in the short run, there are significant unidirectional causality links in the long run.

The existence of a long run unidirectional relationship from output to import growth is at odds with the predictions of many recent endogenous growth models which posit a causal link in the reverse direction (see section 1). Thus, contrary to the predictions associated with the above models, imports do not represent a relevant channel for long run economic growth in the case of India. While endogenous growth models underline some effects originating from the supply side (i.e. the access to intermediate factors of production and foreign technology facilitated from imports), these findings are consistent with a standard keynesian demand side explanations of imports in an open economy. In this perspective, an increase in output generates an increase in aggregate demand, part of which is satisfied through goods and services imported from the rest of the world[2].

[2] As I will discuss later in more detail, this type of causality has rarely been observed in previous empirical work on India. This is hardly surprising as most of earlier contributions focus on the first decades since the independence, when the Indian economy was still relatively closed and highly protected as a consequence of a strict import-substitution development strategy. Since the late 70's, however, the government began to open the domestic economy to foreign competititon, progressively reforming the old

A latter causal relationship emerging from the import equation is the existence of a long run link from export to import growth; our results, finally, do not completely rule out the possibility of a short run causal effect from export to import growth since, according to the F-test, the coefficient of lagged export growth in the third row of table 4 is only marginally insignificant (p-value: 0.111). Taken as a whole, this evidence supports to the 'import compression hypothesis' (see section 1) according to which export growth, by alleviating the foreign exchange constraint, allows to increase import growth with positive spillover effects on the rest of the economy.

It may be interesting, before concluding this section, to briefly compare our results with those achieved in previous work. The existence of a bi-directional causality between output and export growth has sometimes been documented, although previous results usually differ from ours as regards the nature of this relationship. Most research supports a bi-directional link between output and export growth either as a long run causal relationship (Chandra, 2003 and Love and Chandra, 2004), or as an hybrid relationship including short and long run causal effects (Dhawan and Biswal, 1999). To my knowledge, the only previous contributions supporting the existence of a short run bi-directional link between exports and output growth for India are those of Chandra (2002) and Din (2004).

As regards the remaining results of this section, namely the existence of unidirectional effects from output and exports to imports growth, they have been very rarely pointed out in previous analyses. Some evidence along these lines is provided in Shirazi and Abdul Manap (2005), although these authors do not provide any rationale behind the existence of such relationships in the case of India.

3.2 Granger Causality Tests in a Levels VAR Framework

The econometric analysis of section 3.1 relies on various pre-testing procedures aiming at establishing the order of integration of

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import licensing system. Moreover, a deeper and more systematic trade liberalization, both in merchandise and in services, was implemented after the 1991 balance of payments crisis. The sample period covered by the present empirical investigation covers therefore a period of virtual autarky (1950-1975), followed by subsequent periods of progressive and extensive trade liberalization. See Panagariya (2004), for a detailed discussion of this experience and its impact on trade flows, efficiency and growth.

single economic variables and the existence of a long run equilibrium relationship among them. This approach has, however, some limitations due to the uncertain inferences associated with the above pre-testing procedures. It is well known that unit root tests have very low power against the alternative hypothesis of (trend) stationarity. Moreover, Monte Carlo experiments point out that Johansen-type tests for cointegrating ranks are highly sensitive to nuisance parameters in finite samples (Reimers, 1992 and Toda, 1995). This taken into account, the drawbacks associated with such pre-testing procedures have often been underlined in the literature[3], emphasizing the need for alternative methodologies robust to the integration and cointegration properties of data.

Toda and Yamamoto (1995) develop a new estimator to implement Granger causality tests in a VAR framework which overcomes these drawbacks. The main advantage of this estimator is that it can be applied irrespective of the integration or cointegration properties of data, thus avoiding the pretesting procedures characterizing standard causality tests. As explicitly underlined by its proponents, this methodology represents a complementary approach with respect to standard causality tests[4].

Assume that some linear or nonlinear restrictions on the coefficients of a given model have to be tested. Toda and Yamamoto (1995) propose to estimate an 'augmented' VAR expressed in levels, and show that these restrictions can be tested by means of a modified Wald test. The first step in the implementation of this procedure is the selection of the true lag length (k) of a VAR in levels and the determination of the maximum order of integration (d_{max}) of the variables in the system. An over-parametrized VAR in levels of order $p = k + d_{max}$ is then estimated in order to conduct statistical inferences.

Toda and Yamamoto (1995) prove that linear or nonlinear

[3] Toda and Phillips (1993) show that Granger causality tests in a VECM framework may lead to incorrect inferences and suffer from nuisance parameter dependency. In a similar vein, Giles and Mirza (1990) point out that the pre-testing procedures associated with standard Granger causality tests may lead to over rejection of the null hypothesis of non-causality among variables.

[4] In the concluding section the authors write: *"We emphasize, however, that we are not suggesting that our method should totally replace the conventional hypothesis testing that are conditional on the estimation of unit roots and cointegrating ranks. It should rather be regarded as complementing the pretesting method that may suffer serious biases in some cases"* (Toda and Yamamoto, 1995, p. 246).

restrictions on the first k coefficient matrices (Π_1, ..., Π_k) can be tested using standard asymptotic theory; the coefficient matrices of the last d_{max} lagged vectors (Π_{k+1}, ..., Π_{max}) are ignored since these are regarded as zeros. Under the null hypothesis of zero restrictions on the coefficients of each variable for lags one to k, the Wald statistics is asymptotically distributed as a chi-square with usual degrees of freedom, and this does not depend on whether the VAR is stationary (around a linear trend), integrated, or cointegrated of any order.

Specializing the above framework to the analysis of the present paper, this approach involves the estimation of the following VAR system in levels:

$$Z_t = \mu_t + \sum_{i=1}^{k} \Pi_i Z_{t-i} + \varepsilon_t \tag{4}$$

where μ_t is a vector of constant terms, Z_t is a 3x1 column vector including real output, real exports and real imports ($Z' = [Y_t, X_t, M_t]$), Π_i is a coefficient matrix, and ε_t is a 3x1 vector of Gaussian error terms with zero mean and covariance matrix Λ [$\varepsilon_t \sim$ i.i.d. $(0, \Lambda)$]. Denoting with k the true lag length of this VAR, estimation of (4) is first implemented including k + d_{max} lags, while the Wald statistic is computed on the first k coefficient matrices (Π_1, Π_2, ..., Π_k).

The choice of the true lag length of this VAR system involved a careful investigation based on standard model selection criteria and likelihood ratio statistics. The Schwarz Bayesian Criterion (SBC) and likelihood ratio tests suggest an optimal lag length of one (k = 1), whereas the Akaike Information Criterion supports higher lag structures. In the light of this evidence, our analysis was implemented using three alternative sets of levels VAR models based, respectively, on k = 1, 2, and 3.

As documented in section 2.2, all variables included in these VARs are integrated of order one, so that d_{max} = 1 in the present set up; accordingly, three over-parametrized VAR models of order 2, 3, and 4 were estimated. These models include a constant and a linear time trend, while all equations were submitted to standard diagnostic tests on residuals[5].

[5] Likelihood ratio tests pointed out that the null hypothesis of absence of a linear trend component in these VARs is consistently rejected with all lag structures. Diagnostic tests on residuals from levels VAR systems of order 2, 3, and 4 allowed to exclude the existence of serial correlation, non-normality and heteroscedasticity.

The results from the Toda and Yamamoto (1995) estimator are summarized in table 5.

TABLE 5 - *Granger Causality Tests in a Levels VAR Framework*

[Order of VAR = 1 (+1)]

Dependent Variables	Lagged Variables		
	Y	X	M
Y	-	5.648** [0.022]	0.053 [0.818]
X	3.151* [0.082]	-	0.453 [0.504]
M	0.291 [0.592]	5.718** [0.021]	-

[Order of VAR = 2 (+1)]

Dependent Variables	Lagged Variables		
	Y	X	M
Y	-	2.549* [0.090]	0.037 [0.963]
X	5.255** [0.009]	-	0.320 [0.728]
M	1.182 [0.316]	1.247 [0.297]	-

[Order of VAR = 3 (+1)]

Dependent Variables	Lagged Variables		
	Y	X	M
Y	-	2.465* [0.077]	0.799 [0.502]
X	3.826** [0.017]	-	0.671 [0.575]
M	3.237** [0.032]	3.046** [0.040]	-

Notes: All levels VAR models include an intercept and a trend. The optimal order (k) of these levels VAR models is respectively set to 1, 2, and 3 in the above tables. The (+1) term appearing in the headings of these tables represents the overparametrization of levels VAR models implemented in order to apply the Toda and Yamamoto (1995) estimator.
The F-statistics for the null of exclusion restrictions are, respectively, as follows: F(1, 47) (first table); F(2, 43) (second table); F(3, 39) (third table). Marginal significance levels are in square brackets.
* denotes statistical significance at the 10% level; ** denotes statistical significance at the 5% level.

Overall, this empirical evidence is quite consistent across alternative lag structures and displays substantial analogies with the results achieved in the previous section.

Consider, first, the dynamic relationship between exports and output growth. The export-led growth hypothesis is again supported by data. Focusing on the former rows of table 5, the null hypothesis that exports do not affect output is consistently rejected for all lag structures at conventional significance levels. At the same time, these empirical findings corroborate the existence of a reverse causal relationship from output to exports, since the F-statistics for the null of exclusion restrictions on the coefficients of output in the export equation are always highly significant (see the second rows, across alternative lag structures, in table 5).

Taken as a whole, these results confirm the existence of a 'virtuous cycle' between exports and growth. Since the positive interaction between exports and output receives support applying different econometric methodologies, this evidence represents a robust result of our empirical analysis.

Turning to the results associated with the estimate of the import equation (see the third rows of table 5 across alternative lag structures), I find further support for some evidence documented in section 3.1. The null hypothesis that exports do not affect imports growth is rejected, at a 5% significance level, in the levels VAR systems assuming 2 and 4 lags. Thus, in strict analogy with the analysis carried out in the previous section, the Toda and Yamamoto (1995) estimator confirms the existence of a unidirectional causal effect from exports to import growth, further corroborating the 'import compression' hypothesis for India.

Focusing again on the import equation, the F-statistics for the null of exclusion restrictions on the coefficients of output is not significant in two out of three cases, while it turns out to be statistically significant in the equation with the highest lag structure (i.e. when $k + d_{max} = 4$). Therefore, in line with section 3.1, my evidence is again consistent with a standard keynesian demand side effect on imports, although the strength of this effect is much lower than in previous empirical estimates.

To sum up, the Toda and Yamamoto (1995) estimator provides robust support to my previous empirical findings. The alternative Granger causality tests implemented in this section confirm a significant bi-directional relationship between exports and output growth and a significant unidirectional causal effect from exports to imports growth.

4. Some policy implications

The literature surveyed in section 1 has only occasionally addressed the policy implications associated with the relationships between trade and growth. The present section fills the above gap, reflecting on the policy implications of our empirical findings in terms of suitable medium term growth strategies for the Indian economy. Since the topics addressed in this paper are strictly related to the ongoing debate on export-led growth in India, I first summarize the salient features of this debate. The remaining part of this section discusses the policy implications of my results, and evaluates their validity in the light of some recent contributions on the Indian economy and on other developing countries.

An intense debate about the most suitable development strategy for India took place since the mid-1980s. This debate hinges upon two alternative prescriptions: a manufacturing-export-led-growth industrialization strategy and an agriculture-led industrialization strategy.

The former strategy aims to provide a greater role for world market signals to guide domestic resource allocation and to achieve a more efficient growth process through an increase in manufacturing exports. This outward-oriented approach enjoyed a great popularity among the profession both in India and abroad (see, e.g., Ahluwalia, 1991; Bhagwati, 1993 and Srinivasan, 1993). The case for manufacturing-export-led-industrialization is supported by the evidence reported in Lucas (1989), according to which a sustained policy of external and internal liberalization would yield relevant gains to the Indian economy. This strategy received a major impulse after the implementation of an IMF-World Bank structural adjustment program in response to the 1991 balance of payments crisis, which led to the elimination of quantitative controls and to a progressive liberalization of the current account.

The adoption of a strategy of greater outward-orientation, however, was not uncontroversial given the inward-looking character of the Indian industrialization process during the 60s and the 70s. A group of economists raised some criticism towards this strategy, pointing out its negative effects on the already uneven income distribution and the vulnerability of the economy to potential adverse developments in world trade patterns (see, among others, Raj, 1986; Chakravarty, 1987 and Bhaduri, 1993). The distinctive feature of this line of thought is an alternative agricultural-led industrialization strategy, relying on large public investments in agriculture-related infrastructures. Thus, differently from a manufacturing-export-led-growth industrialization strategy, this approach relies on the expansion of internal rather than external demand. The net benefits accruing from an agriculture-led industrialization approach are emphasized in various analyses relying on computable general equilibrium models of the Indian economy (see, e.g., Taylor *et al.*, 1984 and Storm, 1994).

Taking this debate in the background, I evaluate the policy implications of the empirical findings obtained in the present paper.

The main result achieved in the previous section is the existence of a bi-directional relationship between exports growth and real output growth. Since exports significantly contribute to the growth process and this in turn stimulates further exports increases, a purely outward-oriented approach would seemingly represent the most promising development strategy, even for a 'large-size' economy like that of India. A purely export-led growth strategy, relying heavily on the exports of manufacturing products, risks however to be misplaced in the Indian context. A closer examination of the empirical evidence will help to clarify this point.

The evidence obtained in section 3.1 reveals that the export-led growth hypothesis does not receive a strong support as a long run causal relationship in the case of India. Recall, at this purpose, that the empirical estimates derived in a standard VECM framework reveal that the error correction parameter in the equation with real output as dependent variable is only marginally significant. Moreover, the error correction parameter in the equation with real exports as dependent variable was found to be not statistically significant, pointing out that a bi-directional link between exports and output growth receives empirical support only as a short run and not as a long run causal relationship.

The absence of a long run positive interaction between exports and output growth implies that a strategy exclusively focused on outward-oriented policies would not be entirely appropriate. In other words, since exports and output mutually reinforce each other only in the short run, a purely outward-oriented approach does not seem capable to sustain a satisfactory rate of real growth.

The main policy implication from the above discussion is that a neutral policy regime, not discriminating between the export and the domestic sector, is likely to represent the most appropriate development strategy for India. Since exports alone do not seem capable to sustain long run growth, policy-makers should pursue a neutral export-promotion strategy, that is a development strategy where enough resources are devoted to stimulate the domestic sector of the economy[6].

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[6] It may be interesting to underline, at this purpose, that the World Bank

One relevant structural feature of the Indian economy is the lack of adequate infrastructures, both from a physical (road, communication, irrigation, etc.) and from a social (health, education), regulatory and financial viewpoint. Moreover, the recent strategy of strong outward-orientation has generated an increasing gap between highly capital-intensive manufacturing and services sectors, competing on international markets, and other important sectors (agriculture and small-scale manufacturing) characterized by high employment levels but by very low rates of productivity growth.

A purely outward-oriented strategy risks to aggravate this structural gap, generating higher levels of inequalities across India's states and households incomes (Chaudhuri and Ravaillon, 2006). These uneven developments, in turn, may generate serious adverse effects on long run growth, through poverty traps, unequal chances for human capital accumulation, difficult access to credit markets, and a distortion of resources as a result of corruption.

The above discussion implies that, in the context of a neutral export-promotion strategy, an adequate share of public resources should be allocated to alleviate the most troubling aspects of India's recent growth process. The main priorities, to this purpose, are represented by infrastructural policies and a coordinated government intervention to boost productivity growth in agriculture.

Infrastructural policies, particularly in the health and education sectors, are crucial to attract significant flows of foreign direct investments whose pace has recently shown some signs of weakness. Moreover, together with a more efficient labour market regulation, these policies are important to stimulate the growth of labour-intensive manufacturing, thus spurring a greater convergence of living standards within India's regions.

The latter priority, namely a strong stimulus to productivity growth in agriculture, finds support in the context of dualistic developments models à la Lewis, in which productivity expansion in the primary sector pushes down the costs of food and raw materials with positive spillover effects on the rest of the economy[7].

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defines an export-promotion strategy as a policy regime which is neutral between export-promotion and import substitution (World Bank , 1987). The neutral approach advocated in the present paper is in line with the policy prescriptions for long term growth outlined in Chandra (2002; 2003) and Love and Chandra (2004).

[7] These models emphasize further favourable effects induced by a sustained productivity growth in agriculture, such as an improvement in

A significant intervention of public authorities is needed in order to invert the current declining trend of output and productivity growth in the primary sector. This intervention may play a crucial role as regards the investment in new technologies and their diffusion in agriculture, since private activity in this area is seriously hampered by the existence of significant externalities.

To sum up, the neutral export-promotion stance advocated in this paper represents an intermediate approach between the manufacturing-export-led and the agriculture-led industrialization strategies outlined above. While acknowledging the propulsive role exerted by a capital-intensive manufacturing export sector, this strategy points out some limitations of a purely outward-oriented approach. In this perspective, besides the incentives to the export sector, the emphasis is also placed on infrastructural policies and on strategic domestic-oriented sectors, in order to smooth out some uneven features brought about by the rapid growth of the Indian economy during the last two decades.

It may be interesting to underline that the main points made in this section are consistent with the conclusions obtained in some recent empirical contributions. This research focuses both on the specific Indian experience and on that of a group of developing countries, and addresses respectively the following topics:

1. domestic constraints on export-led growth;
2. external demand-side constraints on export-led growth.

The former issue is explored in Storm (1997), where a computable general equilibrium model (CGE) of the Indian economy is used to evaluate the medium term implications of two alternative strategies: a manufacturing-export-led industrialization (MELI) and an agriculture-demand-led industrialization (ADLI) policy[8].

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income distribution (as a consequence of a reduced wage differential with the ‘modern’ sector), increased tax revenues, a better social cohesion and quality of state institutions, and a more effective promotion of structural change as a result of a more balanced long run growth process. See Grabowski (2009) for a more detailed discussion of these issues.

[8] This CGE model is highly disaggregated (including nine productive sectors and seven classes of private households) and, differently from previous contributions in this literature, includes an endogenous private investment demand (see Storm, 1997, Section 3 and Appendix C for details). Simulations exercises inside this framework assume a significant reallocation of public investment across sectors; more specifically, the MELI strategy is characterized

The main insight from the simulation exercises is that any policy favoring export-led industrial growth disregarding the interdependence between agricultural and industrial sectors turns out to be self-defeating, because it does not take into account the negative impact of agricultural price changes on domestic and foreign demand. A MELI strategy complemented with an increase in export subsidies generates a multiplier rise in manufacturing output and incomes and an increase in intermediate and final demand for agricultural goods. Since agricultural supply declines, as a result of a fall in net irrigated area, agricultural prices increase generating further inflationary effects on non-agricultural wages and prices. This increase in domestic inflation reduces the effectiveness of export subsidies and produces a net contractionary effect with respect to the baseline simulation[9]. These negative effects stand in sharp contrast with the results from various ADLI policies, which show a rise in agricultural production, an improvement in industrial performance, and progressive effects on income distribution.

The analysis of Storm (1997) demonstrates that domestic constraints on export-led growth are indeed structural in nature, since inadequate demand for industrial goods is an integral part of the agricultural supply-side constraint. Therefore

> "if a step-up in non-agricultural exports is to contribute to a non-inflationary acceleration of real GDP growth, it needs to be supplemented by adequate policies aimed at raising agricultural output and real incomes" (Storm, 1997, p. 104).

This quotation discloses the analogies between the above approach and the policy implications of the present paper, which underline the need to complement an outward-oriented strategy with a significant support to the agricultural sector.

Turning to the latter point, other recent contributions have pointed out the existence of significant external constraints to a policy of export-led-growth. Various estimates of export demand equations for developing countries show that their manufacturing products do not

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as a reallocation of 20% of public agricultural investment to industry, aimed at raising the efficiency and the international cost-competitiveness of export-oriented industrial sectors.

[9] Since the consumption demand of agricultural goods is relatively price-inelastic, the increase in agricultural prices forces consumers to spend less on non-agricultural goods. The decline in consumer demand for industrial goods, in turn, negatively affects industrial investment.

face large relative price elasticities of export demand, implying that export penetration on high-income markets is significantly affected not only by supply-side factors but also by intra-developing countries competition (see, among others, Muscatelli *et al*., 1994 and Razmi and Blecker, 2008). Thus, if many developing countries simultaneously pursue an export-oriented development strategy, external demand might growth at a pace which is insufficient to accommodate increases in developing countries' export supply.

Razmi (2007) investigates the existence of 'crowding out' effects produced by intra-developing country competition in export markets for manufactured products. This paper applies a dynamic panel data approach to a sample of 22 developing countries (including India), analyzing their exports of manufactured products towards major high-income countries during the period 1984-2004. The full sample estimates including all categories of products document a significant crowding-out effect, with an estimated parameter equal to -0.699[10]. Sub-samples estimates show that the intensity of this effect has been increasing in the more recent period (1994-2004), while being statistically insignificant during the previous decade. The estimates reveal, moreover, the presence of a China effect, i.e. the crowding-out coefficient becomes statistically insignificant if the effects of Chinese export competition are excluded from the sample.

The existence of significant external constraints to a policy of export-led-growth, documented in this empirical literature, further corroborates our critical remarks about the deficiencies of a purely outward-oriented development strategy for India. As revealed by the above discussion, an outward-oriented approach needs to be supplemented with a support to strategic domestic sectors not only to ensure a more balanced growth process, but also to minimize the risks associated with increased international trade competition.

5. Concluding remarks

The variety of potential dynamic links between trade and growth has stimulated, since the early 70's, a large amount of empirical work focusing on many developing countries. This paper extends this strand of literature focusing on India's experience in the post-independence

[10] This means that a 1% increase in competitor exports leads, on average, to a 0.7% decline in the average developing country's export volume.

period, and exploring the causal relationships between exports, imports, and economic growth. A reassessment of the empirical evidence for India is particularly attractive in view of the mixed results achieved so far in the literature and of the radical changes in the policies implemented in this country to sustain long-run growth.

The contribution of this paper to the existing literature is threefold. First, the analysis relies on a larger data sample, which covers a significant period of India's post-liberalization phase since 1991. Second, I assess the robustness of the empirical findings through alternative testing procedures, implemented at all stages of the econometric investigation. Third, I try to put the results in perspective, evaluating their policy implications in terms of suitable growth strategies for the future. This issue is only incidentally addressed in the literature, whereas it deserves a careful discussion given the increasing role of India in the global economic scene.

The main result is the existence of a 'virtuous cycle' between export and output dynamics, i.e. exports significantly contribute to real output growth and this in turn stimulates further exports increases. This result is supported both inside a standard VECM framework and applying an alternative estimator where the testing procedure is robust to the integration and cointegration properties of the VAR process. This bi-directional causality between exports and output growth, however, holds only in the short run, since VECM estimates reveal that error-correction parameters in the export and output equations are either insignificant or only marginally significant. Since I document a weak error-correction mechanism in the equation with real output as dependent variable, these results do not provide strong support to the export-led growth hypothesis as a long-run causal relationship in the case of India.

A further robust result is the existence of a long-run unidirectional causal effect from exports to imports growth. This result confirms the importance of including the import variable in order to obtain unbiased empirical estimates. Moreover, this evidence supports the 'import compression' hypothesis according to which a sustained increase in exports, by alleviating the foreign exchange constraint that developing countries often face, generates a positive effect on imports growth.

The final section of the paper discusses some policy implications of this empirical evidence, in the light of the ongoing debate about the most appropriate development strategies for India. The existence of a short-run positive interaction between exports and output growth suggests that a purely outward-oriented approach, entirely focused on a manufacturing-export-led-growth industrialization strategy, would not be sufficient to ensure a satisfactory rate of long-run growth. This approach, moreover, would further aggravate some relevant structural imbalances characterizing the Indian economy.

This taken into account, the main point made in section 4 is that a neutral policy regime, providing adequate support both to capital-intensive export sectors and to strategic domestic sectors (agriculture, small-scale manufacturing, physical and social infrastructures), represents the most appropriate development strategy for the Indian economy. A final discussion in this section underlines that these policy implications are consistent with other recent empirical contributions, pointing out the existence of significant domestic and external constraints to a policy of export-led growth.

Marco Tronzano
Università degli Studi di Genova,
Dipartimento di Economia e Metodi Quantitativi, Genova, Italia

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ABSTRACT

This paper reassesses the dynamic links between trade and growth in India during the post-independence period. The main result is a short-run bi-directional relationship between exports and output growth. This finding is supported both by standard Granger causality tests, and by an alternative estimator which is robust to the integration and cointegration properties of the VAR process. Moreover, I document a long-run unidirectional causal effect from exports to imports growth. I discuss the policy implications of this evidence and conclude that a neutral policy regime, not discriminating between export and strategic domestic sectors, represents a suitable development strategy for India.

Keywords: Economic Growth, Trade, Granger Causality Tests, India
JEL Classification: C32, F10, F43

RIASSUNTO

Un riesame delle relazioni tra commercio estero e crescita economica: nuova evidenza empirica per l'India

L'articolo esamina le relazioni di causalità tra commercio estero e crescita in India nel periodo successivo alla sua indipendenza. Il risultato principale è l'esistenza di una relazione bidirezionale di breve periodo tra esportazioni e crescita economica. Questo risultato è supportato sia dai tradizionali test di causalità di Granger, che da uno stimatore alternativo indipendente dalle proprietà di integrazione e cointegrazione delle serie storiche utilizzate. Viene inoltre evidenziata l'esistenza di una relazione causale di lungo periodo dalla crescita delle esportazioni a quella delle importazioni. La parte finale del lavoro discute le implicazioni di politica economica di questi risultati e conclude che un regime neutrale, che non discrimina tra settori orientati alle esportazioni e settori orientati al mercato interno, rappresenta la strategia di sviluppo più appropriata per l'India.