Estimation of the Export Supply Function for Iron-ore Exports from Goa

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ABSTRACT

The objective of this paper is to check whether the coefficients in the supply equation i.e. the price elasticities are consistent with the economic theory for iron-ore exports from a regional economy, the State of Goa. Since the export prices are endogenous the Two Stage Least Squares (TSLS) technique is employed as the first step in order to identify the supply equation using all exogenous variables in the equation as instruments using the fixed effect model. Subsequently, an alternative methodology employing a Dynamic Ordinary Least Squares (DOLS) given by Stock and Watson (1993) is estimated for the panel data on firm-level exports. In particular the price elasticity of supply has become positive over time and increased significantly in the recent periods. Thus the results indicate that these firms are more likely to respond to price signals going forward.

Keywords: Supply Function, Estimation, Demand Constraints, Export Performance, Dynamic Panel Data.

INTRODUCTION:

This paper attempts to find whether the coefficients in the supply equation i.e. the price elasticities of Goan iron-ore exports are consistent with the economic theory. It is attempted to explain whether an integrated demand and supply approach can plausibly explain the long-run behavior of exports. The key issues are to find whether the reforms introduced in external sector have an observable effect on regional behavior of export suppliers. Despite an overlap in the vector of determinants across studies on export intensity we provide some value added from the dynamics of demand and supply constraints from a regional context. It is indicated that the initiatives' to identify new markets and by targeting productive capital oriented firms facilitate deeper export penetration and contributes in furthering export growth. Our study is based in the macroeconomic setting using regional panel data and it is found that along with improvements in efficiency, the performance of exports can also be improved by removing structural impediments in terms of provision of better infrastructure and simplification of trade procedures. Such developments on the supply side would necessarily reduce delivery time for exports, improve efficiency in transaction and result in larger volumes of exports. There is a dearth of firm-level studies for the Goa's Iron-ore extracting firms and an unexplained absence of consensus over how to conceptualize and operationalize the various elements of demand and supply constraints in iron-ore export performance. Though the empirical studies like that of Dunning (1994, 1998) and UNCTAD (1999) report the impact of recent increasing governmental efforts and various push and pull factors on the export enhancing role of firms in a region / industry particularly in developing countries, the empirical studies on this issue are scarce. Given the study by Roberts and Tybout (1997) that different idiosyncratic forces determine export behavior of firms in different countries and industries, the present attempt is to improve the prediction and measurement of regional export by revisiting the role of demand and supply factors affecting export performance.

WHY ARE THE CONSTRAINT FUNCTIONS IMPORTANT?: VIEW FROM LITERATURE

The present study attempts to provide empirical evidence to the rising literature on export performance and measurement of demand and supply constraints affecting i.e export elasticity in a regional context. International evidence on these indicators has been mixed; different results have been identified for different countries and industries making generalizations difficult. Thus there is a need to have a deeper understanding on trade performance and role of industry and regional variables in the micro-level setting.

Economic theories are sharply divided on the influencers of export behavior. While the predominant view stresses the importance of supply and policy related constraints other studies find the significance of world demand in the determination of exports. Some studies find relative price factor and real effective exchange rate in particular to be significant. However the emergence of various export sectors over the period of time does not lend support to the observation that only relative prices play an important role, but highlight the importance of various demand and supply factors influencing at the regional level. Individual demand and supply factors can be found to be important for specific short periods, but their confluence very likely determine long run behavior. Trade pattern is largely explained by comparative advantage (Ricardo, Hecksher-Ohlin). The classical assumptions of trade are relaxed and extended to increasing returns to scale and oligopolistic structure. Neo-technology trade theorist emphasized the role of innovation in creating markets and conferring cost advantages while Posner (1961) and Vernon (1966) note that the technology and knowledge are important part of the production function and technological differences of nations determine export activity. The scanty literature available on the issue stresses the importance of supply and demand related constraints. From the supply side firms' that have an inward looking policy, with capacity constraints, lack of competition, and high domestic demand, do not signal enough incentives to export. The findings are a definite improvement over the existing studies on India's exports. Bhagwati and Srinivasan (1975), Joshi and Little (1994) and Wolf (1978) shows that domestic policies have significant effect on trade behavior of developing countries. Arize (1990) finds that in developing countries demand and supply factors are equally important in determining their export growth pattern. Muscatelli et al. (1992) for instance, find high income elasticity of demand for exports, but low price elasticity of demand result in demand being constrained in export markets.

This study establishes the importance of demand factors such as world demand and real effective exchange rates in the determination of India's exports as against the relatively weak relevance of supply side determinants. There are other supply side factors determining export growth as well, especially non-price factors as technology and quality, marketing, infrastructure, and access to export credit, when any of these factors are inadequate, they operate as constraints limiting supplies for exports. Even transaction costs due to procedural delays and sector specific supply constraints are as important to export growth as any other factors. Some studies also find the significance of demand in the determination of exports. Nayyar (1976, 1988), points external constraints provide an upper limit to growth of exports from India. Sinha Roy (2001b, 2002) by analyzing un-sustained pattern of post-reforms export growth in India provide evidence on the primacy of world demand in determining India's exports growth pattern. Thus, the debate on whether India's exports are demand constrained or supply determined is far from being conclusive. It is in this context that we consider the empirical estimation of demand and supply equation for firm-level exporters in a regional context.

In explaining export growth, demand and supply factors are important according to Virmani, (1991) and Krishnamurty and Pandit (1995) in explaining export behavior as most industrializing economies are able to liberalize their respective trade regimes, expand and diversify their exports almost at the same time without facing deteriorating terms of trade or subject to fallacy of composition. Two main conceptual approaches exist to modeling the determinants of export performance, the 'neo-endowment' models and, 'technology-based' models. In the former firms' competitive advantage is based on factor endowments in which competitive advantage derives from the quality of firms' products or services. Studies in the neo-endowment tradition argue that factor-based advantages may be important if the firm has either a natural monopoly of a particular factor or is, for example, located in a particular region where a factor is plentiful. The importance of monopolistic and oligopolistic market structures (large firms) is also accounted for in the theory. There is continuous search and learning process that can have varying results and advocates building technological capability. Montobbio and Rampa (2005) for Latin American and Asian firms analyze the impact of structural change on the sectoral distribution of export

Sousa (2004) lament that there are many ways to operationalize export performance and as many potential drivers for export performance and as a consequence, results are often inconsistent and contradictory. Recently, some studies like that by Gemunden (1991) and Shoham (1998) among others have focused on possible ways to surmount these challenges. In response to Dhanaraj and Beamish's (2003) call for the development of

parsimonious theoretical models, some studies like that by Leonidou (2003), Styles et al. (2003) Child et al. (2003), Wollin and Perry (2004) apply broader theoretical bases such as social exchange theory, natural selection and complexity theory to the study of export performance.

DATA AND METHODS:

Specifically it is checked whether the coefficients in the supply equation i.e. the price elasticises are consistent with the economic theory. However since the export prices are endogenous the Two Stage Least Squares (TSLS) is employed as the first step in order to identify the supply equation using all exogenous variables in the equation as instruments using the fixed effect model. Fixed effects model represents the observed quantities in terms of explanatory variables that are treated as if the quantities were non-random. This is in contrast to random effects models and mixed models in which either all or some of the explanatory variables are treated as if they arise from the random causes. Often the same structure of model, which is usually a linear regression model can be used in panel data analysis, the term fixed effects estimator is used to refer to an estimator for the coefficients in the regression model. If we assume fixed effects, we impose time independent effects for each entity that are possibly correlated with the regressors.

PARAMETER ESTIMATION:

The supply function of the exports is represented in log form as

$$X_{it}^s = \alpha_i^s + \beta P_{it} + \beta_2 E_t + \beta_3 PI_t + \beta_4 AD_t + \beta_5 DP + \beta_6 RDum_t + u_{it}$$ …………………………..……..…..1

Where β_1, β_2, β_3, β_4, β_5, and $\beta_6 > 0$ ……………………………………………….…..…..2

X_{it}^s = export value of i th good, P_{it} = export price of the i th good in US \$, E_t = US \$ per real effective exchange rate, PI_t = wholesale price index , AD_t = aggregate Asian demand for iron-ore, DP_t = Goa state's gross domestic product and $RDum_t$ = dummy for economic reforms.

Subsequently, an alternative methodology employing a Dynamic Ordinary Least Squares (DOLS) given by Stock and Watson (1993) is estimated for the panel data on firm-level exports. This estimation has been shown as superior in panel co-integration relative to the OLS and fully modified OLS as given by Kao and Chiang (2000). The Dynamic OLS involve adding leads and lags of the first order differences of the regressor to the equation and suitable adjustments are made for serial correlation and cross-sectional heterogeneity.

Where $X_{it}^s = \alpha_i^s + \beta Z_t + d_1(L)\Delta Z_t + d_2(L^{-1})\Delta Z_t + u_{it}$ …………………………………....……….3

$d_1(L) = \sum_{k=1}^{\infty} d_{1k} L^k, d_2(L^{-1}) = \sum_{k=1}^{\infty} d_{2k} L^{-k}, \beta = (\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_5, \beta_6)$ …………………………..……..…4

$Z_t = (P_{it}, E_t, PI_t, AD_t, DP_t, RDum_t)$ and **L** is the lag operator and the infinite order polynomials are truncated to a parsimonious specification ……………………………………………………....…………5

and it is hypothesized that β_1, β_2, β_3, β_4, β_5, and $\beta_6 > 0$ …..……………………………..……….6

The Dynamic OLS regression is adjusted for serial correlation and cross-sectional heterogeneity, and the infinite polynomial is truncated to two leads and lags of the regressor. The fixed effect estimation is used for panel sets and homogenous slopes are assumed to allow for heterogeneity in coefficients.

RESULTS AND DISCUSSION:

Our export supply equation is estimated with the endogenous export price index on the right hand side of the equation. In the TSLS and also for the Dynamic OLS allowing for leads and lags, the exogenous variables consisted of real effective exchange rate, the domestic wholesale price index, aggregate Asian demand for iron-ore and the state's GDP.

Table 1: Fixed Effect Panel Regression using Micro level Firm Data

Independent Variables	Two-Stage Least Squares	Dynamic Ordinary Least Squares
P_{it}	3.44 ** (0.69)	3.86 ** (1.22)
E_t	3.14 * (0.57)	4.77 (16.34)
PI_t	4.35 * (1.50)	6.51 ** (1.75)

Independent Variables	Two-Stage Least Squares	Dynamic Ordinary Least Squares
AD_t	1.21** (0.51)	1.89 *** (0.64)
DP_t	0.29 (0.42)	0.33 (0.64)
RDum$_t$	1.21 ** (0.13)	1.92 * (0.12)

Notes: **1.** The system of equations is over-identified. **2.** * denotes significance at 10%, ** denotes significance at 5%, *** denotes significance at 1%. **3.** Standard errors are in parenthesis. **4.** X_{it}^s = export value of ith good, P_{it} = export price of the iron-ore in US \$, E_t = US \$ per real effective exchange rate, PI_t = wholesale price index, AD_t = aggregate Asian demand for iron-ore, DP_t = Goa state's gross domestic product and **RDum$_t$** = dummy for economic reforms.

The results for the TSLS regression are consistent with the explanation that the external sector reforms in India have increased market incentives and encouraged suppliers to positively respond to market signals. The price elasticity of supply is found to be positive after the reforms, and has significantly increased in magnitude in the recent post-reform periods indicating local iron-ore exporting firms increasingly retained the benefits from their exports and higher export prices have stimulated more supplies. The other variables the wholesale domestic price index, aggregate Asian demand are significant and the state's GDP (insignificant coefficient) have the expected signs.

The results from the dynamic OLS estimations are more consistent with those of the TSLS regressions. Correct signs and significant coefficients (except for real effective exchange rate and State's GDP) and the supply price elasticities are found to be greater in magnitude, more particularly in the recent periods. Our regression results for supply elasticises indicate that the exports have behaved according to the predictions of economic theory based on market economy. In particular the price elasticity of supply has become positive over time and increased significantly in the recent periods. These results indicate that these firms are likely to respond to price signals going forward.

The most striking result that this exercise provides is the predominance of price related factor. The demand for Goa's iron-ore exports should depend inversely on the price at which the ore is sold in the international market. Demand for iron-ore exports should increase as the price of the competitor goods in the world market rises and as world income, and thus the Asian demand for imports-grows. The supply of exports in an economy driven by market depends positively on the price at which these goods can be sold in foreign markets. If the exports are priced in the importer's currency, then the price received by exporter in domestic currency will fall as the exchange rate appreciates, which will reduce the incentive to supply. As the price at which the export good can be sold in the domestic market measured by the WPI, the increase in incentive helps the supply to sway from the importers market to domestic market.

As aggregate Asian country demand increases it motivates higher supply from the State. The demand for Goa's iron-ore should depend inversely on the price at which the Goa's iron-ore is sold in the international market. Demand for Goa's iron-ore exports should increase as the price of competitor goods in the world market rises and as world income and thus Asian demand for imports grows. Export supply is also expected to rise with the local state economy's capacity to produce more goods and services. This variable is proxied by the state's gross domestic product however the coefficient has no statistical significance. Export supply rises with the local state economy's capacity to produce more goods and services. The relatively less importance and insignificance of GDP as a supply-side determinant of export growth leave enough room for higher value-added growth providing a better explanation of long run export performance. The sign and magnitude of coefficients of reform dummy suggests that iron-ore export market supplies have begun to be more responsive in the latest periods. The coefficients are significant at five percent levels and thus significant.

SUMMARY AND CONCLUSIONS:

Though no single factor can explain such a changing pattern of Goa's iron-ore export growth, a number of demand and supply-side factors provide an explanation to such a long run phenomenon. In particular the price elasticity of supply has become positive over time and increased significantly in the recent periods. Thus the results indicate that these firms are more likely to respond to price signals going forward. On the whole Goa's iron-ore export performance is explained by such factors as relative general prices, real effective exchange rate, and growing demand from Asian countries. A changing export growth path being coincidental with India's trade liberalization efforts is often attributed to price responsiveness of exports, improvements in incentive structure

towards trade or plausibly due to increasing capability to export with industrialization and changes in development strategy. In explaining export growth on the other hand, demand factors are no less important in explaining export behavior. Important implications of the results are: one, it appears that the iron-ore industry of Goa is fully integrated with the global economy and that the technological capabilities need further reorientation to attract efficiency.

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