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A study of instability in the gravity of trade: The U.S. export import bank

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Abstract
The U.S. Export Import Bank (EXIM Bank) has followed congressional mandates which were unwound when Congress financially constrained these mandates in 2015. In 2015 the EXIM Bank is shown to have followed its mandates to expand exports, lower the trade deficit, and lower country risk. From these mandates a model of EXIM Bank decisions is formulated and formatted from the basis of a Gravity equation for U.S. exports. Three "symmetric" properties of such gravity models are tested and confirmed for the EXIM Bank: (1) a negative elasticity with respect to foreign population, (2) an elasticity with respect to foreign income above 1.0. and (3) a unitary sum of two elasticities. The EXIM Bank's financial exposure mimicked the gravity model of U.S. trade, reflecting these three properties until the congressional constraint of 2015 interrupted agency behavior.

Keywords: U.S. export import bank, gravity of trade, instability

Introduction

The congressional constraint of 2015 challenged the U.S. Export Import Bank (EXIM Bank) to perform its congressional mandates under a severe budget cutback. In 2015, Congress failed to reauthorize the EXIM Bank and halted the bank's lending operations for five months. Subsequently, without enough board members the bank did not have the quorum necessary to authorize the bank's financial exposure above $10 million for any project aiding U.S. exporters. While bank activities had expanded between 2011 and 2015 with a net increase of more than $13 billion to reach $102 billion in financial exposure, there was a net decrease of $61 billion from 2015 to 2021 to reach $41 billion in exposure.

Rarely has a government agency been cut back so severely, providing such an opportunity to measure congressional impact on an agency and on the agency's ability to fulfill its mandate. A model of the EXIM Bank behavior is developed with which to evaluate its adherence to its mandates: exports, employment in export industries, risk reduction, lowering the trade deficit, and a self-funding (section 1). Export models are tested in Section 2. An empirically testable model of the interaction of exports with EXIM Bank behavior is built upon the export model and is tested (section 3) to conclude how the congressional constraint of 2015 affected U.S. exports and the EXIM Bank.

Section 1: The Mandate and Modeling of the EXIM bank

Measuring the impact of the congressional constraint of 2015 poses a challenge because congress constrains a government agency from achieving its own congressional mandates. While many recent studies of the effectiveness of government programs have been undertaken in areas ranging from COVID vaccination to regulation of financial institutions, they generally choose, *deus ex machina*, a criterion in the public interest by which to measure program effectiveness. However, in the analysis of the congressional constraint of 2015 it is congress which has set the criteria, and it is congress that constrains the effectiveness of the EXIM Bank. Congress has set itself up for a normative judgment on its own effectiveness in designing and supporting the EXIM Bank to accomplish its mandate.

Specifically, the analysis of the congressional constraint of 2015 requires an analysis of the congressional constraints which should define the objective function of the EXIM Bank. Beginning in the seventies with the Public Choice literature the objectives of governments and their agencies were integrated into models of regulation. Stigler (1971) [52] and Peltzman (1976) [46] focused on the constituencies that lobby government while Niskanen (1971) [45] focused on the objectives of government regulators themselves. In addition to selfish motives of government agents or agencies, Cox (1980) [15] recognized that an agency's objectives must also include its mandated goals; Cox included curbs on inflation as a price controller objective. Similarly, in the analysis of the EXIM Bank, there are multiple congressional mandates that should be included in the agency objective function.

1. The EXIM Bank Objective Function

The fact that there were many mandates simply adds to the complexity of measuring the impact of the congressional constraint on the EXIM Bank as well as U.S. exports. Particularly in the literature of international trade, a variety of different national objectives have been recognized. In his analysis of the international policy decision-making in the developing countries with respect to exports, Harry Johnson (1986) [30] analyzed multiple objectives including revenue maximization and "maximizing national gain," both of which are similar with the mandates that have been set out in the past for the EXIM Bank:

a. **U.S. employment maximization:** With the contraction of exports during the depression, Franklin Roosevelt set up Export-Import Banks under the National Industrial

Recovery Act. The principal reason was to restore export jobs, a central purpose which continued after Congress authorized the bank (Adams, 1976 [1], Chp. 3). Exports were defined with U.S. content requirements as well as shipping requirements in U.S. flag vessels to assure job creation (Akhtar *et. al.* 2014, p. 12) [5]

b. U.S. export maximization: this mandate was set out explicitly when the EXIM Bank was first authorized by the Export-Import Bank Act of 1945: It is the policy of the United States to foster expansion of exports of manufactured goods, agricultural products, and other goods and services, thereby contributing to the promotion and maintenance of high levels of employment and real income and to the increased development of the productive resources of the United States. Behind the export maximization goal was both more economic growth and more jobs.

c. Balancing the U.S. trade deficit: closely related to the strengthening of exports is the balancing of the trade deficit. Until the U.S. moved to a flexible exchange rate in August of 1971 a perceived policy problem was the large balance of payment deficit run by the U.S. Since that time, the goal has been revised to the balancing of the trade deficit.

More exports would shrink the trade deficit. To the extent that foreign governments aided their exporters and helped them capture business from U.S. exporters, the EXIM Bank was empowered by the Export-Import Bank Act of 1945 to aid U.S. exporters:

To meet this objective, the Export-Import Bank is directed in the exercise of its functions to provide guarantees, insurance, and extensions of credit at rates and on terms and other conditions which are competitive with the government-supported rates and terms and other conditions available for the financing of exports from the principal countries whose exporters compete with United States exporters.[2]

d. Self-funding: the EXIM Bank receives no Congressional appropriations and was set up by Congress to be self-sufficient with the profits made from its lending activities. The interest and fees from its activities have been enough to cover operating costs and the servicing on borrowing. Its default rates on loans have never exceeded 1%. This self-funding makes models of budget maximizing agency behavior (eg. Niskanen 1971) [45] inappropriate for modeling EXIM Bank behavior.

e. Country risk reductio: since the EXIM Bank is self-funded it is incentivized not to take risks that would cause it to experience losses. The principal forms of risk on which the EXIM Bank provides aid have been country risk and some commercial risks. While the export-import banks of some countries provide protection against exchange rate risk and inflation risk, the U.S. EXIM Bank generally does not provide aid to curb such risks. In doing its appraisal of projects it has used a "reasonable assurance of repayment" standard which requires it to judge the commercial viability of each project. Furthermore, it generally requires a guarantor of any loans that it makes. The guarantors: foreign governments, foreign government ministries, government owned foreign banks, and private foreign banks (Baron 1983) [9]. The countries with reliableguarantors are most likely to be the highly developed countries and nearby countries with whomthe U.S. has political and commercial alliances.

Particularly notable is the aggregate level at which these mandates are being targeted. These mandates are framed to expand overall exports, employment, and trade balance without priority for any specific industries. If anything, congress has continually emphasized the need to be more inclusive of small businesses. The approach used here is to assume that the bank sticks to the mandates given to it by Congress, model how it should behave under those mandates, test how well the model explains EXIM Bank behavior before the congressional constraint, and then test how that behavior changed due to the congressional constraint. Fortunately, EXIM Bank actions can be traced and tested because its wide congressional mandates potentially apply to over 223 U.S. trading partners for which trade data is available over the 2015-2021 period being tested.

A quite serviceable linear objective function can be constructed from these mandates The EXIM Bank objective can be summarized as maximizing the total of the bank's portfolio of exports in each year, t:

1. The EXIM Bank Objective Function

$$max \sum_{j=1}^{m} w_{jt} X_{Ujt}$$

which the EXIM Bank maximizes in its choice of the "m" different United States (U) export aid projects out of the "n" potential projects, j, that it might support. The weights, w_{jt}, given to each project would reflect which objective or index of many different objectives the bank might choose in any time period, t. If the bank were to maximize revenue, then the weights would be price indices (i.e. $w_{jt}=p_{jt}$ where p_{jt} is a price index for each project, j).

However, based on the enumerated mandates above, the weights (w_j) used in appraising the value of different projects, should be a combination of balance of payment considerations and financial risks in addition to exports (X_{jt}). Formal measurement of the weights requires choice of surrogates for these mandates:

2. Mandated EXIM Bank weights

$$w_{jt} = \omega M_{jt}^{\gamma} F_{jt}^{\delta}$$

where imports (M_{jt}) and financial risk assessments (F_{jt}) are available by country, j, in each time period, t, and the Greek symbols are constants. The employment and export mandates are not included in the weights because it is assumed that exports (X_{jt}) in the objective function (1) are proxies for both mandates.

Unlike regulatory authorities generally analyzed in the Public Choice literature, the objective function for the EXIM Bank does not reflect conflicting constituencies or budget-maximizing incentives of bureaucrats. Since the

EXIM Bank is self-funding and its competitors are employed by foreign governments these features are not important enough to model.

2. Congressionally Authorized Activities to Achieve Mandated Objectives

To achieve its objective (1), congress enabled the bank to employ activities to add to exports, beyond what would occur without the bank's support. These activities directly applied to two communities; (a) U.S. exporters through export credit insurance and guarantees of working capital loans and (b) buyers of U.S. exports with direct loans and loan guarantees. The U.S. Treasury Department defined additionality "as the probability that EXIM Bank programs have in fact fostered U.S. exports by overcoming capital market imperfections and by meeting the competition of foreign official export credit agencies" (Baron, 1983 [9], p. 223). "Additionality" required an elaborate calculation of the exports that would be lost because of (a) the competitive financing by foreign export-import banks, (b) foreign supplier product advantages, and (c) the lack of financing for foreign importers.

To test the hypothesis that the EXIM Bank achieves additionality with its aid, implicitly an assumption must be made that exports are a function, $X_{jt}(L_{jt})$, of its aid, L_{jt}. Presumably recipients of such aid can produce more exports with more aid (i.e. $X_{jt}^{Lij}>0$ where superscripts indicates partial differentiation with respect to the superscripted variable) but have limited capacity to use the aid, beyond which diminishing returns to the aid occur ($X_{jt}^{LjtLjt}<0$). The bank measures these activities with what it calls its "exposure" which is a measure of its financial commitment to each project that it aids.

3. The Constraints Congress Imposes on EXIM Bank Activities

To judge if Congress has designed the EXIM Bank to achieve its objectives, it is necessary to model the constraints besides the constraint of 2015 which Congress has placed on the EXIM Bank. Congress adjusts this constraint yearly and the exposure constraint is currently set at $135 billion through 2027 (12 U.S. Code § 635e(F)(ii)). The EXIM Bank is limited in achieving its objectives by its total exposure, G_t, authorized by Congress across all the, "m", projects it chooses to support in any year, t. Adopting the EXIM Bank aggregation of projects by each country, j, this exposure constraint becomes:

3. The EXIM Bank Exposure Constraint

$$G_t \geq \sum_{j=1}^{m} L_{jt}X_{Ujt}$$

The bank can be viewed as optimizing its objectives (1) by selecting the fraction, L_{jt}, of a country's total exports from the U.S (U) to each country, j, for each year, t. The bank publishes this optimized decision, so we actually know the "m" countries to which it provides aid out of the "n" countries to which it might have provided such aid. And the EXIM Bank publishes its total "exposure", $L_{jt}X_{Ujt}$, to each country, j, where the U.S. exports.

Just how much to spend on each export project becomes the decision-making problem facing the EXIM Bank. Its optimization decision can be formulated in terms of a Lagrangian objective function, £, that captures both the objective (1) of the agency and its exposure constraint (3) for the "n" projects from which it chooses:

4. The Constrained Objective Function

$$L_{jt}^{*} = max \sum_{j=1}^{n} w_{jt}X_{Ujt} + \lambda_t(G_t \geq \sum_{j=1}^{n} L_{jt}X_{Ujt})$$

where "λ_t" is the Lagrangian mutliplier. The agency optimizes by selecting a fraction, L_{jt}, measured in terms of export revenues to spend aiding exports to each different country project, j. To optimize (4) the EXIM Bank selects the "m" out of "n" projects that produces the maximum value for the objective function. First order conditions achieved at the maximum of this function require the following condition for each project that is chosen:

5. $$L_{jt}^{*} = \left(\frac{\xi_{jt}}{\xi_{jt}+1}\right)\left(\frac{w_{jt}}{\lambda_t^{*}}\right)$$

Where "*" indicates the value of a variable at the optimum, and "ξ_{jt}" is the elasticity of exports to country, j, with respect to the EXIM Bank's aid fraction, L_{jt} (i.e. $\xi_{jt}=\left(\frac{L_{jt}}{X_{Ujt}}\right)\frac{\partial X_{Ujt}}{\partial L_{jt}}$). The first term on the right of (5). reflecting the elasticity of exports, asymptotically approaches 1.0 as the EXIM Bank proves more effective in stimulating additionality to exports with its aid, an effect deadening variation across projects. The optimal Lagrangian multiplier, l_t^{*}, measuring the bang (in weighted exports) per buck (of EXIM Bank exposure), marks the standard that must be achieved for every project that is aided and is therefore constant across all aided projects. The variation across projects to different countries mainly depends upon the weights, w_{jt}, used to evaluate the benefits of projects by the Exim Bank.

A testable equation about EXIM Bank exposure, ($X_{Ujt}L_{jt}^{*}$) can be found by multiplying both sides of (5) by exports, X_{Ujt}, converting the weights to their surrogates (using (2)), and taking logarithms as follows:

6. $$\ln(X_{Ujt}L_{jt}^{*}) = \phi + \gamma lnM_{jt} + \delta lnF_{jt} + \eta lnX_{Ujt} + e_{jt}$$

where $\phi = ln\left(\frac{\omega\xi_{jt}}{\lambda^{*}(\xi_{jt}+1)}\right)$, "$e_{jt}$" is the error of estimation, and the Greek symbols are constants (where *h* is expected to be 1.0). Since imports are outside of EXIM Bank authority and the

EXIM Bank appraises country financial risk, not altering it, the main concern in estimating such an equation is the treatment of exports as exogenous. If additionality is to be achieved, then exports would be affected by the bank's lending decisions, and exports and bank exposure would interact as a system. Such a system would require a model of U.S. exports.

Section 2: Testing the Model of U.S. Exports

Most importantly, when trying to detect EXIM Bank additionality is that U.S. trade is a subset of the world trade

which is constrained by the income-expenditure identities faced by each of the U.S. trading partners. The imports to the U.S. are a large fraction of the exports from U.S. trading partners which are constrained, in turn, by the income-expenditure identity (10). If that constraint holds, then U.S. imports should satisfy the symmetry properties (9).

Both political pressures and economic pressures from floating exchange rates are likely to work dynamically through time to make the two converge; for the 223-country sample used here the logarithms of exports and imports have a correlation coefficient of. 86. An abbreviated model of U.S. exports for any give period of time can be constructed from the estimated population-based gravity equation (16).

The Estimated Population-based Gravity Equation for the U.S. (17).

$$lnX_{Uj} = \hat{\psi}_{UX} + \hat{\epsilon}_{UjXY} lnY_j + \hat{\epsilon}_{UjXN} lnN_j + \hat{\epsilon}_{UjXD} lnD_{ij} + \hat{v}_{Uj}$$

where "j" is the importing country, "U" refers to the U.S., and the " " indicates coefficient estimates and the error term of this equation. Both export and import equations in the form of (17) are tested here to show the applicability of (17) to both. Because the U.S. accounts for such a large percentage of each of the imports of its trading partners, it is hypothesized that the income-expenditure identity (10) will constrain the elasticities in (17) to meet the symmetric properties (9).

However, the models of U.S. exports and imports are tested here over two time periods in which there was a dramatic change in the U.S. Export Import Bank (EXIM Bank) which could be expected to impact a test of the trade model (17). The test is performed on the latest year, 2015, before the effects of a Congressional Constraint limited the bank's performance and the latest year, 2021, after the EXIM Bank's exposure reached its 2020 nadir. The tests require cross-section data on imports, exports, the GDP and population of foreign trading partners, and the distance of the trading partners from the U.S. A concordance of data from both 2015 and 2021 provides a sample of 223 countries for which data is available from each of these three data sources.

Table 1: Testing for the Symmetry of U.S. Trade

Dependent Variable (logarithms)	2015 IMPORTS	EXPORTS	2021 IMPORTS	EXPORTS
Intercept	14.56	17.91	13.95	17.52
(t-statistic)	22.87**	43.38**	26.34**	40.69**
Income (GDP) elasticity	1.48	1.16	1.71	1.24
(t-statistic)	11.04**	13.32**	15.16**	13.53**
Population elasticity	-0.55	-0.32	-0.70	-0.35
(t-statistic)	-3.97**	-3.53**	-6.12**	-3.81**
Distance Elasticity	-0.12	-1.35	-0.16	-1.31
(t-statistic)	-0.39	-6.88**	-0.66	-6.66**
R-square	0.60	0.73	0.73	0.74
F-statistic (@ 223 observations)	107.77	201.19	194.32	211.89
Income + Population elasticities	0.93	0.84	1.01	0.89
Difference from 1.0	-0.07	-0.16	0.01	-0.11
Rejection of symmetry? (t-stat)	-1.21	-4.15**	0.29	-2.89**

Note: The export, income, population, and distance variables are all tested in (17) with 223 observations after being transformed to logarithms. The t-statistics to test if the sum of the income and population elasticities is equal to unity are shown in the final row [1].

* 90%-99% confidence level. ** 99% confidence level or better.

The results from estimating (17) for both 2015 and 2021 can be used to test for the symmetry of U.S. trade (Table 1). The high F and t-tests are significant at more than the 99% level and validate both the export and import trade equations (17) for both 2015 and 2021 (except for the weak importance of distance in explaining imports in both years). They show just how robust the models are over both years as well as how similar they are.

Symmetry cannot be rejected in the import models for either 2015 or 2021. For both imports and exports the income elasticities are well above 1.0 and the population elasticities are significantly negative.

$$ln(X_{Uj}/N_j) = \hat{\hat{\psi}}_{UX} + \hat{\hat{\epsilon}}_{UjXY} ln(Y_j/N_j) + \hat{\hat{\epsilon}}_{UjXN} lnN_j + \hat{\hat{\epsilon}}_{UjXD} lnD_{ij} + \hat{\hat{v}}_{Uj}$$

where " " indicates coefficient estimates, all of which are identical- both coefficients and t-statistics- to their counterparts in (17) except for the coefficient, $\hat{\hat{\epsilon}}_{UjXN}$, on population and its t-statistic. This latter coefficient corresponds to the difference of the sum of the two export elasticities from unity ($i.e.(\hat{\epsilon}_{UjXY} + \hat{\epsilon}_{UjXN} - 1$) from equation (17)), not just population alone, and its t-statistic, reported in in the last row of Table 1, tests if symmetry can be rejected.

The final test for symmetry of the population-based equation (17) depends on the sum of the income and population elasticities which is shown in the third to last row in Table 1. That sum should equal 1.0, and the t-statistic in the very bottom row tests if the estimated sum is significantly different from 1.0. The import models (1st and 3rd columns of Table 1) do not reject symmetry even at a 90% confidence level. The sum of the elasticities is very close to the 1.0 as predicted by the properties of both the loglinear (9) and linear ((13) and (14)) population-based models. Since U.S. imports are the exports of U.S. trading partners, their exports to the U.S. are reflecting the constraints imposed by trading-partner domestic expenditure behavior.

However, symmetry can be rejected for the two export models (2nd and 4th columns of Table 1). While the export equation (17) is validated far beyond a 99% level of confidence for both years, as are all three of its gravity equation determinants, the symmetry condition can also be rejected beyond a 99% level. Such a rejection has occurred based on past data. Data is available from the applied literature of the 1960s (Chenery 1960, p. 645; Deutsche et. al. 1962; and Morrison 1970, p. 1368) that showed the sum of the elasticities to be lower than those estimated in the third to last row of Table 1. Since then, interest in testing for such effects has waned although Alvarez and Lucas (2005) [6] showed theoretically why trade might rise less than proportionally to the size of a nation. Nevertheless, the export elasticities reported for 2015 and 2021 is close enough to 1.0 that the symmetry properties (9) are nearly met by the export equation (17).

The stability of the trade models over these two years is a testament to the stability of domestic expenditure patterns of U.S. trading partners in spite of the impact of the congressional constraint on the EXIM Bank. Attempts to measure changes between the two years that might conceivably measure EXIM Bank behavior and its additionality with exports, and the impact of the congressional budget constraint have proved so unsuccessful that they are not worth reporting in any detail here, although available from the authors upon request. Such a result was anticipated by Agarwal and Wang (2018) [2] who also used a gravity equation and concluded "the general ineffectiveness of the Bank in promoting exports within and across industries" and even earlier by Katz (2014) [31].

The congressional constraint of 2015 has been too recent to attract much review, but a study by Kurban (2021) [36] estimated that the constraint resulted in a 2.2%, reduction in exports. Kurban used a synthetic control method to measure trade impacts by 4-digit NAICS categories for industries which the EXIM Bank had aided and which had been cut back. Left unanswered was how much new unaided exports may have substituted for those that were cut back- data that would not be available from the bank. By contrast, at the aggregation level of total US trade measured in Table 1, only the net trade to a country is recorded. Any cutbacks in aided trade offset by new unaided trade would not appear and would not be of concern, particularly from the point of view of the EXIM Bank's mandates (section 1).

The fact that the EXIM Bank portfolio $61 billion between 2015 and 2021 without causing a dent in the results reported in Table 1 might suggest the EXIM Bank never had an effect on exports. But in 2015 Congress did not abolish the EXIM Bank. All of the bank's clients could expect the congressional constraint to be nothing more than a temporary pause in the bank's activities and that the bank would soon resume those activities in a short period of time. From 2015 and 2019 U.S. exporters might reasonably have taken a "wait and see" attitude rather than make the long run choice to exit the market. The bank did increase its exposure to 20 countries even during the period, 2015 to 2019. By 2019 the EXIM Bank had the authority and quorum of directors that it needed to resume its aid.

Nevertheless, Kurban's (2021) [36] evidence of cutbacks in certain industries may grow to a larger concern in the future. The tracking of entry and exist of exporters and the long term trade impacts of the congressional constraint will provide rich avenues of research for years into the future as more data becomes available. It's just not apparent now. Based on the results from Table 1, the stability of U.S. trade through time prevented the congressional constraint of 2015 from having much, if any, impact.

Section 3: A model of EXIM bank Exposure

While the congressional constraint of 2015 did not affect trade, it did affect the EXIM Bank export aid. We model EXIM Bank behavior in order to witness the impact.

A naïve approach to modelling EXIM Bank financial exposure would be simply to apply a gravity equation to the bank's financial exposure. After all, its major goal (1) is to stimulate exports and so it should reflect the determinants of exports. Furthermore, the process for giving aid begins with exporter applications for aid; more applications are likely to come from where exports are greatest. If the trade equations reflect the symmetric properties (9), so should EXIM Bank exposure. Table 2 shows that what happens.

Table2: The Gravity Equation for EXIM Bank Exposure

Dependent Variable (logarithms)	2015 EXPORTS	2021 EXPORTS
Intercept	-0.89	-0.44
(t-statistic)	-1.15	-0.51
Income (GDP) elasticity	1.24	0.71
(t-statistic)	6.70**	3.47**
Population elasticity	-0.25	0.12
(t-statistic)	-1.33	0.59
Distance Elasticity	-0.48	-0.39
(t-statistic)	-1.25	-0.94
R-square	0.49	0.35
F-statistic (@ 223 observations)	42.12	23.18
Income + Population elasticities	0.99	0.84
Difference from 1.0	0.01	0.16
Rejection of symmetry? (t-stat)	-0.13	-1.48

Note: The only variable different from Table 1 is the dependent variable, USIM Bank exposure in place of U.S. exports. Since only non-zero transactions can be tested using logarithms there are only 136 countries to which the EXIM Bank gave aid in both 2015 and 2021 to be included in the sample. Using the same equation as in Table 1 the t-statistics to test if the sum of the elasticities is equal to unity are shown in the final row.

At least it in 2015 the faint symmetry of EXIM Bank reflects the symmetry (9) of U.S. exports (Table 1). Both the F-test for the 2015 equation and the t-tests for the independent variables are less significant than for the larger sample concerning exports in Table 1. Nevertheless, as hypothesized the coefficient estimates and symmetry are close to those for exports, at least for 2015. However, by 2021 the financial exposure coefficient estimates meet none of the symmetry properties; the income coefficient is below, rather than above, 1.0; the population coefficient is positive rather than negative; and their total is well below 1.0- nearly enough to reject the symmetry hypothesis. The EXIM Bank portfolio diverges from exports.

However, this model provides no insight into the reason for the divergence. Is the EXIM Bank reneging on its responsibility to stimulate exports? How is it performing on its other objectives? This naïve model of EXIM Bank behavior provides no information about any causal relationship between exports and EXIM Bank exposure in 2015, or the deterioration of the relationship in 2021.

A more tailored approach is required to ferret out the impact of the congressional constraint of 2015 on EXIM Bank objectives and performance. Like blocking the sun to see the sun's corona, the export impact can be blocked by treating both U.S. exports and the EXIM Bank's exposure as an interactive system of two separate endogenous variables. Two-stage least squares (2SLS) can be used to estimate the parameters of such a system. The first stage of that system has already been estimated with the export equations (17) in Table 1. The results provide an estimate of U.S. exports for each year, t, that is uncorrelated with the error, e_{jt}, of estimating equation (6) for the EXIM Bank's exposure. With these predicted exports it is finally possible to test the cross-section model of EXIM Bank exposure (6) as shown in the first two columns of Table 3 for both 2015 and 2021.

Table 3: Exim Bank Model Results

	EXIM Bank Exposure		**Logarithm of ratio of**	
Dependent Variable	2015	2021	Exposure from 2021-2015	
Intercept	-27.95	-27.69	Intercept	-4.22
(t-statistic)	-9.47**	-8.58**	(t-statistic)	-0.92
Import elasticity	0.40	0.67	Import elasticity	0.37
(t-statistic)	2.58*	3.25**	(t-statistic)	1.33
Financial Risk	-2.25	-3.13	Financial Risk	-3.43
(t-statistic)	-2.58*	-3.30**	(t-statistic)	-3.04**
Predicted Export Elasticity	1.71	1.33	Income elasticity	-1.17
(t-statistic)	7.94**	4.83**	(t-statistic)	-1.94*
			Population elasticity	1.24
			(t-statistic)	2.82**
			Distance Elasticity	-1.42
			(t-statistic)	-1.75*
observations	223	223		0
R-square	0.54	0.52		0.00
F-statistic	86.96**	79.244**		4.60**

Note: The export, income, population, and distance variables are all tested in (17) after being transformed to logarithms in the first two columns of results. Since the EXIM Bank does not provide aid to all 223 U.S. trading partners listed in the census for both years and since the logarithm of zero exposure is undefined, an arbitrary value ($.5) for zero exposure has been used in the tests of the first two columns. To check for possible bias from these zero observations, tests have been run of smaller samples of (a) 174 countries in which there was nonzero exposure in one of the two years (2015 and 2021) and (b) 136 countries in which there was positive exposure in both years. The results in the first two columns are robust when these smaller samples are tested (available from the authors).

* 90%-99% confidence level. ** 99% confidence level or better.

The cross-section models estimated across 223 countries that the results are statistically significant, as indicated by the F-statistics in the bottom row of the table. Consistent with the EXIM Bank's goal of narrowing the trade deficit, EXIM Bank aid increases by 40% in 2015 and 67% in 2021 of any given percentage increase in U.S. imports, holding exports and country risk factors constant. Consistent with the EXIM Bank's goal of country risk reduction, a dummy variable measuring the EXIM Bank's appraisal of country risk[2] accounts for a dramatic drop in EXIM Bank aid for both years. Consistent with the goals of increasing employment and exports, EXIM Bank aid is estimated to rise more than proportionally to the predicted export variable; at a rate 71% more than export size in 2015 but only by 33% more in 2021.

both years. Consistent with the goals of increasing employment and exports, EXIM Bank aid is estimated to rise more than proportionally to the predicted export variable; at a rate 71% more than export size in 2015 but only by 33% more in 2021.

In both years the results suggest the EXIM Bank financial exposure is correlated with its export mandate. But between the years, 2015 and 2021, there is a subtle unwinding of its portfolio.

Table 3 displays this unwinding with an equation to capture how EXIM Bank behavior changes from 2015 to 2021. The dependent variable is the logarithm of the ratio of exposure in 2021 to exposure in 2015. To see how the behavior changes it is necessary to reduce the sample only to the 174 trading partners who received EXIM Bank aid in at least one of the years, 2015 and 2021. While no significant change occurs in providing aid to exports for the purpose of narrowing the trade deficit (i.e. the coefficient on the import variable is not significantly different from zero), aid is significantly reduced to countries that the EXIM Bank has flagged with any country risk (i.e. the coefficient on the financial risk variable is significantly negative). There is a retreat by the EXIM Bank from making loans to distant countries (i.e. the coefficient on the distance variable is significantly negative at the 90% confidence level). Such changes might be expected from the bank's retrenchment in the face of the congressional constraint of 2015.

Most revealing is a possible rise in financial risk due to the EXIM Bank exposure moving toward smaller per capita countries. Although its exposure still tracks exports in 2021 there is a statistically significant change from the 2015 cross-sectional tracking pattern. From 2015 to 2021 the EXIM Bank portfolio becomes more reliant on smaller income countries (i.e., the coefficient on the income variable is significantly negative), but more reliant on the more populous countries (i.e. the coefficient on the population variable is significantly positive). In other words, the EXIM Bank portfolio becomes more dependent on countries with lower per capita income. Examination of the EXIM Bank's exposure to new projects during the 2015 to 2021 period discloses a relative absence of large aid grants to the higher

per capita countries; a clear result of the congressional constraint in 2015 (as well as the executive failure to appoint enough board members to approve loans) that placed a $10 million cap on the exposure amounts in each aid contract. Less obvious from a detailed country-by-country review is the relatively slower paydown on previously authorized aid in the lower per capita countries than in the higher per capita ones. Both processes wrest control of the portfolio mix from the EXIM Bank, leaving it more vulnerable in its success at self-funding and in its ability to control overall financial risk. The EXIM Bank may also have lost some ability to achieve its goal of maximizing exports and employment from aiding exports.

Nevertheless, by 2021 the EXIM Bank's exposure is still roughly consistent with the mandates it was given by Congress. In the last column of Table 3 the last column analysis of the change of exposure from 2015 to 2021 focused just on the countries to which the EXIM Bank had provided aid in one of those years. But comparison to the countries that had never received aid reveals how much the EXIM Bank was still adhering to its congressional mandates. Out of the sample of 223 countries for which the Census reported export and import information in both 2015 and 2021, a comparison of the characteristics of the 141 countries that the EXIM Bank aided versus the 82 that it did not aid, reflects these mandates.

Table 4: Ratio of Median of Countries Aided to Countries Not Aided

	Medians						***Means***
	US Imports	*US Exports*	*GDP*	*Population*	*Distance (miles)*	*Balance of Trade*	*Financial Risk*
	($million)	*($million)*	*($billion)*	*(millions)*	*(1000 s)*	*($million)*	*%*
Aided	*1.715*	*1.397*	*141.5*	*10.5*	*4.8*	*-3.4*	*16%*
Non-aided	*0.010*	*0.039*	*8.555*	*1.3*	*6.3*	*4.0*	*49%*
Ratio	*166.2*	*36.2*	*16.5*	*8.2*	*0.76*	*-*	*0.33*

Note: The first row shows the median for countries aided by the EXIM Bank, while the second shows the median value for countries that were not given aid. The ratio of the two medians is shown in the third row. Since the "Financial Risk" measure is a dummy variable the last column measures its mean, not its median.

Table 4 arranges these characteristics according to the ratio of the medians of aided countries to those not aided. By far the largest relative disparity between exports to aided countries and those not aided, was defined by the relative size of the median US imports from aided countries to the median of unaided country imports to the US (far left). In other words, exporters to countries from whom the US heavily imported were much more likely to receive export aid from the Export Import Bank than countries that exported little to the U.S. This was consistent with the EXIM Bank actively trying to lower the trade deficit. Confirming this observation in the second to last column of Table 4, the median balance of trade of the aided countries was negative (a deficit) while the median for those not aided was positive (a surplus).

More generally the size of trading partners mattered, whether comparing imports to the U.S., exports from the US, the GDP of US trading partners, or even the population of trading partners. Bigger countries simply got more aid, a pattern consistent with export maximization.

Furthermore, exporters were more likely to receive aid by exporting to countries nearer to the U.S. which tended to be those with lower country risk. The median distance of countries to which aid receivers exported was 4800 miles from the U.S. while the median of distance of unaided countries was 6300 miles from the U.S. According to the EXIM Bank's own country-by-country risk assessment (final column), 16% of the countries receiving aid had some degree of risk, but nearly half the countries that did not receive aid had some degree of risk. The information in Table 4 provides evidence that the EXIM Bank was still carrying out its five mandates (section 1) from Congress in spite of the congressional constraint of 2015.

The structure of the EXIM Bank portfolio and the returns from that portfolio after 2015 prevented the congressional constraint of 2015 from seriously damaging the EXIM Bank's commitment to its congressional mandates. A cautionary tale lurks within these results both for congress and economists seeking to test the effect of government intervention in trade. The domestic expenditures of trading partners produce a powerful symmetric pattern that shows up at even low aggregation levels of trade statistics and measures of the performance of the government agencies that manage trade. Significant statistical results may simply be reflecting these stable, definitionally-rooted, symmetric patterns.

Conclusion

The congressional constraint of 2015 changed the financial exposure of the EXIM Bank, lowered its ability to achieve its congressional mandates, but did not change the EXIM Bank's attempts to achieve those mandates. These conclusions have been reached by modeling how well the EXIM Bank financial exposure reflected the different mandates it was given by the U.S. Congress. The model treats both U.S. exports and EXIM Bank financial exposure as a system. Using 2SLS, a model of exports has first been validated and then has been applied in a separate equation to measure the responsiveness of the EXIM Bank's exposure to its different mandates. While the bank's exposure unwound from 2015 to 2021, U.S. exports and imports remained remarkably stable.

A principal reason for this stability can be found in the properties inherent in gravity trade equations like the one used here. These "population-based" equations include the income and population of trading partners as exogenous variables. Implicitly such population-based models are defining exports as a residual from the difference of production and domestic expenditure of trading partners, as defined by the income-expenditure identity that applies to each trading partner.

The elasticities of income and population from such models have been shown here to satisfy a "symmetry" reflecting three properties; the income elasticity should be greater than 1.0, the population elasticity should be negative, and the sum of the two elasticities should be 1.0. Derived from the income-expenditure identity, these properties help to explain the attractive statistical results of gravity equations. As shown here with U.S. trade data, these properties for world trade are echoed at lower aggregations of trade data and in the behavior of organizations involved in trade, as has been found here with the EXIM Bank. These properties may be

an important reason for the apparent stability of trading patterns through time that make it very hard to detect changes in policies like the U.S. congressional constraint of 2015. As in the case of the U.S. Export Import Bank, trade policy decision-making by a single country may simply be overwhelmed by its trading partner domestic expenditure decisions.

References

1. Adams, Frederick. *The Export-Import Bank and American Foreign Policy 1934-1939*. University of Missouri Press. Columbia, MO, 1976.
2. Agarwal, Natasha, Wang, Zheng. Does the US EXIM Bank really promote US exports? *The World Economy*, 2018:41(5):1378-1414. https://doi.org/10.1111/twec.12537
3. Afesorgbor, Sylvanus. Revisiting the Effect of Regional Integration on African Trade: Evidence from Meta-Analysis and Gravity Model, 2016. *European University Institute Working Paper* MWP 2016/10. Available at: https://www.hendrix.edu/uploadedFiles/Departments_and_Programs/Business_and_Economics/AMAES/Afesorgbor_2016%20Max%20Weber%20working%20paper%20_2016_10.pdf [Accessed 3 December 2021].
4. Ahmed, Shujaat, Hafsa Hina. The Impact of Trade Cost on Exports of Pakistan: An Empirical Modelling. *Research Journal Social Sciences*,2019:6(1):73-81.
5. Akhtar, Shayerah, David Carpeter, Mindy Levit, Julia Taylor. Export-Import Bank Reauthorization: Frequently Asked Questions, 2014. *Congressional Research Service Report 7-5700, R43671* (September) Available at: https://sgp.fas.org/crs/misc/R43671.pdf [Accessed 3 December 2021].
6. Alvarez, Fernando, Lucas, Robert Jr. Equilibrium Analysis of the Eaton-Kortum Model of International Trade. *National Bureau of Economic Research Working Paper 11764* (November), 2005. Available at: https://www.nber.org/papers/w11764 [Accessed 3 December 2021].
7. Balassa, Bela. Intra-industry Specialization: A Cross-country Analysis. *European Economic Review*,1986:30:27-42.
8. Badinger, Harald Url, Thomas. Export Credit Guarantees and Export Performance: Evidence from Austrian Firm-level Data, 2013. *The World Economy* 36 (9) 1115-1130. https://doi.org/10.1111/twec.12085.
9. Baron, David. *The Export-Import Bank: An Economic Analysis*. NY, NY: Academic Press, 1983.
10. Bergstrand, Jeffrey H. The Generalized Gravity Equation, Monopolistic Competition, and the Factor-Proportions Theory in International Trade. *The Review of Economics and Statistics*,1989:71(1):143-153.
11. Bergstrand, Jeffrey H. The Heckscher-Ohlin-Samuelson Model, The Linder Hypothesis and the Determinants of Bilateral Intra-Industry Trade. *The Economic Journal*, 100 (403) (December), 1990, 1216-1229.
12. Brada, Josef C, Méndez, José A. Economic Integration among Developed, Developing and Centrally Planned Economies: A Comparative Analysis. *The Review of Economics and Statistics*,1985:67(4):549-556.
13. Chaney, Thomas. Liquidity constrained exporters. *Journal of Economic Dynamics and Control*,2016:72:141-154. https://doi.org/10.1016/j.jedc.2016.03.010.
14. Choi, Changkyu. Linder hypothesis Revisited. *Applied Economics Letters*, 2002:9:601-605.
15. Cox, Charles. The Enforcement of Public Price Controls. *Journal of Political Economy*,1980:88(5):887-916.
16. Deardorff, Alan V. Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World? in J. A. Frankel, ed., *The Regionalization of the World Economy*. Chicago: University of Chicago Press, 1998, 7-22.
17. Deutsch, Karl, Chester Bliss, Alexander Eckstein. Population, Sovereignty and the Share of Foreign Trade: Economic Development and Cultural Change,1962:10(4):353-366.
18. Due˜nas Marco, Giorgio Fagiolo. Modeling the International-Trade Network: A Gravity Approach. (December). Availabl at, 2011. https://arxiv.org/pdf/1112.2867.pdf [Accessed 3 December 2021].
19. Eaton , Jonathan, Samuel Kortum. Technology, Geography, and Trade. *Econometrica*,2002:70(5):1741-1779.
20. Eichengreen Barry, Douglas A, Irwin. The Role of History in Bilateral Trade Flows, in J. A. Frankel, ed., *The Regionalization of the World Economy*. Chicago: University of Chicago Press, 1998, 33-57.
21. Felbermayr Gabriel Yoto Yotov. From Theory to Policy with Gravitas: A Solution to the Mystery of the Excess Trade Balances. *Kiel Working Paper*, No. 2138, Kiel: Kiel Institute for the World Economy (IfW). Available, 2021. :https://www.econstor.eu/handle/10419/232255 [Accessed 3 December 2021].
22. Francois Joseph, Seth Kaplan. Aggregate Demand Shifts, Income Distribution, and the Linder Hypothesis. *The Review of Economics and Statistics*,1996:78(2):244-250.
23. Freund Caroline, Nadia Rocha. What Constrains Africa's Exports? *The World Bank Economic Review*,2011:25(3):361-38. Available at: https://doi.org/10.1093/wber/lhr016 [Accessed 3 December 2021].
24. Gershenkron, Alexander. *Economic Backwardness in Historical Perspective*. Cambridge: Harvard University Press, 1962.
25. Helpman, Elhanan. International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: a Chamberlin-Heckscher-Ohlin Approach. *Journal of International Economics*,1981:2:305-40.
26. Helpman, Elhanan Paul R, Krugman. *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy*. Cambridge, MA: MIT Press, 1985.
27. Houthakker HS. An International Comparison of Household Expenditure Patterns, Commemorating the Centenary of Engel's Law. *Econometrica*,1957:25:525-51.
28. Isard, W. & M. J. Peck. (1954a) Location Theory and International and Interregional Trade Theory. *Quarterly Journal of Economics*, LXVIII (1) (Feb.), 97-114.

29. Isard, W. (1954b) Location Theory and Trade Theory: Short Run Analysis. *Quarterly Journal of Economics*,1954:68,305-22.
30. Johnson, Harry G. Alternative Maximization Policies for Developing-Country Exports of Primary Products. *Journal of Political Economy*, 1968:76(3):489-93.
31. Katz Diane. U.S. Export-Import Bank: Corporate Welfare on the Backs of Taxpayers. *Heritage Foundation*, 2014.
    Available at: https://www.heritage.org/government-regulation/report/us-export-import-bank-corporate-welfare-the-backs-taxpayers.
32. Kennedy, Thomas E. Richard McHugh. An Intertemporal Test and Rejection of the Linder Hypothesis. *Southern Economic Journal*,1980:46(3):898-903.
33. Khan, Imran Ullah, Kaliappa Kalirajan. The Impact of Trade Costs on Exports: An Empirical Modeling. *ASARC Working Paper* 2011/07 Canberra, Australia: Australian National University, 2011. Available at: http://www.crawford.anu.edu.au/acde/asarc/pdf/papers/2011/WP2011_07.pdf [Accessed 3 December 2021].
34. Kolhagen, Steven W. Income Distribution and "Representative Demand" in International Trade Flows: An Empirical Test of Linder's Hypothesis. *Southern Economic Journal*, 1977:44(1):167-172.
35. Krugman, Paul R. Intra-industry Specialization and the Gains from Trade. *Journal of Political Economy*,1981:89:959-73.
36. Kurban, Danny. Does Public Financing Support Increase Exports? Evidence from a Quasi-Experiment at the US Export-Import Bank, 2021. Available at: https://www.colorado.edu/economics/sites/default/files/attached-files/21-04_-_kurban.pdf [accessed3 September 2022].
37. Kuznets, Simon. Quantitative Aspects of the Economic Growth of nations: II. Industrial Distribution of National Product and Labor Force. *Economic Development and Cultural Change*. 5 supplement 4 (July), 1957.
38. Linder, Staffan B. *An Essay on Trade and Transformation*. New York: John Wiley, 1961.
39. Alvarez, Fernando, Robert, Lucas Jr. Equilibrium Analysis of the Eaton-Kortum Model of International Trade. *National Bureau of Economic Research*. Working Paper, 2005, 11764. [Retrieved at: https://www.nber.org/papers/w11764].
40. Martinez-Zarzoso. Immaculada Felicitas Nowark-Lehmann. (2003) Augmented Gravity Model: An Empirical Application to Mercosur-European Union Trade Flows. *Journal of Applied Economics*,2003:6(2):291-316.
41. Martinez-Zarzoso, Immaculada. Gravity Model: An Application to Trade Between Regional Blocs. *Atlantic Economic Journal*, 2003:31:174-187.
42. Pherson Mc, Michael A, Michael R. Redfearn Margie Tieslau A. International Trade and Developing Countries: an Empirical Investigation of the Linder Hypothesis. *Applied Economics*, 2001:33:649- 657.
43. Mitze, Timo. Endogeneity in Panel Data Models with Time-Varying and Time-Fixed Regressors: To IV or not IV? *Ruhr Economic Papers* #83 (January). Bochum, Germany: Ruhr-Universität Bochum (RUB), 2009.
    Availableat:https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1358224 [Accessed 3 December 2021].
44. Mukherjee S, Chanda R. Financing constraints and exports: Evidence from manufacturing firms in India. *Empirical Economics*,*2021*:61:309-337. https://doi.org/10.1007/s00181-020-01865-9.
45. Niskanen, William A. *Bureaucracy and Representative Government*. Chicago: Aline-Atherton, 1971.
46. Peltzman, Sam. Toward a More General Theory of Regulation. *The Journal of Law & Economics*,1976:19(2):211-40.
47. Peng Shuijun, Zhongqiao Shu, Wencheng Zhang. Does Service Trade Liberalization Relieve Manufacturing Enterprises' Financial Constraints? Evidence from China, *Economic Modelling*, 2022. 106 (C), 10.1016/j.econmod.2021.105710.
48. Qureshi, Usman A, Gary L, French, Joel W. Sailors. Linder's Trade Thesis: A Further Examination. *Southern Economic Journal*,1980:46(3):933-936.
49. Rappeport, Alan. Backers of Export-Import Bank Fret Over Pick to Lead It. *The New York Times* (May 9), A14, 2017.
50. Rostow Walt. The Take-Off into Self-Sustained Growth. *Economic Journal*,1956:66:25-48.
51. Shujiro Urata, Rieti O Misa. The Impacts of Free Trade Agreements on Trade Flows: An Application of the Gravity Model Approach. *RIETI Discussion Paper Series* 07-E-052, 2007 1-36. Available at: https://www.rieti.go.jp/jp/publications/dp/07e052.pdf [Accessed 3 December 2021].
52. Stigler George. The Theory of Economic Regulation. *Bell Journal of Economics and Management Science*, 2 (Spring, 1971, 3-21.
53. Thursby, Jerry G Marie C, Thursby. Bilateral Trade Flows, the Linder Hypothesis, and Exchange Risk. *The Review of Economics and Statistics*,1987:69(3):488-495.
54. Tinbergen Jan. *Shaping the World Economy: Suggestions for a International Economic Policy*. New York: The Twentieth Century Fund, 1962
55. United States Census Bureau. Balance by Partner Country: U.S. Trade in Goods by Country: Download the full dataset for all countries [EXCEL-5 MB], 2021. Available at: https://www.census.gov/foreign-trade/balance/index.html [Accessed 3 December 2021].
56. United States Central Intelligence Agency The World Factbook, 2021. Available at: https://www.cia.gov/library/publications/the-world-factbook/ [Accessed 3 September 2022].
57. United States Export-Import Bank. *Annual Report 2015*. FY 2015 Authorizations by Market, 20-23 "Exposure" (final column), 2015. Available at: https://www.exim.gov/sites/default/files/reports/annual/EXIM-2015-AR.pdf [Accessed 3 December 2021].
58. United States Export-Import Bank. *Annual Report 2021*. FY 2021. Authorizations by Market, 32-5 "Exposure" (final column), 2021. Available at: https://img.exim.gov/s3fs-public/reports/annual/2021/EXIM_2021_AnnualReport.pdf [Accessed 30 august 2022].
59. United States Export-Import Bank. Country Limitation Schedule, 2021. Available at: https://www.exim.gov/resources/country-limitation-schedule [Accessed 3 September 2022].United States

Government Accountability Office. *Export-Import Bank: More Detailed Information about Its Jobs Calculation Methodology Could Improve Transparency*. Report to Congressional Committees (May). Washington, D.C.: U.S. GAO, 2013. Available at: https://www.gao.gov/assets/gao-13-446.pdf [Accessed 3 December 2021].