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Effect of Trade Costs on Future Rare Earth Exports

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Outline

- Background
- Motivation
- Model for Rare Earth Export Growth Decomposition
- Results
- Implications

Background — Rare Earth Supply

- **China produces 95% of total rare earth supply**
- **Lower costs in China have collapsed the supply coming from other mines**
- **China has reduced the effective supply of rare earths through restrictive export policies, such as export taxes and quantitative restrictions**
  - Due to these restrictions, black market activities have spread, leading to further price spikes
  - With this rare earths supply crisis, the USA, the EU, and Japan filed simultaneous complaints against China at the World Trade Organization in 2012

Prominent Rare Earth Deposits by Mining Companies

Source: USGS 2012.

(1) Lynas Corp, (2) Molycorp Minerals, (3) (4) Great Western Minerals, (5) Alkane Resources, (6) Vietnamese govt/Toyota Tsusho/Sojitz, (7) Arafura Resources, (8) Avalon Rare Metals, (9) Kazatomprom/Sumitomo, (10) Stans Energy, (11) Greenland Minerals and Energy, (12) Rare Element Resources, (13) Pete Mountain Resources, (14) Quest Rare Minerals, (15) Ucore Uranium, (16) US Rare Earths, (17) Matamec Explorations, (18) Etruscan Resources, (19) Montero Mining, (20) Tasman Metals, (21) Neo Material Technologies/Mitsubishi

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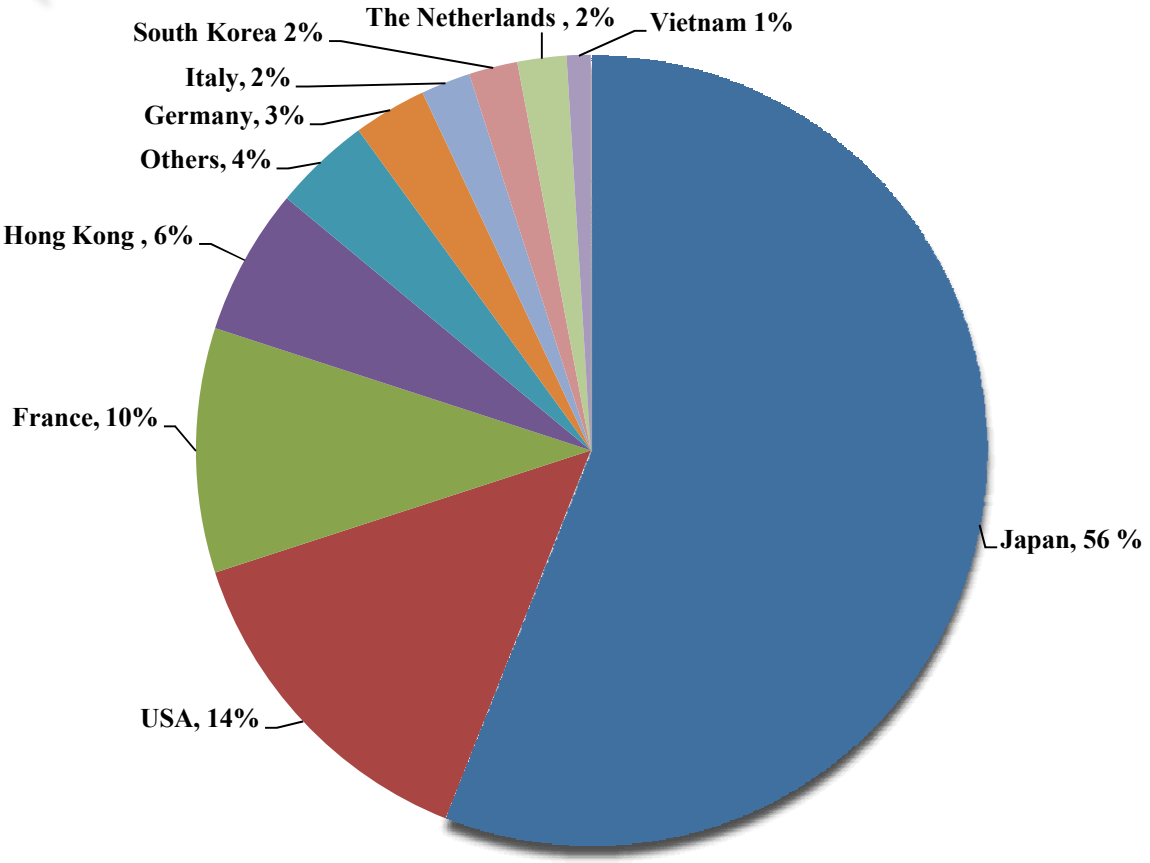
Destination of Exports of Rare Earths (2012)



Source: Created from Roskill Information Services (2011).

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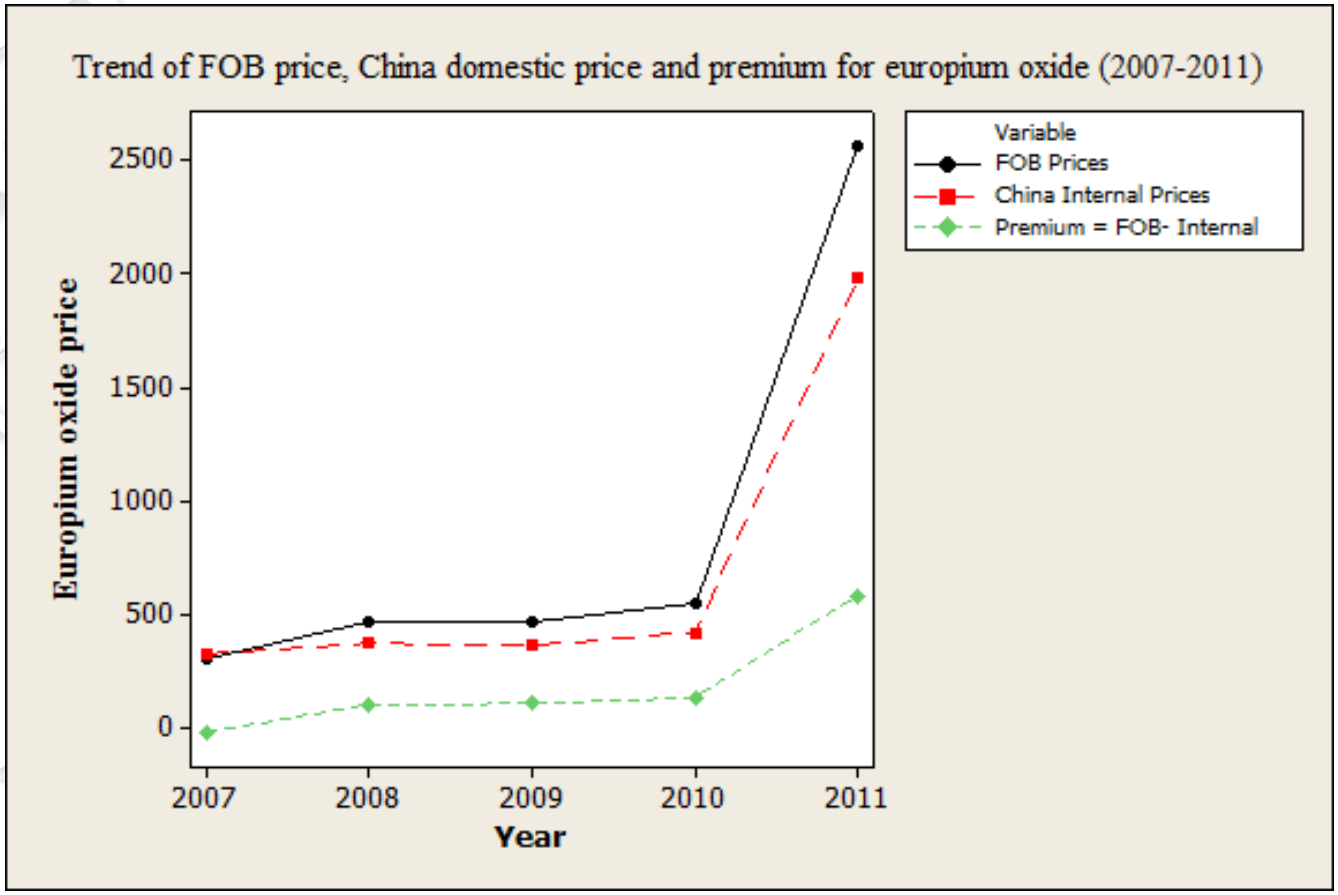
Background — Rationale for Export Controls

- **Export controls are used to:**
  - Promote value-added downstream industries
  - Raise government revenues
  - Control price volatility
  - Achieve non-economic goals such as protecting animal, human, and plant health, and reducing environmental pollution
- **In the case of an export tax imposed by a major exporter:**
  - Foreign consumers cannot buy lower-priced supplies, leading to a higher world price
  - In the exporter's economy, lower prices result in higher domestic consumption
  - In the short-run, higher likelihood of net income transfer from importing to exporting countries
  - Export tax may also lead to domestic inefficiency in downstream industries in home country because prices are kept artificially low

Background — Trends of Domestic Prices, FOB Prices, and Premium Prices



Source: Created from Roskill Information Services (2011).

Questions

- Effect of trade costs on export flows can come from five different sources: (a) traditional demand sources — per capita income or population; (b) natural distance; (c) Explicit beyond the border costs — export taxes and the real exchange rate; (d) “Behind the border costs” in exporting country — trade & transport infrastructure, customs and port reforms, investment in storage infrastructure; (e) “Implicit beyond the border” costs of importing countries — removing regulations on trade
- To which countries did China’s rare earth exports decline due to an increase in ‘behind the border’ trade costs ?
- With which countries did China’s rare earth exports increase due to a decrease in ‘implicit beyond the border’ trade costs?
- Analysis was conducted on a sample of 24 trading partners of China for two periods — 2001 and 2009 to examine the above questions
- What is the future of Rare earth element (REE) trade?

Model for Rare Earth Export Growth Decomposition

- **Stochastic frontier model using a gravity trade framework**
- $y_j = f(x_j, \beta) + v_j - u_j = f(x_j, \beta) + \varepsilon_j$ **(1)**
  - v_j denotes the two-sided noise component
  - u_j denotes the non-negative technical inefficiency term
  - ε_j is not symmetric, because $u_j \geq 0$
- $LnX_{ij} = \alpha + \beta_1 * Ln\,PGDP_j + \beta_2 * Ln\,Dist_j + \beta_3 * Ln(1 + T_{i,j}) + \beta_4 * LnRER_{i,j} - u_j + v_j \quad (2)$
- **Least squares estimation provides consistent estimates except the parameter α, because $E(\varepsilon_j) = -E(u_j) \leq 0$**
- **Main objective is to estimate the technical inefficiencies caused by export taxes**

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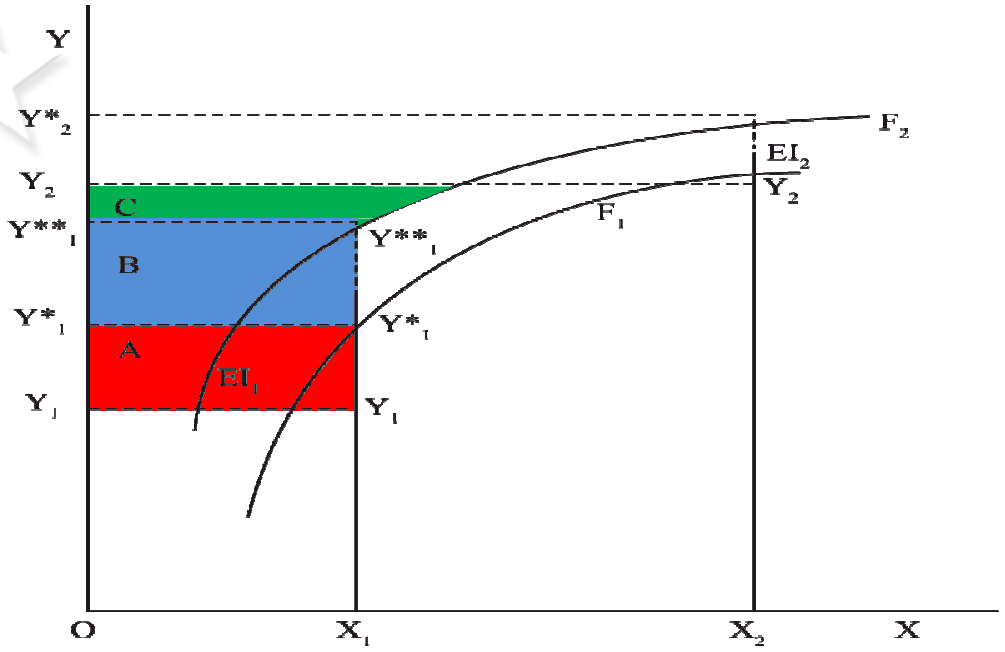
Rare Earth Export Growth Decomposition (cont.)



- $\omega = Y_2 - Y_1 = A + B + C = [Y_1^* - Y_1] + [Y_1^{**} - Y_1^*] + [Y_2 - Y_1^{**}] = \{[Y_1^* - Y_1] - [Y_2^* - Y_2]\} + [Y_1^{**} - Y_1^*] + [Y_2^* - Y_1^{**}]$
- $[Y_1^* - Y_1] - [Y_2^* - Y_2]$ = Difference between export inefficiency in period 1 and period 2 arising from changes in 'behind the border' trade costs in the home country
- $[Y_1^{**} - Y_1^*]$ = Changes in exports due to trade facilitation steps taken by Chinese partner countries; also called "implicit beyond the border costs"
- $[Y_2^* - Y_1^{**}]$ = Changes in exports due to the sum of the changes in the core determinants of trade like income per capita, distance, and changes in "explicit beyond the border costs" such as export taxes and the real exchange rate.

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Data Sources

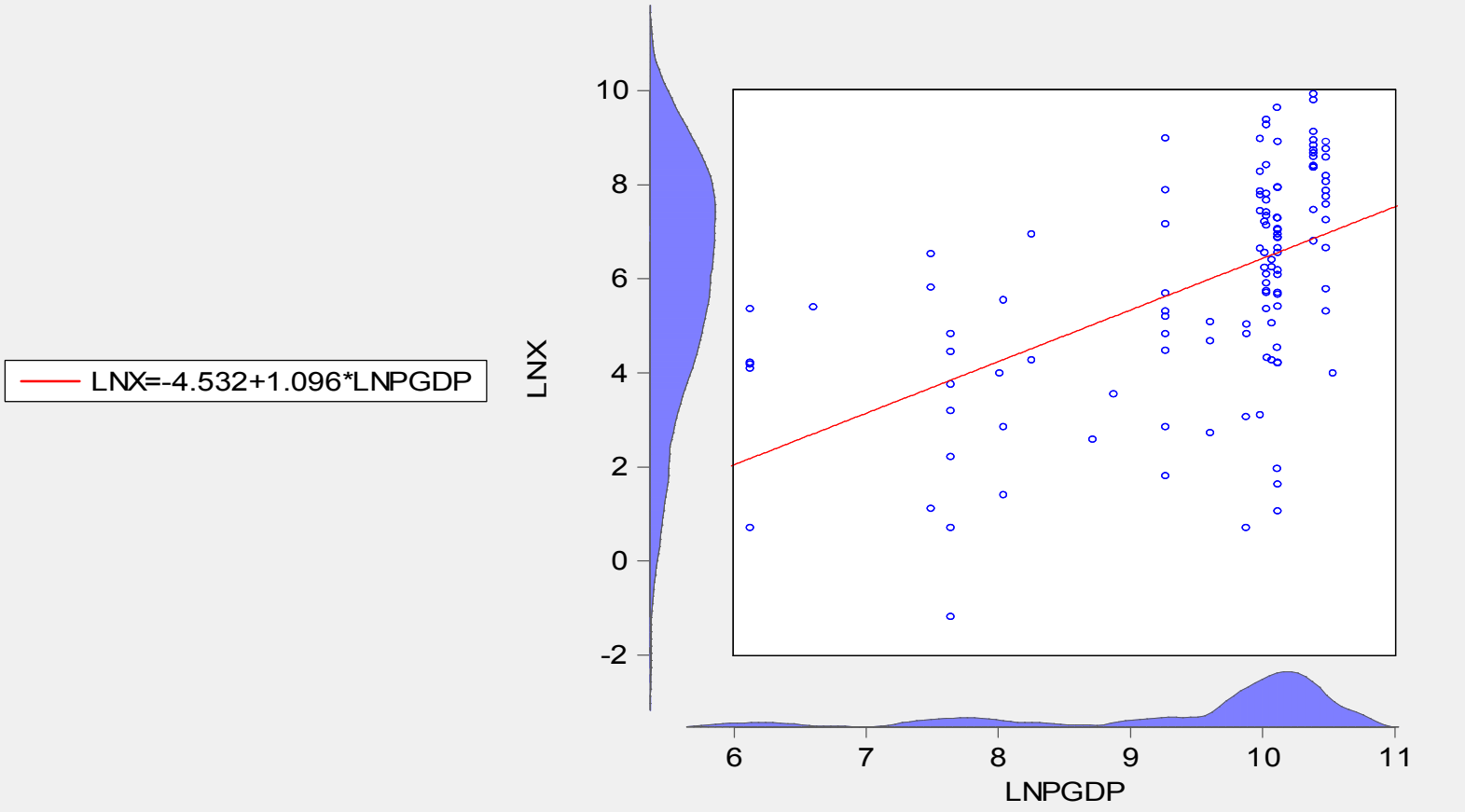
- Exports of rare earths — China Customs Statistics Yearbook, various years
- GDP and Population — World Bank
- Export Taxes — Roskill Information Services
- Bilateral Distance — http://www.developing-trade.com/capacity-building
- Real Exchange Rate — http://forex-markets.com/currency-converter.htm
- We chose 24 trade partners as they represented 90% of REOs from China

Maximum Likelihood Estimates

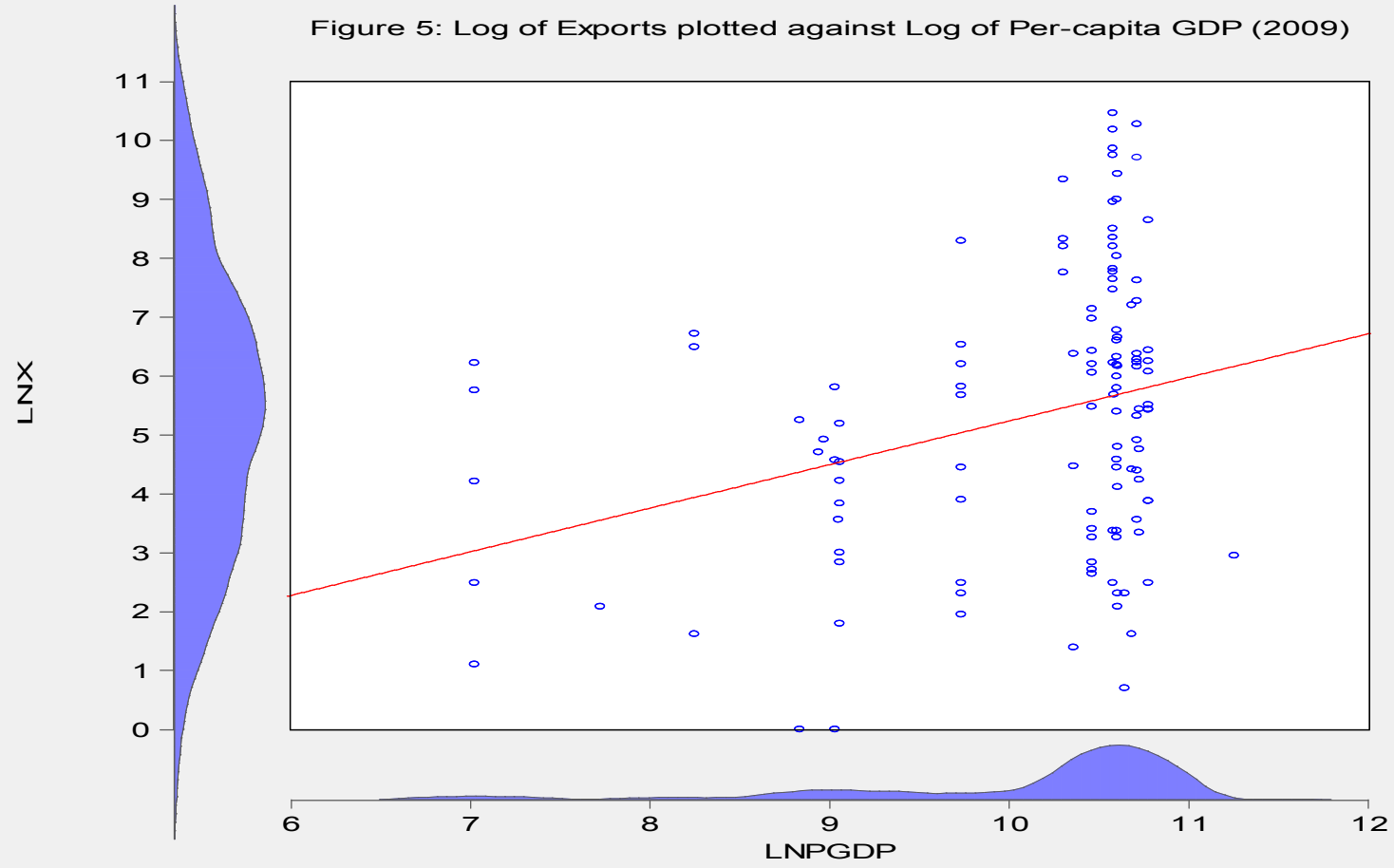
Independent Variables	Estimation for 2001	Estimation for 2009
Log of per capita GDP	1.008 (0.167)***	0.135 (0.37)
Log of Distance	-0.335 (0.184)*	-1.015 (0.30)***
Log of Export price	-0.027 (0.048)	-0.187 (0.172)
Log of Real Exchange rate	0.589 (1.079)	19.764 (6.253)***
Constant	-0.906 (5.233)	-74.57 (25.991)***
N	122	122
Model specification	χ^2_1 = 32.222 ***	χ^2_1 = 3.537 **
σ	2.851 ***	2.223***

Relationship Between Rare Earth Exports and Per-capita GDP

Figure 4: Log of Exports plotted against Log of per-capita GDP (2001)



Relationship Between Rare Earth Exports and Per-capita GDP (contd')



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Main Results

- **Coefficients in the model are of the expected sign, but the significance level of independent variables changes dramatically**
  - Geographical distance matters in trade flows
  - Per capita GDP was not significant during 2009 owing to financial crises and trade protectionism both in the developed and developing world
  - Real exchange rate is significant in 2009 but not in 2001
- **Overall, there has been some structural shifts in the Chinese economy with respect to rare earths trade**

Main Results (contd')

- **FRED BERGSTEIN**

"China's currency manipulation represents the largest protectionist measure maintained by any major economy since the second world war. China has intervened in the foreign exchange markets by an average of $1 billion a day for the last five years, buying dollars to keep them expensive and selling renmimbi to keep them cheap, building a gigantic reserve of $2.5 trillion. The largest trading country in the world is therefore subsidizing all exports by at least 20% and imposing an additional tariff of at least 20% on all imports."

Export Losses Due to "Behind The Border" Trade Costs

- **Difference between the level of exports in the absence of 'behind the border' trade costs (*u =0*) and the actual exports that occurred in the presence of 'behind the border' trade costs (*u > 0*)**

Results on "Behind the Border" Trade Costs

- In 2001, largest export losses were observed with respect to exports to USA (neodymium, not intermixed or interalloyed); Japan and Hong Kong (terbium oxide); and Japan (cerium compounds)

- In 2009, largest export losses were in Hong Kong markets (lanthanum oxide, yttrium oxide, terbium oxide) and Japan (cerium compounds) — Possibly due to re-exports

- Total export losses due to "behind the border" trade costs in 2009 almost trebled compared to the export losses in 2001
  - China shooting themselves in feet?

Export Losses Due to "Implicit Beyond the Border" Trade Costs

- The *v* term in equation (2) shows the potential exports in absence of 'behind the border' trade costs in period 1 and the level of China's potential exports in the absence of 'behind the border' trade costs in period 1 had the second period 'implicit beyond the border' trade costs existed in the first period

Results on "Implicit Beyond the Border" Trade Costs

- China is gaining in markets such as Italy (cerium oxide), Germany (yttrium oxide, lanthanum oxide, and cerium oxide), and Japan (cerium oxide and cerium compounds, nes)

- China is also losing in markets such as USA (neodymium, not intermixed or interalloyed and terbium oxide), Japan (terbium oxide), Canada (Rare earth oxides other than cerium, nes), Norway (Rare earth oxides other than cerium, nes)

Implications

- **Countries are likely to research substitutes for REEs**
  - Rate of technological and product innovations is critical
- **REEs will remain a key component in clean energy and defense technologies in both the short and long-run**
- **New mining development is not feasible in the short run due to initial investment costs and regulatory constraints**