# THE WORLD'S GREATEST COAL ARBITRAGE: CHINA'S COAL IMPORT BEHAVIOR AND IMPLICATIONS FOR THE GLOBAL COAL MARKET

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# The World's Greatest Coal Arbitrage: China's Coal Import Behavior and Implications for the Global Coal Market

*Richard K. Morse and Gang He*

**Introduction**

In 2009 the global coal market witnessed one of the most dramatic realignments it has ever seen – China, long a net exporter of coal, suddenly imported a record-smashing 126 Mt tons (see Figure 1).[1] This inversion of China's role in global coal markets meant that Chinese imports accounted for nearly 15% of all globally traded coal, and China became the focal point of global demand as traditional import markets like Europe and Japan stagnated in the wake of the financial crisis. By the first quarter of 2010, even Colombia was defying established trade patterns by sending cargoes to China despite its massive geographic disadvantage to export coal into Asian markets. The middle kingdom's appetite for imported coal seems insatiable, and the "China Factor" appears to have ushered in a new paradigm for the global coal market.

But China doesn't "need" the coal. The world's largest coal producer cranked out 2.96 Bt of production in 2009, backed up by 114.5 Bt of reserves.[2] While the world's other fastest growing importer, India, is plagued by a growing gap between coal supply and power demand that it is unable to fill domestically, this is not the case in China. The spike in Chinese demand for imported coal is therefore a more complex (and less easily predictable) phenomenon that requires careful examination if the world is to understand what impact China might have on global energy markets in the coming decade.

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[1] 103 Mt net imports. Source: National Energy Administration of China.
[2] This reserve number is widely used by IEA, BP Energy Statistics Review, etc. China's Ministry of Land and Resources shows 183 Bt in its updated "Mineral Resources Reserves Classification". See more details in Wang Qingyi, China Energy Statistics.

In this paper we outline a model that explains Chinese coal import patterns and that can allow the coal market to understand, and to some degree predict, China's coal import behavior. We argue that the unique structure of the Chinese coal market creates a series of key arbitrage relationships between Chinese domestic coal markets and international coal markets that determine Chinese import patterns. Based on this theory of China's import behavior, we construct an arbitrage-based import model that explains the dramatic shift in Chinese net imports over the last several years.

The implications of this model are significant for the development of the global coal trade in the coming decade. First, we find that China's import behavior does not represent a "structural shift" in global markets. China, as a participant in the global coal market, is a cost-minimizer that will be both a buyer and seller in the global market as key price relationships fluctuate. Second, and perhaps most importantly, the arbitrage relationships that we describe directly link the domestic price of coal in China to the global price of coal. This linkage has significant implications for the use of coal and the cost of generating power globally in the coming decades. Developments in China's domestic coal market will be a dominant factor determining global coal prices and trade flows (and by implication power prices in many regions). This makes understanding the domestic Chinese coal market, which operates according to a unique economic and political logic, crucial for any participant in the global markets.[3]

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[3] A series of forthcoming studies on the structure and long term future of the Chinese coal market will be release by PESD Stanford in 2010, and can be found at http://pesd.stanford.edu
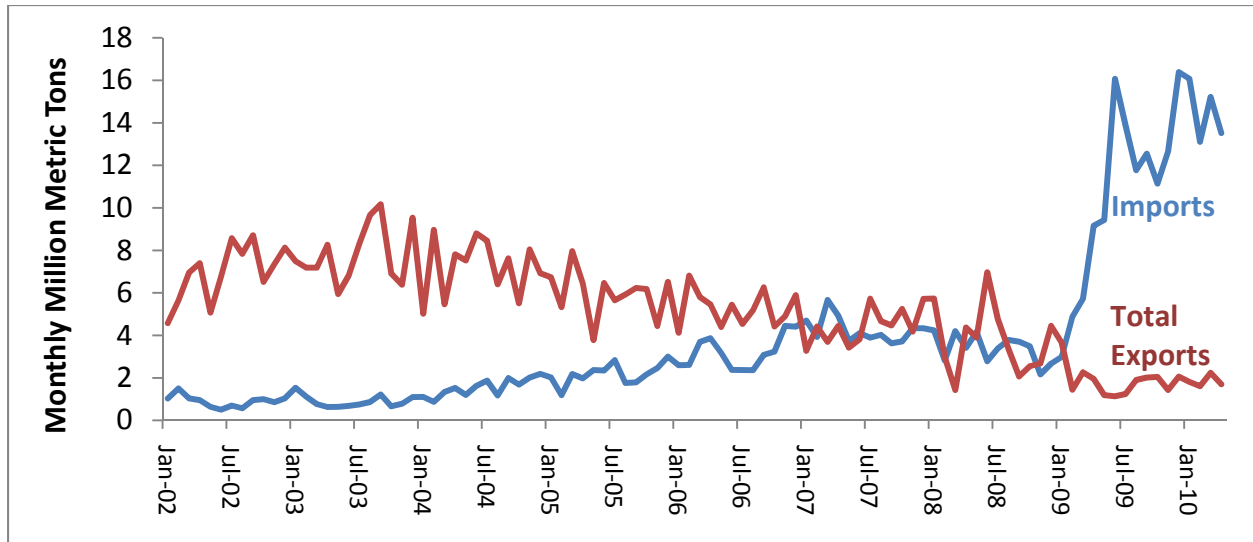
Figure 1 – Chinese net imports were negative until 2008, when historical trade balances inverted dramatically. Source: McCloskey.

# 1 Geographic Fundamentals of the Chinese Coal Market

China's coal reserves and production are concentrated in the North and West of China. Three provinces in these regions – Shanxi, Shaanxi, and Inner Mongolia – have 69% of the country's proven reserves and were home to half of national production in 2009. That same year Inner Mongolia surpassed Shanxi to become the largest producer at 637 Mt; Shanxi produced 615 Mt, and Shaanxi produced 296 Mt.[4] 70% of the production in these three provinces is exported outside of its home province to supply coal demand most heavily concentrated along the eastern and southern coasts. Figure 2 illustrates the basic geography of Chinese coal regions.

Northern coastal Chinese coal demand is served by a network of truck routes and railways that move coal east and south from western and northern production centers. But rail and truck capacity to supply coal to Southeast China is both insufficient and prohibitively expensive. Therefore coal supply for Southeast China is first transported east on rail lines like the Da-Qin and Shuo-Huang to eastern ports like Qinhuangdao, Huanghua, Rizao, next loaded onto boats, and finally shipped south via sea routes. Figure 3 illustrates China's major coal transport infrastructure segments. This rail-to-sea link is still much cheaper than moving coal overland

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[4] National Bureau of Statistics China.

from North to South.  Though the costs associated with this transport route are still high; the transportation cost of moving coal from Shanxi to Guangzhou can be as high as 50-60% of the price of coal delivered to Guangzhou.[5] The high cost of moving coal to the heavily industrialized coastal area that includes the Pearl River Delta and the Yangtze River Delta opens windows for import coals to compete with domestic coals.

Southeast China is also the closest region in China to two major global coal exporting nations, Indonesia and Australia.  Coal buyers in Southeast China therefore are often confronted with two options: buy domestic coal delivered by sea from Northern Chinese ports, or buy international coal. This arbitrage opportunity allows Chinese coal buyers to take advantage of price differentials between domestic Chinese coal and international coal prices.  Until 2009, those differentials had not favored imports.
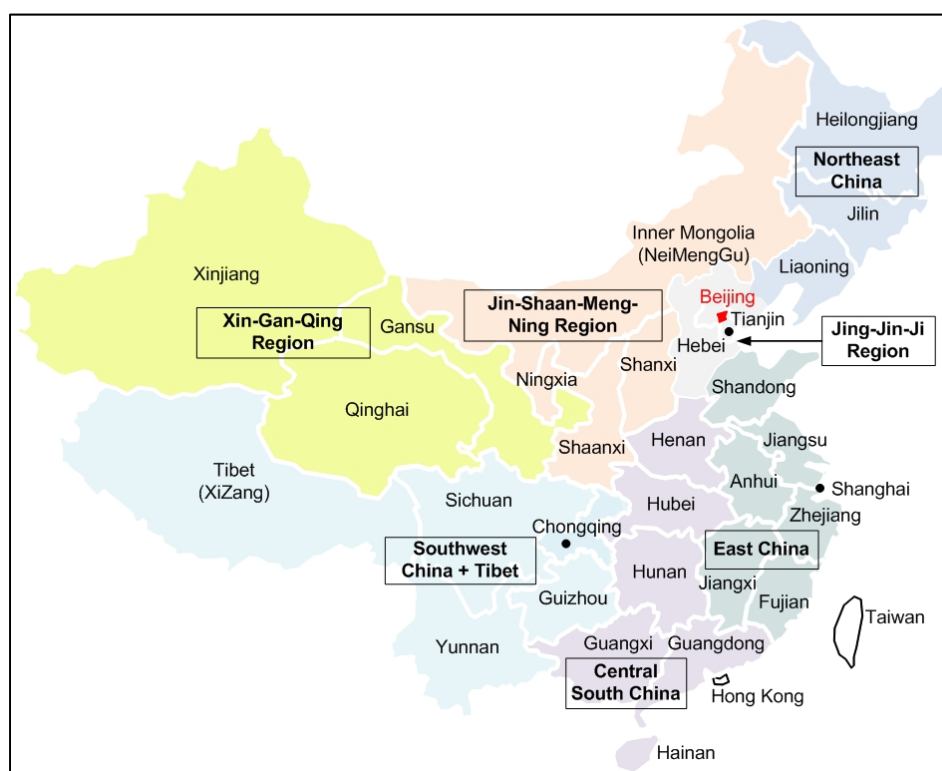


Figure 2 – Map of Chinese "coal planning regions", as described by NDRC's Coal Industry Policy of 2007.  Source:  Kevin Tu.

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[5] This is an estimate.  Costs fluctuate according to the price of coal and the price of shipping coal.
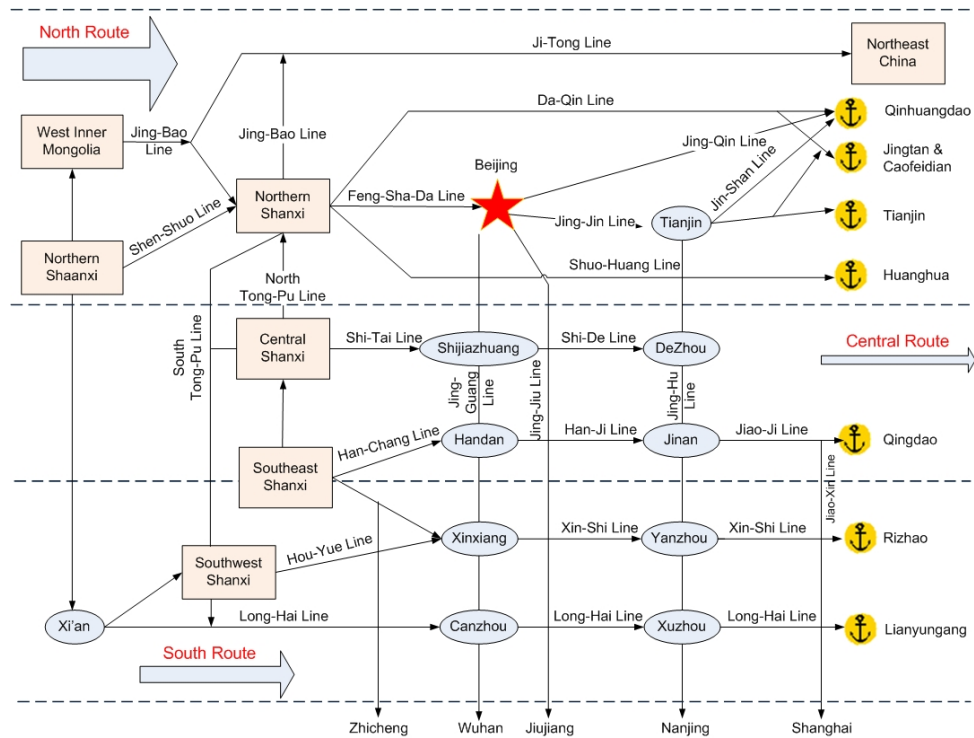
Figure 3 – Schematic of China's major coal transportation infrastructure.  Source:  Kevin Tu.

## 2      The Arbitrage Model of Chinese Coal Imports

We argue that modeling arbitrage spreads between domestic and international coals for coal buyers in Southern China explains China's 2009 import spike and can also be used to reliably analyze China's national import behavior under future market conditions.   In this section we describe the parameters of our model, called the China Coal Import Arbitrage Model (ChinaCoalArb for short), and demonstrate how its results can be used to interpret China's import trends.

Chinese coal buyers in Southeastern China can buy coal from multiple markets, and price discrepancies between different markets create profit opportunities.  For a portion of spot market demand, buyers will compare the CIF[6] cost of coal landed in Guangzhou from multiple destinations and, all other things equal, will take the cheapest coal.[7]  The differentials between CIF Guangzhou coal prices from multiple origins therefore create arbitrage opportunities for

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[6] CIF is a coal market term indicating that a price is for the delivered location, and thus includes all freight costs.
[7] For purposes of modeling we have slightly simplified the dynamics of Chinese coal buying behavior to focus on the domestic vs. import tradeoff.  For instance, we have not included term contracts or prices at port stockpile in our model.

Chinese buyers who can shift their purchasing patterns to capture the differential between domestic and international markets under different conditions. The model calculates these arbitrage relationships of domestic to key international coals.  We then compare these arbitrage relationships to historical imports, demonstrating that import levels have broadly tracked these arbitrage trends, increasing where price spreads favored international coals over domestic coals.

### 3.1 Supply Points and FOB Prices

Chinese domestic prices in ChinaCoalArb are represented by FOB[8] prices at the Qinhuangdao port.  Qinhuangdao port is mainly supplied with coal from Shanxi, Shaanxi and Inner Mongolia and is China's largest coal port.  Qinhuangdao throughput in 2009 was 206.33 Mt, and the total throughput of the seven major coal ports serving Northern China was 433Mt.[9,10]  Coal loaded in Qinhuangdao and delivered to Guangzhou is transported south down the Chinese coast via maritime shipping.  Figure 4 below shows the historical development of prices at Qinhuangdao.

We select three key international coal supply countries as the model's suppliers.  Australia, Indonesia, and Russia were the largest exporters of coal to China in 2009.[11,12]  All three countries are major exporters to the international market and benefit from reasonably proximity to Chinese import markets.  Table 1 shows 2009 total Chinese imports from these origins. FOB coal prices in each of these markets are derived from bids and offers at those locations.[13]  Figure 4 shows the historical development of Russian, Indonesian, and Australian export coal prices from 2005.

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[8] FOB is a shipping term meaning "Free On Board", and in the coal market it indicates the price quoted for coal loaded on the vessel at the port of origin.

[9] Qinhuangdao Port, China Coal Transportation and Distribution Association.

[10] These ports include: Qinhuangdao, Tangshan, Huanghua, Tianjin, Rizhao, Lianyungang, and Qingdao.

[11] China has historically imported coal from Vietnam, but due to increased Vietnamese domestic consumption and price increases imports from Vietnam are expected to decline.

[12] Russian imports are not necessarily delivered into Southern China as the port of Vostochny is north of the Chinese border.  But even though Russian ports are north rather than south, the general arbitrage principal applies and thus we have included Russia in our model even if Russian material is not always imported to Guangzhou.  Russian exports to China are still comparatively small, but increased from 0.76Mt in 2008 to 11.8 Mt in 2009.

[13] There are multiple price indices used in the coal market.  We have used here indices provided by McCloskey and Reuters.
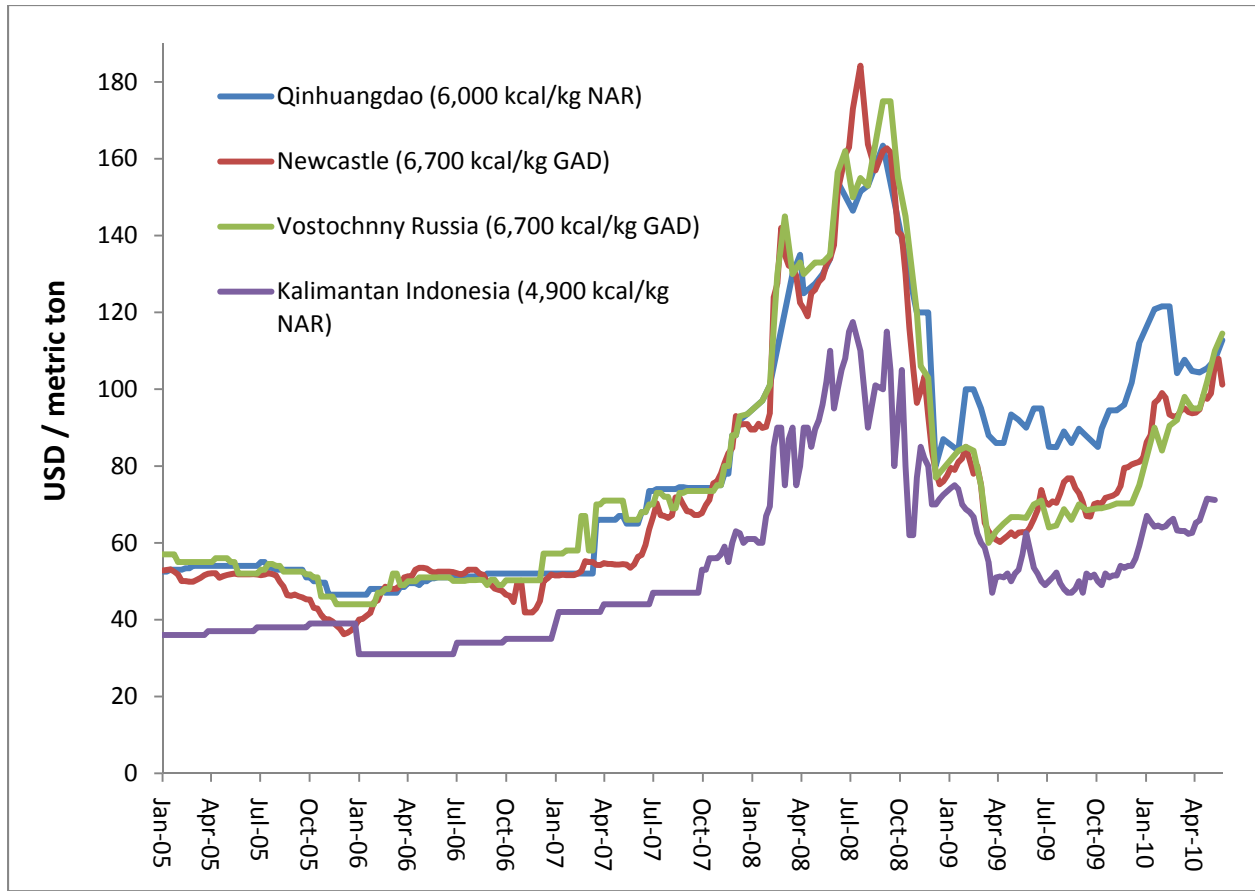
Figure 4 – Major coal price indices in Asia. Source: McCloskey, Reuters.

Table 1 – 2009 China Coal Imports by Source

| Total | Australia | Indonesia | Vietnam | Russia | Mongolia |
|---|---|---|---|---|---|
| 126.491 Mt | 44.602 Mt | 30.461 Mt | 23.932 Mt | 11.787 Mt | 6.002 Mt |

| Canada | North Korea | USA | South Africa | New Zealand | Other |
|---|---|---|---|---|---|
| 4.093 Mt | 3.599 Mt | .805 Mt | .732 Mt | .303 Mt | .145 Mt |

Source: McCloskey. Units: Million metric tons.

## 3.2    Import Demand Centers

The port of Guangzhou in Guangdong province functions as the demand center of our arbitrage model.  Guangdong is a heavily industrialized zone that has historically been the largest coal importing province.   Coal imports by province for 2009 are shown in Table 2.  Guangzhou port's coal handling capacity reached 56.5Mt/year in 2008.  Nearby import centers witness similar price relationships between domestic and international markets and exhibit import patterns.   Arbitrage relationships for Guangzhou can therefore be used as a proxy for arbitrage relationships for all of Southeastern China.[14]  Other major coal ports of Southeastern China include Shanghai, Ningbo, Fuzhou, Xiamen, Quanzhou, Shantou, and Beihai ports.

Table 2 – China coal import by provinces, 2009

| Province | Guangxi | Guangdong | Fujian | Zhejiang | Shanghai | All other | Total |
|----------|---------|-----------|--------|----------|----------|-----------|-------|
| Import   | 14.14   | 33.72     | 12.00  | 10.26    | 3.13     | 52.75     | 126   |

Source: Calculated from China Customs Statistics. Units: Mt.

## 3.3    Freight Prices

The delivered cost of coal in Guangzhou (CIF) is calculated by adding freight costs between loading and discharge ports to the FOB coal cost.[15]  Dry bulk freight rates from Indonesia, Russia, or Australia into China largely track international dry bulk freight markets which are volatile, internationally traded commodity markets (see historical freight rates in Figure 5).[16]  The model uses specific freight prices quoted from each FOB loading port and delivered into Guangzhou port provided by AXS Marine.

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[14] The basis difference between Guangzhou and other cities in Southeast China will be roughly the freight costs differential between those two locations.  Thus while Guangzhou is the center of coal imports in China and is indicative of market conditions for imports in general, some minor basis differentials will exist for other locations.
[15] There are a few other adjustments which we describe later.
[16] The Baltic Dry Index, which is widely used to indicate the cost of chartering dry bulk freight vessels, reached highs of 11,459 in 2008 before crashing to lows near 670 in late that year. The Index is comprised of charter rates for four types of ships: capsize, panamax, supramax, and handysize.  For further details see the Baltic Exchange: http://www.balticexchange.com/default.asp?action=article&ID=1
A price history is available from Bloomberg:
http://www.bloomberg.com/apps/quote?ticker=BDIY&exch=IND&x=15&y=11

Freight prices for the Chinese maritime coastal shipping market are not fully connected to international freight prices, however. Smaller boats are typically dedicated to the domestic market, though larger boats can switch into the international shipping markets when prices are attractive.[17] The Shanghai Shipping Index measures the cost of sending coal from Qinhuangdao to Guangzhou (see Figure 3).[18] Model freight price assumptions assume capesize vessels for all international shipping routes, and 40-50,000 dead weight ton (DWT) vessels for Chinese coastal shipping prices. Representative port handling charges for loading and discharge are added for all ports.[19]
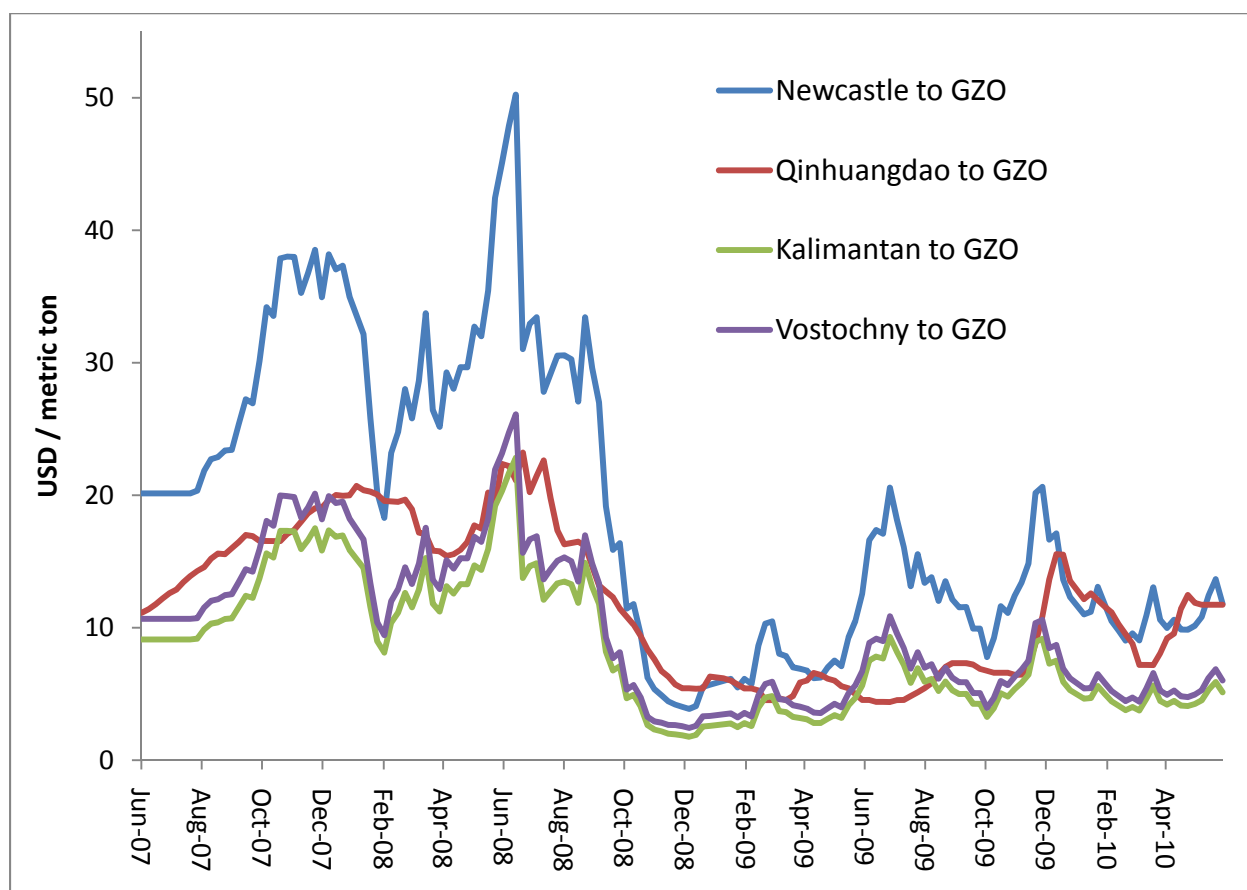


Figure 5 – Dry bulk freight rates from FOB ports to Guangzhou (GZO) port in ChinaCoalArb. Source: AXS Marine, Reuters, authors' analysis. Rates are based on historical quotes for specific shipping routes. All international quotes are based on capesize vessels, China domestic quotes are based on 40-50,000 dwt vessels.

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### 3.4 Adjustments: Energy Content, Taxes, Exchange Rates, Transaction Costs

We make the following adjustments in order to more accurately reflect real market conditions:

First, coal buyers are buying energy. We therefore adjust all FOB prices to an energy equivalent USD/metric ton basis of 6,700 kcal/kg gross air dried (GAD).[20] The original energy content of FOB indices are shown in Figure 4 (above). Energy equivalent prices are shown in Figure 6 (below).

Second, relevant taxes are added to all coal prices. Chinese VAT of 17% is added to the CIF price of all coals. We do not adjust for China's import tax because it has been phased out by 2007, before China's import surge.[21]

Third, all coal and freight prices are adjusted for historical exchange rates between RMB and USD.

Fourth, Chinese buyers face increased transaction costs when purchasing coal from the international market as compared to the domestic market.[22] Transaction costs for Chinese buyers associated with import vs. domestic coal include raising letters of credit (LCs), dealing with foreign sellers and more onerous contracts. Though it is impossible to know precisely the increased transaction costs for individual buyers, we add a $3/ton advantage to Qinhuangdao coal over all international coals.[23]

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[20] We assume a linear relationship between price and energy content, though in some cases pricing may not exactly follow this method, especially pricing for price lower CV coal. For instance, historically, lower CV Indonesian coals have traded at a deeper discount to higher CV material. For more information see PESD Stanford's forthcoming study of the Indonesian coal market by Bart Lucarelli at http://pesd.stanford.edu/publications/the_history_and_future_of_indonesias_coal_industry_impact_of_politics_and_regulatory_framework_on_industry_structure_and_performance/

[21] China's coal import tax for all coals with the exception of coking coal was 6% prior to April 1, 2005, 3% till Nov. 1, 2006, and 1% until May 31, 2007. The import tax was abolished after June 1, 2007. Coking coal import taxes were 3% until January 1, 2005, at which point they were abolished.

[22] Stuart Murray of London Commodity Brokers shared his insights with us on what transaction costs Chinese buyers of international coal face.

[23] Results are not highly sensitive to this assumption because shifts in arbitrage relationships that we describe here are much larger than $3/ton. The overall impact is to make domestic coal slightly more favorable in all circumstances. For instance, the highest import disadvantage prior to 2009, which was for Newcastle against Qinhuangdao, would only drop from highs of $70/ton to $67. Conversely the highest import advantage after 2008, which was for both Indonesian and Russian material, would only increase from highs of about $43/ton to about $46/ton. Though domestic coals at the margin that are less than $3/ton more profitable than import coal may become unprofitable against imports if this assumption is eliminated.
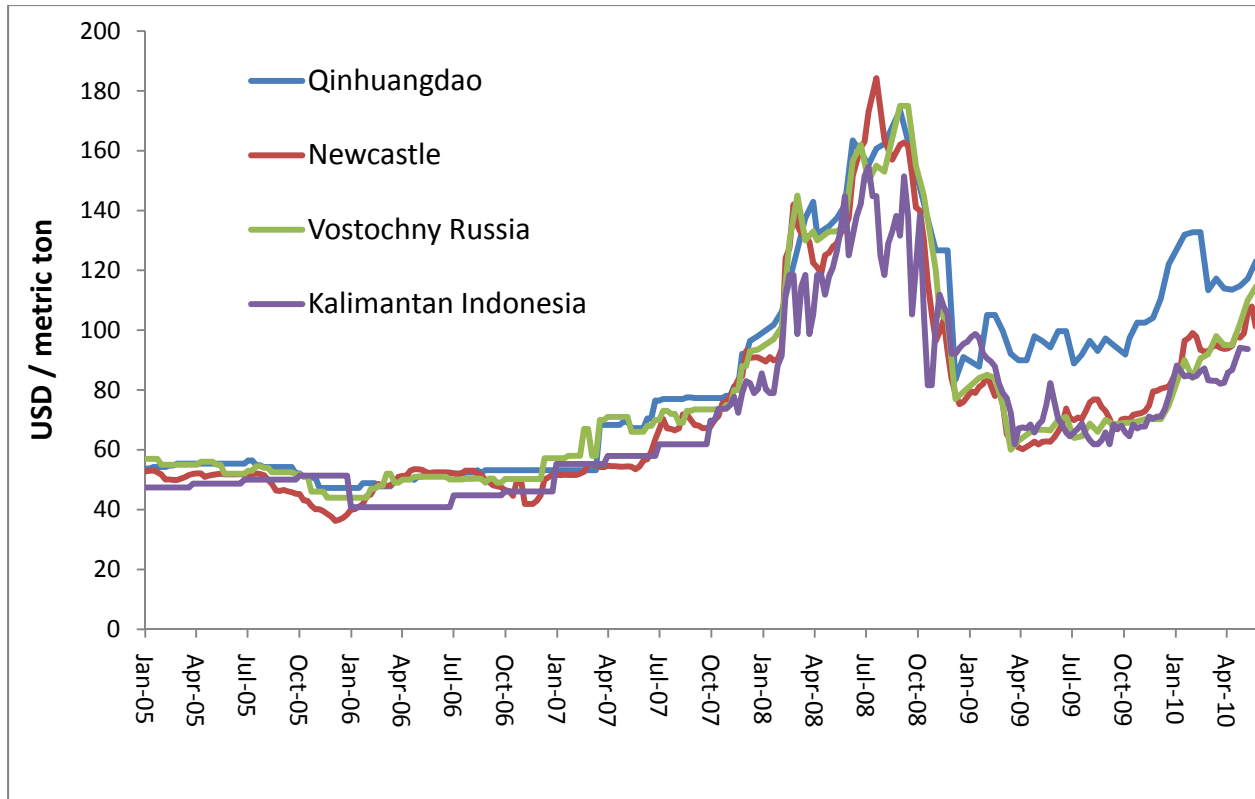
Figure 6 – Energy equivalent coal price indices (6,700 kc/kg GAD). Source: McCloskey, Reuters, authors' analysis.


## 3.5    Implications of Key ChinaCoalArb Assumptions

Several necessary assumptions in ChinaCoalArb may impact the performance of the model and should be noted when comparing model results to real market outcomes.

First, the model does not explicitly separate thermal from coking coal.[24]  Though some coals can switch between these markets making the distinction blurry at times, buying behavior in these markets will differ under certain conditions.  Most worth noting is that some demand for high-quality material is likely less responsive to price movements than demand for thermal coal because high-quality coking coal supplies are much tighter in China and internationally.  We suspect this accounts for a large share of Australian imports into China pre-2009 when CIF prices for most Australian coals compared to Qinhuangdao coals were significantly higher.

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[24] In 2009 total coking coal imports were 34.5 Mt out of 126 Mt total imports.

Second, by using the Qinhuangdao spot price to represent the Chinese domestic price, the model does not take into account discrepancies between spot prices and "term prices" for power generators in the Chinese market. Although in theory the two should be tightly correlated since the deregulation of all coal prices in 2006 (spot was deregulated in 2002 but the NDRC still directly capped term prices for power generators until 2006), this is not always the case in practice. As evidenced by the June 2010 NDRC price cap on term prices,[25] China can in reality have a "two-tiered" coal market under certain conditions. Thus if demand for import coal in the power sector could replace either spot domestic coal or term domestic coal, it may be useful to consider any price discrepancies between these two domestic markets as they will affect arbitrage relationships. Though we argue that the current model capably represents Chinese buying behavior in the aggregate, under certain circumstances modeling of power generators buying behavior may be improved by using the NDRC capped term price as the domestic price instead of spot.[26]

Third, China announced that it would relax foreign exchange controls in June 2010, which has led to minor RMB appreciation. Possible RMB appreciation going forward could increase China's buying power for foreign coal and thus make imports more attractive.[27]

Fourth, while the indicative energy-equivalent coal ton that we have created reflects differences in energy content, the relationship of coal price to energy content may not always be linear (as we have already discussed). Thus lower CV coals that are priced at a deeper discount coals may present a greater arbitrage opportunity than our model indicates.

Fifth, while energy content is arguably the most significant variable impacting coal pricing, the model does not reflect several key variables that can also impact price. Ash, moisture, volatiles, sulfur, and other coal properties will also influence price. It is therefore important to note our energy-equivalent coal ton should be broadly indicative of buying behavior but cannot capture all variables that impact coal purchasing and pricing.

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[25] See NDRC: http://jgs.ndrc.gov.cn/gzdt/t20100625_356688.htm
[26] This is complicated because even coal buyers that can acquire coal at below-market, government-capped prices may still have to buy a fair amount of their supplies from the spot market. We estimate that 40-50% of coal supply for key SOEs is under term contract (and thus impacted by the recent cap) and the remainder is purchased on the spot market.
[27] Albert Saputro and Adam Worthington of Macquarie Securities helpfully highlighted the importance of this issue to us, which they have analyzed in their own research.

Sixth, while we argue that Guangzhou is the best proxy to represent China's national import behavior, other importing locations will witness slightly different arbitrage relationships that might impact purchasing decisions. For instance, Shanghai is slightly farther from Indonesia and Australia than Guangzhou while slightly closer to Qinhuangdao and Russia. This will increase freight costs from the former two and favor coal shipped from the latter two.

## 3.6 Relevant External Factors Not Captured by ChinaCoalArb

Several macro-level factors that could impact coal imports should be noted.

First, there are technical limitations to imports that prevent a full switch to imports even if it was clearly the most profitable option. Power plant boilers are designed to burn specific specifications of coal, which is almost always domestic coal for energy security considerations. However, power generators can blend imports and domestic coal supplies. For each boiler there will be a technical limitation on the amount of blending that can occur.[28] Other industrial applications, like cement or steel making, are likely also designed to burn domestic specifications of coal and may not be able to fully switch to imports.

Second, import port capacity is also a theoretical limit on possible Chinese coal imports (one that has not yet been tested).

## 3.7 Model Results

Figure 7 displays the results of the arbitrage model. We compare arbitrage relationships to total monthly imports in order to demonstrate the relationship. The left axis indicates the price advantage on a $/ton basis of import coals landed in Guangzhou compared to domestic coals landed in Guangzhou. Negative values indicate a profit advantage for domestic coals and positive values indicate a profit advantage for imports. The right axis indicates million tons of

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[28] From interviews with coal and power experts at Yudean Group in Guangdong. This is a complex engineering issue which we will not address in detail here as there are multiple variables that impact blending ratios at coal plants, though we do want to note that some blending limitations may exist.

national coal imports by month.  Figure 8 displays the only arbitrage relationships in greater detail (weekly basis).
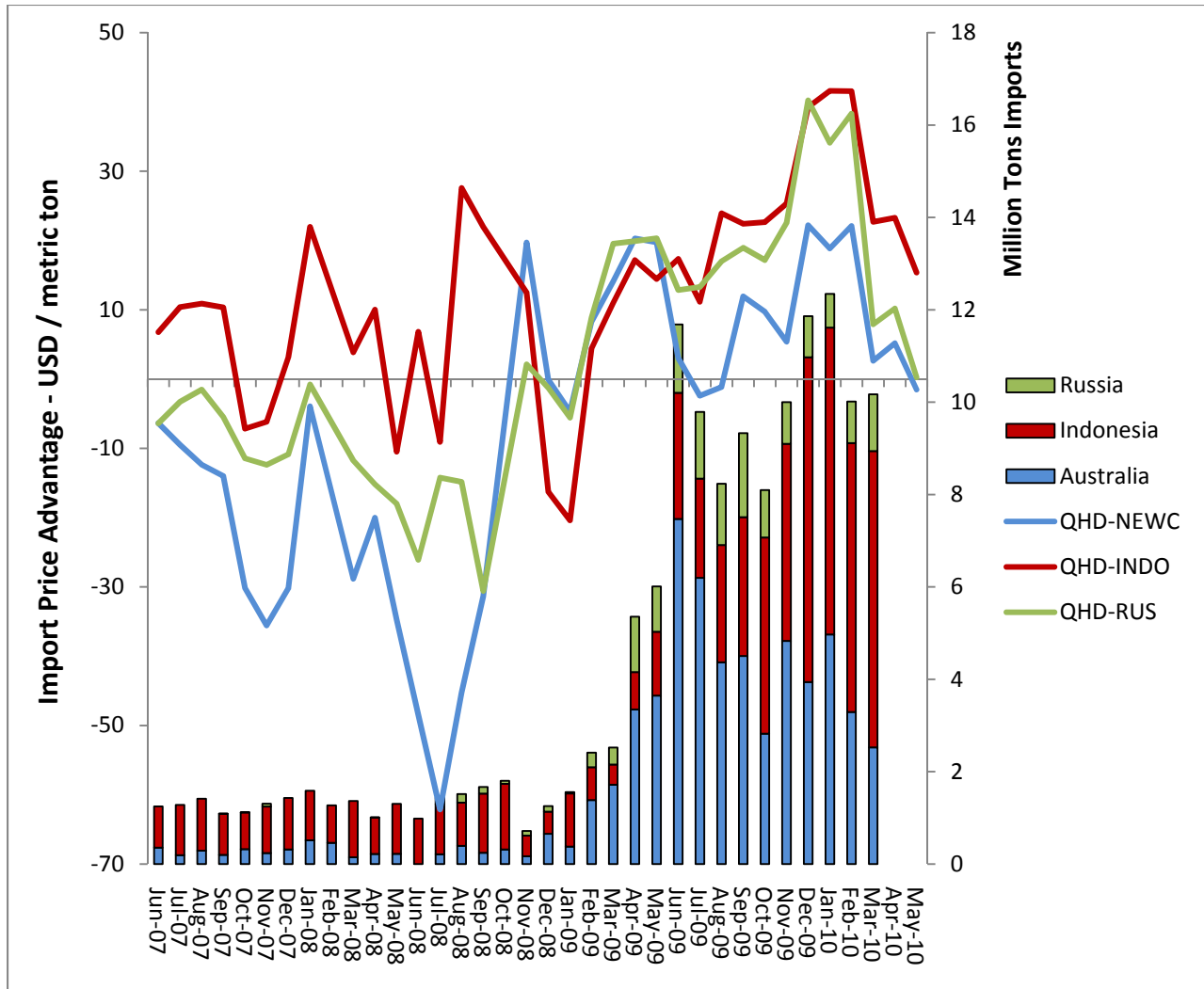


Figure 7 – Arbitrage relationships drive Chinese coal import patterns.  Note:  All arbitrage values are the CIF Guangzhou from Qinhuangdao minus CIF value of imported coals.  Source:  McCloskey, Reuters, AXS Marine, Shanghai Shipping Index, authors' analysis.
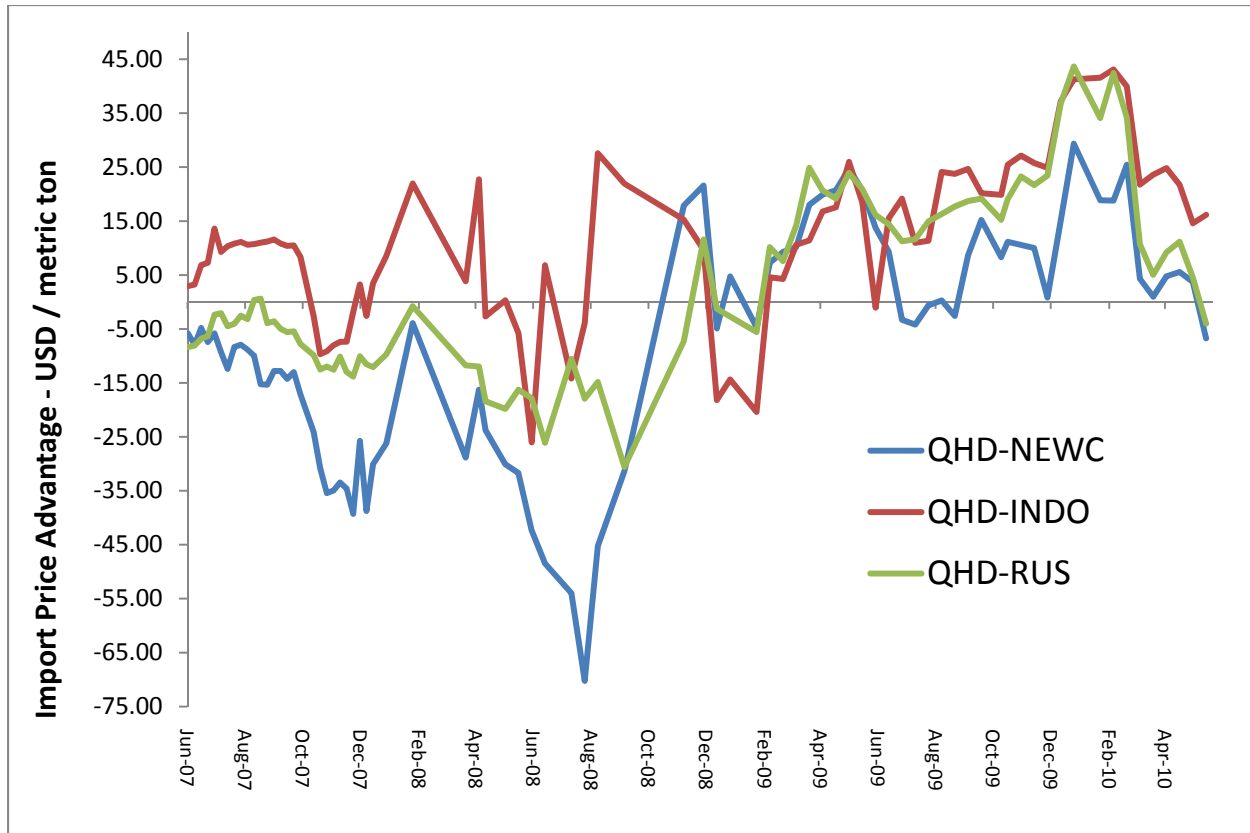
Figure 8 – Weekly arbitrage values from 2007 show the dramatic shift in the relationship of domestic to international coals. Note: All arbitrage values are the CIF Guangzhou from Qinhuangdao (QHD) minus CIF value of imported coals. Source: McCloskey, Reuters, AXS Marine, Shanghai Shipping Index, authors' analysis.

The results explain the dramatic shift from China importing 40.4 Mt in 2008 to importing 126 Mt in 2009. Prior to the fourth quarter of 2008, international coal prices were disadvantaged compared to domestic coal prices. In summer 2008 Australian and Russian imports were out of the money against Qinhuangdao by as much as $65/t and $30/t respectively. While minor amounts of Australian material was still imported – likely specific qualities of coking coal not readily available in the Chinese domestic market – China's imports were negligible because importing wasn't profitable. The partial exception to this description is Indonesian coal, which came in and out of the money against Qinhuangdao in Southern China. This can be attributed to two primary factors, both of which give Indonesia competitive advantage exporting into China. First, Indonesia's geographic proximity to Chinese markets means that it pays a smaller freight penalty than Australia and Russia (assuming Russian material is delivered into South China,

which in reality it may not always be).  Second, Indonesian FOB prices were historically slightly lower than Australian and Russian on an energy adjusted basis.  Thus as freight and domestic and international coal prices fluctuated, import windows opened for Indonesian coal in Southern China.

At the end of 2008 this historical relationship of domestic to international coal changed dramatically.  In the wake of global recession, the historical relationship of domestic to international coals in Southern China inverted and a massive arbitrage opportunity arose.  By late 2009, Indonesian coal was as much as $40/ton more profitable than domestic coal, Australian coal was as much as $29/ton more profitable, and even Russian coal – which suffers from a huge rail transport penalty to move coal from central Russia to eastern ports – was pricing into Southern China against domestic coal at $40/ton better than Qinhuangdao.  Imports skyrocketed, cresting in winter 2009-2010.  International prices have since recovered and the arbitrage window began to close by summer 2010.

This model therefore provides credible explanation of China's coal import behavior and explains China's record imports in 2009.  We conclude China's coal buying behavior follows the logic of a "cost minimizer" and China's coal imports will fluctuate according to the arbitrage differentials between domestic and international coal prices.


## 3.8     Drivers of Arbitrage Inversion in 2009

Analyzing causes of the dramatic inversion of the historical relationship between China's domestic coal market and the international coal market provides a more detailed understanding of the market conditions that caused this shift, and thus enables coal market observers to examine how likely these conditions are to carry forward. We argue that in the wake of the global financial crisis of 2008 seven principal drivers caused the inversion of historical price relationships of international to Chinese coal prices.

First, the macroeconomic impact of the global financial crisis was comparatively smaller on China than many other coal consuming nations.  China's GDP growth rate was 9.6% in 2008 and

9.1% in 2009, declining by only 0.5%.[29] By contrast, real global GDP growth was estimated to be a negative 2.1% in 2009.[30] This meant that Chinese macroeconomic activity sustained a comparatively high level of energy demand relative to other coal importing economies. And in China energy means coal.

Second, after the global financial crisis Chinese domestic freight prices remained higher than international freight prices, giving imports an advantage over domestic coal. Figure 9 shows Chinese domestic freight compared to international freight rates as a percentage of their pre-financial crisis levels.[31] This meant that the freight component of the delivered price of imports decreased relative to its domestic counterpart.

Third, international FOB prices declined more than Chinese domestic FOB prices when measured as a percentage of their pre-financial crisis levels. Figure 10 illustrates this trend. This shift, combined with the relative freight advantage, in put imports at a significant advantage to domestic coal.

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[29] Both are numbers after adjustment announced by China National Bureau of Statistics.
http://www.stats.gov.cn/tjdt/zygg/sjxdtzgg/t20100702_402654527.htm
[30] World Bank global outlook:
http://web.worldbank.org/external/default/main?theSitePK=659149&pagePK=2470434&contentMDK=20370107&menuPK=659160&piPK=2470429
[31] We chose September 2008 as the pre-financial crisis point, as equities markets began their precipitous drop in that month and Lehman Bros filed for bankruptcy. For a history of the performance of the S&P 500 see Bloomberg:
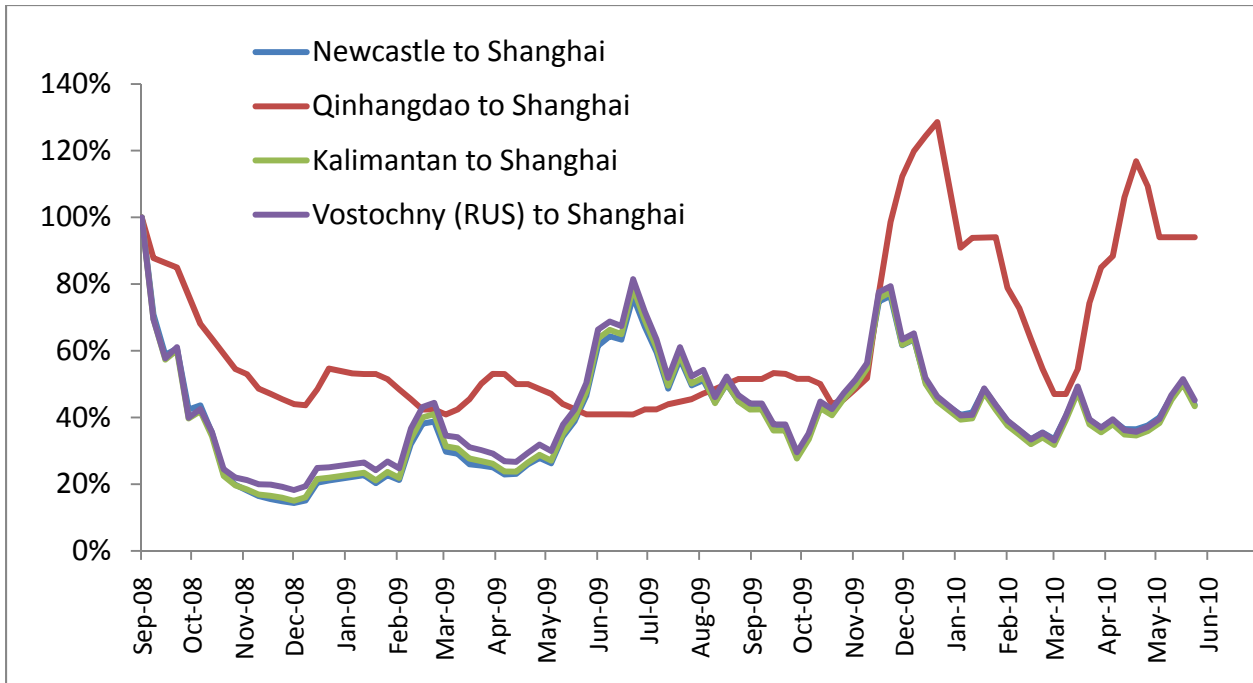http://www.bloomberg.com/apps/quote?ticker=SPX:IND

Figure 9 – Cost of freight indexed to pre-financial crisis levels in September 2008. Source: Shanghai Shipping Index, AXS Marine.
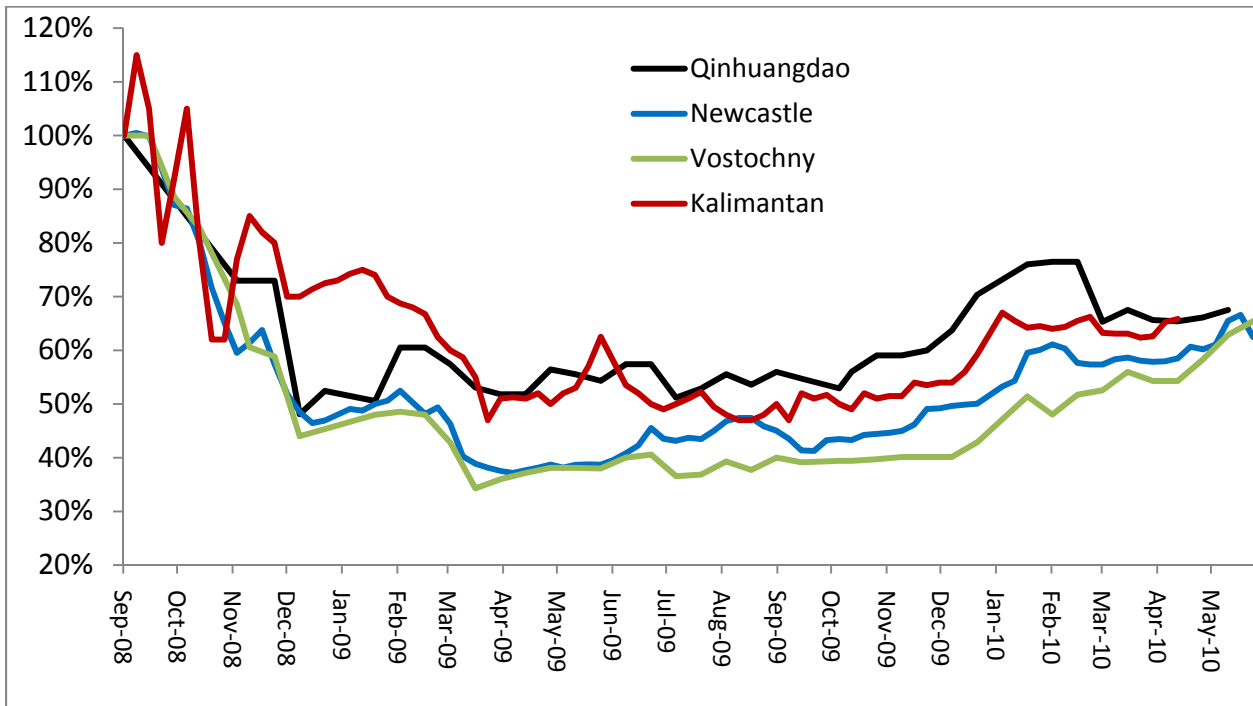


Figure 10 – FOB coal prices indexed to pre-financial crisis levels in September 2008. Source: McCloskey, Reuters.

Fourth, the relative strength of China's domestic coal prices was largely due to a series of regulatory events in key production regions that curtailed supply and supported prices. Consistent with national coal mining policies, Shanxi province embarked on a major campaign of mine consolidation. The government began a program of closing small mines or consolidating them into larger mines and implementing more rigorous safety standards. The targets of that program are shown in Table 3. The result was a shut-in of traditional supply that supported prices. There is evidence in summer 2010 that the program was not completely successful and that government officials may re-implement similar measures.[32]

Table 3 – Mining consolidation targets in Shanxi.

|  | **2008 Target** | **2009 Target** | **2010 Target** |
|---|---|---|---|
| Mine number | 2600 | 1053 | 1000 |
| Average mine size | 300,000 ton/yr | 900,000 ton/yr | 900,000 ton/yr |
| Number of firms | 2200 | 130<br>4 at 100 million scale<br>3 at 50 million scale | 100 |

Source: Government of Shanxi.

Fifth, the traditional negotiations for term coal contracts between coal producers and power generators, which in 2008 allocated 1.1 Bt of coal (40% of China's total coal consumption that year), broke down in 2009 when an agreement on price could not be reached. This led some coal buyers that would otherwise have purchased domestic coal to look overseas.

Sixth, Chinese national policy on resource use facilitated increased imports. The so called "Two Markets, Two Resources"[33] policy encourages coal buyers to import coal when the economics justify it.

Finally, temporary factors in China like weather interruptions of transport and weak hydro generation due to droughts contributed to higher domestic coal prices.

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[32] Research by Macquarie Securities in June 2010.
[33] Two Markets, Two Resources is a Chinese term reflecting a strategy to encourage Chinese company and Chinese industry "Walking Out" of the country to explore both domestic markets and international markets.

There are a number of long term factors that will determine price relationship of Chinese coal to international coal. Several forthcoming studies from Stanford address a set of key issues and reforms that will impact China's domestic market such as the coal power conflict and resulting policy and market reforms, the possible vertical integration of China's coal and power industries, the consolidation of coal producing into larger mines, the adoption of more efficient power generation technologies, and the construction of major coal-power bases that will produce over 100 Mt/year each.[34]

## 4    Conclusions and Implications for the Global Market

Once a largely isolated coal market, China now plays a central role in determining global trade flows and prices. Understanding Chinese import behavior under current and future market conditions is therefore imperative for any analysis of the global coal trade. We have put forward a theory of Chinese import behavior based on arbitrage relationships between China and the global market and proved that theory in the ChinaCoalArb model.

Our findings indicate that China is a "cost minimizer" in the international market that will import heavily when the price is right – as it was in 2009 due to a confluence of circumstances we have described here – and largely rely on domestic coal when imports are unattractive.

The nature of Chinese demand for international coal is therefore fundamentally different from India, the other source of dramatic demand growth in international coal markets. India is structurally short coal because demand growth (mainly for power) has outstripped domestic coal supplies. China, on the other hand, is now the world's largest coal arbitrage trader. This means that the relationship between China's domestic coal price and the international coal price will be one of the key factors in determining global trade flows in the coming decade as China could just as easily buy 15-20% of internationally traded coal as it could buy very little.

China's role as world's largest coal arbitrageur has a hugely significant implication for the global coal market: it links the international price of coal to China's domestic price. China's buying and selling activity on the margins of its massive domestic coal market bring domestic and global prices closer to parity (though at present not to complete parity). In other words, what

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[34] Forthcoming studies from PESD Stanford by Huaichuan Rui, Kevin Tu, and Yu Yuefeng address these issues. See http://pesd.stanford.edu.

happens in the mines of Shanxi will impact the price of power in Munich. The unique politics and economics of the Chinese coal market are now therefore by necessity the politics and economics of the global market, and whether or not China imports coal in a given year, "the China factor" will increasingly define how the world sells, buys, and uses coal.