Essays on Exchange Rate Pass-Through

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Abstract

ESSAYS ON EXCHANGE RATE PASS-THROUGH

by

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Advisor: Professor Sangeeta Pratap

This dissertation examines the degree to which the prices of imports to the United States respond to changes in bilateral exchange rates. The first chapter provides a review of the literature on exchange rate pass-through and outlines how research on the topic has changed over the past forty years. The next two chapters focus individually on specific questions that are important to the pass-through literature. These topics include the impact of imperfect competition and varying market shares on pass-through rates, as well as the decline in pass-through to import prices and the possible effects of China’s increased role in trade with the United States. In each case, I use highly disaggregated data on US imports to calculate pass-through rates and examine competition at the most detailed possible level.

The first chapter of this dissertation explores the theoretical and empirical literature on exchange rate pass-through. Empirical evidence shows that import prices tend to change by a smaller percentage than the exchange rate between trade partners, and this chapter provides explanations for why this response is incomplete and shrinking over time. I start by considering theoretical models based on the law of one price, then focus on the role of variable markups. Examination of the empirical literature discusses the effects of competition, monetary policy, and the shifting nature of trade, both in terms of trade partners and the basket of imported goods.

The second chapter examines the effects of changing market shares on pass-through to US import prices. Based on a static model of imperfect competition, I predict that a country with a larger share of a host’s import market will have lower pass-through than its competitors. Using highly
disaggregated data on US imports, I implement rolling regressions to calculate unique quarterly values of pass-through for specific goods from each exporting country. These values are compared across market shares, indicating a general trend of decreasing pass-through for larger shares. The negative relationship between pass-through and market share holds across most categories of imports. Lastly, I show the market share effect is stronger following larger fluctuations in the exchange rate, particularly after large dollar appreciations. These findings indicate that the muted response of import prices to exchange rate movements is primarily driven by the largest exporters of individual goods.

The third and final chapter of this dissertation focuses on the corresponding trends of increased imports from China and decreasing exchange rate pass-through beginning in the early 1990s. Based on highly disaggregated data, I document China’s rise as a trade partner as measured by total trade volume, total goods traded, imports of new goods, and the number of commodities for which China is the United States’ top trade partner. With the same data, I also show the nearly simultaneous decline in pass-through rates. Lastly, I tie these effects together by showing that pass-through rates from other countries decrease more substantially for goods that have larger increases in China’s market share. As the observed relationship is stronger when the dollar depreciates, these findings suggest the possibility that China’s fixed exchange rate regime forces competitors to maintain low prices following dollar devaluations.
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Chapter 1

Exchange Rate Pass-Through: A Literature Review

1.1 Introduction

The exact nature of the relationship between exchange rates and prices is an important question that economists face on both macroeconomic and microeconomic levels. At its simplest, exchange rate pass-through measures the percent response in prices to movements in the exchange rate. Complete pass-through refers to a one to one relationship, while pass-through is incomplete if prices change by a smaller amount than the exchange rate. However, there are multiple types of pass-through calculations as there are many definitions and measurements of prices. Import and export prices are most directly related to exchange rates, so pass-through calculations typically measure the responsiveness of these values. As such, the term pass-through typically refers to pass-through to import prices. Yet as import prices are a component of an economy’s overall price level, pass-through to producer and consumer price indices can also be calculated\(^1\).

Similarly, the degree to which exchange rate movements pass into prices impacts trade volume as it links to expenditure switching between imports and domestic goods, as well as between imports from different trade partners. As such, import prices affect not only the prices of individual imported goods, but domestic inflation as a whole. So the concept of exchange rate pass-through and what causes it to be incomplete are essential components to the workings of a macroeconomy.

\(^1\)The impact of import prices on overall price indices is sometimes called second stage pass-through.
This chapter provides a review of the literature on exchange rate pass-through. Starting with the law of one price and the work of Dornbusch (1987), I show theoretical explanations for low pass-through (Section 1.2), emphasizing the role of competition. Section 1.3 examines the early comparisons of exchange rate movements and price dynamics. Most of the literature on pass-through is empirical in nature, and recently much of the focus has been on explaining the widespread decline in pass-through rates to import prices in the 1990s and 2000s (and still ongoing). Section 1.4 explores the primary theories for this decline. In doing so, I also document empirical studies that show decreasing pass-through rates and provide possible explanations for such changes. Additionally, I show how the following chapters of this dissertation fit into the growing literature on exchange rate pass-through.

### 1.2 Theoretical Basis

In a perfectly competitive setting, basic theory would predict complete pass-through to import prices. Following the law of one price, arbitrage implies equal international prices. So the price of a good in a host country is the same as it would be in exporter $C$, as measured in the host’s currency:

$$P_{host} = ER_{C}P_{C},$$  \hspace{1cm} (1.1)

where $P_{host}$ and $P_C$ are the prices of the good in the host country and the exporter, respectively, and $ER_C$ is the bilateral exchange rate between the two countries measured as the host’s currency per units of $C$’s currency. Dornbusch (1987) uses the law of one price, noting that foreign exporters do not mark up from marginal costs in perfect competition. Therefore, prices are equal assuming equal costs of production in the two countries and the perfectly competitive price of an imported good from $C$ is simply:

$$P^M = ER_{C}MC_{C},$$  \hspace{1cm} (1.2)
where $P^M$ is the import price in the host country and $MC_C$ is the marginal cost of production in $C$. However, removing the assumption of perfect competition allows for incomplete pass-through. Dornbusch (1987) considers the introduction of markups, changing the import price equation to

$$P^M = MU_C ER_C MC_C,$$

(1.3)

where $MU_C$ is the markup by an exporting firm in country $C$. Specifically, if this markup is constant$^2$, Dornbusch (1987) shows that such a framework predicts complete pass-through as the costs to the foreign firm (as measured in the host’s currency), change by the amount of the exchange rate movement. With constant markups, Equation 1.3 implies that the import price will adjust by this same percent amount.

Incomplete pass-through becomes possible when competition is imperfect and competitors interact strategically. Following the price expression in Equation 1.3, strategic interaction allows for variable markups. Exchange rate movements are either passed into prices, or absorbed into markups. In the simplest example, consider a foreign monopolist operating with a fixed marginal cost structure. As the monopolist’s marginal revenue curve is steeper than its demand function, any exogenous change to the exchange rate results in a smaller percentage change to the price of the good, thus producing incomplete pass-through.

In typical models of imperfect competition, the markup is a function of the price of the good, which in turn depends on the price of competing goods. Atkeson and Burstein (2008) develop one such model with markups, prices, and market shares tying together$^3$. Atkeson and Burstein consider firms engaging in Cournot competition, with each firm maximizing profit by choosing the optimal amount of a good to sell in each country. Goods are grouped into sectors, and the choices of each firm affect the overall sectoral quantity and price. Demand for a good depends on elasticities of substitution within sectors and across sectors. Under these conditions, Atkeson and Burstein show that the optimal markup is a function of a firm’s market share of a sector. Therefore,

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$^2$Such as the model of Dixit and Stiglitz (1977).

$^3$The basic theory of Chapters 2 and 3 of this dissertation incorporates a modification of Atkeson and Burstein’s model.
for firm $j$, in country $C$, the import price to the host country is:

$$P^M_j = MU_j(s_j)ER_CMC_j,$$

(1.4)

where $s_j$ is $j$’s share of the market of the good. Assuming a standard calculation of a firm’s market share for a good (the ratio of total value of the good sold by the firm to overall value of the good that is sold), Equation 1.4 implies that pass-through varies with market share. Specifically, a change in the exchange rate affects the firm’s selling price, but this change causes market shares and markups to adjust. As a result, pass-through is less than complete, and differs for firms with different shares of the market for a good.

Even in the case of monopolistic competition, with exporting firms having negligibly small shares of the host’s import market and constant positive markups, it is possible to generate incomplete pass-through depending on the nature of production. Decreasing returns to scale production, for instance, implies that an appreciation of the host country’s currency and the corresponding rise in demand increase marginal costs for the exporter. When markups are constant (or non-existent), this tradeoff implies that import prices will not fall to the full degree of the change in the exchange rate. In particular, decreasing returns to scale production is important when considering goods that require imports in production, as this is a clear example of marginal costs increasing with production. The role of production functions provides one explanation for low pass-through, as well as for differences in pass-through by industry.

While competition effects are the primary basis for incomplete pass-through, other factors contribute to pricing decisions. The currency in which goods are priced plays into the degree of

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4Section 2.2 shows this in detail.

5To see this tradeoff, consider the import prices in percent changes: $\%\Delta P^M = \%\Delta MU_C + \%\Delta ER_C + \%\Delta MC_C$. A rise (fall) in marginal costs for the exporter at least partially offsets the decrease (increase) in the exchange rate. Olivei (2002) provides an examination of the role of returns to scale in production and markups in pass-through. Olivei includes discussion of the possibility that the production effect could more than offset the exchange rate movement, creating negative pass-through or pass-through that is more than complete.

6Krugman (1987) and Marston (1990) are two early examples of works that show different pass-through rates by industry, with traded machinery and vehicles having particularly low rates. Marazzi and Sheets (2007) advance the idea of differences between industries and goods by examining the role of changing import baskets.
pass-through for imported goods. This is seen in studies of pricing to market, and shown most explicitly by Gopinath et al. (2010). Gopinath et al. focus on imports to the United States and observe pass-through rates that are nearly four times greater for goods priced in the exporter’s currency than for those priced in dollars. This finding calls into question the exogeneity of firm level decisions of currency choice, as well as potential relationships between pass-through and the frequency of price adjustment. In a similar work, Engel (2006) shows that exporters who fix prices for a period (due to contracts or menu-costs, for example) is more likely to price in its own currency when the exchange rate is more volatile.

The issue of price adjustment frequency and currency choice being related to exchange rate stability addresses another potential theoretical explanation for low pass-through: volatility of exchange rates and overall prices. As exporters attempt to maximize long run profits, they take into account the variance of exchange rates and overall prices. Consider again the standard expression of import prices as a markup to the exchange rate and marginal costs (Equation 1.3). Assuming there is some fixed cost of price adjustment, then exporters might be hesitant to increase prices following a rise in the exchange rate unless they view the movement as credible or long-lasting. Instead, such a firm would adjust markups and hold the import price stable in the host country’s currency. Therefore, the relative permanence of an exchange rate movement plays a key role in determining pass-through rates. Froot and Klemperer (1989) is the first to consider the role of temporary versus permanent exchange rate movements with a dynamic model of exporting firms that adjust and maintain market shares. This work shows that permanent exchange rate movements impact potential future costs for the exporter (assuming some production involves imported goods) and create more incentive to adjust prices. The authors also introduce an “interest rate effect”, creating more incentive for foreign exporters to maintain stable prices when faced with a temporary appreciation of the host’s currency. Even if there is no cost of price adjustment, a temporary

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7 Knetter (1989), Marston (1990), and Gagnon and Knetter (1995) show to varying degrees that setting prices in the host country’s currency results in a slower reaction to exchange rate movements.
8 See also Corsetti and Pesenti (2005)
9 Bergin and Feenstra (2001), as well as Gopinath and Itskhoki (2010), show higher pass-through for goods and exporting firms that adjust prices more frequently.
appreciation of the host’s currency makes future profits less valuable than current profits, thereby causing the firm to maximize current profits by not lowering prices\textsuperscript{11}.

Just as the volatility of exchange rates can impact pass-through rates, so too can the inflationary environments of importing and exporting countries. Models of staggered pricing\textsuperscript{12}, can be used to predict that a non-persistent exchange rate movement will pass-through to prices at a lower rate. The importance of exchange rate persistence shows the significance of expectations. Specifically, economists are more likely to consider an exchange rate movement permanent if costs and prices as a whole are changing. If an importing country is experiencing high inflation, agents are more likely to view any depreciation of its currency as a permanent change than they would in a more stable inflationary environment.

1.3 Early Comparisons of Prices and Exchange Rates

The earliest reference to the term exchange rate pass-through is by Hooper and Woo (1984) who find a negative correlation between the United States’ exchange rate\textsuperscript{13} and consumer price index. Hooper and Woo note that a higher exchange rate not only makes imported goods cheaper, but this creates a multiplier effect as domestic producers must lower prices to compete.

While Hooper and Woo (1984) provide the first use of the term pass-through, the idea of measuring the impact of the exchange rate on prices has been around for much longer. Dornbusch and Krugman (1976) discuss European economies in the early 1970s, showing that countries with high inflation tend to experience relative depreciations in currency. Kwack (1977) shows with a study of twelve industrialized countries that changes to the exchange rate impact the typical tradeoff be-

\begin{footnotesize}
\textsuperscript{11}Froot and Klemperer (1989) also show that in a volatile exchange rate environment with less certainty, exporters are more likely to focus on building and maintaining market share due to the problems with maximizing profits through price adjustment. This ties back into the role imperfect competition plays in generating low pass-through.


\textsuperscript{13}Clearly, the term exchange rate should be used in reference to the currencies of two countries. However, in many cases in the literature, the exchange rate of a particular country refers to an average or weighted average of the exchange rates with a group of countries. In this case, Hooper and Woo, calculate the United States’ exchange rate as the trade weighted average of the exchange rates with ten industrialized countries. It should also be noted that a rise in their exchange rate represents an appreciation of the dollar relative to the other ten currencies.
\end{footnotesize}
between inflation and unemployment. This result tying exchange rate movements to the Phillips curve relationship is also suggested by Gordon (1981), and Dornbusch and Fischer (1986). Hooper and Lowrey (1979) combine many of these concepts by examining different econometric techniques for calculating the effects of exchange rate movements, considering models of exogenous and endogenous exchange rates. Generally, most of these early analyses of pass-through conclude that dollar appreciations correlate with reductions in inflation. However, the exact numerical relationship, as well as the way in which it changes over time and from one country to another had not been fully explored.

In general, the relationship between exchange rates and price levels can be examined through two channels: the effect of exchange rates on import prices, and the effect of import prices on overall prices. As the second relationship tends to be driven by the ratio of net exports to domestic production, most studies of pass-through focus on the responsiveness of import (and export) prices to exchange rate movements. Of particular note, Mann (1986) finds pass-through to import prices is significantly less than 100% for both short run and long run analyses. Mann’s fundamental setup involves comparing the change in price of an index of non-oil US imports with a multilateral exchange rate based on ten industrialized trade partners. With this comparison, she shows that a change in the exchange rate leads to a change in the import price of approximately 70% over a two year period. Mann provides several possible explanations for the low pass-through rates, among them changes in foreign production costs that would offset the impact of exchange rate movements. She also considers the possibility of measurement variability, as the ten countries used to create the multilateral exchange rate represent a substantial component of the dollar’s true value, but not the full measure. Therefore, actual exchange rate movements could be less volatile than those in Mann’s study.

While Mann (1986) is the first study to clearly spell out the low pass-through puzzle, other papers produce similar results indicating a lack of responsiveness in import prices to the exchange

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14Mann’s data, with quarterly observations from 1965 through 1982, allows for separate analyses of dollar appreciations vs. depreciations. Dollar appreciations tend to produce a smaller response in import prices, suggesting that foreign exporters increased profit margins rather than adjusting prices. Dollar depreciations lead to larger responses in prices, but in both cases, pass-through remains well below 100%. 

7
rate. Krugman (1987) presents evidence that certain exporters set prices differently to different trade partners, a phenomenon called “pricing to market”. This behavior varies by importer, exporter, and type of good, but indicates that country specific effects (such as demand and competition) force exporters to respond differently to exchange rate movements depending on goods and trade partners\(^\text{15}\). Specifically, Krugman shows that German exports of machinery to the United States maintain more stable prices (even rising) when facing an appreciating dollar, yet exchange rate movements were passed through to prices to a greater degree for the same category of goods exported to other countries. Marston (1990) also finds pricing to market behavior in Japanese exports, developing a model for the ratio of export prices to domestic prices. Marston's model (and empirical findings) shows that the exchange rate is one of many factors that impact this ratio, as overall price levels, income, and costs all determine demand, which in turn affects the prices. The findings of pricing to market and incomplete pass-through hold across a variety of industries.

Giovannini (1988) finds similar results with Japanese data. Both Marston (1990) and Giovannini (1988) attribute a component of low pass-through to prices being pre-set in foreign currencies, but such rigidities only exist in the short run\(^\text{16}\). Gagnon and Knetter (1995) also note the differences in short run versus long run responses to exchange rate movements with an error correction model for German auto trade. They generally find lower short run pass-through rates for importers where goods are more frequently priced in local currencies (such as the United States\(^\text{17}\)), again implying that pricing to market is one component of incomplete pass-through. In a later study, Betts and Devereaux (2000) develop a theoretical model showing that low pass-through due to increased pricing to market reduces the expenditure switching effects of exchange rate movements. In typical macroeconomic models, a depreciation of domestic currency causes an increase in exports, moderating the exchange rate movement. With larger degrees of pricing to market, the rise in exports is slower. As a result, exchange rate volatility tends to increase with pricing to market,

\(^{15}\)Krugman’s study focuses on bilateral exchange rates and bilateral trade, thus avoiding the exchange rate calculation issues in Mann (1986).

\(^{16}\)Both Giovannini (1988) and Marston (1990) estimate an average pass-through of 0.5 for developed countries.

\(^{17}\)One consistent finding in empirical studies of pass-through is that rates are lower for imports in the United States than other countries. The fact that many goods are priced in dollars is a primary explanation for this.
further reducing pass-through rates.

1.4 Empirical Studies of Low Pass-Through

While theoretical explanations for low pass-through exist, most of the literature on the topic is empirical in nature. Many works focus on estimating pass-through rates for a particular country or group of countries, as well as examining effects at an industry level. Calculations of pass-through are consistently less than one, with many of the reasons discussed in Section 1.2 suggested as possible explanations.

1.4.1 Competition and Market Structure

The most fundamental theoretical explanation for low pass-through rates is imperfect competition in the market. As such, many empirical studies focus on the different effects of competition. Froot and Klemperer (1989), supplement their theoretical model with evidence that exporters respond to exchange rate movements differently depending on their shares and potential competition in the market. Knetter (1993) compares the pricing-to-market behavior for exports from Japan, Germany, the UK and the US, focusing on the reduction of markups in markets where currency has depreciated in value. He finds that if an exporter faces more competition in the destination market for a good, there is a tendency to hold prices more stable if currency values fluctuate in that market. Focusing on a specific industry, Feenstra et al. (1996) provide data on the auto industry and imports for 48 country combinations to study the effects of market share on pass-through rates. They show a non-linear, increasing relationship between the variables with pass-through approaching one as market share approaches 100%, indicating that exporters respond differently based on market structure.

More recently, Auer and Schoenle (2012) look at the effects of market structure on exchange rate pass through and use US import data from a large number of exporting countries and more product sectors than are considered in most empirical studies in the pass-through literature. Similar
to Feenstra et al. (1996), they find pass-through rates that are highest at the extremes of the distribution of market shares. Gust et al. (2010) also attribute low pass-through to increased competition. Though they do not specifically explore the role of market shares, Gust et al. show that pass-through to United States import prices has actually declined as more countries enter the US import market. While this seems counterintuitive to the theory of higher pass-through with perfect competition, Gust et al. note that increased competition forces exporters to adjust to each competitors’ prices to a greater degree than to the exchange rate. Yang (1997), Campa and Minguez (2006), Garetto (2012), and Hong and Li (2013) also address the role of market structure in causing low pass-through, basing their findings on evidence from a variety of countries.

1.4.2 Declining Pass-Through

Much of the literature on pass-through since 2000 focuses on the decline in pass-through rates to imports that began at the end of the twentieth century. This phenomenon is most clearly seen in pass-through to import prices in the United States, but a wide range of studies show declining rates for imports in many countries worldwide. Such works differ slightly in their methodology and the exact objectives, but all produce similar empirical results that pass-through for imported goods was significantly greater in the 1980s than it was by the end of the 1990s and into the early 2000s\(^\text{18}\).

Declining pass-through rates are first reported in Mann (1986), and the later literature considers a range of explanations. Many of the possible reasons for declining pass-through rates stem from the theoretical explanations given in the Section 1.2 (competition issues, inflationary environment, currency choice), while others emphasize economic changes occurring specifically during this time period.

\(\text{18Pass-through rates vary by country, but for most developed countries, pass-through to import prices ranged from 0.5 to 0.8 in the 1980s. Estimates fell to between 0.1 and 0.4 in the early 2000s.}\)
Declining Pass-Through Due to Competition

Gust et al. (2010) use a trade-weighted average of exchange rates and import values to show that pass-through to US import prices fell from over 0.5 in the 1980s to less than 0.2 by the late 1990s. The authors attribute this drop to the increased number of countries involved in international trade, which has forced exporters to be more aware of competitors’ prices and therefore less responsive to exchange rate fluctuations with the dollar\textsuperscript{19}. Gust et al. factor in decreased trade costs as a measure of “globalization” and show that the rise in this measure corresponds to declining pass-through rates. Such lower trade costs not only give more countries access to trade in more goods, but also provide existing exporters with greater freedom of markups, allowing for more stable prices.

Otani et al. (2003) attribute declining pass-through rates to Japanese import prices to increased global competition. In their paper, the authors consider import penetration ratios for a variety of industries. They find that in four of five major categories of imports (metals, chemicals, foods, and machinery) as well as overall imports, the import penetration ratio rose from the 1980s to the 1990s, corresponding to a decline in pass-through rates in these categories. As this rise in imports in the market is due to an increased number of competing firms rather than growth of existing trade\textsuperscript{20}, Otani et al. find declining pass-through due to increased pressure from competition similar to Gust et al. (2010).

In a similar approach, Olivei (2002) considers the growing role of multinational firms that import largely from foreign affiliates. Using US import data from 34 categories within the manufacturing sector from 1981 through 1999, Olivei shows fairly uniform, steady declines in pass-through. With large, multinational corporations, “trade” oftentimes involves transferring goods from one branch of the company to another. It is likely that such intra-firm trade would have low, stable pricing and thus be less susceptible to exchange rate movements\textsuperscript{21}.

In general, the changing nature of worldwide trade at least partially explains declining pass-

\textsuperscript{19}Atkeson and Burstein (2008) and Bergin and Feenstra (2001) also consider the role of potential competitors in models of PPP and pricing to market, respectively.

\textsuperscript{20}The authors specifically note increased imports from East Asian economies rising during the 1990s.

\textsuperscript{21}Such results are shown in Clausing (2001).
through rates. Basic theory suggests that with more integrated trade, exporters become more responsive to the behavior of competitors, and therefore less responsive to the exchange rate. Evidence clearly shows growth in global trade, increased dependence on imports, and a rising number of multinational firms during the 1990s. These all contribute to pass-through rates being considerably lower by 2000 than they were in the mid-1980s.

Declining Pass-Through Due to Reduced Inflation

The seminal paper by Taylor (2000) considers the possible relationship between exchange rate pass-through and inflation. Noting that the beginning of the period of declining pass-through rates in most countries (the late 1980s and early 1990s) was also a time of relative price stability in many of those countries, Taylor ties low inflation with a lack of persistence of price and cost changes. Using a theoretical model, as well as empirical data, Taylor shows that the lower persistence of changes in costs (and just as importantly, the lower expected persistence) produces lower pass-through, particularly when the competitive structure is such that firms set prices in advance. Taylor (2000) sets the stage for a host of works comparing pass-through in high and low inflationary environments, eventually leading to questions of the endogeneity of low pass-through and inflation.

McCarthy (2007) also considers the relationship between inflation and the response to exchange rate and import price movements. However, his work focuses on the reverse effect: changes in the exchange rate influencing domestic inflation. Using data from nine industrialized countries, McCarthy sets up a VAR with variables including exchange rate changes and inflation of import prices, CPI, and PPI. Within most countries\(^{22}\), exchange rate movements prove to have a small, but significant relationship with inflation. Unlike other works, McCarthy considers the changing impact of the exchange rate on prices along the distribution chain. As expected, the effect is weaker on PPI than on import prices, and weaker still at the consumer price level. It is worth noting that McCarthy’s data includes a period (mid-1990s) when many industrialized countries experienced very low inflation. Interestingly, while pass-through to import prices declines during this period,

\(^{22}\)The United States is the one notable exception, a difference McCarthy attributes to Fed policies.
the connection between import prices and CPI and PPI inflation remains stable. Thus the implication is that while low inflation occurred while exchange rate pass-through declined, the change in inflation was not primarily due to external factors such as the exchange rate.

Bailliu and Fuji (2004) more closely follow the findings of Taylor (2000) in questioning whether the low inflation in industrialized countries in the 1990s resulted in lower pass-through. With a panel of eleven developed countries, Bailliu and Fuji present similar results showing declining pass-through with shifts to lower inflation regimes in the 1990s. However, they also find a lack of a similar link between pass-through and inflation in many of the same countries during disinflationary periods in the 1980s. To analyze this difference, the authors break down the exact nature of the changes in inflation for each of the eleven countries. In many cases, central banks were viewed as being more independent in the 1990s than they had been in the previous decade. As such, economic agents viewed their actions as more credible during the second shift to lower inflationary environments. Bailliu and Fuji conclude that this increased credibility allowed for monetary policy of the 1990s to have a more widespread effect than earlier policy. Essentially, central bank actions in the 1980s served to reduce inflation, but it was not until the 1990s that similar policies also caused agents to reduce responsiveness to exchange rate movements.

Gagnon and Ihrig (2004) also find a relationship between the monetary policy enacted in industrialized countries and declining pass-through to consumer prices. Using a sample of twenty countries, Gagnon and Ihrig show significant declines in pass-through following the passing of anti-inflationary policies across the majority of the economies studied. Most notably, the authors find empirically that low pass-through correlates with overall price stability. Similar to the findings of Bailliu and Fuji (2004), Gagnon and Ihrig theorize that economic agents in a stable price environment expect central banks responses to rising prices. Therefore, such agents are less inclined to adjust prices following an exchange rate shock. As evidence of the link between price stabilization and low pass-through, the authors find the standard deviation of inflation to be the better predictor of declining pass-through rates, as opposed to the average level of inflation. Such findings

Bailliu and Fuji take as given the idea that the low inflation was primarily caused by changing monetary policies rather than external effects.
contribute to the work of Taylor (2000) among others in linking the inflation-reducing policies of industrialized countries in the 1990s to the corresponding reduction in pass-through rates.

One major expansion of Taylor (2000) is the comparison of pass-through with other macroeconomic indicators shown by Choudhri and Hakura (2006). This study also includes data from more countries (71) than earlier papers, and controls for variables such as exchange rate volatility, variability of inflation, and openness of the importing country (measured as the ratio of total imports to GDP). Even with such controls in place, Choudhri and Hakura find that the inflation effect dominates, showing an importer’s inflationary environment to be the most significant predictor of low pass-through. Interestingly, these findings somewhat contradict those of Gagnon and Ihrig (2004) in that average low inflation, rather than inflation stability, shows the strongest correlation with low pass-through. The authors do note that, as expected, average inflation and the inflation volatility are closely correlated, and that their paper shows a stronger effect of average inflation than what is found in similar studies.24

During the 1990s, many of the world’s leading economies introduced policies aimed at stabilizing and reducing inflation. Such policies are logically tied to low pass-through, particularly pass-through to consumer prices. Most of these policies focused on establishing an inflation target, with formal policies being announced in Canada (1991), the United Kingdom (1992), Australia (1994), and Spain (1994). At approximately the same time, central banks in Denmark, Finland, France, Italy, and the United States shifted monetary policies to be more aggressive in response to inflation. Following Taylor (2000), there was an increased emphasis on studying the relationship between such policies and the corresponding decrease in pass-through. The general consensus is that lower inflation contributes to reduced pass-through, but questions remain about the exact nature and extent of the relationship.

24Choudhri and Hakura specifically note the findings of Gagnon and Ihrig (2004), and Campa and Goldberg (2005) as evidence that inflation volatility is a key predictor of pass-through, along with inflation level.
Declining Pass-Through Due to Trade Composition

In contrast to the relationship identified by Taylor (2000) and others, Campa and Goldberg (2005) address the question of endogeneity of pass-through as it pertains to inflation in a host country. This is a significant concept as the authors suggest that if decreased pass-through is the result of factors other than reduced inflation, then it is more likely that prices remain stable. With a panel of 25 OECD countries, Campa and Goldberg examine country-by-country differences in pass-through rates, as well as the changes in these rates over time. Their results show that the change in trade composition was the primary driver of low pass-through rates, rather than the changes in inflationary environment. Of particular note is that pass-through rates for the food and manufacturing industries tend to be lower than those in raw materials and energy. In the 1990s, as more countries were enacting anti-inflationary policies, trade in food and manufactured goods increased at the expense of raw materials and energy. Campa and Goldberg find that declining pass-through rates correspond more consistently with this change in composition than the reduction in inflation.

The changing composition of goods traded during the 1990s is widely cited as a possible contributor to decreased pass-through. Marazzi and Sheets (2007) note the decreased share of industrial supplies in US imports by the end of the 1990s. Such goods tend to maintain high pass-through rates, so their decreased share would lower pass-through rates as a whole. However, Marazzi and Sheets’ analysis of the changing composition of trade is not limited to the makeup of traded goods, but also the development of new trade partners. Just as a shift in trade towards goods with more stable pricing reduces the impact of exchange rate movements, so to does a move towards exporters with more stable exchange rates. The authors find correlation between China’s increased presence as a trade partner with the United States, and the fall in pass-through to US import prices. Specifically, China’s fixed exchange rate has the potential the shield Chinese exporting firms from

\[ \text{Footnote: Much of this trade composition effect focuses on differences in pass-through rates from one sector to another. In contrast, Olivei’s (2002) study of 34 categories of goods within the manufacturing sector shows that the downward trend in pass-through to US imports exists fairly uniformly across most sectors.} \]
the effects of currency fluctuations that would impact competitors.\textsuperscript{26} Marazzi and Sheets therefore attribute a portion of the drop in pass-through to increased trade with China.

Countering the argument of trade composition causing decreased pass-through, Ceglowski (2010) shows that during the 1990s, Canada was the one major trade partner for which pass-through imports to the United States did not decline. During this period, imports from Canada shifted away from manufactures and Ceglowski shows that imports of Canadian mineral fuels grew the most of any sector.\textsuperscript{27} Many studies show prices of exported mineral fuels and non-manufactured goods in general to be the most responsive to the exchange rate,\textsuperscript{28} yet Ceglowski finds that while pass-through to imports from Canada does not fall, it does not show a significant increase either. Meanwhile, her findings for imports from Europe and Japan suggest declining pass-through despite the fraction of manufactures in imports remaining stable. While such findings do not entirely refute the hypothesis that a changing composition of traded goods contributed to lower pass-through rates, they do suggest that country effects are more significant.\textsuperscript{29}

1.5 Conclusion

The literature on exchange rate pass-through is clearly rich and continues to grow. From early theoretical work to empirical studies of incomplete pass-through, the question of the exchange rate’s role in pricing has been a consistent topic of research for over 30 years. The exact focus of the research has shifted over time due to new data availability, changing monetary policy, and the increasing prevalence of imperfect competition models of trade. As data and measurements

\textsuperscript{26} Bergin and Feenstra (2009) also attribute low pass-through rates to the rise of China as a trade partner with the United States, adding that trade partners with floating exchange rates are more likely to stop exporting to the United States following dollar depreciations. This opens the possibility of further increased imports from China (or any country with a fixed exchange rate). Therefore, it is possible that China’s rising share of US imports is partly endogenous to low pass-through rates.

\textsuperscript{27} In 1990, mineral fuels comprised approximately one-tenth of Canadian exports to the US. By 2008, that fraction had risen to one-third.

\textsuperscript{28} See Marazzi et al. (2005), Marazzi and Sheets (2007), and Gust et al. (2010).

\textsuperscript{29} More recently, Bussiere, Delle Chiaie, and Peltonen (2014) compare pass-through rates to import prices for 40 countries, finding the United States to have the lowest rates among advanced economies. The authors attribute this difference more to the variety of countries that export to the United States than the composition of the traded goods.
improve, new analyses are presenting a clearer picture of how exchange rate movements have impacted prices in the past, and how economists can use this information to better predict the effects of future changes. While early studies of pass-through were primarily on the macro level, recent work has used micro data to inform macro questions.

The following chapters contribute to the literature by examining pass-through to US import prices at a more highly disaggregated level than previous studies. The second chapter (Exchange Rate Pass-Through and the Role of Market Shares) shows how an exporter’s share of the US import market for a very specific good impacts the degree to which that exporter passes an exchange rate movement into its price. The marked advantage this work has over similar studies is the detailed calculation of pass-through values and the market shares across which they are compared. Whereas earlier work focuses on the industry level, I consider competition within a large number of highly specific goods. The third chapter uses this disaggregated data to examine country effects. Specifically, it advances findings on the role of China in the decline of pass-through to US import prices. These calculations make clear the degree to which China has come to dominate the United States’ import market across a wide variety of sectors and the impact this has on pricing by competitors. The detailed nature of the empirical findings in the following two chapters adds to the growing literature on exchange rate pass-through.
Chapter 2

Exchange Rate Pass-Through and the Role of Market Shares

2.1 Introduction

The primary objective of this chapter is to determine the relationship between exchange rate pass-through and trade partners’ shares of the United States’ import market. The reasons for understanding pass-through to import prices relate to the connection between import prices and the overall price level of the US as a whole, as well as the role of the Federal Reserve to adjust monetary policy accordingly. Since import prices play a role in an open economy’s overall price level, the degree to which exchange rate fluctuations are passed on to prices can directly impact the inflation rate of an importing country. On the other hand, since monetary policy is often linked with expected inflation, understanding and anticipating changes in pass-through rates can allow for more effective policy.

Additionally, pass-through is tied to the balance of payments as relatively small reactions in prices to dollar appreciation or depreciation (low pass-through) cause a similar reaction in overall import quantities. The better an importer can estimate the degree of pass-through to prices and how it is changing, the better it can predict the impact that currency devaluations will have on volume of trade. With high pass-through rates to import prices, a currency devaluation could improve the trade balance in that higher prices of imports could result in increased demand for domestic goods. If a foreign country controls a larger share of the import market for a good, then in theory firms
in that foreign country have greater ability to respond through pricing methods, and in turn have
greater effect on the overall import market. Alternatively, an exporter with a smaller share has less
freedom in terms of response. By analyzing the relationship between an exporter’s market share of
a good and the pass-through for that good, we can gain a better understanding for which industries
and which exporters drive these relationships.

The exchange rate disconnect puzzle, as termed by Obstfeld and Rogoff (2001), describes the
extreme volatility of exchange rates relative to other key macroeconomic variables. Obstfeld and
Rogoff note in defining the puzzle that the exchange rate should be one of the most significant
calculations given the sheer number of economic indices that depend on exchange rates\(^1\). Import
prices are perhaps the clearest example of such a measurement that should be closely related to
the exchange rate. Low pass-through of exchange rate fluctuations to import prices could at least
partially explain this disconnect since import and export prices and quantities are generally the in-
struments through which exchange rates impact other macroeconomic variables (national income,
money supply, interest rates, etc.). If pass-through to import prices were complete, then a stronger
tie between exchange rates and these other variables might be observed. So it is essential to un-
derstand the theoretical and empirical explanations for low pass-through. In particular, the market
shares of exporters in a host country’s import market (and the desire to protect these shares) could
be partially responsible for low pass-through rates.

I start with a simple, static model of two foreign countries exporting a single good to a host
country. Such a model shows how the countries respond to changes in exchange rates and how
this behavior differs depending on the size of each country’s share of the host country’s import
market for the good. I find that the general relationship between pass-through and market share
is a skewed U-shape, with pass-through being greatest when shares are very large or very small.
This model predicts the country holding the larger share will have the lower pass-through rate of
the two competitors.

\(^1\)Obstfeld and Rogoff consider the commonly known puzzle of purchasing power parity to be an example of the
exchange rate disconnect puzzle in that the exchange rate does not balance out international price differences as would
be expected in theory.
Empirical tests of the model are based on quarterly observations of US imports at the ten-digit Harmonized System level, as well as bilateral exchange rate and price data from 233 countries from 1990 through 2005. Using such highly disaggregated data, I find several results on pass-through rates across market shares. First, countries with market shares at the extreme high and low ends tend to have higher pass-through rates, though this effect is more dramatic with low shares. Second, specifically focusing on the trade partner with the largest share of the market for a commodity, I find that such countries have significantly lower pass-through rates than their competitors. Lastly, the effect of large market shares in particular varies depending on the type of imported good, as well as the size and direction of an exchange rate fluctuation.

This chapter ties into a vast literature on incomplete exchange rate pass-through, both theoretical and empirical, as discussed in Chapter 1. The basic theoretical model derives from Atkeson and Burstein’s (2008) use of imperfect competition to explain pricing to market. Their model relies on strategic interactions between firms and shows the importance of the distribution of market shares within an industry in explaining why PPP does not hold. Specifically, Atkeson and Burstein allow for better performing firms to have larger market shares within their industry. Due to the nature of substitution both across and within industries, such firms have larger markups. My contribution is to show how market shares, particularly that of the largest trade partner, can play a role in creating lower pass-through rates.

In a similar study to this chapter, Feenstra et al. (1996) show a general theoretical relationship between market share and pass-through within a specific industry. Their models show an increasing relationship (independent of assumptions on demand) between the variables with pass-through approaching one as market share approaches 100%. When smaller market shares are considered, assumptions about the nature of the demand function are necessary and the question of whether pass-through increases or decreases with share depends on firm interactions. Feenstra et al. (1996) supplement their theoretical predictions on market share and pass-through with data on the auto

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2 Another finding is that pass-through tends to be lower for goods that are imported to the US from a relatively small or large number of countries in a specific time period. This relationship generally holds across market shares. However, the data on this is somewhat nebulous and can still be explored further.
industry and imports for 48 country combinations. As predicted by the theoretical model, they show a non-linear relationship between the variables with pass-through increasing as market share approaches 100\%\textsuperscript{3}. In this chapter, I expound on these findings and show how pass-through and market shares relate across all imported goods.

In addition to examining overall pass-through to US import prices and the role of market shares, this chapter takes into account country of origin and specific commodity to determine the differences across host countries and good types. Specifically, the breadth of data considered spans a larger number of countries and more highly disaggregated goods than other works in the literature. Most papers that measure and analyze exchange rate pass-through and its effects use goods disaggregated at the Harmonized Tariff Schedule (HTS) four- or six-digit level, or use Standard Industrial Classification (SIC) codes which are less disaggregated than HTS. Additionally, most studies limit the analysis to interactions with major trade partners such as Canada, Mexico, China, Japan and the dominant EU economies. The main contribution of this chapter is that it starts by considering all countries that imported to the US between 1990 and 2005 and focus on imported goods at the most disaggregated level. This level of detail allows for the examination of relationships within the broader categories used in most studies. In many cases, the behavior of pass-through across shares is different for very specific goods than it is at an industry level\textsuperscript{4}. By examining various relationships between pass-through and market share at such a highly disaggregated level for a wider selection of exporting countries, I generate a more detailed analysis of how US import prices respond to exchange rate shocks.

\textsuperscript{3}More recently, Auer and Schoenle (2012) look at the effects of market structure on exchange rate pass through and use US import data from a large number of exporting countries and more product sectors than are considered in most empirical studies in the pass-through literature.

\textsuperscript{4}In the automobile trade, for example, pass-through to prices of German cars is generally higher when German market share is higher. But when only considering cars with four-cylinder engines and interior volumes no larger than 2.4 cubic meters, the relationship is exactly the opposite.
2.2 A Simple Theoretical Model

Atkeson and Burstein (2008) develop a model comparing countries trading goods in international markets. Their model compares goods that are grouped within sectors, defined as “the lowest level of disaggregation of commodities used in economic censuses and price index construction”\(^5\). For my version of the model, ten-digit goods, as well as the versions of these goods shipped by the competing countries, face constant elasticity of substitution inverse demand functions that depend on elasticities of substitution across goods (\(\eta\)) and within goods (\(\rho\)). Elasticity of substitution across goods is greater than one, but less than elasticity of substitution from one country’s version of a good to another’s. Additionally, both elasticities are finite (\(1 < \eta < \rho < \infty\)). The countries in question play a game of quantity competition in a host market wherein the quantities exported to the host by competitors are taken as given and each country sets its own export quantity accordingly. The structure of the model is “two-tiered” in that exporting countries are assumed to be large enough to influence the quantities and prices of goods, but overall quantity and price-level are fixed by consumer preferences.

Total consumption of imports in the host country is based on a continuum of imported goods, indexed by \(j\):

\[
C = \left( \int_0^1 y_j^{1-\frac{1}{\eta}} \, dj \right)^{\frac{\eta}{\eta-1}}. \tag{2.1}
\]

Demand for each good follows an inverse demand function:

\[
\frac{P_j}{P} = \left( \frac{y_j}{C} \right)^{\frac{1}{\eta}}. \tag{2.2}
\]

\(^5\)Atkeson and Burstein’s model is based on competition between firms rather than countries. In this chapter, I treat each 10-digit commodity in the manner that their research treats sectors, while the version exported by each country is equivalent to what they call a good. Therefore, competition is at the country-level.
This demand for goods can be used to create a theoretical price index for all imported goods:

\[ P = \left( \int_0^1 P_j^{1-\eta} \, dq_j \right)^{\frac{1}{1-\eta}}. \]  

(2.3)

Within each good, as do Atkeson and Burstein, I consider a CES production function such that the total output of good \( j \) produced in all \( K \) foreign countries and sold in the host country is given by:

\[ y_j = \left[ \sum_{k=1}^{K} \left( \frac{q_{jk}}{q_j} \right)^{\frac{\rho}{\rho-1}} \right]^{\frac{\rho-1}{\rho}}. \]  

(2.4)

Each competing country \( (k) \) faces an inverse demand for their version of \( j \):

\[ \frac{p_{jk}}{P_j} = \left( \frac{q_{jk}}{y_j} \right)^{-\frac{1}{\rho}}. \]  

(2.5)

Combining Equations 2.4 and 2.5 gives the theoretical price index for imported good \( j \):

\[ P_j = \left[ \sum_{k=1}^{K} (p_{jk})^{1-\rho} \right]^{\frac{1}{1-\rho}}. \]  

(2.6)

Using this framework, I consider two foreign countries \( (A \) and \( B \)) competing in a host country’s import market for a single good \( (j) \). Country \( A \) maximizes its profit from exporting \( j \):

\[ \Pi_{jA} = p_{jA} q_{jA} - q_{jA} MC_{jA}, \]  

(2.7)

subject to an overall demand function (found by combining Equations 2.2 and 2.5):

\[ \frac{p_{jA}}{P} = \left( \frac{q_{jA}}{y_j} \right)^{-\frac{1}{\rho}} \left( \frac{y_j}{C} \right)^{-\frac{1}{\eta}}. \]  

(2.8)

If the two elasticities of substitution are considered parameters, and overall prices and consumption are taken as given, then \( A \)'s optimal selling price of \( j \) is a markup to marginal cost,
depending on A’s share of the market:

\[ P_{jA} = \left[ 1 - \frac{1}{\rho} (1 - S_{jA}) - \frac{1}{\eta} S_{jA} \right]^{-1} MC_{jA}, \tag{2.9} \]

where share can be expressed as a function of prices from both countries:

\[ S_{jA} = \frac{P_{jA}^{1-\rho}}{P_{jA}^{1-\rho} + P_{jB}^{1-\rho}} \tag{2.10} \]

Note from Equation 2.9 that when A has 100% control of the market for a good \( S_{jA} = 1 \), it will have a markup of \( \eta \), depending solely on the elasticity of substitution across goods. At the other extreme, countries with infinitesimal shares of a market will have markups close to \( \frac{\rho}{\rho - 1} \), which depend exclusively on substitutability within goods. Therefore, A’s markup to marginal cost increases with share, while its share decreases with price.

Typically, exchange rate pass-through for a good imported from a certain country is defined as the ratio of percent change in the import price of that country’s good to the percent change in the exchange rate between the importing and exporting countries. Pass-through is defined as complete if it equals one, meaning a \( k \% \) rise in the exchange rate results in a \( k \% \) rise in import prices. Incomplete pass-through refers to pass-through values that are less than one.

Additionally, a depreciation of the domestic currency relative to the foreign currency increases marginal costs in the foreign country as measured in domestic currency. Therefore, a rise in the exchange rate can be viewed as an increase in marginal costs of production. As a result, pass-through from Country A can be considered as the ratio of percent change in import prices from A

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\(^6\)See Appendix 2.6.1 for the derivation

\(^7\)Exchange rate is expressed as the ratio of host country currency to foreign currency. Therefore a rise in the exchange rate occurs due to a depreciation of the host’s currency or an appreciation of the exporter’s currency. Under this condition, a rise in the exchange rate means the host’s currency is relatively weaker, so prices of its imports (as measured in the host’s currency) would be expected to rise.

\(^8\)Assuming fixed marginal costs in A’s currency, the marginal cost as measured in the host’s currency is \( \epsilon MC^*_A \), and changes only with the exchange rate. Feenstra (1989) is among many that show foreign firms respond similarly to changes in exchange rates as they do to changes in input costs.
to percent change in A’s marginal costs$^9$:

$$ERPT_A = \frac{\partial P_A}{\partial MC_A} \frac{MC_A}{P_A}. \quad (2.11)$$

Using the fact that with two competing countries, shares of the import market must sum to one, Equations (2.9) and (2.10), as well as their respective versions for Country B can be combined to implicitly solve for the derivative in (2.11). Pass-through from Country A can then be expressed$^{10}$:

$$ERPT_A = \frac{(\chi + S_A \zeta)(\chi + S_B \zeta) + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta}{[(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta]\chi + S_B \zeta) + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta}, \quad (2.12)$$

where

$$\chi = 1 - \frac{1}{\rho} \quad \text{and} \quad \zeta = \frac{1}{\rho} - \frac{1}{\eta}.$$ 

Three key theoretical predictions arise from this expression of pass-through (Proofs can be found in Appendices 2.6.3 and 2.6.4).

1. **If 0% < S_A < 100%, then 0 < ERPT_A < 1.**

   As long as more than one foreign country is competing in the market, pass-through will be greater than zero and less than one. This shows the intuitive result that a relative depreciation in a host country’s currency will lead to an increase in import prices as measured in that host country’s currency. Hence, pass-through is greater than zero. But pass-through will also be incomplete when competition exists, in part due to the presence of the alternatives available to consumers. This prevents exporting countries from raising prices by the full amount of the exchange rate fluctuation.

2. **Pass-through as a function of market share follows an asymmetric U-shape, with minimum pass-through occurring when share is greater than 50%.$^{10}$**

\footnotesize

$^9$At this point, I drop the subscript \( j \). But prices, marginal costs and shares continue to refer to a specific good.

$^{10}$See details in Appendix 2.6.2.
The model predicts pass-through to be equal to one when share is zero or 100%, and pass-through between zero and one for all other feasible values of share. The exact share that gives minimum pass-through, as well as the minimum pass-through itself and the degree of skewness in the non-linear function, depend on the two parameters for elasticity of substitution. Figures 2.1 and 2.2 show the effect of changing the elasticity within goods (\( \rho \)) and across goods (\( \eta \)), respectively\(^\text{11}\). For instance, if \( \eta \) is approximately one (the minimum allowed value) and \( \rho \) is significantly greater than \( \eta \), a country’s version of a good is assumed to be easily substituted for the other country’s version, but substituting to a different good is essentially impossible. Under such circumstances (setting \( \eta = 1.01 \) and \( \rho = 10 \)), pass-through decreases with market share almost linearly until share is nearly 100% (See Panel A of Figure 2.1). Additionally, the minimum pass-through is close to zero in this setting. Compare this to Panel B which keeps \( \eta = 1.01 \) but reduces \( \rho \) to 3, implying that different versions of a good are less substitutable. The general shape remains the same, but pass-through is greater for market shares between zero and 100%. Most notably, the minimum pass-through is greater for higher values of \( \rho \). This minimum pass-through rate also occurs at a slightly smaller value of market share, though this effect appears to be minor.

![Figure 2.1: Theoretical Relationship between Pass-Through and Market Share: The effect of \( \rho \).](image)

Changing \( \eta \) while \( \rho \) is held fixed produces similar results. Panel A of Figure 2.2 again shows

\(^{11}\)Auer and Schoenle (2012) and Devereux et al. (2014) find show similar theoretical patterns.
Figure 2.2: Theoretical Relationship between Pass-Through and Market Share: The effect of $\eta$.

$\eta = 1.01$ and $\rho = 10$. Panel B keeps the same value of $\rho$, but increases $\eta$ to three, implying easier substitution to different goods. As is seen when $\rho$ falls, increases in $\eta$ result in pass-through rising across all market shares. However, the share producing the minimum pass-through falls noticeably, creating a more symmetric U-shaped distribution. These effects are more dramatic for larger values of $\rho$, though the minimum pass-through always corresponds to a market share that is greater than 50%.

3. **If $S_A > S_B$, then $ERPT_A < ERPT_B$**

   In the two-country model, pass-through for the trade partner with the larger share of the import market is always less than that of the country with the smaller share. If the competing country’s marginal cost (or exchange rate) is fixed, then a shock to marginal cost has a greater impact on the price of goods from the country with the smaller share than an equal sized shock would have on goods from the country with the larger share. This occurs because countries with larger shares have larger markups on goods, and larger countries lower markups by a greater percentage when faced with a rise in marginal cost or the exchange rate. Expressed in percent-change notation:

\[
\%\Delta Markup = \%\Delta Price - \%\Delta MC. \tag{2.13}
\]
Under the assumption that the change in marginal costs (exchange rate) is the same for both countries, the larger country having a greater percentage drop in markup implies that its export price falls by less than that of the smaller competing country.

These theoretical results suggest that when two countries compete in a host country’s import market for a good, the country with the larger share will have the lower pass-through rate. In particular, if it is assumed that within-good elasticity of substitution is relatively large\(^{12}\) then the downward sloping relationship is more dramatic and suggests that countries with larger shares can have pass-through rates that are far from complete. Under this setting, consumers in the host country can easily substitute goods from one country for goods from another. So exporters with large market shares adjust markups when faced with exchange rate shocks, resulting in lower pass-through rates.

2.3 Data and Methodology

2.3.1 General Data Description

The data used in this study are based on the US Imports Harmonized System data disaggregated to ten digits, with monthly observations from April 1990 through December 2005. Specifically each initial observation contains, for each month and each port of entry into the United States, the number of units of each ten-digit good that are imported from each country of origin, and the total dollar value shipped. Dollar values are split into two variables, one for dollars of freight shipped and another for calculated duties to which foreign merchandise imported into the US is subject. Since port of entry is not a variable of interest at this time, quantities and values of each good, from each country, in each month are summed together to give total quantity and value for each good-country-month combination. Due to the importance of analyzing changes from one time period to the next, the monthly totals are then summed up to the quarterly level. This allows for more

\(^{12}\)Atkeson and Burstein use \(\eta = 1.01\) and \(\rho = 10\) as their “benchmark” model parameters. Additionally, Anderson and van Wincoop (2004) find these values to be realistic based on empirical studies of imports.
coverage in the data as there are fewer periods in which a regular exporter of a good does not ship that particular good to the United States\textsuperscript{13}. Prices are not directly observed but rather, unit values are calculated from the data on total value and total quantity sold per quarter\textsuperscript{14}. Since the United States is the importing country for all data, the total value is based on the cost, insurance and freight calculation (CIF). This includes the free on board (FOB) value of the goods, and insurance and haulage to the dock in the US, but does not include additional shipment costs within the US. In terms of the original data, CIF is found by summing the two variables for the dollar value of the shipment. This CIF value is divided by the number of units to calculate the import price for each specific good-country-quarter combination\textsuperscript{15}.

\textbf{2.3.2 Data}

Some observations in the import data indicate that shipments were valued at an amount greater than zero, but contained zero units of goods. According to Feenstra (1996) this implies that the actual quantity of the good imported is unknown or was not recorded. All such observations were flagged and dropped from the dataset. Additionally, for some months (and therefore some quarters), the US did not receive imports of a particular good from certain countries.

Following the techniques of Auer and Schoenle (2012), I drop any series in which more than ten percent of quarters between the first and last observations either do not have transactions or are flagged as a result of the issues noted above. The remaining quarters with missing or non-existent data are assumed to have the same quantity and value of imports as the previous quarter. Dropping these series with too many missing values limits the potential breadth of the analysis in terms of the number of trade partners, the number of imported goods and combinations of the two. However,

\textsuperscript{13}Henceforth, an “observation” refers to a good-country-quarter combination.

\textsuperscript{14}There is some discussion in the literature about the advantages and disadvantages of actual prices or price indices as opposed to unit values. The primary argument against unit values is they can vary greatly as a result of unseen changes in quality or product combinations. However, at such a disaggregated level (10-digit HTS codes), product mix should not be an issue. Variation in quality within 10-digit codes is also unlikely to cause concern, but as Alessandria and Kaboski (2011) note, it should be taken into consideration as a potential source of bias.

\textsuperscript{15}I use CIF as this is the reported value for imports in most countries. However, the results in this study remain essentially the same when FOB values are used instead of CIF.
any series with observations that are too sporadic or with too many estimated values is unreliable. This also eliminates trade partners with minimal value of goods imported or one-time transactions, etc.

The data are supplemented using quarterly average nominal exchange rates from the IMF’s International Financial Statistics database, with exchange rate measured as dollars per unit of foreign currency. With this measurement, a depreciation of the dollar implies a rise in the exchange rate. When they are used, US GDP values are found from the IFS database as well. Quarterly CPI values for each country in the analysis are taken from the Laborsta database of the ILO, with CPI being an average of monthly observations when quarterly data is unavailable. The bilateral real exchange rate between the US and each foreign country is then calculated by the equation\(^{16}\):

\[
RER = \frac{NER CPI_{Foreign}}{CPI_{US}}.
\] (2.14)

Since prices are measured in dollars, the real price is found by dividing the calculated price by the US CPI from that quarter. In some cases, only monthly, quarterly, or annual percent changes are available rather than actual nominal exchange rates. However, since the focus of the study is on the change in each variable as opposed to the level, indices can be created based on the percent changes in exchange rates. Pass-through calculations can then be determined using the created indices. Any import observation that occurs in a quarter for which the exporting country’s CPI or exchange rate information is unavailable is dropped (as opposed to having a specific value or an estimate from annual data). Such observations only occur at the beginning or end of the series.

Pass-through calculations are only made for goods classified as manufactured goods due to volatility in quantity and price data for non-manufactures. One clear effect of only considering the manufacturing sector is a reduction in the influence of certain pure commodity-rich (mainly

\(^{16}\)An argument can be made that GDP deflator or producer price index are better measures of price levels for the exchange rate calculation. The problem with these variables is the availability of data in the countries and time period of interest. Nearly 1.5 times as many pass-through calculations can be made during period using CPI as opposed to PPI. Additionally, pass-through for at least one good can be calculated in 134 countries using a CPI-based real exchange rate, as opposed to 70 countries with a PPI-based calculation. Most importantly, the basic results of this study remain the same when repeated using real exchange rates based on PPI and GDP deflator for the available data.
oil-rich) countries such as Saudi Arabia and Venezuela. However, the methodology used does not prohibit non-manufactured goods and could easily be extended. Even with the use of only manufactured goods and the elimination of series with sporadic or too much missing data, the sample still includes over 2.7 million price observations for analysis.

Annual data on US imports from the Center for International Data at the University of California – Davis is used to obtain the SIC code corresponding to each HTS ten digit code. This is particularly useful as SIC codes tend to be more effective in dividing goods based on end uses. While the data analyzed was disaggregated at the HTS ten digit level, SIC codes are used to separate out goods that are classified as manufactures (SIC codes with a first digit of 2 or 3).\(^\text{17}\)

Initially, I have data on imports of 22,192 different goods across 63 quarters. There are 233 exporters whose presence in the data ranges from two good-quarter combinations (North Yemen) to 498,046 (Canada). There are 857,178 different good-quarter combinations with an average of just under seven competing exporters in each, for a total of 8,044,110 observations. When non-manufactured goods are removed, I am left with 20,409 goods from 233 exporters and 63 quarters, with totals of 789,411 good-quarter combinations and 7,639,450 observations. This data was used to calculate the each country’s share of the US import market for each good in any quarter.\(^\text{18}\)

The CIF values are used as the basis for calculating a foreign country’s share of the US import market in a given quarter. The exact calculation is expressed:

\[
s_{c,j,t} = \frac{CIF_{c,j,t}}{\sum_{c=1}^{C} CIF_{c,j,t}}. \tag{2.15}\]

Equation (2.15) gives the simplest possible calculation of market share. Other possible calculations involve using multiple quarter intervals. For example, the source country’s share of the market for a good at a given time is the sum of total value of the good imported from that country over the prior four quarters, divided by the total value of the good imported from all countries over those four quarters. Similar calculations can be made with longer intervals. The idea behind

\(^{17}\)Over ninety percent of the types of goods imported are considered manufactures.

\(^{18}\)For some aspects of the study, firm-level data would potentially provide better insight than country level data. This issue is addressed in Appendix 2.7.
this type of calculation is to account for quarter-to-quarter fluctuations in import quantities and overall values, particularly cases where an exporter sends regular shipments less frequently than once per quarter. Such cases would show up inconsistently if market share were only based on one-quarter calculations. However, preliminary results comparing pass-through and market share do not indicate substantial differences based on the method of calculating share.

2.3.3 Methodology

As pass-through is defined as the ratio of percent change of import price to percent change in exchange rate, the basic regression for exchange rate pass-through follows the model:

\[ p_{c,j,t}^m - p_{c,j,t-1}^m = \alpha + \sum_{i=0}^{n} \beta_i \Delta e_{c,t,i} + \sum_{i=0}^{n} \gamma_i x_{t-i} + \varepsilon_{c,j,t}. \]  

(2.16)

In Equation (2.16), pass-through is the sum of the \( \beta_i \) terms; \( p_{c,j,t}^m \) is the real price of good \( j \), imported from Country \( c \) at time \( t \); and \( e_{c,t} \) is the real exchange rate between the United States and Country \( c \) at time \( t \) (all values in logarithms). I initially include just one quarter lag, though estimates in the literature vary in lag use from one quarter up to two years\(^{19}\). Clearly this implies a short run analysis of pass-through. As a check on the robustness of the results, I consider longer lag-lengths as well and the basic findings do not change.

The term \( x_i \) in Equation (2.16) refers to a vector of additional variables that could be included. In my calculation, I include quarterly changes in real GDP of the US, but other variables could be considered as well. As the sole importer considered in this study, US economic growth should be correlated with demand for imports, which in turn impacts import prices. However, in terms of the values calculated for estimated pass-through, I find that the presence of US GDP does not make a substantial difference. Among other variables to consider would be the change in real GDP of the country of origin, or the change in price of a worldwide commodities index. Marazzi and Sheets (2007) use a price index of commodities to account for the indirect effect of exchange rate

\(^{19}\)Ceglowski (2010) comments that bilateral pass-through to import prices is a fast process, generally occurring within six months.
variability on import prices, noting that a rise in commodity prices will result in higher costs of production. The $x$ variables could also be used as indicators as was done by Brun-Aguerre et al. (2012) who added variables to separate positive and negative exchange rate shocks, as well as large vs. small shocks. Other considerations could include the average price change among other goods with the same two- or four-digit HTS code to account for price of competitors.

2.3.4 Rolling Regressions for Pass-Through

I use a rolling regression process to capture the pass-through rate of a unique ten digit good imported from a foreign country in a specific quarter. With this method, a linear equation is estimated for the change in import price of a good using a one quarter lag of percent change in the real exchange rate, as in Equation (2.16). However, in order to establish a time component, only the previous three years of data are used to estimate the pass-through in a particular quarter. For example, the pass-through value for good $j$, from Country $c$, at time $t$ is the coefficient on the change in real exchange rate from a regression using only data on imports of $j$ from $c$ between quarters $t - 12$ and $t$. As a major finding in recent literature on exchange rate pass-through is the idea that pass-through to US import prices as a whole has been falling over the last 30 years, it is worth considering that a similar trend could be found on a more micro level. Using the rolling regression process makes it possible to capture any changes over time in the pass-through of specific commodities from certain countries. Additionally, obtaining a unique pass-through calculation for each good and country at each time has the advantage of being paired with a unique, time-specific market share. Other studies that consider market shares\footnote{Such as Olivei’s (2002) use for calculating trade weights} use the shares for one time period and assume it holds constant (or changes minimally) over a set number of following periods.

The specificity of the rolling regression methodology does have a slight downside. Since twelve observations are required in order to obtain a pass-through calculation, values for the first three years of data for each series cannot be calculated\footnote{Using a one-quarter lag and a twelve quarter window in the rolling regression results in pass-through estimates for 1,803,419 observations, from 387,695 good-quarter combinations. The pass-through estimates are from 50 quarters}. Shrinking the pass-through window to four...
or eight quarters would increase the number of available observations, but it would also increase
the variability and noise within each calculation. In most of the pass-through literature where
regressions are used, between a two and ten year window is chosen, seen for example in Marazzi
and Sheets (2007).

2.4 Results

2.4.1 Pass-Through Across Market Shares

In general, I find that the data support the theoretical predictions regarding the relationship between
pass-through and market shares. Specifically, pass-through rates tend to follow a skewed U-shape
across shares. However, the calculated pass-through values tend to be much smaller than predicted
for all sizes of market shares, including a substantial number of combinations with negative pass-
through rates.

Due to the size of the dataset and the large number of observations, a plot of pass-through vs.
market share for all country-good-month combinations has too much noise to be useful. So I start
by rounding market share up to the nearest percent. The average pass-through rates by percent of
market share are then plotted in Figure 2.3.

Despite the substantial noise in the data, Figure 2.3 shows a skewed U-shaped distribution: a
distinct downward trend while market share is below 70%, followed by rise in pass-through as
market shares approach 100%.22 This general trend matches closely with the theoretical results,
suggesting that a country with a minimal share of a particular good’s import market in the United
States will pass a larger percentage of exchange rate fluctuations into prices. As market shares

22 Figure 2.3 also indicates a substantial number of negative pass-through rates. This violates the theoretical finding
that pass-through should fall between zero and one and implies that exporters raised prices following a dollar appre-
ciation or lowered prices when the dollar devalued. This is in part due to the short-run nature of this calculation,
using only one lag. But it also reflects the high level of disaggregation in the data, as there is more to variations in
individual country’s prices of ten-digit goods than simply exchange rate fluctuations. Future work beyond this study
will investigate negative pass-through rates and potential causes.
increase from the low end, countries will pass on a smaller percentage to prices. The rise in pass-through rates at the upper end of the distribution shows that countries with close to full control of the market behave similarly to those with little market power in terms of percentage of exchange rate fluctuations that are passed into prices. Figure 2.4 shows a similar trend based on the median pass-through rate for each rounded percent of market share. These results follow closely with the basic theoretical model shown in Section 2.2. Pass-through rates that decrease with market share until reaching a minimum at some share greater than 50% is a predictable result if elasticity of substitution across goods is low relative to elasticity of substitution within goods. Other theoretical results in the literature at least partially predict this behavior as well. According to the early theory put forth by Dornbusch (1987), pass-through should be greatest for when market share is largest. This logic could explain the relatively higher values of pass-through at the upper extreme of the distribution, but it would not predict the overall downward trend that is seen in most of the data. However, Feenstra et al. (1996) show that under the assumption of a CES utility function, a U-shaped relationship as found this study is conceivable.
While the trend of pass-through rates across market shares matches the theoretical results, the actual values (particularly those at the extremes) are lower than expected\textsuperscript{23}. The model predicts countries with complete control of the market and countries with market shares close to 0% to have complete pass-through. Empirically, however, I find the median pass-through rate of countries with at least 99% shares to be 12.96% while the median pass-through for countries controlling less than 1% of the market is 16.07%\textsuperscript{24}. These values are relatively high compared to pass-through rates from market shares in the middle but they do not approach the predicted 100% pass-through from the theoretical model\textsuperscript{25}.

\textsuperscript{23}Low pass-through rates relative to theoretical predictions are common in empirical studies, especially those based on data in the 1990s. Marazzi and Sheets (2007), Ceglowski (2010), and Gust et al. (2010) are among the many works that investigate this puzzle.

\textsuperscript{24}These values are particularly low as only one lag is used in the baseline specification of the pass-through calculation (Equation 2.16). However, pass-through calculations based on longer lags are much lower than the theory predicts as well.

\textsuperscript{25}Lower than expected pass-through could also be a result of omitted variables. Clearly, prices do not exclusively depend on the exchange rate as the quality of goods and demand for certain imports are constantly changing. While the rolling regression model accounts for overall price levels in the two countries and GDP of the United States, there are certainly impediments to production and trade at the country and firm levels that are unaccounted for.
To further show the empirical relationship between pass-through rates and market shares, I run a quadratic regression of the calculated pass-through values on market share with dummy variables denoting quarter, two-digit commodity, and country of origin. This regression follows the model:

\[ \text{ERPT}_{c,j,t} = \alpha_c + \gamma_j + \delta_t + \beta_1 \text{share}_{c,j,t} + \beta_2 \text{share}^2_{c,j,t} + \epsilon_{c,j,t}. \] (2.17)

The regression shows significant negative linear and positive quadratic coefficients (Table 2.1), further suggesting that the theoretical U-shaped relationship holds empirically\(^{26}\). The table also shows that this relationship holds when the indicator variables are included in the regressions. Most importantly, the significance of the linear and quadratic coefficients in the presence of quarter-dummy variables implies that the quadratic relationship exists across the full time-span of the dataset.

<table>
<thead>
<tr>
<th>Country Fixed Effect</th>
<th>2-Digit Good Fixed Effect</th>
<th>Quarter Fixed Effect</th>
<th>Share Coefficient</th>
<th>t-Statistic</th>
<th>Share(^2) Coefficient</th>
<th>t-Statistic</th>
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<td>No</td>
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<td>0.0001</td>
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<td>Yes</td>
<td>Yes</td>
<td>-0.0108</td>
<td>-7.76**</td>
<td>0.0001</td>
<td>5.27**</td>
</tr>
</tbody>
</table>

** denotes \(p < 0.01\)

This pattern generally reflects the idea that exporters towards the upper and lower extremes of market power are the most likely to pass exchange rates shocks into import prices. This finding supports the model in Section 2.2 which predicts complete pass-through at the two extremes of market power.

\(^{26}\)The theoretical relationship between pass-through and market share (Equation 2.12) is clearly more involved than a quadratic relationship. Additionally, both the theoretical and empirical plots of the data (Figures 2.1, 2.2, 2.3, and 2.4) show more skew than a standard parabola, as the downward sloping component covers a wider range of market shares than does the upward sloping part. However, given the rises at the extremes, it seems appropriate to model based on a quadratic relationship. Feenstra et al. (1996) also use a quadratic regression of pass-through on market share despite a more complex theoretical model.
market shares. The reduction in pass-through as shares rise from the minimum is also predicted
as exporters with larger shares have greater freedom to adjust markups and absorb shocks without
directly changing prices while smaller competitors are forced to pass exchange rate depreciations
on to prices at a greater rate. Additionally, it could be that countries with larger market shares in
competitive markets are driven by a desire to maintain what they have. In the dynamic model of
Froot and Klemperer (1989), forward-looking firms are motivated to maintain their current market
shares and because of this, exporters will hold prices down when foreign currency appreciates vs.
the dollar. 27 While these models do not explicitly state whether firms with small, medium or large
market shares are more or less inclined to behave this way, it is reasonable to suggest that countries
with relative dominance in the US import market for a particular good will resist price adjustment
due to exchange rate fluctuations in order to maintain that control.

**Linear Splines Show Increasing Pass-Through with Large Shares**

The plots of pass-through across market shares (Figures 2.3 and 2.4) show much clearer patterns
of pass-through declining as shares increase at the low end of the distribution compared to the
rise in pass-through at the upper end. Linear regressions of pass-through on market shares show
significant, negative slope coefficients, implying that the downward trend is the stronger component
of the relationship. To examine the behavior of pass-through specifically at the upper end of the
distribution, I fit the data with a linear spline of the form:

$$ERPT_{c,j,t} = \alpha_c + \gamma_j + \delta_t + \beta_1 \text{share}_{c,j,t} + (\beta_2 - \beta_1)(\text{share}_{c,j,t} - \kappa)_+ + \epsilon_{c,j,t}. \quad (2.18)$$

In Equation 2.18, \(\kappa\) denotes the spline’s knot, and \(X_+\), takes the value of \(X\) if it is positive
and zero otherwise. The coefficients \(\beta_1\) and \(\beta_2\) refer to the slopes of the linear components below

---

27 Kleshchelski and Vincent (2009) show with survey data that firms hold prices stable in order to maintain market
share and keep the customers they have. While not directly referring to pass-through, there is also evidence from
the industrial organization and marketing literatures suggesting that firms will attempt to maintain market shares to
increase long-run profits, even if it means accepting a short-term loss. Fornell and Wernerfelt (1987) address this
in terms of marketing strategies to maintain market shares. Klemperer (1995) addresses the importance of “brand
loyalty”, noting the long-term benefits of low prices to build and keep a share of the market.
and above the knot respectively. As with the quadratic regression, this model includes indicator variables for quarter, two-digit commodity, and country of origin. Different values of $\kappa$ produce different slope coefficients for lower and higher shares (Table 2.2). However, when the knot is at any share greater than 56%, there is a significant, positive slope coefficient on the upper part of the spline, implying a significant rise in pass-through when market shares approach 100%.

<table>
<thead>
<tr>
<th>Knot Location</th>
<th>Lower Component</th>
<th>Upper Component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slope Coefficient</td>
<td>t-statistic</td>
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<tr>
<td>50%</td>
<td>−0.0068</td>
<td>−8.21**</td>
</tr>
<tr>
<td>60%</td>
<td>−0.0062</td>
<td>−8.52**</td>
</tr>
<tr>
<td>70%</td>
<td>−0.0057</td>
<td>−8.80**</td>
</tr>
<tr>
<td>80%</td>
<td>−0.0052</td>
<td>−8.77**</td>
</tr>
<tr>
<td>90%</td>
<td>−0.0046</td>
<td>−8.52**</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$

Finally, I compare the quadratic and linear spline models to determine the better fit. Davidson and McKinnon’s (1981) $J$ test rejects the spline model in favor of the quadratic model for all knot placements ($p < 0.01$). Reversing the roles, the $J$ test rejects the quadratic model in favor of the spline when the knot is set at any market share greater than 56% and less than 63%. As an alternative, I consider a Cox test to compare the models. The Cox test suggests that the regressors in the quadratic model are appropriate ($q = 1.85$). The test also rejects the hypothesis that a linear spline is an appropriate model ($|q| > 1.96$ for all knots, $56\% < \kappa < 63\%$). In conclusion, I find that a quadratic fit is a better model of pass-through across market shares than a two-component linear spline. However, the spline does show the significant rise in pass-through at the upper end of the range of shares.

### 2.4.2 Examining the Largest Shares

Having shown the general pattern of pass-through across market shares, I now show that the trade partner holding the largest share has lower pass-through than its competitors. This finding holds fairly consistently across the full timespan of the data and does not vary based on which country
has the largest share.

One prediction of the theoretical model discussed in Section 2.2 is that the country with the larger market share will have the lower pass-through rate (see Appendix 2.6.4 for the proof). For this section, I only consider commodity-quarter combinations for which the pass-through rate from the country with the largest share is calculated, plus at least one other observation so as to have a basis of comparison. This clearly implies that only commodity-quarters where at least two countries are competing are included. An initial t-test indicates a significantly lower average pass-through rate for goods with the largest share as compared to other goods (\( p < 0.0001 \)). Similar results are found using the more robust Mann-Whitney test comparing median pass-through for maximum shares (0.0507) with non-maximum shares (0.1139)\(^{28}\). A chi-square test also suggests a significant relationship (\( p < 0.0001 \)) between an exporter having the largest share of the market and having the lowest pass-through rate in that market.

As is previously noted, one of the common findings in the literature on pass-through is a large drop in pass-through rates in the late 1990s. This trend is found in many calculations of pass-through for both imports and exports worldwide, but it is particularly dramatic in pass-through to US imports. Across all observations with pass-through calculations, I find a median rate of 0.1778 in the first quarter of 1998, which falls to 0.0418 by the second quarter of 2002 before rising again. The established relationship of higher market shares having lower pass-through rates could play a role in this drop-off. Figure 2.5 shows a plot of the median pass-through from the largest shareholder over time, in comparison to the median pass-through of all goods and competing countries. While the largest exporter’s pass-through is fairly consistently lower than that of the smaller exporters across the full time span, this is particularly true for the drop in the late 1990s and early 2000s. In fact, during the later quarters, when overall pass-through is at its lowest, the median pass-through rate of the largest exporters is negative, implying that such countries actu-

\(^{28}\)The median pass-through for exporters with maximum shares is also significantly lower than the median pass-through for those with the second largest share, a result that holds true even when only considering two exporters whose shares are within 5\% of each other. For good-quarter combinations that have at least three competing exporters, there is no significant difference between the pass-through rates of the second largest competitor and the third largest. This suggests that the lead exporter behaves differently than its competitors, beyond the general downward trend in pass-through by shares shown in Section 2.4.1
ally lowered prices of imports to the United States following a devaluation of the dollar. This is not necessarily evidence that the largest competitors fully caused pass-through to drop. But it does suggest a possible connection between the two trends. It should also be noted that the median value for the largest market share is between 47% and 49.5% at all times. So it is unlikely that larger exporters controlling a greater share caused the drop in pass-through, but rather those countries reduced pass-through to even lower rates.

Figure 2.5: Median pass-through over time for all data and specifically for countries holding the largest share of a good’s market in a quarter.

2.4.3 Differences in Pass-Through for Types of Goods

In this section, I show that the overall relationship between pass-through rates and market share holds when taking into account the type good being traded. The general U-shaped pattern is seen in most of the categories of goods when they are viewed individually, particularly those goods that comprise a larger share of total imports.

According to the United States International Trade Commission, imported goods can be broken
into twenty categories based on the first two digits of the HTS code. Table 2.3 indicates the categories, and gives the percentage of the dataset that each comprises as well as the median pass-through rate for goods in each category. Clearly, the twenty categories vary drastically in size. The categories “Machinery and Mechanical Appliances, etc” and “Vehicles, Aircraft, etc” each contain more than 23% of the value, while eight other categories have less than two percent each. Focusing in particular on the largest category (machinery), the median pass-through rate for goods in this category (0.0845) is slightly smaller than the median overall rate (0.1028). However, a plot of pass-through by market shares for machinery as compared to pass-through for all other goods (Figure 2.6) shows generally similar patterns for the two groups.

![Figure 2.6: Median pass-through by market share for machinery compared with all other goods.](image)

---

29“Percentage” of the dataset refers to the percentage of dollar value among imports for which pass-through calculations were made. The only category for which this percentage differs greatly from the percentage of overall import value is “Mineral Products” which is the sixth largest category among all imports, but the sixteenth largest for which pass-through calculations were made. Most commodities classified as “mineral products” are not manufactures, and are imported more sporadically than most manufactured goods. This explains the large drop in this category’s market share.

30Similar graphs for the other 19 categories have substantially more noise due to the reduced number of observations in those categories.
Table 2.3: Market shares and median pass-through rates by category of imported good.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent of Market Share</th>
<th>Median Pass-Through</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live Animals; Animal Products</td>
<td>0.61%</td>
<td>0.2261</td>
</tr>
<tr>
<td>Vegetable Products</td>
<td>0.35%</td>
<td>0.1103</td>
</tr>
<tr>
<td>Animal or Vegetable Fats and Oils</td>
<td>0.23%</td>
<td>0.2077</td>
</tr>
<tr>
<td>Prepared Foodstuffs</td>
<td>2.92%</td>
<td>0.1728</td>
</tr>
<tr>
<td>Mineral Products</td>
<td>1.22%</td>
<td>0.0898</td>
</tr>
<tr>
<td>Products of the Chemical Industries etc</td>
<td>6.08%</td>
<td>0.1296</td>
</tr>
<tr>
<td>Plastics and Rubber Articles</td>
<td>3.00%</td>
<td>0.1180</td>
</tr>
<tr>
<td>Raw Hides and Skins, Leather, etc</td>
<td>1.28%</td>
<td>0.0609</td>
</tr>
<tr>
<td>Wood and Articles of Wood</td>
<td>1.83%</td>
<td>-0.0261</td>
</tr>
<tr>
<td>Pulp of Wood etc</td>
<td>3.17%</td>
<td>0.1638</td>
</tr>
<tr>
<td>Textile and Textile Articles</td>
<td>9.85%</td>
<td>0.1055</td>
</tr>
<tr>
<td>Footwear, Headgear, etc</td>
<td>2.49%</td>
<td>0.0448</td>
</tr>
<tr>
<td>Misc Manufactured Articles</td>
<td>1.33%</td>
<td>0.1222</td>
</tr>
<tr>
<td>Precious or Semi Precious Stones, etc</td>
<td>2.93%</td>
<td>-0.0153</td>
</tr>
<tr>
<td>Base Metals and Articles of Base Metals</td>
<td>6.32%</td>
<td>0.0551</td>
</tr>
<tr>
<td>Machinery and Mechanical Appliances, etc</td>
<td>27.38%</td>
<td>0.0845</td>
</tr>
<tr>
<td>Vehicles, Aircraft, etc</td>
<td>23.62%</td>
<td>0.1118</td>
</tr>
<tr>
<td>Optical, Photographic, etc</td>
<td>2.69%</td>
<td>0.1122</td>
</tr>
<tr>
<td>Arms and Ammunition</td>
<td>0.07%</td>
<td>0.2270</td>
</tr>
<tr>
<td>Articles of Stone, Plaster, etc</td>
<td>2.61%</td>
<td>0.1111</td>
</tr>
</tbody>
</table>

Based on regressions of pass-through on market share for each category, ten of the twenty categories show the same positive quadratic relationship \((p < 0.10)\) that is seen for the dataset as a whole (Table 2.4). These ten categories represent 54% of the total observations in the dataset, and 32% of the total value of goods considered. However, only two categories (“Prepared Foodstuffs” and “Footwear, Headgear, etc”) completely contradict the general findings, with positive linear and significant negative quadratic coefficients. These two contradicting categories comprise only 5.41% of the total value of imported goods. Additionally, fifteen of the twenty categories (representing over 90% of the value of imports) indicate the predicted positive U-shaped pattern, though not necessarily with significance. So while the findings within each category are clearly not perfect matches of the overall predicted pattern, there is an indication that the basic relationship holds.
exists between pass-through and market share, it is a negative relationship.

In the dataset, and 86% of the total value of imported goods. This list also includes the four largest categories and six of the top seven. On the other hand, none of the twenty categories shows a significant negative linear trend than positive quadratic relationships. More categories, representing a greater proportion of import quantity and value, show significant negative linear trends than positive quadratic relationships.

As an alternative, I examine a linear regression of pass-through on market share within each category to show overall downward trend in most types of goods (Table 2.5). For thirteen of the twenty categories, I find at least moderately significant negative coefficients on the slope term in the linear regression ($p < 0.10$). These thirteen categories comprise 85% of the total observations in the dataset, and 86% of the total value of imported goods. This list also includes the four largest categories and six of the top seven. On the other hand, none of the twenty categories shows a significant positive slope. This suggests that within specific categories of goods, where a relationship exists between pass-through and market share, it is a negative relationship. Countries with larger market shares tend to pass exchange rate movements into prices to a lesser degree than those with

\[ \text{Percent of Market Share} \]

**Table 2.4: Quadratic regression results of pass-through on market shares by category of goods.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent of Market Share</th>
<th>Share Coefficient</th>
<th>t-statistic</th>
<th>Share$^2$ Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery, Mechanical Appliances, etc</td>
<td>27.38%</td>
<td>-0.0131</td>
<td>-3.23**</td>
<td>0.0001</td>
<td>1.24</td>
</tr>
<tr>
<td>Vehicles, Aircraft, etc</td>
<td>23.62%</td>
<td>-0.0103</td>
<td>-1.64</td>
<td>0.0001</td>
<td>0.75</td>
</tr>
<tr>
<td>Textile and Textile Articles</td>
<td>9.85%</td>
<td>-0.0149</td>
<td>-6.87**</td>
<td>0.0002</td>
<td>5.54**</td>
</tr>
<tr>
<td>Base Metals, Articles of Base Metals</td>
<td>6.32%</td>
<td>-0.0199</td>
<td>-6.21**</td>
<td>0.0002</td>
<td>2.59**</td>
</tr>
<tr>
<td>Products of the Chemical Industries etc</td>
<td>6.08%</td>
<td>-0.0012</td>
<td>-0.38</td>
<td>0.0001</td>
<td>0.80</td>
</tr>
<tr>
<td>Pulp of Wood etc</td>
<td>3.17%</td>
<td>-0.0280</td>
<td>-3.90**</td>
<td>0.0003</td>
<td>3.00**</td>
</tr>
<tr>
<td>Plastics and Rubber Articles</td>
<td>3.00%</td>
<td>-0.0271</td>
<td>-3.72**</td>
<td>0.0002</td>
<td>1.90†</td>
</tr>
<tr>
<td>Precious or Semi Precious Stones, etc</td>
<td>2.93%</td>
<td>-0.1391</td>
<td>-3.44**</td>
<td>0.0015</td>
<td>3.15**</td>
</tr>
<tr>
<td>Prepared Foodstuffs</td>
<td>2.92%</td>
<td>0.0134</td>
<td>5.13**</td>
<td>-0.0002</td>
<td>-5.17**</td>
</tr>
<tr>
<td>Optical, Photographic, etc</td>
<td>2.69%</td>
<td>-0.0200</td>
<td>-2.63**</td>
<td>0.0002</td>
<td>2.16*</td>
</tr>
<tr>
<td>Articles of Stone, Plaster, etc</td>
<td>2.61%</td>
<td>-0.0280</td>
<td>-0.32</td>
<td>-0.0003</td>
<td>-2.64**</td>
</tr>
<tr>
<td>Footwear, Headgear, etc</td>
<td>2.49%</td>
<td>0.0105</td>
<td>1.42</td>
<td>-0.0002</td>
<td>-2.77**</td>
</tr>
<tr>
<td>Wood and Articles of Wood</td>
<td>1.83%</td>
<td>-0.0182</td>
<td>-2.21*</td>
<td>0.0001</td>
<td>1.74†</td>
</tr>
<tr>
<td>Misc Manufactured Articles</td>
<td>1.33%</td>
<td>-0.0499</td>
<td>-4.88**</td>
<td>0.0005</td>
<td>3.26**</td>
</tr>
<tr>
<td>Raw Hides and Skins, Leather, etc</td>
<td>1.28%</td>
<td>-0.0235</td>
<td>-2.00*</td>
<td>-0.0002</td>
<td>-1.23</td>
</tr>
<tr>
<td>Mineral Products</td>
<td>1.22%</td>
<td>-0.0154</td>
<td>-1.29</td>
<td>0.0002</td>
<td>1.21</td>
</tr>
<tr>
<td>Live Animals; Animal Products</td>
<td>0.61%</td>
<td>-0.0393</td>
<td>-5.34**</td>
<td>0.0004</td>
<td>5.88**</td>
</tr>
<tr>
<td>Vegetable Products</td>
<td>0.35%</td>
<td>-0.0313</td>
<td>-3.98**</td>
<td>0.0003</td>
<td>3.43**</td>
</tr>
<tr>
<td>Animal or Vegetable Fats and Oils</td>
<td>0.23%</td>
<td>-0.0070</td>
<td>-0.65</td>
<td>0.0001</td>
<td>0.66</td>
</tr>
<tr>
<td>Arms and Ammunition</td>
<td>0.07%</td>
<td>0.0178</td>
<td>0.89</td>
<td>-0.0001</td>
<td>-0.47</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$

**Linear Regression Models**

As an alternative, I examine a linear regression of pass-through on market share within each category to show overall downward trend in most types of goods (Table 2.5). For thirteen of the twenty categories, I find at least moderately significant negative coefficients on the slope term in the linear regression ($p < 0.10$). These thirteen categories comprise 85% of the total observations in the dataset, and 86% of the total value of imported goods. This list also includes the four largest categories and six of the top seven. On the other hand, none of the twenty categories shows a significant positive slope. This suggests that within specific categories of goods, where a relationship exists between pass-through and market share, it is a negative relationship. Countries with larger market shares tend to pass exchange rate movements into prices to a lesser degree than those with
small shares, with pass-through rates decreasing linearly starting at the low end of the distribution of market shares.

Table 2.5: Linear regression results of pass-through on market shares by category of goods.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent of Market Share</th>
<th>Share Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery and Mechanical Appliances, etc</td>
<td>27.38%</td>
<td>-0.0084</td>
<td>-5.73**</td>
</tr>
<tr>
<td>Vehicles, Aircraft, etc</td>
<td>23.62%</td>
<td>-0.0058</td>
<td>-3.05**</td>
</tr>
<tr>
<td>Textile and Textile Articles</td>
<td>9.85%</td>
<td>-0.0037</td>
<td>-4.80**</td>
</tr>
<tr>
<td>Base Metals and Articles of Base Metals</td>
<td>6.32%</td>
<td>-0.0121</td>
<td>-10.92**</td>
</tr>
<tr>
<td>Products of the Chemical Industries etc</td>
<td>6.08%</td>
<td>0.0012</td>
<td>1.23</td>
</tr>
<tr>
<td>Pulp of Wood etc</td>
<td>3.17%</td>
<td>-0.0075</td>
<td>-3.41**</td>
</tr>
<tr>
<td>Plastics and Rubber Articles</td>
<td>3.00%</td>
<td>-0.0142</td>
<td>-5.35**</td>
</tr>
<tr>
<td>Precious or Semi Precious Stones, etc</td>
<td>2.93%</td>
<td>-0.0192</td>
<td>-1.40</td>
</tr>
<tr>
<td>Prepared Foodstuffs</td>
<td>2.92%</td>
<td>0.0005</td>
<td>0.64</td>
</tr>
<tr>
<td>Optical, Photographic, etc</td>
<td>2.69%</td>
<td>-0.0042</td>
<td>-1.94†</td>
</tr>
<tr>
<td>Articles of Stone, Plaster, etc</td>
<td>2.61%</td>
<td>-0.0249</td>
<td>-8.64**</td>
</tr>
<tr>
<td>Footwear, Headgear, etc</td>
<td>2.49%</td>
<td>-0.0092</td>
<td>-4.62**</td>
</tr>
<tr>
<td>Wood and Articles of Wood</td>
<td>1.83%</td>
<td>-0.0042</td>
<td>-2.28*</td>
</tr>
<tr>
<td>Misc Manufactured Articles</td>
<td>1.33%</td>
<td>-0.0188</td>
<td>-5.12**</td>
</tr>
<tr>
<td>Raw Hides and Skins, Leather, etc</td>
<td>1.28%</td>
<td>-0.0374</td>
<td>-10.43**</td>
</tr>
<tr>
<td>Mineral Products</td>
<td>1.22%</td>
<td>-0.0015</td>
<td>-0.45</td>
</tr>
<tr>
<td>Live Animals; Animal Products</td>
<td>0.61%</td>
<td>0.0028</td>
<td>1.64</td>
</tr>
<tr>
<td>Vegetable Products</td>
<td>0.35%</td>
<td>-0.0054</td>
<td>-2.46*</td>
</tr>
<tr>
<td>Animal or Vegetable Fats and Oils</td>
<td>0.23%</td>
<td>-0.0001</td>
<td>-0.02</td>
</tr>
<tr>
<td>Arms and Ammunition</td>
<td>0.07%</td>
<td>0.0087</td>
<td>1.31</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$

The fact that a significant negative linear relationship holds across more categories representing a larger proportion of total imports goes against the theoretical U-shaped relationship discussed in Section 2.2. However, that predicted relationship is not necessarily parabolic. In fact, while the theory predicts complete pass-through when market share is 0% or 100%, as well as a minimum pass-through that occurs when share is greater than 50%, the exact location of the minimum and the skewness of the relationship depend on the elasticities of substitution. These values (elasticity of substitution from one commodity to another and elasticity of substitution from one country’s version of a commodity to another country’s) are different for each good and each exporting country. Furthermore, the exact nature of how pass-through rises to one at the upper end of the distribution of market shares is unclear. It is entirely possible that within many of the categories, the elas-
ticities are such that the U-shaped distribution is skewed enough that the downslope component dominates, making a linear fit more appropriate than a quadratic. The empirical findings seem to suggest that for a large proportion of traded goods, the elasticity of substitution from one version to another greatly exceeds the elasticity of substitution to a different good. As can be seen in Panel A of Figures 2.1 and 2.2, when $\rho$ greatly exceeds $\eta$, the model predicts essentially a linear relationship until market share is nearly 100%. Given the relative scarcity of observations with high market shares compared to those at the lower end, it makes sense that the nature of the empirical relationship with pass-through would be less clear as market shares approach 100%. Under these settings, for most categories of imports, the empirical findings reflect the theoretical predictions.

2.4.4 Effects of Size and Direction of Fluctuations

While Sections 2.4.1 - 2.4.3 show the show that pass-through rates behave as predicted across market shares, with the general pattern holding within most specific categories of imports, here I consider asymmetries in pass-through behavior depending on the size and the direction of exchange rate movements. I find that the direction of fluctuations alone does not play a role in determining pass-through. However, the established relationship between pass-through and market share is more dramatic following large exchange rate movements as opposed to small changes. In particular, combining the size and direction effects, I find that the relationship holds with large increases in the dollar’s value, but breaks down after a large devaluation.

Symmetry of Exchange Rate Appreciations and Depreciations

Recent theoretical and empirical studies on exchange rate pass-through have made note of possible differences in the way prices respond to exchange rate fluctuations depending on the whether the importing country’s currency appreciates or depreciates relative to the exporter’s, as well as the size of such fluctuations\textsuperscript{32}. I first test whether the direction of the exchange rate fluctuation im-

\textsuperscript{32}Pollard and Coughlin (2004) examine the possibility of asymmetric effects from exchange rate movements. Using industry-level data on manufactured goods, they find that pass-through behaves differently in most industries following an appreciation of the dollar’s value as opposed to a depreciation, though the magnitude and direction of this effect
pacts the rate of pass-through by separating observations for which the real exchange rate rose over the twelve year rolling regression window (dollar depreciation) from those in which the exchange rate fell (dollar appreciation). Noting that over the life of this dataset, the dollar generally became stronger against most foreign currencies, there are more observations for which the exchange rate drops (1,068,254) as opposed to rises (735,211). An initial comparison of pass-through rates suggests that the direction the exchange rate moves does not impact pass-through. While the median pass-through rate following a fall in the real exchange rate (0.1038) is marginally greater than following a rise (0.1014), a Mann-Whitney test does not indicate that the difference is significant ($p = 0.36$).

Additionally, the U-shaped relationship between pass-through and market share remains essentially the same following a rise and a fall, as is seen in the plot of median pass-through rates by rounded market shares (Figure 2.7). Individual quadratic regressions on observations corresponding to both directions of exchange rate movement show significant positive quadratic coefficients ($p < 0.01$), results that hold when dummy variables for two-digit goods and country of origin are included. Clearly, on its own, the direction in which the real exchange rate moves does not drastically impact pass-through or its relationship with market share.

**Larger Exchange Rate Movements Have Greater Effects on Pass-Through**

After finding that the direction of a change in exchange rate does not impact pass-through in terms of size or relationship with market share, I next examine the impact of different size changes in the exchange rate. The focus is specifically on the absolute value of the percent change in real exchange rate over the twelve-quarter window for the rolling regressions used to calculate pass-through. Breaking all observations into ten equal sized groups and ordering from smallest to largest by percent change in real exchange rate, the first columns of Table 2.6 show a general pattern of the differents across industries. They also find pass-through rates to be different depending on the size of the change in exchange rate, with larger fluctuations resulting in higher pass-through. This difference based on size holds for both rises and falls in the exchange rate and is a stronger effect than the direction effect. Knetter (1994) addresses the possibility of pass-through being different following exchange rate appreciations as opposed to depreciations, and Olivei (2002) also notes it as a potential reason for the decline in pass-through in the 1990s.
Figure 2.7: Median pass-through by market share following dollar appreciations and depreciations. Median pass-through increasing as the size of the exchange rate fluctuation increases in magnitude. This trend suggests that exporters to the United States adjust markups by a smaller amount when faced with a larger change in the exchange rate, thus allowing prices to reflect the changing dollar value to a greater degree. However, the top group, representing the largest 10% of exchange rate movements, shows a much smaller median pass-through rate following exchange rate fluctuations larger than 30.55% in either direction.

Of greater interest for this chapter is the relationship of pass-through across market shares based on the size of the exchange rate movement. Quadratic regressions within each group (Table 2.6) show significant positive quadratic coefficients for each of the top eight groups, indicating that the U-shaped relationship between pass-through and market share predicted in Section 2.2 and seen with the analysis of the full dataset holds true across the largest 80% of exchange rate movements (though the relationship within largest group is only moderately significant). But this relationship does not hold for small changes in exchange rates. This finding (along with the relatively low median pass-through rates for the lowest two groups) implies that when the real exchange rate
remains relatively steady, exporters adjust markups to hold prices more constant, independent of the market shares held by such exporters.

**Large Dollar Appreciations Impact Pass-Through More Than Depreciations**

The impact of the size of the exchange rate movement on pass-through rates and the seeming lack of importance of the direction of the movement lead to a question of interaction between the size and direction effects. Specifically, I focus only on observations with large changes in the real exchange rate, defined by an exchange rate movement of at least $13.91\%$ in either direction. The first columns of Table 2.7 show that the median pass-through is larger following a large appreciation of the dollar (0.1223) than after a dollar depreciation (0.0877). This finding is strengthened by the Mann-Whitney comparison of medians showing that the difference is significant ($p < 0.001$).

These results point to a general conclusion that US import prices are more responsive to large rises in the value of the dollar than to large falls.$^{34}$

---

$^{33}$Note from Table 2.6 that this value represents the upper 50% of observations when ranked by $|\%\Delta RER|$. 545,819 out of the 900,567 observations considered (60.61%) represent exchange rate decreases. However, this is approximately proportional to the percentage of observations following drops in exchange rate in the full dataset (59.23%). So it seems an appropriate cutoff for comparing the effect of the direction of large exchange rate movements.

$^{34}$Knetter (1994) shows that foreign firms attempting to maintain market shares will adjust markups to a greater degree (and thus have higher pass-through rates) when the home country’s currency appreciates rather than depreciates.
Table 2.7: Median pass-through rates and quadratic regression results of pass-through on market shares following large real exchange rate rises and falls.

<table>
<thead>
<tr>
<th>Percent Change in Real Exchange Rate</th>
<th>Median Pass-Through</th>
<th>Share Coefficient</th>
<th>Share(^2) Coefficient</th>
<th>t-statistic</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dollar Appreciates</td>
<td>0.1223</td>
<td>-0.0113</td>
<td>-6.29**</td>
<td>0.0001</td>
<td>5.43**</td>
</tr>
<tr>
<td>Dollar Depreciates</td>
<td>0.0877</td>
<td>-0.0007</td>
<td>-0.25†</td>
<td>-0.0001</td>
<td>-0.07</td>
</tr>
</tbody>
</table>

** denotes \(p < 0.01\)  * denotes \(p < 0.05\)  † denotes \(p < 0.10\)

The difference between large appreciations and large depreciations carries over to the relationship with market shares. While pass-through is lower following dollar depreciations, it also no longer maintains a significant quadratic relationship across market shares. Table 2.7 also shows the regression results of pass-through on market share and squared market share based only on observations following large real exchange rate changes. While the linear and quadratic regression coefficients are still positive and negative respectively, the quadratic term is not significant following a dollar depreciation. This finding suggests that market share plays less of a role in exporters’ pricing decisions due to a dramatically weakening dollar than under typical circumstances. Alternatively, both coefficients are significant using data following a large dollar appreciation, implying that countries with very large and very small shares of the US market will lower prices the most when faced with a stronger dollar. If the relationship between pass-through and market share is assumed to be linear, regressions show negative trends following large exchange rate changes in either direction \((p < 0.05)\). However, when country and two-digit good effects are included, the trend is not significant for large increases in the exchange rate \((p = 0.356)\), but remains significant following large decreases \((p = 0.001)\).

Examining the differences between pass-through rates following large dollar appreciations and depreciations across categories of imports, linear regressions within each category (Table 2.8) show that the overall negative trend holds slightly better after dollar appreciations. Seven of the twenty categories have negative slope coefficients following appreciations, but these categories contain 66% of the observations considered and 72% of the value of imported goods. More noticeable is the lack of significant linear relationships in the large categories following dollar depreciations.
Six categories of goods show significant negative coefficients, but these categories represent 35% of observations and just 18% of the total import value. These findings further show the collapse of any association between market shares and pass-through following large dollar devaluations.

Table 2.8: Linear regression results of pass-through on market shares by category of goods following large rises and falls in the real exchange rate.

<table>
<thead>
<tr>
<th>Category</th>
<th>Exchange Rate Increase Share Coefficient</th>
<th>t-statistic</th>
<th>Exchange Rate Decrease Share Coefficient</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery and Mechanical Appliances, etc</td>
<td>-0.0006</td>
<td>-0.22</td>
<td>-0.0035</td>
<td>-1.76†</td>
</tr>
<tr>
<td>Vehicles, Aircraft, etc</td>
<td>-0.0037</td>
<td>-1.18</td>
<td>-0.0062</td>
<td>-2.26*</td>
</tr>
<tr>
<td>Textile and Textile Articles</td>
<td>-0.0032</td>
<td>-2.06*</td>
<td>-0.0023</td>
<td>-2.30*</td>
</tr>
<tr>
<td>Base Metals and Articles of Base Metals</td>
<td>-0.0021</td>
<td>-0.96</td>
<td>-0.0048</td>
<td>-3.12**</td>
</tr>
<tr>
<td>Products of the Chemical Industries etc</td>
<td>0.0001</td>
<td>0.07</td>
<td>0.0047</td>
<td>4.04**</td>
</tr>
<tr>
<td>Pulp of Wood etc</td>
<td>-0.0093</td>
<td>-1.51</td>
<td>-0.0020</td>
<td>-0.64</td>
</tr>
<tr>
<td>Plastics and Rubber Articles</td>
<td>-0.0150</td>
<td>-1.74†</td>
<td>-0.0034</td>
<td>-1.13</td>
</tr>
<tr>
<td>Precious or Semi Precious Stones, etc</td>
<td>0.0178</td>
<td>1.24</td>
<td>0.0274</td>
<td>3.12**</td>
</tr>
<tr>
<td>Prepared Foodstuffs</td>
<td>-0.0044</td>
<td>-3.64**</td>
<td>-0.0023</td>
<td>-2.34*</td>
</tr>
<tr>
<td>Optical, Photographic, etc</td>
<td>-0.0047</td>
<td>-1.30</td>
<td>-0.0038</td>
<td>-1.23</td>
</tr>
<tr>
<td>Articles of Stone, Plaster, etc</td>
<td>0.0023</td>
<td>0.35</td>
<td>-0.0013</td>
<td>-0.22</td>
</tr>
<tr>
<td>Footwear, Headgear, etc</td>
<td>0.0041</td>
<td>1.29</td>
<td>-0.0049</td>
<td>-1.15</td>
</tr>
<tr>
<td>Wood and Articles of Wood</td>
<td>-0.0108</td>
<td>-3.41**</td>
<td>0.0110</td>
<td>4.77**</td>
</tr>
<tr>
<td>Misc Manufactured Articles</td>
<td>-0.0036</td>
<td>-0.77</td>
<td>-0.0072</td>
<td>-1.66†</td>
</tr>
<tr>
<td>Raw Hides and Skins, Leather, etc</td>
<td>0.0275</td>
<td>3.59**</td>
<td>-0.0015</td>
<td>-0.25</td>
</tr>
<tr>
<td>Mineral Products</td>
<td>0.0005</td>
<td>0.14</td>
<td>0.0079</td>
<td>1.40</td>
</tr>
<tr>
<td>Live Animals; Animal Products</td>
<td>-0.0052</td>
<td>-3.45**</td>
<td>0.0025</td>
<td>1.21</td>
</tr>
<tr>
<td>Vegetable Products</td>
<td>-0.0183</td>
<td>-3.88**</td>
<td>-0.0048</td>
<td>-2.24*</td>
</tr>
<tr>
<td>Animal or Vegetable Fats and Oils</td>
<td>-0.0055</td>
<td>-0.99</td>
<td>0.0027</td>
<td>0.70</td>
</tr>
<tr>
<td>Arms and Ammunition</td>
<td>0.0128</td>
<td>1.30</td>
<td>0.0005</td>
<td>0.07</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$ † denotes $p < 0.10$

The results in this section show some asymmetries in pass-through rates, particularly in terms of behavior across market shares. On its own, the direction of an exchange rate fluctuation does not produce different pass-through results. However, the larger changes in the real exchange rate, specifically those representing a weakening dollar, result in a breakdown of the general relationship between pass-through and market shares. Under such settings, market share is no longer a significant predictor of pass-through rates.
2.4.5 Robustness Checks

The results presented in this section are based on certain specifications of the rolling regression model (Equation 2.16). Specifically, I use a lag length of one quarter and a rolling regression window of twelve quarters. It is necessary to check the effects of changing either of these settings. Therefore, I repeat each section of the analysis using two lags instead of one, and with rolling regression windows of four, eight, and twenty quarters. Additionally, prior to calculating pass-through, I dropped any commodity-country combination for which more than 10% of prices had to be imputed due to incorrect or missing data, or lack of trade in that particular good. While the 10% cutoff is accepted in the literature, I also repeat the calculations using only commodity-country series for which all data is available.

Different Model Specifications Produce Similar Results

In total, there are sixteen different specification combinations (two lag lengths, four windows, and two thresholds for dropping a series). The quadratic regressions of pass-through on market shares are significant under all specifications, though there is more variability in the data when the smaller rolling regression windows are considered. Introducing indicator variables for two-digit commodities does not change the results, but when country-level dummy variables are included the quadratic terms are insignificant in four of the sixteen specifications (two quarter lags, four or twenty quarter windows, both thresholds). The fact that the relationship holds under all specifications with one lag but not with two lags could imply that the observed pattern of pass-through across market shares is more of a short-run effect that fades slightly over time. However, it could also call into question the importance of considering country-specific indicators. Linear regressions find significant negative relationships between pass-through and market share under all specifications, with or without country, quarter, and two-digit good indicators.

The country holding the largest share of the import market for a good has a significantly lower median pass-through rate under all specifications. This effect gets stronger when the model includes two lags instead of one. Plots of median pass-through over time for the country with the
largest share vs. all countries (similar to Figure 2.5) show a larger and more consistent gap between the two, though this gap is less striking for smaller windows. When considering different categories, the results in the previous sections hold true under all sixteen settings, though fewer categories show any relationship when the window length is set at four quarters. Likewise, large drops in the exchange rate result in pass-through that varies with market share under all settings. This relationship breaks down for large rises in the exchange rate in all sixteen versions of the model as well. In general, the threshold for removing a series does not appear to have any effect on the results (at least when that value is set at 90% or greater). Other than in quadratic regressions with country-level dummy variables, varying between one and two quarter lags does not impact the results either. The choice of rolling regression window appears to be the one setting that has some effect as shorter windows do not allow some of the results to show. While the literature provides a basis for using windows of anywhere between four and twenty quarters, this chapter’s results appear clearest when the model is based on longer windows.

**Results Hold Using Market Share Percentiles Instead of Shares**

Exporters’ market shares are not evenly distributed from 0% to 100%. Substantially more countries have small shares of the market for a good than large shares, as is shown in Table 2.9. With the exception of a slight increase for countries with 100% of the import market, the number of observations by market share is monotonically decreasing. Because of this trend, I repeat the linear and quadratic regressions using market share percentile rather than actual market shares. This change does not alter the findings of the research as the same general patterns occur.
Table 2.9: Distribution of observations by market share.

<table>
<thead>
<tr>
<th>Percent of Market Share</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1%</td>
<td>445,150</td>
<td>25.37%</td>
</tr>
<tr>
<td>1-2%</td>
<td>181,164</td>
<td>10.32%</td>
</tr>
<tr>
<td>2-3%</td>
<td>119,220</td>
<td>6.79%</td>
</tr>
<tr>
<td>3-4%</td>
<td>89,262</td>
<td>5.09%</td>
</tr>
<tr>
<td>4-5%</td>
<td>71,430</td>
<td>4.07%</td>
</tr>
<tr>
<td>5-6%</td>
<td>58,714</td>
<td>3.35%</td>
</tr>
<tr>
<td>6-7%</td>
<td>49,774</td>
<td>2.84%</td>
</tr>
<tr>
<td>7-8%</td>
<td>43,348</td>
<td>2.47%</td>
</tr>
<tr>
<td>8-9%</td>
<td>38,038</td>
<td>2.17%</td>
</tr>
<tr>
<td>9-10%</td>
<td>34,023</td>
<td>1.94%</td>
</tr>
<tr>
<td>10-15%</td>
<td>128,097</td>
<td>7.30%</td>
</tr>
<tr>
<td>15-20%</td>
<td>86,978</td>
<td>4.96%</td>
</tr>
<tr>
<td>20-30%</td>
<td>113,875</td>
<td>6.49%</td>
</tr>
<tr>
<td>30-40%</td>
<td>73,604</td>
<td>4.19%</td>
</tr>
<tr>
<td>40-50%</td>
<td>53,083</td>
<td>3.02%</td>
</tr>
<tr>
<td>50-60%</td>
<td>40,700</td>
<td>2.32%</td>
</tr>
<tr>
<td>60-70%</td>
<td>33,365</td>
<td>1.90%</td>
</tr>
<tr>
<td>70-80%</td>
<td>28,347</td>
<td>1.62%</td>
</tr>
<tr>
<td>80-90%</td>
<td>25,695</td>
<td>1.46%</td>
</tr>
<tr>
<td>90-99.99%</td>
<td>31,212</td>
<td>1.78%</td>
</tr>
<tr>
<td>100%</td>
<td>9,891</td>
<td>0.56%</td>
</tr>
</tbody>
</table>

2.5 Conclusion

The disconnect between exchange rate dynamics and overall price levels remains one of the primary puzzles in international economics, particularly as it pertains to import prices. In this chapter I have shown the clear relationship between the size of an exporting country’s market share and the degree to which that country passes exchange rate fluctuations into prices. As evidenced by highly disaggregated data on US imports, there is a clear negative relationship showing that pass-through is largest for trade partners with minimal shares of the market for a good. Pass-through rates tend to shrink for countries with larger market shares. Though the trend is less clear, pass-through rates rise for countries with very large market shares. I have also documented the finding that pass-through rates for the country with the largest share have significantly lower rates of pass-through than their competitors. These general findings hold true across many categories of imported man-
ufactured goods, most significantly in the fields with the highest volume and total value of trade. Additionally, I find that the direction in which the exchange rate moves over a given period does not seem to impact pass-through rates. However, when faced with large devaluations of the dollar, pass-through tends to be lower than following increases in the dollar’s value. Any relationship between pass-through and market share also tends to break down in the face of such large devaluations.

A simple theoretical model predicts many of these findings using basic assumptions of demand, production and competition between two exporting countries. In particular, the model predicts a U-shaped relationship similar to that seen in the US import data. It also provides a theoretical basis for the largest trade partner having smaller pass-through rates than its competitors. While the model predicts the highest pass-through rates to occur for countries controlling close to zero or close to one hundred percent of the market, it remains unclear how pass-through rises at the upper end of the distribution. This lack of clarity is seen in the data as the downward trend in pass-through as shares rise from zero is substantially more noticeable than the rise as shares approach 100%.

The findings in this chapter contribute to recent studies on low pass-through rates, including many involving the United States’ import market. As larger trade partners naturally influence overall import prices to a greater degree, the fact that countries with the smallest shares have the highest pass-through rates can at least partially explain why exchange rate dynamics are not seen in prices to the degree that they are expected. That such trends exist across the categories that dominate US trade in manufactures suggests that the disconnect between prices and exchange rates will persist as long as individual large exporters control trade in specific goods.
2.6 Appendix - Derivations and Proofs

2.6.1 Derivation of Optimal Price (Equation 2.9)

Country A maximizes its profit from exporting good $j$:

$$
\Pi_{jA} = p_{jA} q_{jA} - q_{jA} MC_{jA},
$$

where (from Equation 2.8):

$$
p_{jA} = P \left( \frac{q_{jA}}{y_j} \right)^{-\frac{1}{\rho}} \left( \frac{y_j}{C} \right)^{-\frac{1}{\eta}} = PC_{jA}^{\frac{1}{\eta}} q_{jA}^{1-\frac{1}{\rho}}. \tag{2.19}
$$

So A’s profit can be expressed:

$$
\Pi_{jA} = PC_{jA}^{\frac{1}{\eta}} q_{jA}^{1-\frac{1}{\rho}} - q_{jA} MC_{jA}. \tag{2.20}
$$

The first order condition of 2.20 gives:

$$
PC_{jA}^{\frac{1}{\eta}} \left( 1 - \frac{1}{\rho} \right) q_{jA}^{1-\frac{1}{\rho}} + PC_{jA}^{\frac{1}{\eta}} \left( \frac{1}{\rho} - \frac{1}{\eta} \right) y_j^{\frac{1}{\rho} - \frac{1}{\eta} - 1} \frac{\partial y_j}{\partial q_{jA}} q_{jA}^{1-\frac{1}{\rho}} = PC_{jA}^{\frac{1}{\eta}} q_{jA}^{1-\frac{1}{\rho}} \left[ 1 - \frac{1}{\rho} + \left( \frac{1}{\rho} - \frac{1}{\eta} \right) q_{jA} y_j^{-1} \frac{\partial y_j}{\partial q_{jA}} \right] = MC_{jA}. \tag{2.21}
$$

Substituting from Equation 2.19 gives:

$$
p_{jA} \left[ 1 - \frac{1}{\rho} + \left( \frac{1}{\rho} - \frac{1}{\eta} \right) q_{jA} y_j^{-1} \frac{\partial y_j}{\partial q_{jA}} \right] = MC_{jA}. \tag{2.22}
$$

Note that from Equation 2.4:

$$
y_j = \left[ \frac{\rho \eta}{q_{jA} + q_{jB}} \right]^{\frac{1}{\rho-1}}, \tag{2.23}
$$
so:

\[
\frac{\partial y_j}{\partial q_{jA}} = \left[ \frac{\varrho^{-1}}{q_{jA}} + \frac{\varrho^{-1}}{q_{jB}} \right] q_{jA}^{\varrho - 1} q_{jA}^{-1},
\]

(2.24)

and:

\[
q_{jA} y_j^{-1} \frac{\partial y_j}{\partial q_{jA}} = \left[ \frac{\varrho^{-1}}{q_{jA}} + \frac{\varrho^{-1}}{q_{jB}} \right] q_{jA}^{-1} q_{jA}^{\varrho}.
\]

(2.25)

From Equation 2.5:

\[
q_{jA} = \left( \frac{p_{jA}}{P_j} \right)^{-\varrho} y_j.
\]

(2.26)

Substituting for \(q_{jA}\) and \(q_{jB}\) in Equation 2.25 gives:

\[
q_{jA} y_j^{-1} \frac{\partial y_j}{\partial q_{jA}} = \left[ \left( \frac{p_{jA}}{P_j} \right)^{1-\varrho} y_j + \left( \frac{p_{jB}}{P_j} \right)^{1-\varrho} y_j \right]^{-1} \left( \frac{p_{jA}}{P_j} \right)^{1-\varrho} y_j^{\varrho}
\]

\[
= \frac{p_{jA}^{1-\varrho}}{p_{jA}^{1-\varrho} + p_{jB}^{1-\varrho}}.
\]

(2.27)

Additionally, using the standard expression for \(A\)’s share:

\[
S_{jA} = \frac{p_{jA} q_{jA}}{p_{jA} q_{jA} + p_{jB} q_{jB}}.
\]

(2.28)

Substituting Equation 2.26 produces:

\[
S_{jA} = \frac{p_{jA} \left( \frac{p_{jA}}{P_j} \right)^{-\varrho} y_j}{p_{jA} \left( \frac{p_{jA}}{P_j} \right)^{-\varrho} y_j + p_{jB} \left( \frac{p_{jB}}{P_j} \right)^{-\varrho} y_j} = \frac{p_{jA}^{1-\varrho}}{p_{jA}^{1-\varrho} + p_{jB}^{1-\varrho}},
\]

(2.29)

and therefore:

\[
q_{jA} y_j^{-1} \frac{\partial y_j}{\partial q_{jA}} = S_{jA},
\]

(2.30)
Plugging $A$'s share into the first order condition (Equation 2.22) gives:

\[ p_{jA} \left[ 1 - \frac{1}{\rho} + \left( \frac{1}{\rho} - \frac{1}{\eta} \right) S_{jA} \right] = MC_{jA}. \]  

(2.31)

Country $A$ then chooses the optimal selling price:

\[ p_{jA} = \left[ 1 - \frac{1}{\rho}(1 - S_{jA}) - \frac{1}{\eta} S_{jA} \right]^{-1} MC_{jA}. \]  

(2.32)

### 2.6.2 Derivation of the Pass-Through Expression (Equation 2.12)

Country $A$’s share of the import market for a good for which there are two competing trade partners is given:

\[ S_A = \frac{P_1^{1-\rho}}{P_1^{1-\rho} + P_B^{1-\rho}}, \]  

(2.33)

And $B$’s share is similarly:

\[ S_B = \frac{P_B^{1-\rho}}{P_A^{1-\rho} + P_B^{1-\rho}} = 1 - S_A. \]  

(2.34)

If prices are defined as a markup to marginal costs based on price-elasticity of demand, then prices can be expressed:

\[ P_A = \left[ 1 - \frac{1}{\rho}(1 - S_A) - \frac{1}{\eta} S_A \right]^{-1} MC_A = \frac{MC_A}{\chi + S_A \zeta} \]  

(2.35)

\[ P_B = \left[ 1 - \frac{1}{\rho}(1 - S_B) - \frac{1}{\eta} S_B \right]^{-1} MC_B = \frac{MC_B}{\chi + S_B \zeta} = \frac{MC_B}{\chi + \zeta - S_A \zeta}, \]  

(2.36)
where

\[ \chi = 1 - \frac{1}{\rho} \quad (2.37) \]

and

\[ \zeta = \frac{1}{\rho} - \frac{1}{\eta} \quad (2.38) \]

Note that since \( \eta > \rho > 1 \), then \( 0 < \chi < 1 \), \( -1 < \zeta < 0 \) and \( \chi > |\zeta| \). Therefore, if it is assumed that A has a larger share of the import market than B, then \( 0 < \chi + S_A \chi < \chi + \zeta - S_A \zeta \).

Plug (2.33) into (2.35) and solve for \( P_B \) as a function of \( P_A \):

\[
MC_A = (\chi + \frac{P_A^{1-\rho} \zeta}{P_A^{1-\rho} + P_B^{1-\rho}})P_A
\]

\[
MC_A = \chi P_A + \frac{P_A^{2-\rho} \zeta}{P_A^{1-\rho} + P_B^{1-\rho}}
\]

\[
P_A^{1-\rho} + P_B^{1-\rho} = \frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A}
\]

\[
P_B^{1-\rho} = \frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A} - P_A^{1-\rho}
\]

Compare (2.36) with (2.40):
\[
\frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A} - P_A^{1-\rho} = (\chi + \zeta - S_A \zeta)^{\rho-1} MC_B^{1-\rho}
\] (2.41)

Plug in (2.33) for \(A\)'s share:

\[
\frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A} - P_A^{1-\rho} = (\chi + \zeta - \frac{P_A^{1-\rho}}{P_A^{1-\rho} + P_B^{1-\rho}} \zeta)^{\rho-1} MC_B^{1-\rho}
\] (2.42)

Replace \(P_b^{1-\rho}\) using (2.40):

\[
\frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A} - P_A^{1-\rho} = (\chi + \zeta - \frac{P_A^{1-\rho}}{P_A^{1-\rho} + \frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A}} \zeta)^{\rho-1} MC_B^{1-\rho}
\] (2.43)

\[
\frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A} - P_A^{1-\rho} = (\chi + \zeta - \frac{P_A^{1-\rho} (MC_A - \chi P_A)}{P_A^{2-\rho} \zeta})^{\rho-1} MC_B^{1-\rho}
\] (2.44)

\[
\frac{P_A^{2-\rho} \zeta}{MC_A - \chi P_A} - P_A^{1-\rho} = (2\chi + \zeta - \frac{MC_A}{P_A} \zeta)^{\rho-1} MC_B^{1-\rho}
\] (2.45)

Equation (2.45) equates two expressions involving only \(P_A\), exogenous variables, and parameters. Due to complications isolating \(P_A\), I use implicit differentiation on both sides of (2.45) to determine \(\frac{\partial P_A}{\partial MC_A}\).

**Left Hand Side of (2.45)**

\[
\alpha = \frac{\partial P_A}{\partial MC_A}
\] (2.46)
\[
\frac{(MC_A - \chi P_A)\zeta(2 - \rho) P_A^{1-\rho} \alpha - \zeta P_A^{2-\rho}(1 - \alpha \chi)}{(MC_A - \chi P_A)^2} - (1 - \rho) P_A^{-\rho} \alpha
\]

(2.47)

\[
\frac{(MC_A - \chi P_A)\zeta(2 - \rho) P_A^{1-\rho} \alpha}{(MC_A - \chi P_A)^2} - \frac{\zeta P_A^{2-\rho}}{(MC_A - \chi P_A)^2} + \frac{\zeta \chi P_A^{2-\rho} \alpha}{(MC_A - \chi P_A)^2} - (1 - \rho) P_A^{-\rho} \alpha
\]

(2.48)

**Right Hand Side of (2.45)**

\[
MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2} \left(\frac{MC_A \alpha}{P_A^2} - \frac{1}{P_A}\right)
\]

(2.49)

\[
MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A \alpha}{P_A^2} - MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2} \frac{1}{P_A})
\]

(2.50)

**Solving for \(\alpha\)**

Equate (2.48) and (2.50), then separate terms with \(\alpha\) from terms without \(\alpha\).

\[
\frac{(MC_A - \chi P_A)\zeta(2 - \rho) P_A^{1-\rho} \alpha}{(MC_A - \chi P_A)^2} + \frac{\zeta \chi P_A^{2-\rho} \alpha}{(MC_A - \chi P_A)^2} - (1 - \rho) P_A^{-\rho} \alpha - MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2} \frac{1}{P_A}
\]

\[
= \frac{\zeta P_A^{2-\rho}}{(MC_A - \chi P_A)^2} - MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2} \frac{1}{P_A}
\]

(2.51)

\[
\alpha = \frac{\frac{\zeta P_A^{2-\rho}}{(MC_A - \chi P_A)^2} - MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2} \frac{1}{P_A}}{(MC_A - \chi P_A)(2 - \rho) P_A^{1-\rho} + \frac{\zeta \chi P_A^{2-\rho}}{(MC_A - \chi P_A)^2} - (1 - \rho) P_A^{-\rho} - MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2} \frac{MC_A}{P_A}}
\]

(2.52)

Since exchange rate pass-through is the percent change in price due to a percent change in
exchange rates (or marginal costs in this example), then $A$’s pass-through is (2.52) multiplied by

$$\frac{MC_A}{P_A}$$

$$PT = \frac{[\frac{\zeta P_A^{2-\rho}}{P_A} - \frac{MC_B^{1-\rho} P_A^{2-\rho} (\rho - 1) (2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2}}{P_A}]}{MC_A - \chi P_A} \left[ \frac{MC_B^{1-\rho} P_A^{2-\rho} (\rho - 1) (2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2}}{P_A} \right]$$

(2.53)

Simplifying the Pass-Through Expression

The numerator of 2.53 is:

$$\frac{\zeta P_A^{2-\rho}}{P_A} - \frac{MC_B^{1-\rho} P_A^{2-\rho} (\rho - 1) (2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2}}{P_A}$$

(2.54)

$$\frac{\zeta P_A^{1-\rho} MC_A}{P_A} - \frac{MC_B^{1-\rho} MC_A (\rho - 1) (2\chi + \zeta - \frac{MC_A}{P_A})^{\rho - 2}}{P_A^{2}}$$

(2.55)

Use $MC_A = (\chi + S_A \zeta) P_A$:

$$\frac{\zeta P_A^{1-\rho} (\chi + S_A \zeta) P_A}{(\chi + S_A \zeta P_A - \chi P_A)^2} - \frac{MC_B^{1-\rho} (\chi + S_A \zeta) P_A (\rho - 1) (2\chi + \zeta - \frac{(\chi + S_A \zeta) P_A}{P_A})^{\rho - 2}}{P_A^{2}}$$

(2.56)

$$\frac{\zeta P_A^{2-\rho} (\chi + S_A \zeta)}{(S_A \zeta P_A)^2} - \frac{MC_B^{1-\rho} (\chi + S_A \zeta) (\rho - 1) (\chi + \zeta - S_A \zeta)^{\rho - 2}}{P_A}$$

(2.57)

Use $MC_B = (\chi + \zeta - S_A \zeta) P_B$:

$$\frac{P_A^{2-\rho} \chi \zeta + P_B^{2-\rho} S_A \zeta^2}{(S_A \zeta P_A)^2} - \frac{(\chi + S_A \zeta) (\rho - 1) P_B^{1-\rho}}{P_A (\chi + \zeta - S_A \zeta)}$$

(2.58)
\[
\frac{(\chi + S_A \zeta) P_A^{-\rho}}{S_A^2 \zeta} - \frac{(\chi + S_A \zeta)(\rho - 1) P_B^{1-\rho}}{P_A(\chi + \zeta - S_A \zeta)}
\]

(2.59)

The denominator of 2.53 is:

\[
\frac{(MC_A - \chi P_A) \zeta (2 - \rho) P_A^{1-\rho}}{(MC_A - \chi P_A)^2} + \frac{\zeta P_A^{2-\rho}}{(MC_A - \chi P_A)^2} - (1 - \rho) P_A^{-\rho} - MC_B^{1-\rho}(\rho - 1)(2\chi + \zeta - \frac{MC_A}{P_A}) P_A^2
\]

(2.60)

Use \(MC_A = (\chi + S_A \zeta) P_A\):

\[
\frac{((\chi + S_A \zeta) - \chi P_A) \zeta (2 - \rho) P_A^{1-\rho}}{((\chi + S_A \zeta) - \chi P_A)^2} + \frac{\zeta P_A^{2-\rho}}{(P \chi + S_A \zeta - \chi P_A)^2} - (1 - \rho) P_A^{-\rho} - MC_B^{1-\rho}(\rho - 1)(\chi + \zeta - S_A \zeta) P_A^2
\]

(2.61)

\[
\frac{(2 - \rho) P_A^{\rho}}{S_A} + \frac{\chi P_A^{2-\rho}}{S_A^2 \zeta} - (1 - \rho) P_A^{-\rho} - MC_B^{1-\rho}(\rho - 1)(\chi + \zeta - S_A \zeta) P_A^2
\]

(2.62)

Use \(MC_B = (\chi + \zeta - S_A \zeta) P_B\):

\[
\frac{(2 - \rho) P_A^{\rho}}{S_A} + \frac{\chi P_A^{2-\rho}}{S_A^2 \zeta} - (1 - \rho) P_A^{-\rho} - \frac{(\rho - 1)(\chi + S_A \zeta) P_A^{1-\rho}}{P_A(\chi + \zeta - S_A \zeta)}
\]

(2.63)
\[
\frac{(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta}{S_A^2 \zeta} P_A^\rho - \frac{(\rho - 1)(\chi + S_A \zeta)}{P_A(\chi + \zeta - S_A \zeta)} P_B^{1-\rho}
\] (2.64)

Pass-through is now a combination of 2.59 and 2.64

\[
ERPT = \frac{(\chi + S_A \zeta) P_A^\rho}{S_A^2 \zeta} - \frac{(\chi + S_A \zeta)(\rho - 1) P_B^{1-\rho}}{P_A(\chi + \zeta - S_A \zeta)} \frac{[(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta]}{S_A^2 \zeta} P_A^{\rho - (1 - \rho)(\chi + S_A \zeta) P_B^{1-\rho}} S_A^2 \zeta
\] (2.65)

\[
ERPT = \frac{(\chi + S_A \zeta)(\chi + \zeta - S_A \zeta) P_A^{1-\rho} - (\rho - 1)(\chi + S_A \zeta) P_B^{1-\rho} S_A^2 \zeta}{[(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta] P_A^{1-\rho} (\chi + \zeta - S_A \zeta) - (\rho - 1)(\chi + S_A \zeta) P_B^{1-\rho} S_A^2 \zeta}
\] (2.66)

\[
ERPT = \frac{(\chi + S_A \zeta)(\chi + S_B \zeta) + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta}{[(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta][\chi + S_B \zeta] + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta}
\] (2.67)

Use \( P_A^{1-\rho} = (P_A^{1-\rho} + P_B^{1-\rho})S_A \), \( P_B^{1-\rho} = (P_A^{1-\rho} + P_B^{1-\rho})S_B \), and \( \chi + \zeta - S_A \zeta = \chi + S_B \zeta \):

\[
ERPT = \frac{(\chi + S_A \zeta)(\chi + S_B \zeta) + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta}{[(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta][\chi + S_B \zeta] + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta}
\] (2.68)

2.6.3 Proof that 0 < ERPT < 1

Rewrite (2.68) as:

\[
ERPT = \frac{A + C}{B + C}
\] (2.69)
where

\[ A = (\chi + S_A \zeta)(\chi + S_B \zeta) \]

\[ B = [(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta](\chi + S_B \zeta) \]

\[ C = (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta \]

By the definitions of \( \chi \) and \( \zeta \), as well as the restrictions on \( \rho \) and \( \eta \), it is clear that \( A \) and \( C \) are positive. Comparing \( A \) and \( B \):

\[ S_A^2 < S_A \]
\[ (1 - \rho)S_A^2 > (1 - \rho)S_A \]
\[ \rho S_A + (1 - \rho)S_A^2 > S_A \]
\[ -\rho S_A \zeta - (1 - \rho)S_A^2 \zeta > -S_A \zeta \]
\[ 2S_A \zeta - \rho S_A \zeta - (1 - \rho)S_A^2 \zeta > S_A \zeta \] (2.71)
\[ 2S_A \zeta - \rho S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta > \chi + S_A \zeta \]
\[ (2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta > \chi + S_A \zeta \]
\[ [(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta](\chi + S_B \zeta) > (\chi + S_A \zeta)(\chi + S_B \zeta) > 0 \]

So the denominator of (2.68) is greater than the numerator, implying that pass-through is positive and less than one (as long as the country does not have 100% market share).

### 2.6.4 Proof that Country A has Lower Pass-Through

If the pass-through for Country A is given by (2.68),

\[ ERPT_A = \frac{(\chi + S_A \zeta)(\chi + S_B \zeta) + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta}{[(2 - \rho)S_A \zeta + \chi - (1 - \rho)S_A^2 \zeta](\chi + S_B \zeta) + (1 - \rho)(\chi + S_A \zeta)S_A S_B \zeta} \] (2.72)
then the pass-through for Country B can be expressed:

\[
ERPT_B = \frac{(\chi + S_B\zeta)(\chi + S_A\zeta) + (1 - \rho)(\chi + S_B\zeta)S_B S_A\zeta}{[(2 - \rho)S_B\zeta + \chi - (1 - \rho)S_B^2\zeta](\chi + S_A\zeta) + (1 - \rho)(\chi + S_B\zeta)S_B S_A\zeta}
\] (2.73)

It can be shown that the denominators of (2.68) and (2.73) are equal (see below). So the lower numerator corresponds to the country with the lower pass-through rate. The numerators are identical except pass-through for A contains a multiple of \(\chi + S_A\zeta\) in the second term of the numerator while that term in pass-through for B is multiplied by \(\chi + S_B\zeta\). Since \(\chi + S_B\zeta > \chi + S_A\zeta\), this implies that Country B (with the smaller market share) has larger pass-through.

**Proof that the Denominators of (2.68) and (2.73) are Equal**

\[
S_A S_B = S_A S_B
\]

\[
S_A(1 - S_A) = (1 - S_B)S_B
\]

\[
S_A - S_A^2 = S_B - S_B^2
\]

\[
(1 - \rho)S_A - (1 - \rho)S_A^2 = (1 - \rho)S_B - (1 - \rho)S_B^2
\]

\[
(1 - \rho)S_A\chi\zeta - (1 - \rho)S_A^2\chi\zeta = (1 - \rho)S_B\chi\zeta - (1 - \rho)S_B^2\chi\zeta
\]

\[
(2 - \rho)S_A\chi\zeta - (1 - \rho)S_A^2\chi\zeta + S_B\chi\zeta = (2 - \rho)S_B\chi\zeta - (1 - \rho)S_B^2\chi\zeta + S_A\chi\zeta
\]

(2.74)

\[
(2 - \rho)S_A\chi\zeta + \chi^2 - (1 - \rho)S_A^2\chi\zeta + (2 - \rho)S_A S_B\zeta^2
\]

\[
+ S_B\chi\zeta - (1 - \rho)S_B^2\chi\zeta + (1 - \rho)S_A S_B\zeta + (1 - \rho)S_A^2 S_B\zeta^2
\]

\[
= (2 - \rho)S_B\chi\zeta + \chi^2 - (1 - \rho)S_B^2\chi\zeta + (2 - \rho)S_B S_A\zeta^2
\]

\[
+ S_A\chi\zeta - (1 - \rho)S_B^2 S_A\zeta^2 + (1 - \rho)S_B S_A\zeta + (1 - \rho)S_B^2 S_A\zeta^2
\]

\[
[(2 - \rho)S_A\zeta + \chi - (1 - \rho)S_A^2\zeta](\chi + S_B\zeta) + (1 - \rho)(\chi + S_A\zeta)S_A S_B\zeta
\]

\[
= [(2 - \rho)S_B\zeta + \chi - (1 - \rho)S_B^2\zeta](\chi + S_A\zeta) + (1 - \rho)(\chi + S_B\zeta)S_B S_A\zeta
\]

66
2.7 Appendix - Potential Problem with Country-Level Data

It should be noted that while the import data is highly disaggregated, the lack of firm level data creates a potential problem. Market shares and pass-through rates would ideally be calculated at the firm level to get a true sense of the nature of competition within the import market for each good. With data only available at the country level, “competition” can only exist between countries. A country that controls the market for a specific good might actually have many competing exporting firms that could price goods differently than a single firm would.

But while firm-specific data on US imports is unavailable at this time, I do have information on the number of shipments of each good to the United States from all exporting countries in a given quarter. Figure 2.8 shows the average number of shipments of a good per quarter in relation to the number of foreign countries competing in the market for the good in that quarter. There is a clear positive linear relationship, showing that more shipments tend to be received in quarters when more countries are competing in the market for a good. For reference, the comparison of shipments and number of exporting countries should be used in conjunction with Figure 2.9 which shows the number of commodity-quarter combinations versus the number of exporters for the combination. There are over 80,000 commodity-quarter combinations where one country controls 100% the market, but as Figure 2.8 indicates, this number declines to under 3,000 when 31 countries are competing and under 1,000 when 41 countries are involved. As a result, the relationship between total shipments and competing countries should be focused on the low end of the spectrum displayed in Figure 2.8. This still shows a clear upward trend with a small dip at the very beginning.

Specifically, I examine the 81,085 cases where there is only one exporter of a good to the United States in a quarter. These cases average 38.83 shipments per quarter as opposed to 40.50 shipments per country per quarter when more than one country is involved. A larger number of shipments
Figure 2.8: Average quarterly number of shipments, per country per quarter, of a commodity by number of countries shipping in a quarter.

do not necessarily imply a larger number of exporting firms as one firm could be responsible for multiple shipments of a commodity in a quarter. But it seems reasonable to assume an association between total shipments and number of exporting firms. Without firm-specific data, analyzing at the country level seems to be the best choice, but this issue underscores the potential benefit of obtaining data with information on specific firms exporting to the United States.
Figure 2.9: Number of commodity/quarter combinations by number of countries shipping in a quarter.
Chapter 3

Enter the Dragon: China’s Impact on Pass-Through to US Import Prices

3.1 Introduction

From 1991 through 2005, the total annual value of imports to the United States from China increased by a factor of nearly 11.5. While total imports grew dramatically from all countries during this time, China’s share of the US import market rose from just over four percent in 1991 to nearly 13.5% in 2005. China’s rise as a trade partner with the United States coincides with a period in which exchange rate pass-through to US imports declined, and pass-through to imports from China was substantially lower than from any other major country. The primary objectives of this chapter are to examine these trends and show the impact of China’s increased presence in the market on exchange rate pass-through to US import prices.

One consistent theme in the recent literature on exchange rate pass-through is the empirical result that pass-through to import prices in the United States declined dramatically over the last part of the twentieth century. Estimates for pass-through rates in the 1980s typically fall between 0.6 and 0.8, while similar measurements in the early 2000s have pass-through coefficients between 0.1 and 0.3. Various studies of pass-through consider a wide range of possible explanations for this decline, as is seen in Chapter 1.

The increased presence of China as a trade partner for the US is one possible reason for the drop in pass-through rates. Marazzi et al. (2005), Marazzi and Sheets (2007), and Bergin and Feenstra
include empirical research on China’s role in the decline of US import pass-through. The logic behind this theory is that as China has become more prominent in the United States’ import market, the increased competition, or even the threat of increased competition, has forced other exporting countries to lower their pass-through rates.

By a variety of measures, the proportion of US imports originating from China increased dramatically in the late 1990s and early 2000s. During that time, China rose from being one of the United States’ top ten trade partners to the clear number one in terms of dollar value of imports. This rise occurred through increased volume of trade in established goods, as well as the introduction new goods to the market. The clear growth can be seen across a variety of types of goods. Overall imports increased, but the change is most notably seen in categories representing “raw hides and skins, leather, etc”, “footwear, headgear, etc” and “machinery and mechanical appliances, etc”. The last of these is the largest category of all US imports. In addition to the breadth of trade, China also increased its dominance of the markets for individual goods by becoming the top exporter to the United States for more goods than any other country. This control of all facets of the import market has clear effects on overall pass-through rates to US import prices.

China’s rise as an exporter to the United States coincides with the period of declining pass-through rates in all US imports. Particularly of note is the pass-through of goods from China itself, which is consistently lower than those from the rest of the world. Pass-through of Chinese goods is even negative for a period of time, implying that import prices from China actually tend to rise when the dollar strengthens and fall as the dollar weakens. Due to responses to increased competition, a larger volume of trade between the US and China has the potential to affect the prices of imports not just from China, but from all countries. Since trade with China does not appear to be slowing down in the near future, it becomes more important to understand the effects that this relationship has on import prices.

Similarly, Ceglowski (2010) focuses specifically on bilateral import prices to show decreasing pass-through rates to US imports over time. Her study finds a significant break in the series of pass-through for goods from four major trade partners. The break is particularly severe for imports from Asia and coincides with the Asian financial crisis and the rise of China in the US import market.

Imports are classified into twenty categories according to the USITC.
One common thread in the studies of declining pass-through is the focus on pass-through rates to import prices as a whole or by somewhat broad categories of goods\(^3\). So the logic and methodology used in these studies and the results found could be applied and tested using more refined, detailed data on imported goods. In this chapter I show the connection between China’s rise as a power in the US import market and overall declining pass-through. Looking at goods across categories, the great majority experience declines in pass-through, though some categories of goods experience more severe drops than others. The categories with the largest increases in China’s share of the market tend to be those where pass-through drops the most. At the level of individual goods, pass-through rates tend to be lower when China competes that when it does not, an effect that becomes more substantial when China is the number one exporter of a good. Finally, I show that goods that China never exports to the US do not show the same drop in pass-through that occurs in goods shipped from China at least once. All of this provides evidence of China’s role in driving down pass-through rates.

By showing the extent to which China has come to dominate the US import market and tying it to overall declines in pass-through, this chapter shows the growing impact that China has on its competitors in the United States. The highly disaggregated nature of the data allows for analysis of changes in price, market shares, and pass-through at a more refined level than is used in much of the literature. Using this data, I show the effects of China’s growing presence on the pricing decisions of other exporters, as well as the types of goods and exchange rate movements where China’s influence is strongest.

### 3.2 A Theoretical Example

The general theoretical framework for this chapter derives from Atkeson and Burstein (2008) and is detailed in Chapter 2 of this dissertation. Atkeson and Burstein develop a model of oligopolistic competition that relates prices and market shares of exporters using constant elasticities of sub-

\(^3\)Olivei’s (2002) analysis of the 34 categories is the most detailed in terms of disaggregated product data.
stitution both within goods (competition between exporters) and across different goods. With this framework, the dollar price of imports of good \( j \) from exporter \( A \) can be expressed as a markup to marginal costs and the exchange rate\(^4\), where markup is a function of \( A \)’s share of the host country’s import market for \( j \). As in Chapter 2, the import price of good \( j \) from country \( A \) is:

\[
P_{jA} = (\chi + S_{jA}\zeta)^{-1}ER_A\text{MC}_{jA},
\]

(3.1)

where:

\[
\chi = 1 - \frac{1}{\rho} \quad \text{and} \quad \zeta = \frac{1}{\rho} - \frac{1}{\eta}.
\]

(3.2)

The constants \( \rho \) and \( \eta \) refer to the elasticities of substitution within goods and across goods, respectively. I assume both elasticities are finite and it is easier to substitute between different countries’ versions of goods than from one good to another (\( 1 < \eta < \rho < \infty \)).

Using the two-tiered model of Atkeson and Burstein (2008), \( A \)’s share of the import market for \( j \) can be written as a function of the prices of all exporters and the elasticity of substitution within the good:

\[
S_{jA} = \frac{P_{1-\rho}^{1,1}}{N}.
\]

(3.3)

To show the effect of China’s market share on the pass-through rates of its competitors, consider two goods (\( g \) and \( h \)) imported by a host country from the same \( N \) exporters (\( N \geq 3 \)). Each good has the same elasticities of substitution and every exporter’s marginal costs of production is the same for the two goods. Three of the exporters are \( A, B, \) and \( C \). Exporter \( C \) has a fixed exchange rate, while the remaining \( N - 1 \) exporters have floating exchange rates. For good \( g \), exporter \( B \) has an \( n\% \) share of the market while \( C \) has a share of \( m\% \) (\( m > n \)). The other \( N - 2 \) exporters have

\(^4\)The host country’s bilateral exchange rate with Country \( A \) is defined as the ratio of host currency to \( A \)’s currency, then an appreciation of the host’s currency is represented by a reduction in the exchange rate, while a depreciation results in an exchange rate increase.
varying sized shares of the market for \( g \) to make the total sum to 100\%. For good \( h \), each exporter has the same share as it had for \( g \), except \( B \) has an \( m\% \) share and \( C \) has an \( n\% \) share\(^5\).

Consider a \( k\% \) change in the host country’s currency with respect to all currencies with floating exchange rates. This implies the exchange rates of the \( N-1 \) floating exporters multiply by \( k \), while \( C \)’s exchange rate remains the same. I now compare the impact of this change on \( A \)’s price of good \( g \) and its price of good \( h \).

According to Equation 3.3, \( A \)’s initial shares of the two goods can be calculated:

\[
S_{g0,A} = \frac{P_{g1,A} - \rho_{g0}}{\sum_{i=1}^{N} P_{g0,i}^{1-\rho}}, \quad \text{and} \quad S_{h0,A} = \frac{P_{h1,A} - \rho_{h0}}{\sum_{i=1}^{N} P_{h0,i}^{1-\rho}}. \tag{3.4}
\]

Assuming the two goods have equal within-good elasticities of substitution, then the fact that each good has the same number of competing exporters and the same distribution of shares implies that \( S_{g0,A} = S_{h0,A} \). Following the exchange rate movement, \( A \)’s share is no longer the same for the two goods. According to Equation 3.1, the prices from all exporters besides \( C \) multiply by \( k \), which in turn changes each country’s share. \( A \)’s new share of \( g \) is calculated:

\[
S_{g1,A} = \frac{P_{g1,A}^{1-\rho}}{\sum_{i=1}^{N} P_{g1,i}^{1-\rho}} = \frac{k^{1-\rho} P_{g0,A}^{1-\rho}}{k^{1-\rho} \sum_{i \neq C} P_{g0,i}^{1-\rho} + P_{g0,C}^{1-\rho}}. \tag{3.5}
\]

Factoring in the change in the exchange rate and the corresponding change in \( A \)’s market share, the ratio of \( A \)’s current to initial price of good \( g \) can be expressed:

\[
\frac{P_{g1,A}}{P_{g0,A}} = \frac{(\chi + S_{g0,A} \zeta)k}{\chi + S_{g1,A} \zeta}. \tag{3.6}
\]

Alternatively, for good \( h \), the ratio of \( A \)’s current to initial price is:

\[
\frac{P_{h1,A}}{P_{h0,A}} = \frac{(\chi + S_{h0,A} \zeta)k}{\chi + S_{h1,A} \zeta}. \tag{3.7}
\]

\(^5\)Essentially, the structure of the import market is the same for \( g \) and \( h \), except \( C \) controls a larger share of the market for \( g \) and \( B \) controls a larger share for \( h \). The size of the shares of the remaining \( N-2 \) exporters is irrelevant to this exercise as long as the shares are the same for both goods.
Comparing Equations 3.6 and 3.7, it is straightforward to show that A’s price of good g moves by a smaller amount as a result of the exchange rate movement than its price of good h. This result holds for both appreciations and depreciations of the exchange rate, so this example does not predict a “direction effect”. As such, for equal initial shares and any exchange rate movement, an exporter will have lower pass-through when a competitor with a fixed exchange rate has a larger share of the import market.

In a more general sense, low pass-through rates are a result of increasing returns to scale production or imperfect competition (which in turn results in variable markups). It is the latter of these, combined with the effects of China’s fixed exchange rate regime, that connects China’s rise as a trade partner with the US to declining pass-through. Assume the price of an import of good j from A is determined by a markup to the exchange rate:

\[ P_{iA} = \frac{\$}{FC_A} Markup_{iA}. \]

(3.8)

So if the dollar were to depreciate by \( k\% \), then in percent changes:

\[ \%\Delta P_{iA} = k\% + \%\Delta Markup_{iA}. \]

(3.9)

However, if the exporting country has a fixed exchange rate policy such as China’s, then Equation 3.9 reduces to a simple statement that the change in price equals the change in markup. So Chinese exporters are able to set prices more freely as they are “sheltered” from potential exchange rate fluctuations. If Chinese exporters do not change their markups in this scenario, then exporters in other countries would have to reduce markups by \( k\% \) to hold their prices fixed. Otherwise, such competitors would risk losing market share due to China undercutting prices. Clearly, this issue would become more problematic when China’s market share is larger. As China’s shares increase, so too does the degree of imperfection in competition, thus driving down pass-through rates from

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\(^{6}\)Proof in Appendix 3.8.

\(^{7}\)Connections between the degree of imperfection in competition and low pass-through are shown by Olivei (2002), Feenstra (1995), and Yang (1997).
competing countries. So low pass-through rates from other countries seem likely to occur when China’s market share is larger as the threat of China’s low prices force competitors to keep prices of exports to the United States low.

Unlike in the example, this rationale changes slightly when considering a drop in the exchange rate rather than a rise (the dollar appreciates against the foreign currency as opposed to depreciates). When the exchange rate falls, so does the price of an import according to Equation 3.8. However, in terms of gaining and maintaining market shares, a competitor with a floating exchange rate can lower their price to the full extent of the exchange rate fluctuation, while China would have to lower markups in order to match the change in price. Due to competition and a wide variety of other factors, exporters do not fully transmit these decreases into prices, but it stands to reason that the impact of China’s presence is less when the dollar increases in value.

### 3.3 Data and Methodology

The data used in this chapter are described in detail in Chapter 2: US Imports Harmonized System ten-digit goods from all exporters from April, 1990 through December, 2005. The data used for calculating market shares includes 20,403 goods from 233 countries and 63 quarters, with totals of 789,033 good-quarter combinations and 7,630,933 observations. As this chapter focuses on the role of China as an exporter to the United States, it should be noted that China is active in all 63 quarters and is in the market at least once for 16,129 different commodities, with a total of 361,623 good-quarter combinations. Observations from China comprise 4.74% of the dataset.

As in Chapter 2, the basic regression for exchange rate pass-through follows the model:

$$p_{c,j,t} - p_{c,j,t-1} = \alpha + \sum_{i=0}^{n} \beta_i \Delta e_{c,i,t-i} + \sum_{i=0}^{n} \gamma_i x_{t-i} + \epsilon_{c,j,t},$$

(3.10)

where pass-through is the sum of the $\beta_i$ terms; $p_{c,j,t}^m$ is the real price of good $j$, imported from

---

8 Chapter 2 contains a more thorough description of the data and calculation of pass-through, as well as details on the treatment of missing data.
country \( c \) at time \( t \); and \( e_{c,t} \) is the real exchange rate between the United States and country \( c \) at time \( t \). Equation 3.10 is used to calculate the rolling regressions described in Section 2.3.3. The findings of this chapter are robust to different lag lengths and rolling regression windows. The primary specifications that are reported use two quarter lags in Equation 3.10 and a rolling regression window of 12 quarters.

### 3.4 Analyzing the Rise in Imports from China

In this section I show China’s rise from a small player in the US import market in the early 1990s to the United States’ top trade partner by 2005. The discussion is centered around three facts. First, in terms of overall growth, the dollar-value of imports from China increased twelve-fold during this period (Section 3.4.1). Secondly, growth in the extensive (newly-traded goods) margin is substantially greater for China than its competitors (Section 3.4.2). Finally, Section 3.4.3 shows China’s increased trade in specific goods and how China became the top exporter for a wide variety of goods during this period.

#### 3.4.1 China’s Overall Dominance of US Imports

The increasing presence of China in the US import market is a clear trend that developed over the latter part of the twentieth century and has continued into the twenty-first. Figure 3.1 shows that China’s market share among US imports for manufactured goods more than quadruples over the life of the dataset. A similar trend appears when considering all imports as opposed to just manufactures. In both cases, China’s share of the US import market rises steadily from 1991 through 2005, with particularly strong growth post 2000. The results in terms of raw value of manufactured imports are even more dramatic. While the total dollar value of goods imported by the United States more than tripled from 1991 to 2005 ($344 billion to $1.16 trillion), the dollar

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9 Using quantities of goods to calculate market share rather than dollar values produces an almost identical trend.

10 Note that while the dataset starts with observations from the second quarter of 1990, the first full year of data is 1991.
value imported from China increased by a multiple of more than twelve ($15.7 billion to $190 billion) over that same period.

While China’s market share of US imports grew, so too did its rank among exporters of total manufactured goods to the US. Table 3.1 shows not only China’s growing market share on an annual basis, but also that it rose from being the eighth largest trade partner by import value in 1990 to the largest in 2005.

To put the change in China’s share into context, consider how the shares and ranks of other countries changed over this timeframe. The two largest exporters to the United States had their shares drop: Canada fell from 18.44% in 1990 to 16.25% in 2005, while Japan’s market share dropped from 20.54% to 9.84% as it fell from being the top exporter to the US to number three. Even Mexico, another country whose market share grew over the life of the dataset, only doubled its share from 4.64% to 9.26%. Additionally, Mexico’s relative standing in the market tapered off in the last years, peaking as the third largest exporter at 11.07% in 2002. So China’s rise (which continues beyond 2005) surpasses that of other growing US trade partners.
Table 3.1: China’s exports, market share and rank among all exporters to the US.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Dollars (Billions)</th>
<th>China’s Rank</th>
<th>China’s Share</th>
<th>Countries Exporting More than China</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>$263</td>
<td>8</td>
<td>3.73%</td>
<td>Japan, Canada, Germany, South Korea, Taiwan, Mexico, UK</td>
</tr>
<tr>
<td>1991</td>
<td>$344</td>
<td>6</td>
<td>4.57%</td>
<td>Japan, Canada, Germany, Taiwan, Mexico</td>
</tr>
<tr>
<td>1992</td>
<td>$375</td>
<td>4</td>
<td>5.58%</td>
<td>Japan, Canada, Germany</td>
</tr>
<tr>
<td>1993</td>
<td>$413</td>
<td>3</td>
<td>6.33%</td>
<td>Japan, Canada</td>
</tr>
<tr>
<td>1994</td>
<td>$476</td>
<td>3</td>
<td>6.61%</td>
<td>Japan, Canada</td>
</tr>
<tr>
<td>1995</td>
<td>$556</td>
<td>4</td>
<td>6.61%</td>
<td>Canada, Japan, Mexico</td>
</tr>
<tr>
<td>1996</td>
<td>$582</td>
<td>4</td>
<td>7.00%</td>
<td>Canada, Japan, Mexico</td>
</tr>
<tr>
<td>1997</td>
<td>$638</td>
<td>4</td>
<td>7.69%</td>
<td>Canada, Japan, Mexico</td>
</tr>
<tr>
<td>1998</td>
<td>$687</td>
<td>4</td>
<td>8.49%</td>
<td>Canada, Japan, Mexico</td>
</tr>
<tr>
<td>1999</td>
<td>$762</td>
<td>4</td>
<td>8.83%</td>
<td>Canada, Japan, Mexico</td>
</tr>
<tr>
<td>2000</td>
<td>$880</td>
<td>4</td>
<td>9.24%</td>
<td>Canada, Japan, Mexico</td>
</tr>
<tr>
<td>2001</td>
<td>$827</td>
<td>4</td>
<td>9.30%</td>
<td>Canada, Japan, Mexico</td>
</tr>
<tr>
<td>2002</td>
<td>$847</td>
<td>3</td>
<td>11.06%</td>
<td>Canada, Japan</td>
</tr>
<tr>
<td>2003</td>
<td>$903</td>
<td>3</td>
<td>12.83%</td>
<td>Canada</td>
</tr>
<tr>
<td>2004</td>
<td>$1.050</td>
<td>2</td>
<td>14.47%</td>
<td>Canada</td>
</tr>
<tr>
<td>2005</td>
<td>$1.160</td>
<td>1</td>
<td>16.40%</td>
<td>none</td>
</tr>
</tbody>
</table>

3.4.2 Rise in Intensive and Extensive Margins of Trade from China

I next consider how much of China’s exporting growth came through newly traded goods (extensive margin) compared with how much came through increased trade in goods that were already established in the market. Defining the extensive margin as any ten digit code that first appears in the data from a country in 1992 or later, it is clear that such goods make up a significant proportion of Chinese exports to the US.

I define import growth from one time period to another as the difference between the two periods divided by the average of the two periods. This technique allows for a simple decomposition into the intensive and extensive margins of imports. Define $V_t$ as the total dollar value of US imports from a certain country at time $t$, and $v_{i,t}$ as the dollar value of imports of ten-digit good $i$ at time $t$ from that country. Growth in trade from that country at time $t$ can then be decomposed:

$$
\frac{V_t - V_{1991}}{V_{1991}} = \sum_{i \in C} \frac{v_{i,t} - v_{i,1991}}{V_{1991}} + \sum_{i \in N} \frac{v_{i,t}}{V_{1991}} - \sum_{i \in X} \frac{v_{i,1991}}{V_{1991}}.
$$

11 Technically this implies that any good in the extensive margin is either being imported by the United States from a specific country for the first time, or trade is restarting after a minimum of two years.

12 A similar definition and subsequent decomposition is used by Eaton et al. (2007) and also by Alessandria et al. (2013).
Goods are defined as *continuing* \((C)\) if they are imported from the country of interest in both 1991 and Year \(t\); *entering* \((N)\) if they are imported at \(t\) but not in 1991; and *exiting* \((X)\) if they are imported in 1991 but not in Year \(t\). The first term on the right hand side of Equation 3.11 represents the intensive margin, while the difference of the second and third terms is the extensive margin.

The annual growth of imports from China and its top competitors both in the extensive margin and overall is shown in Figure 3.2. By the measure described in Equation 3.11, China’s growth far exceeds that of its top competitors, with only Mexico’s growth being relatively close. From 1991 to 2005, total imports from China to the US increased by a factor of more than 11, as compared to factors of nearly 5.5 for goods from Mexico, less than two for Canadian goods, and 0.6 for Japanese goods\(^{13}\). In fact, when plotted on the same scale as in Figure 3.2, the growth rates of imports from Canada and Japan almost do not register. Even more notably, China’s extensive margin growth outpaces its competitors as well as its own growth on the intensive margin. This rise in newly traded goods from China between 1992 and 2005 actually exceeds the total growth in imports from any other individual country during the same period.

The percentage of China’s total import growth due to the extensive margin steadily rises over time, as seen in Figure 3.3. Growth in imports from Mexico due to the extensive margin follows an almost identical pattern as China, while Canada’s extensive margin constantly grows but consistently comprises a smaller percentage of total growth than that of China or Mexico. Alternatively, this component of imports from Japan actually shrinks over time, implying that growth in trade from Japan is primarily due to goods that were already being imported in 1991. These findings suggest that China and Mexico emphasized new trading patterns with the United States, as opposed to deepening already-established relationships in terms of which goods are exported. Combine this with China’s overall higher volume of trade and it becomes clearer why imports from China grew at such a high rate during the late 1990s and early 2000s.

The other side of China’s growth in trade on the extensive margin is a relatively low percentage

\(^{13}\)Similar displays of the growth of imports from other major trade partners also indicate much slower growth than China and Mexico.
Figure 3.2: Decomposition of intensive and extensive margins of growth for the largest exporters.

of total imports that were already traded in 1991 or earlier\textsuperscript{14}. However, this low percentage is much more a factor of China’s rapid growth in terms of new goods exported as opposed to a sign that trade in established goods slowed down. Examining the totals from 2005, $72.2$ billion worth of imports came from China in goods that were already imported in 1991, trailing only Canada ($112.2$ billion) and Japan ($72.5$ billion). Clearly, China was able to dramatically increase trade both in new goods and continuing goods during this period.

3.4.3 Variety of Imports and China’s Control of Individual Goods

As I discuss in the previous section, the growth of trade with China comes through two channels: China entering the market for goods that they did not export to the United States in the early 1990s, and China increasing the volume of trade in goods that were already exported to the US. In 1991, the United States imported 12,139 unique 10-digit commodities. This value grew to 14,151 unique goods in 2005. Over this time period, the number of unique goods imported from China increased

\textsuperscript{14}By the definitions of extensive and intensive margin percentages, China’s having the largest percentage of trade value in the extensive margin implies that it has the smallest in the intensive margin among US’s primary trade partners
Figure 3.3: Percent of growth of trade due to the extensive margin for the largest exporters. From 4,882 to 10,755. Figure 3.4 shows the number of different goods imported on a quarterly basis both from China and overall.

While China competes in the market for less than 30% of goods in the early quarters, it trades in over two thirds of all goods in each quarter of 2005. Similar calculations reveal that other major trade partners did not increase the number of unique goods traded to nearly the same degree as China\textsuperscript{15}, as seen in Figure 3.5.

As China’s presence in the US import market increases over time, there is also an increase in the number of goods for which China is the United States’ top trade partner (Table 3.2). Of the 12,139 unique goods imported in 1991, less than seven percent had China as the number one exporter. By 2005, China was the United States’ top trade partner for over one quarter of the 14,151 unique goods that were imported. This change, showing that China not only increased its volume of trade but also grew to dominate the market for many goods, far outpaces the percentage of goods

\textsuperscript{15}The percentage of total unique goods imported from Canada, Japan, and Germany remain relatively constant over time, with Japan’s value actually shrinking slightly. Similar to China, Mexico only trades in slightly over a quarter of all goods in the early 1990s. This value rises to approximately 40% by 2005, well short of the variety of markets in which China competes.
for which other major trade partners are the top exporter.

Additionally, I track the number of goods for which a major partner is the number one exporter, measured over time as a percentage of the total number of goods exported from that country (Figure 3.6). By the mid 2000s, China is the lead exporter of more than 35% of all goods that it trades, as compared to less than 20% in the early 1990s. This upward trend differs from the more stable patterns displayed by Canada and Mexico, and the decreasing percentage of goods dominated by Japan and Germany. As these findings show, from the early 1990s through 2005, China became the primary supplier of imports to the United States; both in terms of sheer overall volume and the way it controls the market for such a large number of individual goods.
Figure 3.5: Percentage of all individual goods imported from the top five trade partners.

Table 3.2: Percentage of goods for which each country is the top exporter to the United States.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Unique Imported Goods</th>
<th>Top Exporter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>China</td>
</tr>
<tr>
<td>1991</td>
<td>12,139</td>
<td>6.76%</td>
</tr>
<tr>
<td>1992</td>
<td>12,175</td>
<td>8.12%</td>
</tr>
<tr>
<td>1993</td>
<td>12,285</td>
<td>9.11%</td>
</tr>
<tr>
<td>1994</td>
<td>12,621</td>
<td>9.88%</td>
</tr>
<tr>
<td>1995</td>
<td>13,191</td>
<td>10.24%</td>
</tr>
<tr>
<td>1996</td>
<td>13,440</td>
<td>10.62%</td>
</tr>
<tr>
<td>1997</td>
<td>13,766</td>
<td>11.43%</td>
</tr>
<tr>
<td>1998</td>
<td>13,655</td>
<td>11.78%</td>
</tr>
<tr>
<td>1999</td>
<td>13,661</td>
<td>12.75%</td>
</tr>
<tr>
<td>2000</td>
<td>13,735</td>
<td>13.44%</td>
</tr>
<tr>
<td>2001</td>
<td>13,686</td>
<td>14.31%</td>
</tr>
<tr>
<td>2002</td>
<td>14,075</td>
<td>16.54%</td>
</tr>
<tr>
<td>2003</td>
<td>14,100</td>
<td>18.48%</td>
</tr>
<tr>
<td>2004</td>
<td>14,134</td>
<td>20.43%</td>
</tr>
<tr>
<td>2005</td>
<td>14,151</td>
<td>25.03%</td>
</tr>
</tbody>
</table>
Figure 3.6: Percentage of goods from top five trade partners for which that country is the top exporter to the United States.
3.5 Changes in Pass-Through

At the same time that China established itself as the primary exporter of goods to the United States, exchange rate pass-through to US import prices experienced a period of decline. Figure 3.7 displays the median pass-through of all imports to the United States on a quarterly basis from the fourth quarter of 1993\textsuperscript{16} through the end of 2005.

![Figure 3.7: Median quarterly pass-through rate to all US imports.](image)

The period of sharp decline in the late 1990s and early 2000s is well established in the literature\textsuperscript{17}, and pass-through rates appear to spike upward shortly before and after this time. Despite these fluctuations, the general trend in the data shows pass-through declining over time. Comparing the first eight quarters with available data to the last eight quarters, the median pass-through rate is 0.2478 at the beginning vs. 0.1688 at the end.

Focusing solely on China, Figure 3.8 shows pass-through of imports from China over the same period shown in Figure 3.7. The most obvious feature of Chinese pass-through is the sharp drop

---

\textsuperscript{16} Due to the rolling regression used to calculate pass-through, pass-through calculations are unavailable for the first 14 quarters.

\textsuperscript{17} See Taylor (2000), Marazzi et al. (2007), and Ceglowski (2010) among others.
in rates in the early 2000s, a period where the median pass-through for Chinese goods is actually negative\textsuperscript{18}. Also of note is that China’s pass-through is fairly consistently lower than overall pass-through to import prices. This is more clearly visible in Figure 3.9 showing median pass-through rates from of all countries besides China, compared with rates when China is included.

\textbf{Figure 3.8:} Median quarterly pass-through rate to all US imports from China.

The two plots in Figure 3.9 roughly align with each other, following the same trend, with pass-through typically being slightly lower when the calculation includes observations from China. In fact, of the 49 quarters considered, pass-through from China is lower than overall pass-through in 41, suggesting that low pass-through from China is not unique to the early 2000s. Comparing pass-through rates from countries besides China, the median rate during the first eight quarters (0.2825) is again substantially greater than in the last eight quarters (0.1693).

\textsuperscript{18}Negative pass-through is a somewhat counterintuitive concept caused by exporting firms lowering prices when the exchange rate rises or raising prices when the exchange rate falls. Clearly, this is not something that is likely to occur regularly or for extended periods of time. Note though that Figure 3.8 provides the median pass-through rate for all goods from China at the ten-digit level. At such a highly disaggregated level, prices of goods can change for a variety of reasons, making negative pass-through (or pass-through greater than one) more likely to occur than if calculations were made using price indices. Marazzi et al. (2005) attribute China’s low pass-through to firms holding prices lower even in the face of an increasing exchange rate. Therefore, such firms were not necessarily maximizing profits at the time, but rather maintaining or increasing their market shares in order to increase future profits. Clearly, China came to dominate the US import market over this period (Section 3.4), so such a theory is plausible.
Figure 3.9: Median quarterly pass-through rate to all US imports compared to imports from all countries except China.

The similar pattern that the two plots in Figure 3.9 follow is also notable in that median pass-through from countries other than China follows a clear downward trend. This suggests that while pass-through from China is lower than from the rest of the world during this period of declining pass-through, the drop-off is not directly due to China’s low rates. It is possible, however, that China’s low pass-through indirectly results in lower pass-through from other countries as such exporters must maintain lower prices in order to compete\(^\text{19}\).

Examining the trends in prices and exchange rates with China and the rest of the world (Figure 3.10), the bilateral real exchange rate between the United States and China peaks in 1997 before steadily decreasing as the dollar strengthens. Alternatively, the trade weighted real exchange rate with the rest of the world generally declines during the 1990s before rising again at the start of the twenty-first century. As a result, with complete pass-through, imports from China should become cheaper as the exchange rate declines. However, examining median quarterly import prices both from China and the rest of the world, both price series remain relatively steady over time, with

\(^{19}\text{Marazzi et al. (2005) also explore this possibility.}\)
goods from China being consistently less expensive than those from its competitors\textsuperscript{20}.

![Figure 3.10: Real exchange rates and median price of goods imported from China and the rest of the world.](image)

Comparing prices to exchange rates directly, the quarterly fluctuations in prices from the rest of the world match those in the corresponding exchange rate series more closely than can be seen in the data from China. The real exchange rate with China is much smoother than that of the rest of the world\textsuperscript{21}, especially during the period of its decline after 1997. As a result, import prices from China are relatively more variable, including many periods where prices increase despite the reduced exchange rate. A simple calculation of correlation between percent change in price and percent change in pass-through shows a much lower coefficient for China ($\rho = 0.03$) than for the rest of the world ($\rho = 0.17$). This implies a weaker connection between the exchange rate and import prices from China than from other countries.

In addition to the general disconnect between quarterly changes in Chinese prices and its exchange rate, China’s maintaining of lower prices despite the weakening dollar prior to 1997 coin-

\textsuperscript{20}To avoid potential problems involving units of measurement, the price plots in Figure 3.10 only consider goods that are imported from both China and at least one other country in a quarter.

\textsuperscript{21}This is in part due to the extra variability that comes with a trade-weighted average as compared to a single country, and in part due to China’s fixed nominal exchange rate.
cides with the beginning of its rise as a major exporter to the US. As China establishes itself as a power in the market, other countries naturally have to account for China’s prices in order to stay competitive. This includes potentially holding prices steady in the face of exchange rate shocks. As a result, lower pass-through rates can be expected as import prices become further disconnected from exchange rates.

3.6 Comparing China’s Market Share and Overall Pass-Through

In this section I employ a number of different techniques and comparisons to show the relationship between China’s increased presence as a trade partner with the United States and low pass-through to US imports from countries competing with China. I start by showing the effects of China simply being in the market for a good, as well as the impact of China having the largest share of a particular good’s market (Section 3.6.1). This is enhanced by comparisons of pass-through and China’s share of the market (Section 3.6.2). In Section 3.6.3 I compare how pass-through rates change over time for goods that China begins exporting to the US as opposed to goods it does not export. Section 3.6.4 shows the relationship between pass-through and China’s share holds across categories of imported goods. I show that China’s influence on its competitors’ pass-through rates is stronger following a dollar depreciation than an appreciation (Section 3.6.5). Lastly, Section 3.6.6 compares China’s impact on pass-through with that of other growing trade partners, and also shows the more stable pattern of pass-through over time for goods that are never imported from China.

3.6.1 China’s Standing in the Market Impacts Pass-Through

To analyze the possibility that China’s presence in the US import market impacts the pass-through rates of other countries, I begin by comparing the pass-through rates of commodity-quarter combinations where China is in the market to those without China. Chinese goods are removed from the calculation of pass-through rates in this section. Clearly, Chinese imports have low pass-through rates, so they bring down overall rates. But the question is whether there is a difference in the pass-through from other countries depending on China’s presence in the market. To answer this, I consider pass-through from all countries except China.
when China is in the market for a good (0.2172) is considerably less than pass-through for goods and quarters in which China does not compete (0.2430), a significant difference based on a Mann-Whitney test ($p < 0.01$). Comparing the differences over time, Figure 3.11 shows that pass-through tends to be lower when China is competing in the market for a good than when it is not, with the clear exception of a brief period from 1996-1998.

![Figure 3.11: Median pass-through rate in quarters when China exports a good to the US vs. quarters when China does not export.](image)

Regressions are then run on China’s presence in the market, following the estimating equation:

$$ERPT_{i,c,t} = \delta_{i_2} + \alpha_c + \beta_t + \gamma X_{i,c,t},$$

(3.12)

where $\delta_{i_2}$, $\alpha_c$, and $\beta_t$ are possible indicator variables denoting two digit good, country of origin and quarter, respectively. The variable $X_{i,c,t}$ takes the value of one if China is in the market for good $i$ at time $t$, and zero otherwise. The coefficient of interest is therefore $\gamma$. These regression results generally show negative coefficients (Table 3.3).

Of particular note is the coefficient when all indicator variables are included in the model

91
Table 3.3: Regression results on China’s presence in the market.

<table>
<thead>
<tr>
<th>Country</th>
<th>Two-Digit Good</th>
<th>Quarter</th>
<th>Fixed Effect</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Included</td>
<td>Included</td>
<td>Included</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>-0.0941</td>
<td>-3.48**</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>-0.0533</td>
<td>-1.94†</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>-0.0942</td>
<td>-3.13**</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>-0.0438</td>
<td>-1.42</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>-0.0274</td>
<td>0.99</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>0.0134</td>
<td>0.47</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-0.0498</td>
<td>-1.63</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-0.0019</td>
<td>0.06</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$

($\gamma = -0.0019$). Using a difference of differences method, this value can be interpreted as:

$$\gamma = (ERPT_{i,c,t} - ERPT_{i,c,s}) - (ERPT_{j,c,t} - ERPT_{j,c,s}), \quad (3.13)$$

where commodity $i$ is imported from China in period $t$ but not in period $s$ ($t > s$), and commodity $j$ is not imported from China in either period\(^{23}\). So based on this, it is expected that if $i$ and $j$ are imported from the same time country in both periods $s$ and $t$, then the change in pass-through of good $i$ would be 0.0019 less than that of good $j$.

However, these results and their significance vary when indicator variables denoting two-digit good, country of origin, and quarter are included\(^{24}\). In particular, the effect of China’s presence tends to be time dependent, which can be seen by the quarterly fluctuations of both plots in Figure 3.11.

As is shown in Section 3.4.3, China’s growth as an exporter to the United States is not just

\(^{23}\) Derivation in Appendix 3.8.

\(^{24}\) The robustness of these results is shown by the similar findings in Tables 3.14 and 3.15 in Appendix 3.9. Table 3.14 repeats the regressions of pass-through on China’s presence in the market each quarter, but only considers goods that China exports to the United States at least once between 1990 and 2005. Limiting the scope of the data in this manner accounts for the possibility that China exports goods with inherently lower pass-through rates than goods they do not trade. Table 3.15 also repeats the regressions shown in Table 3.3 but considers China to be competing in the market if it has exported a particular commodity to the US at any point during the year. In theory, this should account for pass-through rates changing after China enters the market rather than just contemporaneously. All specifications of the regression produce similar results in terms of the sign and significance of the coefficient for China’s presence.
seen through the number of different goods traded, but also by the way China came to dominate the market for so many goods. Because of this, I next examine the difference in pass-through rates when China is the number one exporter of a good as opposed to any other country. The median rate when China is the lead exporter (0.2091) is significantly lower than when another country has the highest share (0.2335, \( p < 0.01 \)). Regressing pass-through on an indicator variable denoting whether China has the highest share (Table 3.4) suggests a negative relationship that is stronger than the negative relationship with China’s mere presence in the market. All specifications of the model give negative coefficients and all are significant except when dummy variables for both quarter and country of origin are included. Based on these findings, China being the number one exporter of a good to the United States tends to drive down pass-through rates for that good.

Table 3.4: Regression results of pass-through on whether China is the number one exporter of a good to the US in a quarter.

<table>
<thead>
<tr>
<th>Country Fixed Effect Included</th>
<th>2-Digit Good Fixed Effect Included</th>
<th>Quarter Fixed Effect Included</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>-0.1564</td>
<td>-5.05**</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>-0.1107</td>
<td>-3.52**</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>-0.1412</td>
<td>-4.10**</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>-0.0809</td>
<td>-2.30*</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>-0.0954</td>
<td>-3.03**</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>-0.0501</td>
<td>-1.56</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>-0.0986</td>
<td>-2.84**</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>-0.0412</td>
<td>-1.16</td>
</tr>
</tbody>
</table>

** denotes \( p < 0.01 \) * denotes \( p < 0.05 \) † denotes \( p < 0.10 \)

This table only considers observations that are not from the top trade partner.

\(^{25}\)These calculations of pass-through only include good-quarter combinations in which two or more countries are in the market. Additionally, the countries with the largest shares are not considered, nor are observations on imports from China. Including Chinese goods or top shareholders would make the results even more dramatic. As presented, however, this analysis shows the difference in pricing for smaller competitors when China is the top country compared to when another country leads market.
3.6.2 Pass-Through is Lower When China’s Share is Larger

I next show the negative relationship between pass-through and China’s market share by a regression of pass-through on China’s quarterly share of the market for each ten-digit good, according to the equation:

\[ ERPT_{i,c,t} = \delta_{t_2} + \alpha_c + \beta_t + \lambda S_{i,\text{China},t}. \] (3.14)

The terms in Equation 3.14 have the same meanings as those in Equation 3.12, with the exception that the variable of interest \((S_{i,\text{China},t})\) is now China’s share of the market for good \(i\) in period \(t\) and is continuous rather than an indicator. The coefficient on China’s share is negative and significant \((p < 0.10)\) for all specifications of the model (Table 3.5), including all possible combinations of indicator variables for country of origin, two-digit commodity, and quarter.

Table 3.5: Regression results on China’s share of the market for each ten digit commodity.

<table>
<thead>
<tr>
<th>Country</th>
<th>2-Digit Good</th>
<th>Quarter</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed Effect</td>
<td>Fixed Effect</td>
<td>Included</td>
<td>Included</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>−0.0033</td>
<td>−6.19**</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>−0.0024</td>
<td>−4.33**</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>−0.0033</td>
<td>−5.28**</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>−0.0020</td>
<td>−3.03**</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>−0.0024</td>
<td>−4.31**</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>−0.0014</td>
<td>−2.52*</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>−0.0026</td>
<td>−4.09**</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>−0.0012</td>
<td>−1.95 †</td>
</tr>
</tbody>
</table>

** denotes \( p < 0.01 \)  * denotes \( p < 0.05 \) † denotes \( p < 0.10 \)

As with the regression of pass-through on China’s presence (Equation 3.12), the coefficient when all indicators are included \((\lambda = -0.0012)\) can be interpreted using a difference of differences method:

\[ \lambda = \frac{(ERPT_{i,c,d} - ERPT_{i,c,s}) - (ERPT_{j,c,d} - ERPT_{j,c,s})}{S_{i,\text{China},t} - S_{i,\text{China},s}}, \] (3.15)
where commodity \( i \) is a commodity for which China’s share of the market changes between periods \( s \) and \( t \), and commodity \( j \) sees China’s share stay the same (\( j \) could also once again be a good that China doesn’t export to the US in either period). So \( \lambda = -0.0012 \) implies that if both goods are imported from the same country in periods \( s \) and \( t \), then the change in pass-through for \( i \) would be 0.0012 less than \( j \) for every percentage point that China’s share of \( i \) increases\(^{26}\).

At first look, it seems that the negative relationships shown in Table 3.5 are simply an example of the findings of Chapter 2, with the lowest pass-through rates coming from the exporters with the largest shares\(^{27}\). However, it should be noted that all results in this chapter comparing pass-through with China’s presence or share do not include Chinese goods in the calculation of pass-through. So while it makes sense based on the results of Chapter 2 that pass-through from China would be lower as China’s market share increases, the findings here show that pass-through rates from other countries are lower when China’s share of the good is larger. This effect is not seen for other top trade partners. Running similar regressions of pass-through on the market share of ten digit goods from other competitors in the US import market, none of the top five other countries (Canada, Japan, Mexico, Germany, and South Korea) have significant negative coefficients on their market share. In fact, of the United States’ top ten trade partners, only France shows the same negative relationship. However, the negative coefficient on French shares is insignificant \( (p > 0.10) \) when only goods imported from France at least once are considered. The lack of response in pass-through to changing market shares of other countries further suggests that pricing behavior from all countries is different when China’s share increases.

\(^{26}\)The findings shown in Table 3.5 are supported by similar results when only goods that are imported from China at least once are considered (Table 3.16 in Appendix 3.9), and when only good-quarter combinations in which China competes are considered (Table 3.17 in Appendix 3.9). Additionally, I examine the relationship between pass-through and China’s share using only data from 1997-2005, the period when China’s growth is strongest. The negative relationship continues to hold (Table 3.18 in Appendix 3.9) with the coefficient on China’s share becoming more significant \( (p < 0.05) \) when all indicators are included. The strong negative relationship between China’s market share and pass-through (as compared to the less clear findings comparing pass-through with China’s presence in the market) suggests that China’s establishment as a dominant competitor in the market for a good drives down pass-through, not simply China’s presence.

\(^{27}\)Ignoring imports from China, among goods with at least two competitors in a given quarter, the median pass-through for the top trade partner is 0.2067, which is significantly less than the 0.2289 rate for all other competitors \( (p < 0.01) \).
3.6.3 Treatment-Control Tests on the Impact of China

The negative coefficients in the regressions of pass-through on China’s presence and share of the market can be further validated by comparing pass-through for a control group consisting of goods for which China never enters the market, and a treatment group of goods for which China joins the market at some point during the span of the dataset. For this test, I consider only goods that were imported from at least one country both in 1994 and 2005. Any good imported from China in 1994 is dropped. Goods that are not imported from China in either year are considered the control group and goods that are imported from China in 2005 but not in 1994 comprise the treatment group. As seen in Table 3.6, between 1994 and 2005, median overall pass-through in the control group falls by 0.1236, while pass-through in the treatment group falls by 0.1722, a difference of 0.0486.

Table 3.6: Comparing changes in pass-through between 1994 and 2005 for goods not imported from China in either year vs. goods imported from China in 2005 but not 1994.

<table>
<thead>
<tr>
<th>Group</th>
<th>Observations</th>
<th>Median Pass-Through:</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1994</td>
<td>2005</td>
</tr>
<tr>
<td>Goods not Imported from China in 1994 or 2005</td>
<td>8,660</td>
<td>0.2489</td>
<td>0.1253</td>
</tr>
<tr>
<td>Goods Imported from China in 2005 but not 1994</td>
<td>33,817</td>
<td>0.3321</td>
<td>0.1599</td>
</tr>
</tbody>
</table>

Similarly, the effect of China’s increasing market shares can be determined by comparing control and treatment groups. In this setting, the control group is again defined as goods for which China does not compete in either 1994 or 2005. However, the treatment group includes all other observations as I also consider the average change in China’s share of each good from start to finish. In this case, pass-through for the treatment group falls by 0.1883 compared to the 0.1236 drop seen in the control group. During this period, China’s share increases by an average of 14.01% for observations in the test group. Combining these values according to Equation 3.15 gives an estimated coefficient of −.0046, which is more negative than the value found in the regression, though

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28Note that 1994 is the first full year for which pass-through calculations are available.
29Similar results are found using different starting and ending points. Interestingly, overall pass-through falls by 0.1841 between 1994 and 2005, a larger amount than either group. This suggests that the drop in pass-through is primarily due to goods imported from China in both 1994 and 2005. It also provides some explanation for the weak effect of China’s presence in the market on pass-through (Table 3.3).
it should be noted that this test compares only 1994 vs. 2005 while the regression uses quarterly observations across the full time span.

The results are even more striking when the treatment and control groups are defined to account for whether China’s share changes or not as opposed to simply China’s not competing in the market. Table 3.7 shows that goods for which China’s share changes by less than one percent from 1994 to 2005 (control) have a median pass-through that falls by 0.1245. This can be compared to goods for which China’s share changes by more than one percent (treatment) which see median pass-through fall by 0.2095. China’s shares in the treatment group increased by an average of 16.70% for an estimated coefficient of -0.0051. This value is again more negative than the actual regression coefficient, showing the clear impact of China’s increasing shares of the US import market.

Table 3.7: Comparing changes in pass-through between 1994 and 2005 by the change in China’s share over that time.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China’s share did not change from 1994 to 2005</td>
<td>38,733</td>
<td>0.2978</td>
<td>0.1733</td>
<td>-0.1245</td>
</tr>
<tr>
<td>China’s share changed from 1994 to 2005</td>
<td>154,259</td>
<td>0.3029</td>
<td>0.0934</td>
<td>-0.2095</td>
</tr>
</tbody>
</table>

China’s increasing presence and share is obviously not the only factor that caused pass-through to US import prices to drop, but these results clearly show that China contributed to the decline. The median pass-through rate in 1994 was 0.2776, compared to 0.1213 in 2005, declining by 0.1563 over eleven years. During that period, China’s share of all US imports rose from 6.61% to 16.41%, a rise of 9.80%. Using the coefficient of -0.0051 on China’s share calculated above, it can be estimated that China’s market share increasing by 9.80% would cause pass-through to fall by 0.05. As such, these calculations estimate that China’s increased share of the market explains 31.99% of the overall decline in pass-through.
3.6.4 A Disaggregated View of China’s Share and Pass-Through

According to the United States International Trade Commission, imported goods can be broken into twenty categories based on the first two digits of the HTS code. Table 3.8 indicates the categories, the percentage of total import value that each comprises both from the world and from China, and China’s rank among all exporters of goods to the United States in each category from 1990 through 2005. With few exceptions, imports from China tend to fall in the same categories as imports from the whole world.

Table 3.8: Categories of imports with the percent of total imports devoted to each category from the world and from China specifically, as well as China’s rank among exporters of goods in each category.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Percent of Total Imports</th>
<th>Percent of Imports from China</th>
<th>China’s Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Live Animals; Animal Products</td>
<td>0.65%</td>
<td>0.10%</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Vegetable Products</td>
<td>0.33%</td>
<td>0.22%</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Animal or Vegetable Fats and Oils</td>
<td>0.22%</td>
<td>0.01%</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>Prepared Foodstuffs</td>
<td>2.71%</td>
<td>0.64%</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>Mineral Products</td>
<td>3.39%</td>
<td>0.58%</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>Products of the Chemical Industries etc</td>
<td>8.09%</td>
<td>2.51%</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>Plastics and Rubber Articles</td>
<td>2.74%</td>
<td>2.23%</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Raw Hides and Skins, Leather, etc</td>
<td>1.04%</td>
<td>4.92%</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Wood and Articles of Wood</td>
<td>1.86%</td>
<td>0.83%</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>Pulp of Wood etc</td>
<td>2.77%</td>
<td>1.37%</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Textile and Textile Articles</td>
<td>9.11%</td>
<td>13.30%</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Footwear, Headgear, etc</td>
<td>2.26%</td>
<td>12.37%</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>Misc Manufactured Articles</td>
<td>1.12%</td>
<td>1.43%</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>Precious or Semi Precious Stones, etc</td>
<td>2.27%</td>
<td>0.07%</td>
<td>22</td>
</tr>
<tr>
<td>15</td>
<td>Base Metals and Articles of Base Metals</td>
<td>6.72%</td>
<td>5.64%</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>Machinery and Mechanical Appliances, etc</td>
<td>29.41%</td>
<td>36.35%</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>Vehicles, Aircraft, etc</td>
<td>20.63%</td>
<td>2.17%</td>
<td>10</td>
</tr>
<tr>
<td>18</td>
<td>Optical, Photographic, etc</td>
<td>2.28%</td>
<td>3.21%</td>
<td>2</td>
</tr>
<tr>
<td>19</td>
<td>Armes and Ammunition</td>
<td>0.08%</td>
<td>0.04%</td>
<td>7</td>
</tr>
<tr>
<td>20</td>
<td>Articles of Stone, Plaster, etc</td>
<td>2.32%</td>
<td>12.01%</td>
<td>1</td>
</tr>
</tbody>
</table>

To more fully show the extent of China’s rise, Figure 3.14 (in Appendix 3.9) shows China’s share of each category over time, along with China’s overall market share of US imports from 1990 through 2005. The most obvious trend across the plots of Figure 3.14 is the clear rise of China’s
share in many of the categories\textsuperscript{30}. In fact, China’s share of the US import market is larger in 2005 than in 1991 in all but one category\textsuperscript{31}. In sixteen categories, China’s share increases by more than two percentage points\textsuperscript{32}, and in ten categories it increases by more than ten percentage points.

Comparing changes in pass-through across these categories, pass-through tends to be lower in categories where China’s share grows the most. Figure 3.15 (in Appendix 3.9) shows median pass-through for each category as it changes over time, in comparison to the overall pass-through rate across all categories. Clearly, the plots of pass-through have more noise within each category, but most categories tend to show pass-through lowering from the early quarters of the dataset to the end. Specifically, in only six of the twenty categories (categories 1, 5, 7, 9, 13, and 19) is the median pass-through greater in the last eight quarters than in the first. Categories 12, 18, and 20 show the steepest drops in pass-through. Each initially has a rate dramatically greater than that of all US imports, but then falls over time to be less than or equal to the median of the full dataset.

Categories with larger drops in pass-through also tend to be categories where China’s presence in the market increases the most. Table 3.9 compares the change in pass-through in each category with the corresponding change in market share over the same time period. The two categories that experience decreases in China’s market share (5 and 19) are among the six categories for which pass-through increases. Of the five categories in which China’s share increases by more than ten percentage points, four are categories in which pass-through falls by more than 0.1.

Figure 3.12 shows the trend more clearly, plotting the change in pass-through against the change in China’s share for each category. Despite one outlier\textsuperscript{33}, there is a clear negative rela-

\textsuperscript{30}The plots in Figure 3.14 are ordered by China’s rank as an exporter of goods in that category to the US. As such, the plots near the top tend to show China’s category share exceeding its overall share. With a few exceptions, these also tend to be the categories that see the largest increases in China’s share.

\textsuperscript{31}In category 19, arms and ammunition, China’s 2005 share is 6.05% as opposed to 6.72% in 1991, an approximately 10% drop. However, this category comprises less than one tenth of one percent of total imports to the US during this period, so it is essentially negligible.

\textsuperscript{32}In addition to category 19, categories 3 (animal or vegetable fats and oils), 5 (mineral products), and 14 (precious or semi-precious stones, etc) comprise less than six percent of all import value. Therefore, more than 94% of US imports from 1990 through 2005 are in categories where China’s market share grew by more than two percentage points.

\textsuperscript{33}Category 18 (optical, photographic, etc.) has the largest drop in pass-through despite only an average increase in China’s share. Interestingly, while the change in China’s share of this category is approximately the same as the change in China’s overall share over the full span of the data, the trends are different as can be seen in Figure 3.14. The share of category 18 increases sharply in the late 1990s before leveling off, while overall share follows more of
Table 3.9: Change in median pass-through rate and China’s share of categories from the start of the period to the end.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Change in Pass-Through</th>
<th>Change in China’s Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Live Animals; Animal Products</td>
<td>0.2319</td>
<td>4.06</td>
</tr>
<tr>
<td>2</td>
<td>Vegetable Products</td>
<td>−0.0692</td>
<td>1.65</td>
</tr>
<tr>
<td>3</td>
<td>Animal or Vegetable Fats and Oils</td>
<td>−0.0594</td>
<td>0.31</td>
</tr>
<tr>
<td>4</td>
<td>Prepared Foodstuffs</td>
<td>−0.1339</td>
<td>2.32</td>
</tr>
<tr>
<td>5</td>
<td>Mineral Products</td>
<td>0.0058</td>
<td>−0.25</td>
</tr>
<tr>
<td>6</td>
<td>Products of the Chemical Industries etc</td>
<td>−0.0299</td>
<td>1.35</td>
</tr>
<tr>
<td>7</td>
<td>Plastics and Rubber Articles</td>
<td>0.0014</td>
<td>8.73</td>
</tr>
<tr>
<td>8</td>
<td>Raw Hides and Skins, Leather, etc</td>
<td>−0.1515</td>
<td>24.87</td>
</tr>
<tr>
<td>9</td>
<td>Wood and Articles of Wood</td>
<td>0.1158</td>
<td>5.75</td>
</tr>
<tr>
<td>10</td>
<td>Pulp of Wood etc</td>
<td>−0.1982</td>
<td>8.70</td>
</tr>
<tr>
<td>11</td>
<td>Textile and Textile Articles</td>
<td>−0.1560</td>
<td>7.16</td>
</tr>
<tr>
<td>12</td>
<td>Footwear, Headgear, etc</td>
<td>−0.4789</td>
<td>24.30</td>
</tr>
<tr>
<td>13</td>
<td>Misc Manufactured Articles</td>
<td>0.0468</td>
<td>9.65</td>
</tr>
<tr>
<td>14</td>
<td>Precious or Semi Precious Stones, etc</td>
<td>−0.1115</td>
<td>0.03</td>
</tr>
<tr>
<td>15</td>
<td>Base Metals and Articles of Base Metals</td>
<td>−0.1310</td>
<td>10.81</td>
</tr>
<tr>
<td>16</td>
<td>Machinery and Mechanical Appliances, etc</td>
<td>−0.0444</td>
<td>20.58</td>
</tr>
<tr>
<td>17</td>
<td>Vehicles, Aircraft, etc</td>
<td>−0.1559</td>
<td>1.54</td>
</tr>
<tr>
<td>18</td>
<td>Optical, Photographic, etc</td>
<td>−0.6618</td>
<td>8.27</td>
</tr>
<tr>
<td>19</td>
<td>Arms and Ammunition</td>
<td>0.3897</td>
<td>−2.97</td>
</tr>
<tr>
<td>20</td>
<td>Articles of Stone, Plaster, etc</td>
<td>−0.2301</td>
<td>20.10</td>
</tr>
</tbody>
</table>

The start and end of the period are defined as the first and last eight quarters of available data: The 4th quarter of 1993 through the 3rd quarter of 1995 vs. the 1st quarter of 2004 through the 4th quarter of 2005.

To show the breadth of the negative relationship between pass-through and China’s market share numerically, I regress the median pass-through rate of all non-Chinese imports on China’s share of each of the twenty categories of imports. The regressions in Table 3.10 show the expected negative relationship in fourteen of the twenty categories, with nine of those fourteen being significant ($p < 0.01$). Combined, the six categories for which the relationship is not negative combine for 7.57% of all import value, and just 3.17% of imports from China. So as is suggested in Figures 3.14 and 3.15, the categories in which trade is most active (particularly trade with China) show a steady rise. This early rise in China’s share may partially explain the larger than average drop in pass-through for this category. The three other categories for which China’s share increased earlier than normal (categories 8, 12, and 20) also rank among the largest drops in pass-through. But these three categories fit better into the trend shown in Figure 3.12 as in each case China’s share of the category far exceeds their overall share for the entire period.
negative relationships between pass-through and China’s market share.

3.6.5 Differences Between Dollar Appreciation and Depreciation

As is discussed in Section 3.2, there is some theoretical reasoning to suggest that the effect of competition with China on exchange rate pass-through is different when the dollar appreciates in value against a foreign currency than when it depreciates. To test this “direction effect”, I regress pass-through on China’s market share first considering only observations that occur after an exchange rate increase, then using observations after an exchange rate decrease. Due to the highly variable nature of exchange rates and the rolling regressions used to capture pass-through, I classify an increase or decrease in the nominal exchange rate based on whether the series rose or fell from its value 12 quarters prior.

The regression results (Table 3.11) are dramatically different depending on the direction of the

---

\(^{34}\)While the specific example presented in Section 3.2 does not predict a direction effect, the general theory and logic suggests that China’s increased presence will cause lower pass-through for competitors following a dollar depreciation moreso than after an appreciation.
Table 3.10: Regression results of median pass-through rates on China’s share of each category.

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Live Animals; Animal Products</td>
<td>0.0614</td>
<td>2.20*</td>
</tr>
<tr>
<td>2</td>
<td>Vegetable Products</td>
<td>0.0084</td>
<td>1.27</td>
</tr>
<tr>
<td>3</td>
<td>Animal or Vegetable Fats and Oils</td>
<td>0.1724</td>
<td>0.67</td>
</tr>
<tr>
<td>4</td>
<td>Prepared Foodstuffs</td>
<td>−0.0513</td>
<td>−5.30**</td>
</tr>
<tr>
<td>5</td>
<td>Mineral Products</td>
<td>0.0428</td>
<td>1.73†</td>
</tr>
<tr>
<td>6</td>
<td>Products of the Chemical Industries etc</td>
<td>−0.0016</td>
<td>−0.07</td>
</tr>
<tr>
<td>7</td>
<td>Plastics and Rubber Articles</td>
<td>−0.0078</td>
<td>−1.26</td>
</tr>
<tr>
<td>8</td>
<td>Raw Hides and Skins, Leather, etc</td>
<td>−0.0057</td>
<td>−4.33**</td>
</tr>
<tr>
<td>9</td>
<td>Wood and Articles of Wood</td>
<td>0.0050</td>
<td>0.51</td>
</tr>
<tr>
<td>10</td>
<td>Pulp of Wood etc</td>
<td>−0.0173</td>
<td>−2.21*</td>
</tr>
<tr>
<td>11</td>
<td>Textile and Textile Articles</td>
<td>−0.0150</td>
<td>−3.18**</td>
</tr>
<tr>
<td>12</td>
<td>Footwear, Headgear, etc</td>
<td>−0.0196</td>
<td>−9.12**</td>
</tr>
<tr>
<td>13</td>
<td>Misc Manufactured Articles</td>
<td>0.0028</td>
<td>0.87</td>
</tr>
<tr>
<td>14</td>
<td>Precious or Semi Precious Stones, etc</td>
<td>−0.2571</td>
<td>−0.71</td>
</tr>
<tr>
<td>15</td>
<td>Base Metals and Articles of Base Metals</td>
<td>−0.0105</td>
<td>−3.09**</td>
</tr>
<tr>
<td>16</td>
<td>Machinery and Mechanical Appliances, etc</td>
<td>−0.0015</td>
<td>−1.27</td>
</tr>
<tr>
<td>17</td>
<td>Vehicles, Aircraft, etc</td>
<td>−0.0188</td>
<td>−0.63</td>
</tr>
<tr>
<td>18</td>
<td>Optical, Photographic, etc</td>
<td>−0.0512</td>
<td>−7.13**</td>
</tr>
<tr>
<td>19</td>
<td>Arms and Ammunition</td>
<td>−0.0315</td>
<td>−3.47**</td>
</tr>
<tr>
<td>20</td>
<td>Articles of Stone, Plaster, etc</td>
<td>−0.0105</td>
<td>−7.13**</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$   * denotes $p < 0.05$   † denotes $p < 0.10$

exchange rate movement. When the dollar strengthens against the foreign currency, the coefficient on China’s share is positive under all specifications, though it is only significant ($p < 0.05$) when both two-digit good and quarter indicators are included. Alternatively, following dollar depreciations, all specifications of the model produce strongly significant negative coefficients.

The findings shown in Table 3.11 support the logic that the role of China in pass-through is more noticeable following a dollar depreciation. China’s increasing share of the market disincentivizes competitors from raising prices to the full extent of the exchange rate increase when the dollar’s value decreases. However, when the dollar strengthens, exporters tend to lower prices to the same degree no matter how much of the market is controlled by China. If anything, there is some evidence that these competitors are more eager to lower prices following a dollar appreciation when China has a larger share of the market\textsuperscript{35} (as seen by the significant positive coefficients

\textsuperscript{35}Interestingly, the size of the exchange rate movement does not seem to impact the influence of China on its
Table 3.11: Regression results of pass-through on China’s market share following dollar depreciations vs. appreciations.

<table>
<thead>
<tr>
<th>Country Fixed Effect Included</th>
<th>2-Digit Good Fixed Effect Included</th>
<th>Quarter Fixed Effect Included</th>
<th>Dollar Depreciates Coefficient</th>
<th>t-Statistic</th>
<th>Dollar Appreciates Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>−0.0060</td>
<td>−6.35**</td>
<td>0.0001</td>
<td>0.10</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>−0.0048</td>
<td>−4.93**</td>
<td>0.0009</td>
<td>1.47</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>−0.0064</td>
<td>−5.79**</td>
<td>0.0005</td>
<td>0.71</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>−0.0048</td>
<td>−4.19**</td>
<td>0.0017</td>
<td>2.34*</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>−0.0045</td>
<td>−4.57**</td>
<td>0.0008</td>
<td>1.20</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>−0.0034</td>
<td>−3.36**</td>
<td>0.0012</td>
<td>1.91†</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>−0.0051</td>
<td>−4.52**</td>
<td>0.0011</td>
<td>1.47</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>−0.0037</td>
<td>−3.15**</td>
<td>0.0018</td>
<td>2.43*</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$

under certain model specifications). In Chapter 2, I show pass-through rates to be lower following a large depreciation of the dollar compared to a large appreciation. The difference in the effect of China’s market share following appreciations vs. depreciations could partially explain this difference.

As is the case when examining China’s role in its competitors’ pass-through rates in general (Tables 3.3 and 3.5), the effects of dollar appreciations and depreciations are stronger when pass-through is compared with China’s share of the market rather than merely China’s presence. Following a depreciation of the dollar, pass-through is negatively related to China’s presence in the market under all specifications of the model, though the relationship is no longer significant when both country-level and time dummy variables are included. When the dollar appreciates, China’s presence in the market is positively related to pass-through when country effects are included, and negatively related when they are not, with no specification producing a statistically significant coefficient.

competitors’ pricing decisions. Table 3.19 in (Appendix 3.9) compares pass-through rates and China’s share of the import market following dollar appreciations and depreciations, using only the largest 50% of exchange rate movements for each exporter. The findings are essentially the same as those seen in Table 3.11, with a significant negative relationship following dollar depreciations and minimal positive relationship when the dollar strengthens.

36In general, the direction of the exchange rate’s movement does not impact pass-through rates. It is just when only the largest 50% of changes are considered that the difference appears.
3.6.6 Checks for Spurious Relationships

As with any analysis of variables that are changing over time, the possibility of spurious relationships should be considered. Despite the inclusion of quarterly indicator variables in the regressions, it remains conceivable that the relationship between pass-through and China’s market share (shown most clearly in Table 3.5) is simply due to China’s share of the US market rising at the same time as pass-through rates to import prices decline. I address this possibility by examining the effects of other countries with increasing market shares, and by showing the lack of decline in pass-through for goods that China never trades.

I first consider pass-through rates of other countries with increasing shares of the US import market during the same period. Most notably, the share of US imports from Mexico rises by more than any country except China (as shown in Section 3.4.1 and Figure 3.2). However, while the relationship between median pass-through rates and Mexico’s share of the market for each good is negative for all specifications of the model (Table 3.12), each coefficient is smaller in absolute value than the corresponding coefficient of the regression of pass-through on China’s share (Table 3.5). Additionally, the relationship with Mexico’s market share is only moderately significant when no indicator variables are included in the model, further indicating the lack of influence of Mexico’s increasing shares on pass-through rates from its competitors.

Table 3.12: Regression results on Mexico’s share of the market for each ten digit commodity.

<table>
<thead>
<tr>
<th>Country Fixed Effect</th>
<th>2-Digit Good Fixed Effect</th>
<th>Quarter Fixed Effect</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>−0.0015</td>
<td>−1.70 †</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>−0.0011</td>
<td>−1.19</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>−0.0008</td>
<td>−0.85</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>−0.0005</td>
<td>−0.47</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>−0.0014</td>
<td>−1.49</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>−0.0010</td>
<td>−1.02</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>−0.0008</td>
<td>−0.87</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>−0.0005</td>
<td>−0.51</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$ * denotes $p < 0.05$ † denotes $p < 0.10$
Comparing the pass-through rates of goods that China exports to the United States at least once with those that it never exports to the US, Figure 3.13 shows the median pass-through rates of all goods in each group (removing observations of goods imported from China). The decline in pass-through rates starting from the early 1990s is much clearer for goods exported from China, similar to the numerical findings of Section 3.6.3.

Figure 3.13: Median quarterly pass-through rates for goods that China exports to the US vs. goods it does not export.

Looking at the data at a more highly disaggregated level, it is obviously impossible to analyze the effect of China’s shares of ten-digit goods that it never trades. However, it is possible to examine the difference in the relationship between pass-through and eight-digit market shares for the two groups. To do this, I first determine China’s quarterly share of the import market for all eight-digit goods. Using the eight-digit shares, I regress pass-through for each ten-digit good on the eight-digit share, plus quarter, country, and two-digit good indicators.

\[ \text{ERPT}_{i,c,t} = \delta_{i_2} + \alpha_c + \beta_t + \zeta S_{i_8,China,t} \]  

(3.16)
This regression is run both for ten-digit goods that are exported from China at least once, as well as for ten-digit goods never exported from China. The results (Table 3.13) again show a significant negative coefficient on China’s market share for goods that China trades, and an insignificant relationship for goods that China does not trade.

Table 3.13: Regressions of quarterly pass-through rates of ten-digit goods on China’s market share of eight-digit goods.

<table>
<thead>
<tr>
<th>Data Description</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods Imported from China at Least Once</td>
<td>−0.0016</td>
<td>−2.09*</td>
</tr>
<tr>
<td>Goods Never Imported from China</td>
<td>−0.0007</td>
<td>−0.15</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$    * denotes $p < 0.05$    † denotes $p < 0.10$

Regressions include indicator variables for country of origin, quarter, and two-digit good.

Pass-through for varieties of eight-digit goods that are never exported from China is not significantly related to China’s eight-digit share, while pass-through for varieties traded by China shows a significant negative pattern. This provides the strongest proof that the observed relationship is not simply due to autocorrelation. Based on the findings in this section, there appears to be ample evidence of a negative relationship between China’s market share for a good and that good’s import price pass-through.

### 3.7 Conclusion

The increasing role of China as an exporter of goods to the United States has been one of the most important developments in international trade over the past 25 years. In this chapter, I illustrate the extent to which China rose to control the US import market from 1991 through 2005, both in terms of breadth of goods imported and the dominance of the market for so many goods. Of particular note is the degree to which China outpaces its competition in growth of newly traded goods during this time. I also show the stark decrease in exchange rate pass-through to US imports that occurs in this same period. Pass-through rates from China are particularly low, but the drop is evident in rates from competing countries as well. I display the connection between these two
trends, linking the threat of increased competition from China (with its fixed exchange rate regime) and the reluctance of other countries to raise the price of imports when facing a weakened dollar.

Using highly disaggregated data on US imports to calculate a specific value of pass-through for each ten-digit commodity from each country of origin in a quarter. I show the influence of China on pricing decisions of its competitors marginally through regressions of these pass-through values on an indicator of China’s presence in the market during a quarter, then more strongly through regressions of pass-through on China’s market share for the good of interest during that quarter. These findings generally hold within categories of goods as well, with categories of imports for which China’s share increases the most having larger declines in pass-through. Finally, as predicted by simple theory, it is evident that China’s fixed exchange rate impacts competitors’ prices more when the dollar decreases in value than when it increases.

This chapter contributes to a larger literature on exchange rate pass-through, specifically those studies focusing on the decline in pass-through to US import prices in the 1990s. China’s rise as a trade partner with the United States clearly contributes to this decline through its own low pass-through rates, as well as its influence on the rates of other US trade partners. As a result, China’s dominance of the US import market furthers the disconnect between the exchange rate dynamics of all countries and overall US price levels. As China’s growth and control over the US import market continues, this disconnect seems likely to persist into the future.

3.8 Appendix - Proofs and Derivations

3.8.1 Lower pass-through when fixed ER exporter has a larger share.

As described Section 3.2, suppose the import markets for goods $g$ and $h$ are structured the exact same way. All $N$ exporters have the same share of the market for each good, except $C$ has the same share of $g$ as $B$ has of $h$, and vice-versa. Also assume $C$ is the only exporter with a fixed exchange rate and $C$’s share of $g$ is larger than $B$'s share (and therefore $B$'s share of $h$ is larger than $C$’s).

Suppose the host country’s currency devalues, so the exchange rate for all exporters except $C$
increases by a factor of $k$. Compare the change in $A$’s price of $g$ to its price of $h$.

Note that according to Equation 3.3, if:

$$S_{g0,C} > S_{g0,B},$$

then:

$$P_{g0,C}^{1-\rho} > P_{g0,B}^{1-\rho}$$

(3.18)

$$P_{g0,C}^{1-\rho}(1 - k^{1-\rho}) > P_{g0,B}^{1-\rho}(1 - k^{1-\rho})$$

(3.19)

$$P_{g0,C}^{1-\rho} - k^{1-\rho}P_{g0,C}^{1-\rho} > P_{g0,B}^{1-\rho} - k^{1-\rho}P_{g0,B}^{1-\rho}$$

(3.20)

$$k^{1-\rho}P_{g0,B}^{1-\rho} + P_{g0,C}^{1-\rho} > P_{g0,B}^{1-\rho} + k^{1-\rho}P_{g0,C}^{1-\rho}$$

(3.21)

$$k^{1-\rho} \sum_{i \in C} (P_{g0,i}^{1-\rho}) + P_{g0,C}^{1-\rho} > k^{1-\rho} \sum_{i \in B} (P_{g0,i}^{1-\rho}) + P_{g0,B}^{1-\rho}$$

(3.22)

$$\frac{k^{1-\rho}P_{g0,A}^{1-\rho}}{k^{1-\rho} \sum_{i \in B} (P_{g0,i}^{1-\rho}) + P_{g0,B}^{1-\rho}} < \frac{k^{1-\rho}P_{g0,A}^{1-\rho}}{k^{1-\rho} \sum_{i \in C} (P_{g0,i}^{1-\rho}) + P_{g0,C}^{1-\rho}}$$

(3.23)

Note that due to the structure of the import markets for goods $g$ and $h$, specifically the fact that $C$’s initial share of $g$ is the same as $B$’s initial share of $h$ and vice versa:

$$\frac{k^{1-\rho}P_{g0,A}^{1-\rho}}{k^{1-\rho} \sum_{i \neq B} (P_{g0,i}^{1-\rho}) + P_{g0,B}^{1-\rho}} = \frac{k^{1-\rho}P_{h0,A}^{1-\rho}}{k^{1-\rho} \sum_{i \neq C} (P_{h0,i}^{1-\rho}) + P_{h0,C}^{1-\rho}}$$

Therefore:

$$\frac{k^{1-\rho}P_{g0,A}^{1-\rho}}{k^{1-\rho} \sum_{i \in C} (P_{g0,i}^{1-\rho}) + P_{g0,C}^{1-\rho}} < \frac{k^{1-\rho}P_{h0,A}^{1-\rho}}{k^{1-\rho} \sum_{i \in C} (P_{h0,i}^{1-\rho}) + P_{h0,C}^{1-\rho}}$$

(3.24)

And by Equation 3.5, these represent exporter $A$’s shares of goods $g$ and $h$, respectively, following
the exchange rate movement:

\[ S_{g1,A} < S_{h1,A} \]  

(3.25)

Using the definitions of \( \chi \) and \( \zeta \) from Equation 3.2:

\[ \chi + S_{g1,A} \zeta > \chi + S_{h1,A} \zeta \]  

(3.26)

\[ \frac{1}{\chi + S_{g1,A} \zeta} < \frac{1}{\chi + S_{h1,A} \zeta} \]  

(3.27)

\[ \frac{\left( \chi + S_{g0,A} \zeta \right) k}{\chi + S_{g1,A} \zeta} < \frac{\left( \chi + S_{h0,A} \zeta \right) k}{\chi + S_{h1,A} \zeta} \]  

(3.28)

Finally, using Equation 3.6 for the ratio of A’s final price to initial price:

\[ \frac{P_{g1,A}}{P_{g0,A}} < \frac{P_{h1,A}}{P_{h0,A}} \]  

(3.29)

So A’s price of good \( g \) (the good for which \( C’ \)’s share is larger) increases by a smaller amount than its price of good \( h \), implying lower pass-through. Note that if the exchange rate were to decrease \( (k < 1) \), then the inequalities in (3.19) - (3.29) would be the opposite. This would mean that A’s price of good \( g \) falls by less than its price of good \( h \). So in both cases, lower pass-through occurs when the country with a fixed exchange rate has a larger share.

### 3.8.2 Derivation of Equation 3.13

Suppose commodity \( i \) is imported from China in period \( t \), but not in an earlier period \( s \). Then pass-through of \( i \) from country \( c \) in each period (according to Equation 3.12 would be estimated by:

\[ ERPT_{i,c,t} = \delta_{i,t} + \alpha_c + \beta_t + \gamma \]  

(3.30)
The change in pass-through of $i$ from period $s$ to $t$ is:

$$ ERPT_{i,c,t} - ERPT_{i,c,s} = \beta_t - \beta_s + \gamma $$ (3.32)

Or

$$ \beta_t - \beta_s = ERPT_{i,c,t} - ERPT_{i,c,s} - \gamma $$ (3.33)

If commodity $j$ has the same first two digits as $i$ and is not imported from China in period $s$ or $t$, then pass-through of $j$ from country $c$ in each period would be estimated by:

$$ ERPT_{j,c,t} = \delta_{i_2} + \alpha_c + \beta_t $$ (3.34)

and

$$ ERPT_{j,c,s} = \delta_{i_2} + \alpha_c + \beta_s $$ (3.35)

So the change in pass-through of $j$ from country $c$ would be:

$$ ERPT_{j,c,t} - ERPT_{j,c,s} = \beta_t - \beta_s $$ (3.36)
Equating 3.33 and 3.36 gives:

\[
ERPT_{i,c,t} - ERPT_{i,c,s} - \gamma = ERPT_{j,c,t} - ERPT_{j,c,s} \tag{3.37}
\]

Or:

\[
\gamma = (ERPT_{i,c,t} - ERPT_{i,c,s}) - (ERPT_{j,c,t} - ERPT_{j,c,s}) \tag{3.38}
\]

### 3.8.3 Derivation of Equation 3.15

Similar to the derivation of Equation 3.13, assume China’s share of \( i \) changes between period \( s \) and \( t \), while its share of \( j \) remains constant. Then pass-through from country \( c \) can be estimated:

\[
ERPT_{i,c,t} = \delta_{i_2} + \alpha_c + \beta_t + \lambda S_{i,\text{China},t} \tag{3.39}
\]

\[
ERPT_{i,c,s} = \delta_{i_2} + \alpha_c + \beta_s + \lambda S_{i,\text{China},s} \tag{3.40}
\]

\[
ERPT_{j,c,t} = \delta_{i_2} + \alpha_c + \beta_t + \lambda S_{j,\text{China},t} \tag{3.41}
\]

and

\[
ERPT_{j,c,s} = \delta_{i_2} + \alpha_c + \beta_s + \lambda S_{j,\text{China},s} \tag{3.42}
\]

The changes in pass-through become:

\[
ERPT_{i,c,t} - ERPT_{i,c,s} = (\beta_t - \beta_s) + \lambda(S_{i,\text{China},t} - S_{i,\text{China},s}) \tag{3.43}
\]
and

\[ ERPT_{j,c,t} - ERPT_{j,c,s} = (\beta_t - \beta_s) \]  

(3.44)

Substituting 3.44 into 3.43 and solving gives:

\[ \lambda = \frac{(ERPT_{i,c,t} - ERPT_{i,c,s}) - (ERPT_{j,c,t} - ERPT_{j,c,s})}{S_{i,China,t} - S_{i,China,s}} \]  

(3.45)

3.9 Appendix - Supplementary Tables and Figures

Table 3.14: Regression results on China’s presence in the market for goods that China exports to the US at least once.

<table>
<thead>
<tr>
<th>Country</th>
<th>Fixed Effect Included</th>
<th>2-Digit Good Fixed Effect Included</th>
<th>Quarter Fixed Effect Included</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>−0.0858</td>
<td>−3.02**</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>−0.0400</td>
<td>−1.38</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>−0.0902</td>
<td>−2.90**</td>
</tr>
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<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>−0.0372</td>
<td>−1.17</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>−0.0159</td>
<td>−0.53</td>
</tr>
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<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>0.0296</td>
<td>1.00</td>
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<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>−0.0455</td>
<td>−1.44</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>0.0046</td>
<td>0.14</td>
</tr>
</tbody>
</table>

** denotes \( p < 0.01 \)  
* denotes \( p < 0.05 \)  
† denotes \( p < 0.10 \)
Table 3.15: Regression results on China’s presence in the market at any point during the year.

<table>
<thead>
<tr>
<th>Country 2-Digit Good</th>
<th>Quarter Fixed Effect Included</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No  No  No</td>
<td>No</td>
<td>-0.0843</td>
<td>-3.19**</td>
</tr>
<tr>
<td>No  No  Yes</td>
<td>No</td>
<td>-0.0436</td>
<td>-1.62 †</td>
</tr>
<tr>
<td>No  Yes  No</td>
<td>Yes</td>
<td>-0.0820</td>
<td>-2.78**</td>
</tr>
<tr>
<td>No  Yes  Yes</td>
<td>No</td>
<td>-0.0317</td>
<td>-1.05</td>
</tr>
<tr>
<td>Yes No  No</td>
<td>Yes</td>
<td>-0.0162</td>
<td>-0.59</td>
</tr>
<tr>
<td>Yes No  Yes</td>
<td>No</td>
<td>0.0247</td>
<td>0.89</td>
</tr>
<tr>
<td>Yes Yes No</td>
<td>Yes</td>
<td>-0.0358</td>
<td>-1.19</td>
</tr>
<tr>
<td>Yes Yes Yes</td>
<td>Yes</td>
<td>0.0121</td>
<td>0.40</td>
</tr>
</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$

Table 3.16: Regression results on China’s share of the market for each ten digit commodity that China exports to the US at some point.

<table>
<thead>
<tr>
<th>Country 2-Digit Good</th>
<th>Quarter Fixed Effect Included</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No  No  No</td>
<td>No</td>
<td>-0.0032</td>
<td>-5.97**</td>
</tr>
<tr>
<td>No  No  Yes</td>
<td>No</td>
<td>-0.0023</td>
<td>-4.12**</td>
</tr>
<tr>
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<td>Yes</td>
<td>-0.0033</td>
<td>-5.20**</td>
</tr>
<tr>
<td>No  Yes  Yes</td>
<td>No</td>
<td>-0.0020</td>
<td>-2.97**</td>
</tr>
<tr>
<td>Yes No  No</td>
<td>Yes</td>
<td>-0.0023</td>
<td>-4.18**</td>
</tr>
<tr>
<td>Yes No  Yes</td>
<td>No</td>
<td>-0.0013</td>
<td>-2.39*</td>
</tr>
<tr>
<td>Yes Yes No</td>
<td>Yes</td>
<td>-0.0026</td>
<td>-4.03**</td>
</tr>
<tr>
<td>Yes Yes Yes</td>
<td>Yes</td>
<td>-0.0012</td>
<td>-1.92 †</td>
</tr>
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</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$
Table 3.17: Regression results on China’s share of the market for each ten digit commodity using only quarters when the commodity is exported from China.

<table>
<thead>
<tr>
<th>Country Fixed Effect Included</th>
<th>2-Digit Good Fixed Effect Included</th>
<th>Quarter Fixed Effect Included</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>−0.0030</td>
<td>−5.03**</td>
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<td>No</td>
<td>No</td>
<td>Yes</td>
<td>−0.0021</td>
<td>−3.50**</td>
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<tr>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>−0.0033</td>
<td>−4.80**</td>
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<tr>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>−0.0020</td>
<td>−2.75**</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>−0.0024</td>
<td>−3.96**</td>
</tr>
<tr>
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<td>No</td>
<td>Yes</td>
<td>−0.0015</td>
<td>−2.38*</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>−0.0028</td>
<td>−3.95**</td>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>−0.0014</td>
<td>−1.94†</td>
</tr>
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** denotes p < 0.01  * denotes p < 0.05  † denotes p < 0.10

Table 3.18: Regression results on China’s share of the market for each ten digit commodity from 1997 through 2005.

<table>
<thead>
<tr>
<th>Country Fixed Effect Included</th>
<th>2-Digit Good Fixed Effect Included</th>
<th>Quarter Fixed Effect Included</th>
<th>Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>−0.0029</td>
<td>−5.38**</td>
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<tr>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>−0.0019</td>
<td>−3.46**</td>
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<td>Yes</td>
<td>No</td>
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<td>No</td>
<td>−0.0022</td>
<td>−4.09**</td>
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** denotes p < 0.01  * denotes p < 0.05  † denotes p < 0.10
Table 3.19: Regression results of pass-through on China’s market share following large dollar depreciations vs. appreciations.

<table>
<thead>
<tr>
<th>Country Fixed Effect Included</th>
<th>2-Digit Good Fixed Effect Included</th>
<th>Quarter Fixed Effect Included</th>
<th>Large Depreciation Coefficient</th>
<th>t-Statistic</th>
<th>Large Appreciation Coefficient</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
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<td>No</td>
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<td>−4.64**</td>
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<td>0.66</td>
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<td>No</td>
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<td>−4.13**</td>
<td>0.0014</td>
<td>1.78†</td>
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<td>No</td>
<td>−0.0044</td>
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<td>0.35</td>
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<td>0.0013</td>
<td>1.38</td>
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<td>−0.0050</td>
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<td>0.0016</td>
<td>1.99*</td>
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<td>−0.0037</td>
<td>−2.72**</td>
<td>0.0016</td>
<td>1.61</td>
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</tbody>
</table>

** denotes $p < 0.01$  * denotes $p < 0.05$  † denotes $p < 0.10$
Figure 3.14: Percentage of import value from China by category and overall, with categories ordered by China’s rank in the US import market.
Figure 3.15: Exchange rate pass-through by category and overall, with categories ordered by China’s rank in the US import market.
Bibliography


