The End of Currency Manipulation? Global Supply Chains and Exchange Rate Politics

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Abstract

"Where have all the [currency manipulators] gone?" (Cole, 1997). Export-oriented industrialization provided spectacular growth rates for developing states since the 1970s, but as of 2018, export-dependent states were no longer using purposive exchange rate depreciation, an essential tool of this growth strategy. This is puzzling given (a) the past success of the growth model as well as (b) current protectionism in the West. I argue that global supply chain integration over the previous quarter century has decreased the political and economic benefits of engaging in currency manipulation as a policy of export-led growth while the costs remain substantial. Utilizing panel data across 35 advanced and emerging market economies between 1995 and 2015, I demonstrate a relationship between global supply chain trade and exchange rate appreciation as well as decreased foreign exchange intervention. I consider a political model of heterogenous firms and global supply chain integration to support this outcome, exhibiting that indeed firm preferences for exchange rate undervaluation are non-linear with respect to size and global supply chain dependence. Together, these results suggest that economic power via firm size and global supply chain integration are closely linked to the disappearance of currency manipulators.

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1 Introduction

In the post-Bretton Woods financial order of freely-floating exchange rates, several developing states followed a strategy of export-led growth by running a depreciated exchange rate. A weakened exchange rate gave exporting firms in these states a competitive edge in international trade while simultaneously protecting import-competing firms. This model of export-oriented industrialization led to spectacular growth rates in numerous East and Southeast Asian states—e.g., China, Japan, South Korea, Taiwan—while simultaneously being blamed for global trade imbalances in the West. The United States, as chief complainant of these trade imbalances, orchestrated concessions from Japan and West Germany in the 1985 Plaza Accords, but, since 2000, has failed to reach similar agreements with export-dependent states who depreciate their currencies.

Between 2000 and 2017, economists at the Peterson Institute for International Economics labeled eight of these export-dependent states "currency manipulators," albeit not all in the same year: China, Israel, Japan, Malaysia, South Korea, Sweden, Taiwan, and Thailand. Currency manipulation is the purposive action of a state to weaken the value of its currency in order to positively affect its trade balance. In 2007, at the height of contemporary currency manipulation, China, Malaysia, and Thailand purchased a combined $675 billion in foreign exchange to maintain undervalued exchange rates (China alone purchased $621 billion), which had a demonstrable effect on their large trade surpluses: 6 percent of GDP in Thailand, 10 percent in China, and an astonishing 15 percent in Malaysia (Bergsten and Gagnon, 2017, pp. 208-12). However, as the decade continued, the practice of governments manipulating their currencies abated; in some cases countries began selling their foreign exchange reserves

to prevent their currencies from depreciating further—this negative flow reached a peak in 2016, again led by China. By 2018 no currency manipulators remained, despite increased protectionism from the main importer of many of these goods, the United States. So why has this *beggar-thy-neighbor* practice ended, especially in an era of heightened protectionism?

I argue that integration in global supply chains over the previous quarter century has decreased the political and economic benefits of engaging in currency manipulation as a policy of export-led growth, while the costs remain substantial. A depreciated currency alters relative prices, shifting domestic demand from foreign to domestic goods (more expensive imports), as well as making exported goods more competitive (cheaper exports). Thus, this policy tends to favor import-competing firms and industries (protection against imports) as well as exporting firms and industries (subsidized exports). These outcomes, however, come at a cost to other domestic groups, on top of the government's cost of purchasing foreign exchange reserves. The costs to domestic groups of undervaluation include an increased foreign debt burden (Walter, 2008), reduced purchasing power of consumers and local businesses (Frieden, 1991), and higher domestic borrowing costs for all (Gagnon, 2011). The political challenge for governments comes in deciding whether to engage in this neo-mercantilist practice given the domestic distributional effects.

As firms unbundle the production process into global supply chains, the benefits of a depreciated currency diminish. The imported inputs used to manufacture a final good (or an intermediate input that is exported again) tend to become more expensive, thus negating the benefit for exporters. Using country-level production data from the OECD-WTO Trade in Value Added (TiVA) database, I evaluate the relationship between global supply chain integration and currency values. I demonstrate an appreciating relationship between global

supply chains and exchange rate valuation, but the results are statistically insignificant. Exchange rate valuations tend to be quite noisy, with a lot of variation driven by market forces rather than government policy. I isolate the government's role in currency manipulation by evaluating the effect of global supply chain integration on foreign exchange intervention and find a strongly negative relationship. This provides a unique explanation for the recent disappearance of currency manipulators among export-dependent states.

In the second part of the paper, I suggest a political explanation for this relationship between global supply chains and diminished currency manipulation. If the costs and benefits of exchange rate levels are determined by how the exchange rate affects specific socioeconomic groups—e.g., exporters, importers, or consumers—, then the exchange rate policy decisions should be conditional on the aggregation of exchange rate preferences across the electorate. All else equal, consumers will oppose an undervalued exchange rate due to the increased price of goods (Frieden, 2014). Thus, the decision to forego currency undervaluation will be based upon the preferences of import-competing and exporting firms. If we assume that import-competing firms remained constant since the 1990s when currency manipulation began to pick up steam—it is more likely that these firms actually decreased in number due to the reduction in trade barriers since the 1990s, so this assumption would bias my results adversely—then it must be the evolution of exporting firms that explains the change in policy. I argue there is a divergence in exchange rate preferences among exporting firms due to their size and production location decisions. Very large firms will tend to be both importers and exporters—so-called "superstar" firms (Osgood et al., 2017)—and thus will exhibit policy preferences unique to their situation (Plouffe, 2015). These firms also employ a large percentage of laborers and account for the majority of value added in manufacturing

(Bernard et al., 2007). Thus, the preferences of superstar firms should hold more weight given their impact on the economy. I evaluate the non-linearity in exchange rate preferences across firm size and production network intensity using firm survey data from the World Bank and utilized in Egan (2017). I reproduce Egan's study using his finer-grained measure of firm size to illustrate that it is the largest firms in countries with an undervalued exchange rate that are most concerned with the value of the domestic currency. This finding does not contradict his results; it merely provides added support for my story of global supply chains, firm heterogeneity, and exchange rate outcomes.

This paper adds to the literature on exchange rate politics by explicitly including global supply chain trade in the analysis. Moreover, it provides a unique political explanation for the recent puzzle of the disappearing currency manipulators. In the following section, I illustrate the model of exchange rate politics, global supply chain trade, and heterogenous firms. In Section 3, I detail the recent transformation in international trade and introduce the data on global supply chains. In Section 4, I define currency manipulation, overview how scholars have treated this *beggar-thy-neighbor* policy in historical and contemporary contexts, and introduce the data for measuring this phenomenon. In Section 5, I test the hypotheses I detail in the next section. Section 6 discusses the implications for these findings and concludes.

2 Global Supply Chains, Firms, and Exchange Rate Politics

The theory I develop in this section is a straightforward amendment of the exchange rate politics model of Frieden (1991, 2014), but which I complicate with the inclusion of heteroge-

nous firms. This addition to the model provides the micro-foundations for the connection between global supply chains, firm-level exchange rate preferences, and monetary outcomes.

On the supply side of the model, I argue that a government will maintain a depreciated exchange rate as long as the benefits outweigh the costs, all else equal. There would be little political (or economic) benefit to a government running a depreciated exchange rate outside of the traditional distributional effects detailed prior: providing protection for import-competing firms (or industries) or providing a subsidy to exporting firms (or industries).[1] The costs of undervaluation include the government's purchasing of foreign exchange to depreciate the exchange rate and maintain the currency's value. The political costs arise from the distributional effects of depreciation: increased import prices, foreign debt burden, and borrowing costs, as well as decreased purchasing power of consumers. Note that global supply chains do not *directly* affect the supply side of the model. They do so indirectly by altering directly the costs and benefits on the demand side of the model.

On the demand side of exchange rate policy, I argue that global supply chain integration weakens the traditional preference of an exporting firm for an undervalued exchange rate. The greater the amount of imported inputs used by an exporting firm, the less benefit it receives from a currency depreciation, and, especially if the firm is limited in access to hedging instruments, the higher the cost. The origins of these firm-level production decisions to offshore parts of the production process stem from the preferential trade agreements (PTAs)

[1]One could make the case that another political (or economic) benefit is to outlast a trade competitor in a protracted trade war—e.g., China's recent depreciation of the yuan after an escalation in tariff increases by the Trump administration. China's seemingly small buildup in foreign exchange reserves may be seen as a hedge against counter moves by the Trump administration, or as a strategy to outlast the administration until after the 2020 presidential elections when more favorable trade terms may arise. However, the trade war has also disrupted the supply chain network built between the US and China. Thus, future currency manipulation may be a reaction to a reversal of global supply chain integration.

that reduced barriers to trade and provided firms with protections in foreign markets to expand their supply chains. This expansion of global supply chains has a simultaneous effect of concentrating production of manufactured goods in fewer—but much larger and more productive—firms (Melitz, 2003). With increased market power comes increased political influence (Salamon and Siegfried, 1977; Faccio, 2006), which ultimately affects exchange rate outcomes.

In determining the preferences of firms for the exchange rate, I begin with the now-standard model of exchange rate politics (Frieden, 1991, 2014). Frieden models the exchange rate preferences of a firm, industry, or socioeconomic group, as dependent on (1) their international exposure to exchange rate risk, (2) the tradability of their goods, and (3) the exchange rate pass-through onto these goods.[2]

First, Frieden predicts that the greater a firm's immersion in cross-border trade and investment, the greater its support for a fixed exchange rate. This is due to the transaction costs associated with cross-border exchange. Indeed, this was a leading argument for monetary union amongst European economies in the early 1990s, which follows from the theory of optimum currency areas (Mundell, 1961). This should also hold for global supply chains, where firms try to minimize the costs of production. While globally-engaged firms have access to hedging instruments for unexpected (or even expected) exchange rate movements (Garrett, 1998; Knight, 2010), this is an added cost to be minimized.[3]

Second, and most important for my argument about preferences for the exchange rate level conditional on global supply chain dependence, Frieden predicts that the larger the

[2]As I focus explicitly on firms in this paper, I will henceforth drop the term "industry" from the text for ease of exposition.

[3]This model does not make any conjectures on the stability of exchange rates. See Walter (2008) for a model that takes into account the level *and* stability of exchange rates.

share of tradable goods in a firm's output (or non-tradable goods in a firm's inputs), the stronger its support for a depreciated exchange rate. Conversely, the larger the share of tradable goods in a firm's inputs (or non-tradable goods in a firm's output), the stronger its support for an appreciated exchange rate. In an environment of global supply chains where firms both import and export, there are contradictory predictions: firms that import tradable inputs for use in exported tradable goods cannot prefer simultaneously an appreciated *and* depreciated exchange rate. It is here where I amend Frieden's model by explicitly accounting for firms that rely on complex global supply chains. I argue that globally-integrated firms who rely on imported inputs will not prefer an undervalued exchange rate.[4] Where I further complicate the model is that the weakened preference for an undervalued exchange rate may not be uniform across all firms. The larger the firm, the more products produced and the more countries to which they export or from which they import (Bernard et al., 2007). Accordingly, firm size should be strongly correlated with the intensity of the production network, and, with that, larger firms should have stronger preferences against an undervalued exchange rate.

This theory of heterogenous firms, global supply chains, and exchange rate politics is further supported by the last element in Frieden's model of exchange rate preferences: exchange rate pass-through, that is, the elasticity of domestic prices to exchange rate movements. He predicts that the more incomplete a firm's pass-through—i.e., the more limited the effect of a change in the exchange rate on domestic prices—the greater its support for a fixed exchange rate. Studies in the field of economics have found that exporting firms with incomplete pass-through are more likely to be heavily-reliant on imported inputs (Amiti, Itskhoki and

[4]This argument is also found in Egan (2017), which is similar to the framework of Walter (2008).

Konings, 2014). It follows that firms reliant on global supply chains would prefer a fixed exchange rate, and, given their dependence on imported inputs, an exchange rate that is not undervalued. Frieden (2014, pp. 30-33) suggests, however, that these firms with limited pass-through may actually prefer a flexible exchange rate due to the possibility of gaining market power by crowding out firms who cannot "price-to-market." This again follows the theory of heterogenous firms, namely, that these firms may prefer temporarily an undervalued exchange rate whilst firms who cannot hedge against such price changes exit the market (cf. Melitz, 2003). When market power is reached, the preferences for an undervalued exchange rate by these large firms weakens as there is no further benefit to be gained. Moreover, consumers/voters in countries that have experienced currency depreciation in the past tend to have an elevated economic knowledge (Nelson and Steinberg, 2018), and thus governments may find it more beneficial to replace undervaluation with less transparent trade barriers (Kono, 2006).

I propose a series of hypotheses that underscore the role that export dependence and global supply chains have in explaining exchange rate valuations, some of which are identical to Frieden's. In particular, these testable hypotheses seek to show how an increased reliance on global supply chains weakens the preference for an undervalued exchange rate.

Hypothesis 1: *The greater a state's exports as a share of GDP, the stronger the preference for a undervalued/depreciated exchange rate and the greater its stock of foreign exchange reserves.*

This follows directly from Frieden's proposition on the role of *tradability* in exchange rate preferences. Firm preferences for exchange rate policy are contingent upon their exposure to international trade and investment. An exporting firm will prefer a relatively depreciated

or devalued currency. Therefore, the greater an state's exports as a share of GDP, the more the exchange rate will deviate (negatively) from its market-determined rate and the greater its stock-pile of foreign exchange reserves.

Hypothesis 2: *The greater a state's participation in global supply chains, conditional on their export dependence, the weaker the preference for an undervalued exchange rate and the lower its stock of foreign exchange reserves.*

Firms that rely heavily on the cross-border exchange of intermediate inputs will not prefer an undervalued exchange rate (as in H1). The greater an state's reliance on exports as a share of GDP and participation in global supply chains, the weaker the preference for an undervalued exchange rate. This will have an appreciating effect on the exchange rate, with a simultaneous decrease in the stockpile of foreign exchange reserves.

Hypothesis 2(a): *The greater a state's reliance on imported intermediate inputs (exported intermediate inputs), conditional on their export dependence, the weaker (stronger) the preference for an undervalued exchange rate and the lower (higher) its foreign exchange reserves.*

This is similar to H2, but here I consider the components of global supply chains: imported (exported) intermediate inputs. Firms that rely heavily on imported inputs will not prefer an undervalued exchange rate, but rather, its market-determined rate. In contrast, firms that export intermediate inputs will have similar preferences as traditional exporting firms, preferring a depreciated exchange rate.

Hypothesis 2(b): *The larger the firm, the greater its participation in global supply chains, and thus the weaker its preference for an undervalued exchange rate.*

Similar to H2(a), but here I focus on the *preferences* of firms for exchange rate policy as evaluated in Egan (2017). Larger firms should tend to have a stronger preference against

undervalued exchange rates due to their dependence on imported inputs.

In the next sections I describe the transformation of trade into complex global supply chains, currency manipulation as a strategy for export-led growth, and how the literature has discussed these issues in political science and economics. In describing each, I also introduce the data for testing the hypotheses laid out above.

3 Global Supply Chain Trade

Global supply chain trade is the defining feature of the 21st century international economy. For centuries, international trade involved the arms-length exchange of goods extracted, farmed, or produced within a single border—e.g., raw materials, commodities, and manufactured goods. Over the last quarter century, however, firms have increasingly unbundled the production process into global supply chains: the cross-border exchange of intermediate inputs at different stages of the production process. This has been made possible by significant decreases in coordination costs as a result of innovations in communication and transportation (Baldwin, 2016). Moreover, hundreds of preferential trade agreements containing 'deep provisions' have decreased barriers to trade and provided protections for firms operating in foreign markets (Manger, 2009). Between 1995 and 2015, the effectively applied tariff rate among advanced and emerging market economies decreased from an average of 11.3% to 3.3%. At the same time, inward foreign direct investment (FDI) increased from $583 billion in 1994 to $10.4 trillion in 2017 in emerging market economies, and in advanced countries from $1.72 trillion in 1994 to $20.3 trillion in 2017 (UNCTAD, 1995, 2018). Together, this has led to an increase in the use of global supply chains—i.e., the share of foreign

inputs in domestic exports plus the share of domestic inputs in foreign exports—from 63.2% of exported goods in 1995 to 68.3% in 2014. While this is a large share of gross exports of manufactured goods (more than two-thirds), it is a rather small increase of only 5 percentage points over 20 years. This small increase is due to a shift between the components that make up this index.

I follow convention in deriving the index of participation in global supply chains (Koopman et al., 2010). I first calculate the components of a country's position within the supply chain. *Forward linkages* are the share of domestic exports that are inputs in foreign exports. These types of linkages decreased from 35.0% of exported goods in 1995 to 31.7% in 2014. Conversely, *backward linkages* are the share of imported foreign inputs used in exported goods, which increased from 28.2% in 1995 to 36.6% in 2014. The sum of these two components creates the global supply chain participation index. The log ratio of a country's forward linkage to its backward linkage ($log(forward) - log(backward)$) provides a measure of that country's position within the supply chain—the more negative the measure, the higher the reliance on foreign inputs (or further downstream); the more positive, the greater the reliance on exporting intermediate inputs (further upstream). The data to derive these measures originates from the OECD-WTO Trade in Value Added (TiVA) database and is available for the years 1995–2014.

Figure 1: Participation in Global Supply Chains, 1995 and 2014

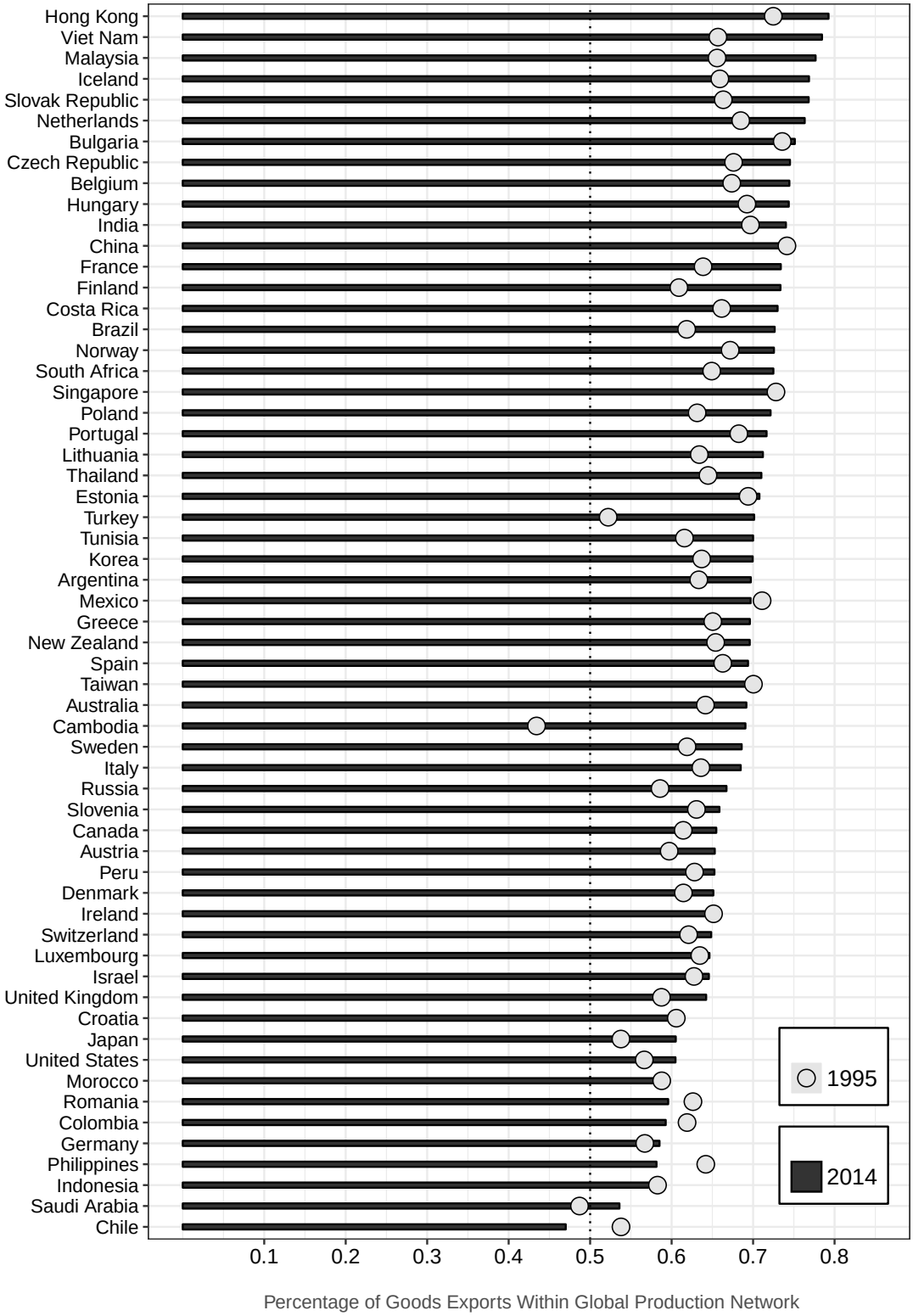
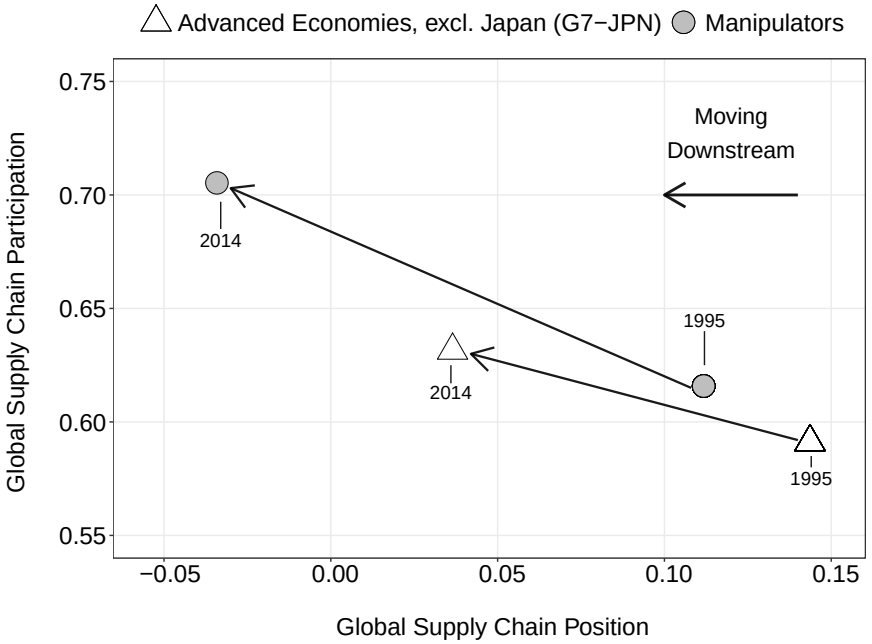


Figure 1 illustrates the country-level evolution of global supply chains between 1995 and 2014. Countries with the most dependence tend to be those tightly linked in East and Southeast Asia, and Central Europe. In Central Europe, these countries are tightly intertwined in German supply chains—e.g., Slovak Republic, Czech Republic, Bulgaria, and Hungary. The Asian countries that utilized neo-mercantilism as a strategy for export-led growth—e.g., China, South Korea, Taiwan, and Thailand—have also become prime locations for this type of intermediate trade.

While Figure 1 shows the *total* participation in global supply chains, hidden are the components, which drive the theory. As stated above, I expect the backward linkages, that is the share of imported inputs in total exports, to have the strongest effect on revaluing currencies towards their market-determined rate. Recall that an undervalued currency will make imported inputs more expensive, thus negating the competitive effects for exports that rely on these inputs. Figure 2 illustrates the evolution of global supply chain participation (y-axis) as well as position (x-axis) for two groups of countries: the currency manipulators (China, Israel, Japan, Malaysia, South Korea, Sweden, Thailand, and Taiwan) and the advanced Group of Seven (G7) economies minus Japan (Canada, France, Germany, Italy, United Kingdom, and United States). Countries who used currency manipulation as a strategy for export-led growth during this time period, also tend to become much more reliant on global supply chains over the two decades. Even more important, is that these countries have shifted their production more downstream, becoming more reliant on imported inputs for their exported goods. I will exploit this variation in supply chain position in my empirical analysis and consider this crucial to unlocking the puzzle of the disappearing currency manipulators.

Figure 2: Participation and Position in Global Supply Chain, select countries, 1995-2014



Note: G7 countries include Canada, France, Germany, Italy, United Kingdom, and United States (less Japan). The group of countries included in the classification of manipulators for trade purposes are China, Israel, Japan, Malaysia, South Korea, Sweden, Thailand, and Taiwan. "Moving Downstream" refers to a greater reliance on foreign inputs for gross exports (backward linkages). A movement to the right would be "upstream" and would denote a greater reliance on exports of intermediate inputs (forward linkages) as a share of total exports.

The literature on global supply chains tends to fall along two lines of inquiry: (i) the political or economic setting that lead to these supply chains and (ii) the outcomes these supply chains influence or cause. Baldwin and Lopez-Gonzalez (2015) provide a thorough portrait of the evolution of global supply chains since 1995, arguing that the embrace of trade liberalization by emerging market economies in the early 1990s was the major impetus for the production sharing in these networks:

> Developing nations that had eschewed trade liberalisation for decades suddenly embraced openness that facilitated international production sharing. [...] They slashed tariffs unilaterally (especially on intermediates), signed bilateral investment treaties (BITs, which are mostly unilateral concessions to rich-nation firms seeking to invest), and signed regional trade agreements (RTAs) with 'deep' provi-

> sions that are pro-supply-chain (e.g., assurances for intellectual property, capital movements, competition policy, etc.). (p. 1683)

Indeed, Büthe and Milner (2008) demonstrate that developing countries that belong to the World Trade Organization (WTO) and participate in more regional trade agreements (RTAs) enjoy greater FDI inflows than otherwise due to the "deep provisions" embedded in these agreements. In Asia, where the most integration in global supply chains has occurred (Europe is a close second), these RTAs were originally driven by private sector (firm) interests, and only later by governments (Kim, 2015). Even without the codified commitments in RTAs, firms may enjoy greater *de facto* protections once linked with other firms in a global supply chains in a foreign market (Johns and Wellhausen, 2016).

Geographic features are also a major determinant in a country's location *within* the supply chain. Although firms may want to exploit agglomeration economies by sharing production across countries, natural trade barriers—such as country location, distance, and port access—also affect transportation costs. de Gortari and Antras (2016) model this "proximity-concentration tradeoff," illustrating the optimal location of firms within the supply chain. They find that countries that are relatively central or in a well-connected location will tend to attract downstream firms (backward linkages), while more remote locations will attract upstream firms specialized in the production of intermediate inputs (forward linkages). In this paper, the location of a country in the supply chain matters—specifically, how downstream a country finds itself in the supply chain—, as this is a crucial parameter in determining exchange rate preferences. Notably, all currency manipulators are located in well-connected areas, close to other production centers.

Global supply chains can also affect firm preferences on trade policy and labor standards.

For example, Blanchard and Matschke (2015) find that when U.S. multinational firms offshore production to a foreign country, there is increased incentive for policymakers to provide preferential access to imported products from the same industry, since (by law) trade policy cannot discriminate at the firm level (see also Kim, 2017). Similarly, product differentiation can also matter in improving international labor standards within the supply chain (Malesky and Mosley, 2018). Restraint in temporary trade protections and lower import tariffs also follow with stronger supply chain linkages (Blanchard, Bown and Johnson, 2017), a finding supported by Jensen, Quinn and Weymouth (2015) who analyze the decrease in U.S. firm-level AD filings since 2001 despite persistent exchange rate undervaluations and subsequent import competition. They find that increased vertical FDI decreases the likelihood of trade disputes, even in the context of an undervalued currency.

The work most closely related to this paper addresses a recent phenomenon in international trade: the elasticity of exports to the real effective exchange rate (REER)—a measure of price competitiveness—has decreased over time (Ahmed, Appendino and Ruta, 2015; Ollivaud, Rusticelli and Schwellnus, 2015; Cheng et al., 2016). These authors hypothesize that global supply chains may play a role in this changing elasticity. In a globalized economy where firms import many of the inputs that comprise an exported good, a currency depreciation may no longer give a boost to these exports due to the increased cost of the foreign inputs. These findings motivated the global supply chain theory laid out in Section 2, that is, global supply chains will diminish the benefits of an undervalued currency, thus undermining the viability of currency manipulation as a strategy for export-led growth. In the next section, I briefly address the issue surrounding currency manipulation and how it is measured in practice as well as in this paper.

4 Currency Manipulation: The "Secret Tariff"

In a competitive global economy, as states trade more, they may seek advantage over their rivals by engaging in neo-mercantilist practices. One of the tools of neo-mercantilism, especially in the post-WWII era, has been to run a depreciated exchange rate to pursue a strategy of export-led growth. Japan pursued this strategy after WWII, and it is the strategy followed most recently by China, each lamented by past and current U.S. administrations. These complaints are about neo-mercantilism in general, but the attacks are often against the weapon: currency manipulation. Currency manipulation is the state's purposive action of affecting the value of its currency through intervention in foreign exchange markets—buying its currency to appreciate in value, selling to depreciate. At the peak of Chinese foreign exchange intervention in 2007, the government purchased $2 billion of foreign exchange per business day (on average) with a corresponding printing and selling of yuan, thus depreciating its value. Herein, I focus on this type of currency manipulation, i.e., purposive depreciation (or undervaluation), which tends to draw considerable condemnation from global competitors.

Most recently, President Trump has sounded the alarm on currency manipulation, albeit without material evidence to support his claims. Dating back to November 10, 2015, then-candidate Trump pledged to declare China a currency manipulator on his first day in office. This past May, his Treasury department issued its fifth report to Congress in which they again declined to label China or any other major trading partner as such. According to the Omnibus Trade and Competitiveness Act of 1988, Congress requires the Treasury to report semi-annually on the foreign exchange policies of major trading partners. The Treasury must deem a trading partner a manipulator—and may begin the process of imposing countervailing

duties[5]—(*i*) if the trading partner has a current account surplus that exceeds 3 percent of gross domestic product (GDP), (*ii*) their net acquisition of official foreign assets—i.e., foreign exchange reserves—exceeds 2 percent of GDP, and (*iii*) their bilateral trade surplus with the U.S. (in goods, not services) exceeds $20 billion. It has only labeled three countries as manipulators since 1988—Japan in 1988, Taiwan in 1988 and 1992, and China from 1992 until 1994—but has monitored several countries who have met two of three criteria according to the 2015 Trade Facilitation and Trade Enforcement Act—currently China, Japan, Malaysia, Singapore, South Korea, Vietnam, and three members of the European Monetary Union: Germany, Ireland, and Italy. Although the Treasury labeled China as a currency manipulator on August 5, 2019, China has not met the full criteria according to the 1988 or 2015 laws, in particular, net acquisition of foreign assets that exceeds 2 percent of GDP.

The Peterson Institute for International Economics (PIIE) publishes a separate policy memo on currency manipulation, which captures more manipulators by casting a wider net. The PIIE drops the bilateral trade criterion of the Treasury, but includes three additional criteria: (*i-ii*) foreign exchange reserves and other official foreign assets exceed three months of imports *and* 100 percent of short-term external debt (public and private), and (*iii*) the country is classified as a high- or upper-middle-income country according to the World Bank (Bergsten and Gagnon, 2017). Given these criteria, the PIIE labeled eight manufacturing exporters as currency manipulators between 2000 and 2017—again, China, Israel, Japan, Malaysia, South Korea, Sweden, Taiwan, and Thailand. However, as seen in Figure 3, the number of countries manipulating (right-axis), and the number of years in which they do,

[5]Currency manipulation is seen as a subsidy to exporters, hence the use of countervailing duties to offset the impact.

Figure 3: Number of Currency Manipulators (right-axis) and Net Foreign Exchange Flows (left-axis)

Note: Data sources from Bergsten and Gagnon (2017) and Collins and Gagnon (2019).

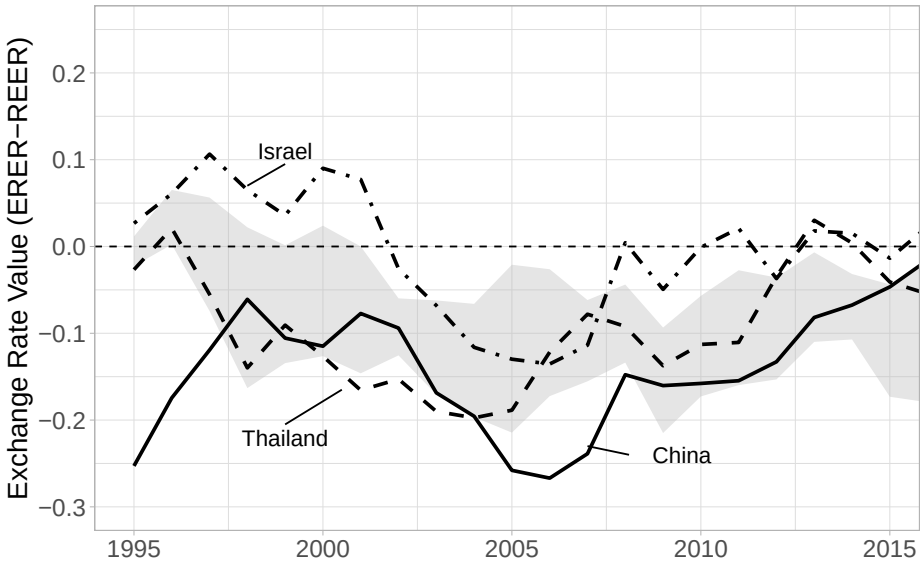
has dwindled since 2013. There is a similar drop in the flow of foreign exchange reserves, or official foreign assets (left-axis, Figure 3). In fact, in the PIIE's latest report, as of 2018 there were no remaining manipulators among manufacturing exporters (Collins and Gagnon, 2019).

While the PIIE's classification of currency manipulation is useful for deeming a country a manipulator, a continuous measure of exchange rate values illustrates the intensity of this manipulation. I use the exchange rate measure most often utilized in the economics literature, which considers a country's real effective exchange rate (REER)—i.e., how competitive the exchange rate is against a basket of its top-30 trading partners—and the REER's deviation from the market-determined rate known as the equilibrium real exchange rate (ERER). The difference between the two measures is the intensity of undervaluation (negative value)

or overvaluation (positive value). The closer the value is to zero, the closer the exchange rate is to its estimated market-determined rate.[6] Figure 4 plots exchange rate misalignment (`xr_misalignment`) for the 0.25–0.75 percentile of currency manipulators (in light grey) as well as the values for China, Israel, and Thailand. Israel and Thailand were the two last currency manipulators in the 2016-2018 time period. It is important to note that an undervalued currency does not necessarily indicate currency manipulation, but it could still lead to global trade imbalances. For example, the PIIE did not classify Israel as a currency manipulator between 2003 and 2007 when its currency was undervalued by an average of 10 percent. It is not until the 2008-9 financial crisis that Israel began intervening in foreign exchange markets, with purchases between 6-8 percent of GDP, which increased its current account surplus from 1 percent in 2008 to 4 percent in 2009 (Bergsten and Gagnon, 2017, p. 208). Similarly, the PIIE removed China from its list of manipulators in 2013, yet its exchange rate was still undervalued by over 10 percent (see Figure 4). Thus, an undervalued exchange rate does not necessarily suggest the state is intervening in foreign exchange markets, which is why I control for foreign exchange intervention and other covariates in my analysis. The same holds true for Thailand between 2004 and 2006, except the absence of their manipulator classification during these years is due to their lack of a 3 percent trade surplus. While this paper seeks to explain the disappearance of currency manipulators, I

[6] I use the equilibrium real exchange rate (ERER) provided in the EQCHANGE database (Couharde et al., 2017). They estimate the ERER using the behavioral equilibrium exchange rate (BEER) approach, which considers the ERER as a function of a country's medium- and long-term fundamentals. These fundamentals, which are estimated sequentially, include: (*i*) productivity changes between the tradable and non-tradable sectors, relative to trading partners—i.e., the Balassa-Samuelson approach, which I will estimate separately as a robustness check; (*ii*) net foreign asset position; and (*iii*) terms of trade. The measure of currency misalignment is simply the difference between a country's real effective exchange rate (REER) and its ERER. This data covers 182 countries between 1973 and 2016, of which I utilize 37 countries beginning in 1995. Not included are the European Monetary Union (EMU) and Taiwan.

Figure 4: Exchange Rate Valuation, Sample



Note: I estimate the exchange rate value using the behavioral equilibrium exchange rate (BEER) approach. The BEER approach estimates the deviation of a country's exchange rate from its long-run equilibrium by considering the relationship between the real exchange rate and its fundamentals, in particular, the terms of trade, the net foreign asset position, and the relative productivity of the tradable sector. A value below zero (black dotted line) denotes an undervalued exchange rate; above zero, an overvalued exchange rate. The grey shaded area denotes the 0.25-0.75 percentile of the sample of currency manipulators: China, Israel, Japan, Malaysia, South Korea, Sweden, Taiwan, and Thailand.

exploit the richness of this continuous exchange rate measure rather than relying only on a dichotomous classification.

While the best measure of a country's market-determined exchange rate, `xr_misalignment` does not contain data for Taiwan—a former manipulator—and the EMU—a major supply chain hub. Thus, I also estimate all of my models with a separate outcome variable that uses the Balassa-Samuelson approach for exchange rate values (Balassa, 1964; Samuelson, 1964). I use this as a robustness check only, because the Balassa-Samuelson assumptions on price-determination and factor mobility do not always characterize accurately the features of a currency manipulator's economy—e.g, China (Frankel, 2006). I follow the approach of

Rodrik (2008) in adjusting for the Balassa-Samuelson effect. Utilizing data from the Penn World Table Version 9.0 and the Organization for Economic Cooperation and Development's statistical division, OECD.stat, for the Euro area (12 countries),[7] I first calculate the real exchange rate (RER) for each of the 39 countries in the sample (38 individual countries and the EA12). This is determined by dividing a country's nominal exchange rate by its purchasing power parity (PPP), which I invert for ease of interpretation. The inverted RER allows me to classify negative deviations from the equilibrium exchange rate as an undervaluation and positive deviations as an appreciation. Second, I estimate the equilibrium exchange rate by regressing the logged RER on logged real GDP per capita (RGDPPC) with year fixed effects:

$$\ln RER_{it} = \alpha + \beta \ln RGDPPC_{it} + f_t + \epsilon_{it}, \tag{1}$$

where f_t is the year fixed effect and ϵ_{it} is the error term. The estimated β from Equation 1 is 0.56 with a very high t-statistic of 39.6, suggesting a strong and accurately estimated Balassa-Samuelson effect (as incomes rise by 10 per cent, the RER increases by around 5.6 per cent). Finally, to calculate the main outcome variable, exchange rate misalignment (`xr_misalignment_bs`), I take the difference between the measured real exchange rate and the Balassa-Samuelson-adjusted exchange rate—i.e., the residual from Equation 1.

As a third measure of currency manipulation, I account for direct government intervention in foreign exchange markets. For this I use the logged stock of foreign exchange reserves—

[7] I only include those countries that acceded into the eurozone by 2001. Although six more countries acceded between 2007 and 2014, this occurs in the midst of the Great Recession, a sovereign debt crisis, and the beginning of a quantitative easing program by the ECB. To address any anticipatory effects, I exclude the countries that were acceding or will be acceding after the end of the sample period and the results hold.

$ln(\texttt{Forex})$—as reported by the International Monetary Fund (IMF). I expect $ln(\texttt{Forex})$ to decrease as global supply chain reliance increases. As larger countries are more likely to have a larger proportion of `Forex` due to international exposure to trade, I also control for country size (`GDP`) lagged one year.

The political science literature has addressed the issue of currency undervaluation (and overvaluation) in the past, but this paper is unique in that it specifically addresses the puzzle of the disappearing currency manipulators. As the advanced and emerging market economies continued to liberalize after the Uruguay Round concluded in 1994, there was growing fear amongst policymakers that countries would undervalue their currency as a neo-mercantilist, protectionist measure, that is, a "secret tariff."[8] While a traditional tariff can protect a specific industry or firm from trade competition, an undervalued currency is a broad protectionist measure against *all* imports and an implicit subsidy for exports. The fear of countries utilizing this secret tariff for a competitive edge is not without merit. Copelovitch and Pevehouse (2013) demonstrate that countries with pegged exchange rates who sign a regional trade agreement with their "base" country, and thus lower tariffs over time, will often transition to a flexible exchange rate in order to maintain monetary and fiscal autonomy. In turn, this gives them the policy space to engage in currency manipulation.

Research on currency politics tends to fall along two lines: a state-centric approach where governments use their exchange rate or currency power for some foreign-policy goal (Kirshner, 1997; Cohen, 2018), and the "open-economy politics" (OEP) approach where the preferences of socioeconomic actors affect exchange rate outcomes (Walter, 2008; Frieden, 1991, 2014; Steinberg, 2015; Egan, 2017). I follow the latter approach in this paper, focusing

[8]Term from National Public Radio's *Planet Money* (Kestenbaum, 2015).

the theoretical model and supporting analysis on heterogenous firms. Given the size of these global firms in terms of output and employment (see e.g., Bernard et al., 2007), the model predicts that an increased reliance on global supply chains, which are used most intensely by these large firms, will decrease the benefits of an undervalued currency beyond its cost, thus binding governments from manipulating their currencies for competitive gain.

Most closely related to this paper are Frieden (2014), Steinberg (2015), and Egan (2017). Frieden (2014) outlines a clear theory of exchange rate politics that builds upon his seminal 1991 article. While Frieden tends to focus on the political and economic context that precedes exchange rate outcomes as I discussed earlier, Steinberg (2015) examines the institutional context. He finds that undervaluation is largely a product of a country's domestic political arrangement. He develops a conditional preference theory where manufacturer preferences influence exchange rate policy, but the institutional structure of workers' rights and state control over the financial system govern whether manufacturers lobby for an undervalued (or overvalued) exchange rate. In this paper, I adopt a similar conditional preference approach to Steinberg, except I condition currency manipulation on a country's reliance on global supply chains.

Egan (2017) directly tests the theory that global supply chains, in particular a firm's reliance on imported inputs, will affect the exchange rate preferences of exporting firms. Using surveys of firm representatives conducted by the World Bank in 2002 and 2005, he finds that firms with a higher dependence on imported inputs are more likely to express dissatisfaction with a depreciating currency. In the second part of this paper, I replicate Egan's study to show that this effect is not uniform across all firms. It is the largest firms, which happen to be the most reliant on imported inputs, that tend to exhibit the most

dissatisfaction over currency depreciation.

5 The Chains That Bind: Empirical Model and Results

How does global supply chain integration affect exchange rate outcomes? If undervaluation is a costly enterprise by policymakers that favor a particular socioeconomic group (or groups), then as the benefits of this policy decrease—holding the costs constant—we should see a change in policy. Recounting the theoretical predictions from earlier, I expect the following, all else equal:

H1: The greater a state's exports as a share of GDP, the stronger the preference for an undervalued exchange rate (predicted coefficient: negative) and the greater its foreign exchange reserves (predicted coefficient: positive).

H2: The greater an export-dependent state's participation in global supply chains, the weaker the preference for an undervalued exchange rate (predicted coefficient: positive) and the lower its foreign exchange reserves (predicted coefficient: negative).

H2(a): The greater an export-dependent state's participation in backward linkages, the weaker the preference for an undervalued exchange rate (predicted coefficient: positive) and the lower its foreign exchange reserves (predicted coefficient: negative). Conversely, the greater an export-dependent state's participation in forward linkages, the stronger the preference for an undervalued exchange rate (predicted coefficient: negative) and the greater its foreign exchange reserves (predicted coefficient: positive).

H2(b): The larger the firm, the greater its participation in backward linkages, and thus the

weaker its preference for an undervalued exchange rate (predicted coefficient: positive, and stronger in magnitude as firm size increases).

To test the first hypothesis (*H1*), which stems from the theoretical predictions of the Frieden model on international exposure, I estimate a linear model with country and year fixed effects so that comparisons are within treatment units, and then cluster the standard errors by country:

$$(\texttt{xr\_misalignment})_{i,t} = \alpha_i + \alpha_t + \beta_1 \ln\left(\frac{\texttt{Exports}}{\texttt{GDP}}\right)_{i,t-1} + \beta X_{i,t-1} + u_{i,t}, \tag{2}$$

where `xr_misalignment` is the difference between the real effective exchange rate and its estimated equilibrium exchange rate ($REER - \widehat{ERER}$), α_i are country fixed effects, and $X_{i,t-1}$ is a vector of lagged (and log-transformed) control variables. I control for various country-level variables that may also affect currency values, as well as foreign exchange intervention, on top of country-level fixed-effects. The rationale for including these covariates is due to the many external forces that could affect a country's exchange rate besides government intervention—e.g., the appreciation of many emerging market economy's exchange rates following the quantitative easing of the United States, United Kingdom, and Japan following the 2008 global financial crisis. By controlling for time-varying state-level covariates that can affect exchange rates, we can measure purposeful exchange rate movements rather than only market-determined movements. The same control variables are used in all empirical models with $ln(\texttt{Forex})$ as the outcome variable.

First, I control for a central bank's foreign exchange (`Forex/GDP`) intervention by including the amount of foreign exchange reserves as a share of GDP, as reported by the

International Monetary Fund. This is the main policy tool a government will use to influence the level of the exchange rate—I will also use the stock of foreign exchange reserves as an outcome variable in a second analysis. As a country's foreign exchange reserves increase, there should be downward pressure on the exchange rate value, all else equal. Next, I control for openness (`kaopen`): the less open a country's capital flows, the greater leverage it has to control the level of the exchange rate (Chinn and Ito, 2006). Thus, the predicted sign on the `kaopen` coefficient is positive: the lower the capital openness, the lower the exchange rate. I only use this as a robustness check as the data does not cover all years and countries. I also control for the outward stock of foreign direct investment as a share of total GDP (`FDI/GDP`), as reported by the UN Conference on Trade and Development. This controls for foreign debt holders in a home country who lose from a currency devaluation by decreasing the value of their investment. Thus, we should expect a positive coefficient on this variable. The final manipulation control is a country's savings rate (`savings_rate`) as reported by the World Bank, which is often associated with an undervalued exchange rate. Finally, I include the political `regime` as measured by the Polity IV index. Bearce and Hallerberg (2011) argue that democratic regimes tend to support floating regimes, while autocratic regimes a more fixed exchange rate, whereas Son (2019) finds that democratic regimes tend to have larger stockpiles of reserves when the exporting sector is relatively small. The direction of the effect of democracy on exchange rate outcomes is thus ambiguous. Note that I do not report the coefficients on all control variables as they have statistically little effect on the outcome (available upon request). Summary statistics of all variables are provided in Table 1.

The main coefficient of interest is β_1, which shows the effect of international exposure, measured by exports as a share of GDP, on exchange rate misalignment. The measure of

Table 1: Summary Statistics: Variables of Interest and Covariates

	Manipulators†	Non-Manipulators
xr_misalignment		
Mean ± SD	–7.27 ± 11.9	.17 ± 18.4
% change, 1995-2014	130.5	–203.1
xr_misalignment_bs‡		
Mean ± SD	–5.55 ± 28.2	1.26 ± 23.7
% change, 1995-2014	69.5	–332.3
Forex (trillion $)		
Mean ± SD	38.0 ± 72.7	5.42 ± 9.59
% change, 1995-2014	869	595
GPN_participation		
Mean ± SD	67.9 ± 6.2	66.4 ± 6.3
% change, 1995-2014	7.9	8.3
backward_linkage		
Mean ± SD	37.7 ± 11.9	32.7 ± 12.6
% change, 1995-2014	41.3	35.0
forward_linkage		
Mean ± SD	30.2 ± 6.7	33.7 ± 10.4
% change, 1995-2014	–9.6	–4.8
Exports/GDP††		
Mean ± SD	17.4 ± 8.4	11.9 ± 9.5
% change, 1995-2014	112	123
Imports/GDP††		
Mean ± SD	12.9 ± 6.0	13.2 ± 7.9
% change, 1995-2014	68.6	97.5
savings_rate		
Mean ± SD	33.1 ± 8.9	23.8 ± 9.0
% change, 1995-2014	12.0	15.3
kaopen		
Mean ± SD	.63 ± 1.5	.89 ± 1.5
% change, 1995-2014	–85.0	–176
FDI/GDP (%)		
Mean ± SD	20.4 ± 20.8	39.9 ± 117.0
% change, 1995-2014	569	6403
regime**		
Mean ± SD	5.7 ± 5.6	7.2 ± 4.6
% change, 1995-2014	–.87	3.7

Note:The percent change measures the average of all country-level 19-year percent changes. †: China, Israel, Japan, Malaysia, South Korea, Sweden, Taiwan, and Thailand. ‡: Balassa-Samuelson adjustment of real exchange rate. ††: these are calculated as the exports and imports in the manufacturing sector as a share of total valued added across all sectors. *: = 1 if executive is leftist, 0 if rightist, NA otherwise. **: ranges from -10 (authoritarian) to +10 (democratic).

exchange rate values used in this empirical specification is from the BEER approach—recall, I use the Balassa-Samuelson approach as a robustness check for all empirical models, which

yields similar results. I do not include a lagged dependent variable due to the stationarity and persistence of the data. When I include a lagged dependent variable, it absorbs all of the variation from the other variables and has a highly significant coefficient close to one. Thus, including a lagged dependent variable when the outcome variable is stationary and persistent will absorb all variation in the model (Achen, 2000).

Table 2, columns (1) and (5), present the results from the first hypothesis—the relationship between exports (in manufacturing) as a share of GDP (total across all sectors) on currency misalignment—with and without controls, respectively. Note that the number of observations drops by 20 due to a few missing years for the control variables. In both specifications I include imports as a share of GDP to estimate the effect of import-competing interests. The signs on both coefficients in column 1 support the theoretical predictions: the more reliant a country becomes on exports as a share of total output, the greater the likelihood of a depreciated exchange rate. And likewise, the more reliant on imports, the greater the likelihood of an appreciated exchange rate. However, only imports as a share of GDP is statistically (significant at the 5% level). The addition of control variables does not change the outcome, but increases the magnitude of imports/GDP.

Next, I introduce the explanatory variable of interest, global supply chain participation, to test its moderating effect on currency misalignment (*H2*) as well as the effect of its components, backward and forward linkages (*H2(a)*). Again, I estimate a linear model with (i) country and year fixed effects and (ii) clustered standard errors by country:

$$(\texttt{xr\_misalignment})_{i,t} = \alpha_i + \alpha_t + \beta_1 \ln(\texttt{GSC\_Participation}_{i,t-1}) \times \ln\left(\frac{\texttt{Exports}}{\texttt{GDP}}\right)_{i,t-1} + \beta X_{i,t-1} + u_{it}, \tag{3}$$

but here include the interaction of the moderating variable global supply chain participation `GSC_Participation` with the main predictor variable `Exports/GDP`, both log-transformed and lagged one year. The rationale for an interaction term in this model specification stems from the theoretical predictions of the model. Recall that a country with high dependence on exports will prefer a depreciated exchange rate, but this effect is moderated by its participation in global supply chains.

Table 2, columns (2) and (6), present the results for *H2*, while columns (3-4) and (7-8) present the results for *H2(a)*. Beginning with *H2* (columns 2 and 6), the results show a weakly positive effect of global supply chain participation on currency realignment, both directly and as a moderating variable. The potential explanation for this insignificant finding is the opposing effects of the supply chain components. Turning to columns 3-4, we see a weakly positive effect of backward linkages on currency realignment, and a weakly negative effect of forward linkages on currency realignment, as predicted by the model. The statistically insignificant results are stable to the inclusion of control variables (columns 7-8). These results hold when the sample of countries is restricted to only currency manipulators as well as when I use the alternate measure of currency misalignment, the Balassa-Samuelson approach. A likely explanation for these statistically insignificant results is that a currency's value is not only affected by government intervention, but other market forces; hence, the outcome variable is quite noisy. Therefore, I do a similar analysis using a government's

Table 2: Global Supply Chains and Currency Misalignment

	Dependent Variable: ln(xr_misalign)							
Independent Variables, $t-1$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Exports/GDP)†	−0.03	−0.02	0.08	−0.32	−0.13	−0.18	−0.02	−0.41
	(0.09)	(0.13)	(0.11)	(0.31)	(0.15)	(0.17)	(0.09)	(0.32)
ln(Imports/GDP)†	0.19*	0.18	0.22*	0.20*	0.25*	0.24*	0.28*	0.26*
	(0.10)	(0.09)	(0.09)	(0.09)	(0.13)	(0.12)	(0.11)	(0.11)
ln(GSC_part)×ln(Exp/GDP)†		0.05				−0.06		
		(0.35)				(0.30)		
ln(GSC_part)†		0.36				0.17		
		(0.76)				(0.65)		
ln(Bwd_Link)×ln(Exp/GDP)†			0.07				0.06	
			(0.12)				(0.10)	
ln(Bwd_Link)†			−0.08				−0.11	
			(0.28)				(0.24)	
ln(Fwd_Link)×ln(Exp/GDP)†				−0.25				−0.25
				(0.21)				(0.19)
ln(Fwd_Link)†				−0.27				−0.25
				(0.42)				(0.35)
Country/Year F.E.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CSE(country)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls?‡	No	No	No	No	Yes	Yes	Yes	Yes
	0.46	0.46	0.51	0.50	0.49	0.49	0.53	0.53
Adj. R^2	0.40	0.40	0.45	0.45	0.42	0.43	0.47	0.47
Observations	581	581	581	581	561	561	561	561
Countries	35	35	35	35	35	35	35	35

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. All independent and control variables log-transformed and lagged one year. † – Data limited to the manufacturing sector, taken as a share of real GDP. ‡ – Control variables include foreign direct investment as a share of GDP, foreign exchange reserves as a share of GDP, savings rate, and Polity IV.

foreign exchange intervention as the outcome variable, a clear policy choice by a government to manipulate a currency. In this model I also include a control for the size of the economy as larger economies will tend to maintain larger stockpiles of reserves.

Table 3 presents the results on the relationship between global supply chain participation and foreign exchange intervention. In all model specifications (1-8), the effect of country size, ln(GDP), is strongly positive at the 0.1% level of statistical significance; larger economies will tend to maintain larger reserves of foreign exchange. The remaining results tend to follow the model's predictions, albeit statistically insignificant. As predicted, global supply chain par-

ticipation tends to moderate the effect of export-dependence on foreign exchange intervention (columns 2 and 6). The predictions hold when splitting supply chain participation into its principal components, with backward linkages moderating the impact of export-dependence, while forward linkages have a weakly positive impact when interacted with export dependence. The statistically weak results may be due to the number of countries in the sample that may be acquiring or selling foreign exchange for other reasons beyond currency control. Thus, in the next model I restrict my sample to the eight currency manipulators—China, Israel, Japan, Malaysia, South Korea, Sweden, Taiwan, and Thailand—in order to focus the analysis on what accounts for the disappearance of this export strategy.

Table 4 presents the results of the restricted sample. As before, I include country size, ln(`GDP`), in all specifications, which is strongly positive. Columns 1 and 5 test predictions from the first hypothesis and show a positive relationship between export dependence and intervention in foreign exchange markets, affirming the predictions from *H1*. A 1 percent increase in exports as a share of GDP results in a 0.49 percent increase in foreign exchange reserves. Now, if global supply chains have a moderating effect on this outcome, we would expect this relationship to diminish and a stronger relationship between the interaction of exports and supply chain participation.

Columns 2 and 6 test the theoretical predictions of *H2*, that global supply chain participation will moderate the positive effect of export dependence. Indeed, exports drop in magnitude and the direct effect of global supply chain participation (`GSC_part`) is a strong decrease in foreign exchange intervention, by an amount that is over ten times the effect of export dependence (columns 1 and 5). In column 2, a 1 percent increase in global supply chain participation results in an almost 3 percent decrease in foreign exchange reserves. This

Table 3: Global Supply Chains and Foreign Exchange Intervention

	Dependent Variable: ln(Forex)							
Independent Variables, $t-1$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(GDP)	1.09**	1.10**	1.00**	1.01**	1.12**	1.13**	1.03**	1.05**
	(0.34)	(0.35)	(0.34)	(0.35)	(0.36)	(0.36)	(0.39)	(0.37)
ln(Exports/GDP)†	0.13	0.04	0.02	0.18	0.09	0.04	0.01	0.10
	(0.18)	(0.43)	(0.23)	(0.30)	(0.23)	(0.50)	(0.28)	(0.35)
ln(Imports/GDP)†	0.46**	0.45**	0.50**	0.49**	0.50**	0.49**	0.54**	0.53**
	(0.16)	(0.15)	(0.16)	(0.16)	(0.19)	(0.18)	(0.20)	(0.19)
ln(GSC_part)×ln(Exp/GDP)†		−0.20				−0.08		
		(1.07)				(1.09)		
ln(GSC_part)†		−0.32				0.05		
		(3.03)				(3.02)		
ln(Bwd_Link)×ln(Exp/GDP)†			−0.12				−0.09	
			(0.16)				(0.17)	
ln(Bwd_Link)†			−0.55				−0.47	
			(0.62)				(0.77)	
ln(Fwd_Link)×ln(Exp/GDP)†				0.03				0.01
				(0.23)				(0.23)
ln(Fwd_Link)†				0.42				0.40
				(0.46)				(0.48)
Country/Year F.E.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CSE(country)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls?‡	No	No	No	No	Yes	Yes	Yes	Yes
R^2	0.95	0.95	0.95	0.95	0.94	0.94	0.94	0.94
Adj. R^2	0.94	0.94	0.94	0.94	0.93	0.93	0.93	0.94
Observations	607	607	607	607	582	582	582	582
Countries	35	35	35	35	35	35	35	35

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. All independent and control variables log-transformed and lagged one year. † – Data limited to the manufacturing sector, taken as a share of real GDP. ‡ – Control variables include foreign direct investment as a share of GDP, foreign exchange reserves as a share of GDP, savings rate, and Polity IV.

effect is even more statistically significant with the inclusion of control variables (column 5), where foreign direct investment as a share of GDP (a proxy for firms investing in the country to build up supply chains) has a diminishing effect on foreign exchange intervention. The moderating effect of the interaction is statistically insignificant in the baseline model, but in the predicted direction. In columns 3-4 and 7-8, I show that the decrease in currency manipulation (via foreign exchange intervention) is driven by the backward linkages (columns 3 and 7) rather than the forward linkages. In case these results are driven by China, the

Table 4: Global Supply Chains and Foreign Exchange Intervention, Manipulators Only

	Dependent Variable: ln(Forex)							
Independent Variables, $t-1$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(GDP)	1.27***	1.09***	1.07***	0.81*	1.18***	1.21***	1.15***	0.69*
	(0.28)	(0.28)	(0.26)	(0.36)	(0.22)	(0.29)	(0.31)	(0.27)
ln(Exports/GDP)†	0.49	0.32	0.08	−0.10	0.63	0.24	0.21	0.04
	(0.41)	(0.49)	(0.42)	(0.27)	(0.37)	(0.24)	(0.33)	(0.53)
ln(Imports/GDP)†	0.30	0.31	0.32	0.44	0.11	0.06	0.08	0.31
	(0.39)	(0.38)	(0.37)	(0.32)	(0.37)	(0.40)	(0.45)	(0.30)
ln(GSC_part)×ln(Exp/GDP)†		−0.82				−1.47		
		(0.96)				(1.04)		
ln(GSC_part)†		−5.69**				−5.36***		
		(1.93)				(1.48)		
ln(Bwd_Link)×ln(Exp/GDP)†			−0.54***				−0.56***	
			(0.15)				(0.10)	
ln(Bwd_Link)†			−1.77***				−1.58***	
			(0.42)				(0.24)	
ln(Fwd_Link)×ln(Exp/GDP)†				−0.39*				−0.35
				(0.18)				(0.27)
ln(Fwd_Link)†				0.02				0.20
				(0.25)				(0.27)
ln(FDI/GDP)					−0.34**	−0.30**	−0.33***	−0.31**
					(0.11)	(0.11)	(0.09)	(0.11)
Country/Year F.E.?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CSE(country)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls?‡	No	No	No	No	Yes	Yes	Yes	Yes
R^2	0.98	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. R^2	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99
Observations	134	134	134	134	134	134	134	134
Countries	8	8	8	8	8	8	8	8

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. All independent and control variables log-transformed and lagged one year. † – Data limited to the manufacturing sector, taken as a share of real GDP. ‡ – Control variables include foreign direct investment as a share of GDP, foreign exchange reserves as a share of GDP, savings rate, and Polity IV.

largest (by dollar amount) intervener in foreign exchange markets, I also run all analyses without China and the results hold.

If global supply chain dependence, specifically backward linkages, account for the decrease in foreign exchange intervention by currency manipulators in recent years, what is the political link between the two? Next I turn to a firm-level analysis of exchange rate preferences, conditional on the firm's dependence on backward linkages and their overall size.

Recall that I predict larger firms will be more concerned with undervalued exchange rates than smaller firms as they will also be more dependent on imported inputs.

The World Bank conducted surveys of 85,000 firms across 106 countries from 2002 and 2005. These surveys include a question on how much of an obstacle macroeconomic instability is for its business operations (major obstacle = 4, moderate = 3, minor = 2, not an obstacle = 1, don't know = 0). The survey limits "macroeconomic instability" to inflation and exchange rate volatility in particular. Egan (2017) analyzes how a firm's percentage of imported inputs affects their answer to this question and finds a statistically strong relationship between backward linkages and firm attitudes towards currency depreciation. He also finds the effect varies by firm size by including dummy variables for the number of employees within the firm. Larger firms tend to view currency depreciation as a larger obstacle. I reproduce this study but use a finer-grained measure of firm size, as well as the continuous measure of firm employment to see how this effect varies across the entire distribution of firms. Table 5 shows the results of this replication.

The model used in Table 5 is a multilevel ordered logit model with four cut points (τ) due to the ordinal dependent variable (`Firm attitude on XR stability`). Table entries are odds ratios $e(\beta)$, with the standard errors in parentheses. In column 1, I show that a 10% increase in imported inputs is associated with a 4% increase in the odds of having an attitude score above a given cut point (τ). This is similar to Model 9 in Egan (2017). The firm-size dummies show that the odds increase as the size of the firm increases, lending credence to the heterogenous firm model of exchange rate outcomes. This is supported with the continuous measure of firm-level employment in column 2, which shows a 1% increase in firm size is associated with a 6% increase in the odds of having an attitude score above

Table 5: Global Supply Chains and Firm Attitudes on Exchange Rate

	Dependent Variable: `Firm attitude on XR instability`	
	(1)	(2)
`Input percent`^{f}	1.004***	1.004***
	(0.00)	(0.00)
$\texttt{REER}^c_{t-1}$	0.987	0.979*
	(0.01)	(0.01)
`Input percent`$^f \times \texttt{REER}^c_{t-1}$	1.0009*	1.0009*
	(0.00)	(0.00)
$\texttt{Inflation}^c_{t-1}$	1.04**	1.04***
	(0.01)	(0.01)
`Ownership domestic` (dummy)^f	1.08	1.10*
	(0.05)	(0.05)
`Capital account openness`^{c}	0.96*	0.95
	(0.05)	(0.06)
`Trade openness`^{c}	0.99***	0.99***
	(0.00)	(0.00)
ln(`FDI/GDP`)^c	0.75***	0.75***
	(0.05)	(0.06)
`Democracy`^{c}	1.08***	1.08***
	(0.02)	(0.02)
ln(`Employment`)^f		1.06***
		(0.01)
`Firms, small (10-20)` (dummy)^f	1.07*	
	(0.04)	
`Firms, medium (20-99)` (dummy)^f	1.11**	
	(0.05)	
`Firms, large (100-200)` (dummy)^f	1.26***	
	(0.07)	
`Firms, very large (>200)` (dummy)^f	1.23***	
	(0.06)	
τ_1	−2.91	−2.93
τ_2	−2.02	−2.03
τ_3	−0.91	−0.92
τ_4	1.12	1.11
Log-likelihood	-24,965	-25,007
Observations	17,242	17,271
Countries	39	39

Note: Replication materials from Egan (2017). Multilevel ordered logit model for ordinal dependent variable. Table entries are odds ratios $e(\beta)$, with standard errors in parentheses. $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. ^{f} – firm-level variables. ^{c} – country-level variables.

a given cut point. This is not surprising as larger firms tend to be much more reliant on imported inputs. In Table 6 I show the mean and standard deviation of the percentage of

Table 6: Summary of input percentage, by firm size

Firm size†	Mean	St. Dev.	N
Micro (<10)	21.3	35.5	10,527
Small (10-49)	23.2	35.9	15,212
Medium (50-99)	28.2	36.7	4,904
Large (100-199)	32.4	38.5	4,421
Very Large (>200)	39.4	39.0	5,241

†: Firm size based upon employment levels of permanent and temporary workers (where duration available).

imported inputs by firm size. The smallest firms (<10 employees) source about 21% of their inputs from abroad, while the largest firms (>200 employees) import 39% of their inputs on average. Clearly there is heterogeneity in firm production profiles by size, and these firms have heterogenous attitudes towards currency depreciation. This provides a likely political story for the connection between global supply chains and the disappearance of currency manipulators: larger firms have strong preferences against currency undervaluation due to their participation in global supply chains, which affects the economic and political benefits of such a policy pursued by a government.

6 Conclusion

Studying the effect of trade patterns on currency manipulation is particularly relevant given the populist pushback on globalization across the developed world and animosity towards countries that have maintained an undervalued currency in the past (Weiss and Wichowsky, 2013). Since the 2008 global financial crisis there has been an outpouring of populist antitrade rhetoric in the developed world—e.g., French politicians' outcries (both on the Left and

Right) against the Transatlantic Trade and Investment Partnership (TTIP), the Belgian region of Wallonia's referendum against the negotiated Canada-EU trade agreement, the impending Brexit, and the escalating trade war between the the US and China. Much of this disdain towards international trade is the result of the uneven distributional effects felt by many in an increasingly globalized world. From a policy perspective, this paper addresses a central grievance of both the antitrade movement and global capitalists: how can governments constrain currency manipulators?

The conclusions from this analysis are that global supply chain integration has a strong effect on limiting foreign exchange intervention, which explains the recent disappearance of currency manipulators. The trade link that drives this effect is the backward linkage as predicted by the theoretical model. There is support that these outcomes originate from firm-level preferences on undervaluation, with large, globally-integrated firms maintaining the strongest preferences against this neo-mercantilist policy. Currency manipulation is a costly venture. As the benefits wane due to global production decisions by large, productive firms, the costs of maintaining such a policy (both political and economic) become too high.

A contending explanation for the disappearance of currency manipulators is a shift in these countries' internal economies: from export-led to consumption-based. This story would certainly hold for a country like China that has undergone a transformation in the previous decade. However, it does not address more developed economies like Japan and Sweden, which are not undergoing an economic transformation. Given the differences in country production profiles, democratic institutions, and consumption/saving habits, the argument put forth in this paper provides a unique explanation for the surprising trajectory of these export-dependent economies: the end of currency manipulation. It will be interesting to

see if there is a reversal in this trajectory as the US continues to impose barriers to trade, stymieing growth in global supply chains.

References

Achen, Christopher H. 2000. "Why lagged dependent variables can suppress the explanatory power of other independent variables." *Ann Arbor* 1001(2000):48106–1248.

Ahmed, Swarnali, Maximiliano Appendino and Michele Ruta. 2015. "Depreciations Without fs? Global Value Chains and the Exchange Rate Elasticity of Exports." *World Bank Policy Research Working Paper* (7390).

Amiti, Mary, Oleg Itskhoki and Jozef Konings. 2014. "Importers, Exporters, and Exchange Rate Disconnect." *The American Economic Review* 104(7):1942–78.

Balassa, Bela. 1964. "The purchasing-power parity doctrine: a reappraisal." *Journal of political Economy* 72(6):584–596.

Baldwin, Richard. 2016. *The Great Convergence*. Harvard University Press.

Baldwin, Richard and Javier Lopez-Gonzalez. 2015. "Supply-chain Trade: A Portrait of Global Patterns and Several Testable Hypotheses." *The World Economy* 38(11):1682–1721.

Bearce, David H and Mark Hallerberg. 2011. "Democracy and de facto exchange rate regimes." *Economics & Politics* 23(2):172–194.

Bergsten, C Fred and Joseph E Gagnon. 2017. *Currency Conflict and Trade Policy: A New Strategy for the United States*. Columbia University Press.

Bernard, Andrew B, J Bradford Jensen, Stephen J Redding and Peter K Schott. 2007. "Firms in International Trade." *Journal of Economic perspectives* 21(3):105–130.

Blanchard, Emily J, Chad P Bown and Robert C Johnson. 2017. "Global Value Chains and Trade Policy." Working paper.

Blanchard, Emily and Xenia Matschke. 2015. "US multinationals and preferential market access." *Review of Economics and Statistics* 97(4):839–854.

Büthe, Tim and Helen V Milner. 2008. "The politics of foreign direct investment into developing countries: increasing FDI through international trade agreements?" *American Journal of Political Science* 52(4):741–762.

Cheng, Kevin, Gee Hee Hong, Dulani Seneviratne and Rachel van Elkan. 2016. "Rethinking the Exchange Rate Impact on Trade in a World with Global Value Chains." *International Economic Journal* 30(2):204–16.

Chinn, Menzie D and Hiro Ito. 2006. "What matters for financial development? Capital controls, institutions, and interactions." *Journal of development economics* 81(1):163–192.

Cohen, Benjamin J. 2018. *Currency Statecraft: Monetary Rivalry and Geopolitical Ambition*. University of Chicago Press.

Collins, Christopher G and Joseph E Gagnon. 2019. "Currency Manipulation Continues to Decline." `https://www.piie.com/blogs/trade-investment-policy-watch/currency-manipulation-continues-decline`.

Copelovitch, Mark S and Jon CW Pevehouse. 2013. "Ties that bind? Preferential trade agreements and exchange rate policy choice." *International Studies Quarterly* 57(2):385–399.

Couharde, Cécile, Anne-Laure Delatte, Carl Grekou, Valérie Mignon and Florian Morvillier. 2017. EQCHANGE: A World Database on Actual and Equilibrium Effective Exchange Rates. Working Papers 2017-14 CEPII.

de Gortari, Alonso and Pol Antras. 2016. On the Geography of Global Value Chains. Technical report Society for Economic Dynamics.

Egan, Patrick JW. 2017. "The Political Economy of Exchange Rates in an Era of Global Production Chains." *International Interactions* 43(3):507–536.

Faccio, Mara. 2006. "Politically connected firms." *American economic review* 96(1):369–386.

Frankel, Jeffrey. 2006. "On the Yuan: The Choice Between Adjustment Under a Fixed Exchange Rate and Adjustment Under a Flexible Rate." *CESifo Economic Studies* 52(2):246–275.

Frieden, Jeffry A. 1991. "Invested Interests: The Politics of National Economic Policies in a World of Global Finance." *International Organization* 45(4):425–451.

Frieden, Jeffry A. 2014. *Currency Politics: The Political Economy of Exchange Rate Policy*. Princeton University Press.

Gagnon, Joseph E. 2011. *Flexible exchange rates for a stable world economy*. Peterson Institute.

Garrett, Geoffrey. 1998. "Global markets and national politics: collision course or virtuous circle?" *International organization* 52(4):787–824.

Jensen, J Bradford, Dennis P Quinn and Stephen Weymouth. 2015. "The influence of firm global supply chains and foreign currency undervaluations on US trade disputes." *International Organization* 69(4):913–947.

Johns, Leslie and Rachel L Wellhausen. 2016. "Under one roof: Supply chains and the protection of foreign investment." *American Political Science Review* 110(1):31–51.

Kestenbaum, David. 2015. "Massive Pacific Trade Agreement Ignores One Huge Tariff: Currency Manipulation." `http://www.npr.org/2015/11/12/455797475/massive-pacific-trade-agreement-ignores-one-huge-tariff-currency-manipulation`.

Kim, In Song. 2017. "Political Cleavages Within Industry: Firm-Level Lobbying for Trade Liberalization." *American Political Science Review* 111(1):1–20.

Kim, Soo Yeon. 2015. Regionalization in search of regionalism: Production networks and deep integration commitments in Asia's PTAs. In *Trade cooperation: the purpose, design and effects of preferential trade agreements*, ed. Manfred Elsig and Andreas Duer. Cambridge University Press Cambridge pp. 134–164.

Kirshner, Jonathan. 1997. *Currency and coercion: the political economy of international monetary power*. Princeton University Press.

Knight, Sarah Cleeland. 2010. "Divested Interests: Globalization and the New Politics of Exchange Rates." *Business and Politics* 12(2):1–28.

Kono, Daniel Y. 2006. "Optimal obfuscation: Democracy and trade policy transparency." *American Political Science Review* 100(3):369–384.

Koopman, Robert, William Powers, Zhi Wang and Shang-Jin Wei. 2010. Give Credit Where Credit is Due: Tracing Value Added in Global Production Chains. Technical report National Bureau of Economic Research.

Malesky, Edmund J and Layna Mosley. 2018. "Chains of Love? Global Production and the Firm-Level Diffusion of Labor Standards." *American Journal of Political Science* 62(3):712–728.

Manger, Mark S. 2009. *Investing in protection: The politics of preferential trade agreements between north and south*. Cambridge University Press.

Melitz, Marc J. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71(6):1695–1725.

Mundell, Robert A. 1961. "A Theory of Optimum Currency Areas." *The American Economic Review* 51(4):657–665.

Nelson, Stephen C and David A Steinberg. 2018. "Default Positions: What Shapes Public Attitudes about International Debt Disputes?" *International Studies Quarterly* 62(3):520–533.

Ollivaud, Patrice, Elena Rusticelli and Cyrille Schwellnus. 2015. "The Changing Role of the Exchange Rate for Macroeconomic Adjustment." *OECD Economics Department Working Papers* (1190).

Osgood, Iain, Dustin Tingley, Thomas Bernauer, In Song Kim, Helen V Milner and Gabriele Spilker. 2017. "The charmed life of superstar exporters: Survey evidence on firms and trade policy." *The Journal of Politics* 79(1):133–152.

Plouffe, Michael. 2015. "Heterogeneous firms and policy preferences." *The Oxford handbook of the political economy of international trade* p. 196.

Rodrik, Dani. 2008. "The real exchange rate and economic growth." *Brookings papers on economic activity* 2008(2):365–412.

Salamon, Lester M and John J Siegfried. 1977. "Economic power and political influence: The impact of industry structure on public policy." *American Political Science Review* 71(3):1026–1043.

Samuelson, Paul A. 1964. "Theoretical notes on trade problems." *The Review of Economics and Statistics* pp. 145–154.

Son, Byunghwan. 2019. "Democracy and Reserves." *Foreign Policy Analysis* .
URL: *https://doi.org/10.1093/fpa/orz020*

Steinberg, David. 2015. *Demanding devaluation: Exchange rate politics in the developing world*. Cornell University Press.

UNCTAD. 1995. *World Investment Report*. Geneva: UNCTAD.

UNCTAD. 2018. *World Investment Report*. Geneva: UNCTAD.

Walter, Stefanie. 2008. "A new approach for determining exchange-rate level preferences." *International Organization* 62(3):405–438.

Weiss, Jessica Chen and Amber Wichowsky. 2013. "More than Cheap Talk: US Campaign Rhetoric and China's Currency Reform.". Working Paper.