The Chains That Bind: Global Supply Chains, Firms, and Currency Politics

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Abstract

How do global supply chain linkages affect the exchange rate preferences of firms? Are these linkages empirically important determinants of exchange rate valuations within countries? To address these questions, I model the exchange rate preferences of exporting firms as a function of their reliance on imported inputs and the posterior distributional effects of exchange rate movements. I demonstrate that global supply chain linkages, in particular the share of foreign inputs in total exports, weaken the traditional preferences among exporting firms for an undervalued exchange rate. Supply chain integration decreases the benefit of maintaining an undervalued exchange rate beyond its cost, thus constraining governments from manipulating their currencies for competitive gain. Utilizing time-series cross-sectional data covering 61 advanced and emerging market economies over the period 1995-2014, I find strong evidence that supply chain linkages bind governments from engaging in competitive exchange rate policies, pushing undervalued currencies towards their equilibrium levels. These results suggest that global supply chains bind governments from engaging in exchange rate depreciation as a strategy for export-led growth. These results are supported with firm-level cross-sectional survey data that directly measures the exchange rate preferences of firms, conditional on their supply chain dependence.

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1 Introduction

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 currency to pursue a strategy of export-led growth. A depreciated currency alters relative prices, shifting domestic demand from foreign to domestic goods and services (i.e., more expensive imports), as well as making exported goods and services more competitive (i.e., cheaper exports). 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 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 (FX) markets—buying its currency to appreciate in value, selling to depreciate. At the peak of Chinese FX intervention in 2007, the government purchased $2 billion per business day (on average) with a corresponding selling of yuan, leading to a current account surplus of 10 percent of GDP.[1] Bergsten and Gagnon (2017) argue that foreign exchange intervention by China and other global economies was the *most* important driver of global trade imbalances in the 2000s.

These massive trade imbalances fueled a post-financial-crisis backlash across the advanced world against globalization in general, and currency manipulation in particular. The issue has even brought together an increasingly-polarized U.S. House of Representatives. In 2010, the House voted overwhelmingly in support (348-79) of the "Currency Reform for Fair Trade Act," (H.R.2378) which has yet to become law, despite its introduction in each subsequent session of Congress.[2] The legislation would punish currency manipulators by imposing a countervailing or antidumping duty on all imports from countries with a fundamentally undervalued currency.[3] More recently, President Trump has expressed disdain for these neo-

[1]The average foreign exchange intervention between 1994, the first year of China's intervention, and 2002 was $1 billion per business day (Bergsten and Gagnon, 2017, p. 74). Much of these FX purchases were in U.S. Treasury bonds, which kept interest rates low in the U.S., adding additional fuel to the speculative real estate bubble in the early to mid-2000s.

[2]In 2011, the 112^{th} Congress introduced H.R.639; in 2013, the 113^{th} Congress introduced H.R.1276; in 2015, the 114^{th} Congress introduced H.R.820; and finally in 2017 the 115^{th} Congress introduced H.R.2039.

[3]See 115th Congress 2017, "H.R.2039: Currency Reform for Fair Trade Act."

mercantilist practices,[4] referring to China as a currency manipulator despite his government declaring otherwise.[5] In fact, China has not been a currency manipulator for more than a decade. The puzzle for scholars of international political economy (IPE) is why we are seeing the disappearance of currency manipulation as a viable, neo-mercantilist strategy.

In the decade prior to 2014, Bergsten and Gagnon (2017) acknowledge that 20 countries engaged in currency manipulation, eight of which relied heavily on manufacturing exports.[6] Between 2015 and 2017, these currency manipulators dropped by half, and only three remained in the group of eight manufacturing exporters: Israel, Taiwan, and Thailand (no longer included were China, Japan, Korea, Malaysia, and Sweden).[7] This paper asks the question, what explains this recent disappearance of currency manipulation as a strategy for export-led growth? I argue that the changing trade patterns over the previous quarter century, in particular, the growth in global supply chain integration, explains the disappearance of currency manipulation as a viable, political strategy for export-led growth.

In the early 1990s, firms began taking advantage of low-cost labor in developing economies. Following a reduction in trade and communication costs due to revolutions in transportation and information technology (Baldwin, 2016), as well as a surge in regional trade agreements (RTAs) between advanced and emerging market economies,[8] firms found it profitable to frag-

[4]The irony is palpable, considering the administration's use of neo-mercantilist measures and rhetoric to correct bilateral trade imbalances.

[5]Since 2015, China has actually tried to stop the rapid depreciation of the yuan by intervening in the opposite direction, i.e., buying yuan with its massive trove of forex reserves. Trump seems to use this as a negotiating tactic for better trade deals, even calling the eurozone a currency manipulator shortly after restarting negotiations on a US-EU trade deal (Mason and Holland, 2018).

[6]Bergsten and Gagnon (2017, p. 72) divide these countries into three groups: (1) manufacturing exporters include China, Israel, Japan, Korea, Malaysia, Sweden, Taiwan, and Thailand; (2) financial centers include Hong Kong, Macao, Singapore, and Switerland; and (3) resource exporters include Algeria, Kuwait, Libya, Norway, Oman, Russia, Trinidad and Tobago, and the United Arab Emirates. In this paper, I focus my attention on the manufacturing exporters, which are the largest group by volume, based upon net official asset flows.

[7]See Gagnon and Morrison 2018. While Taiwan has maintained an undervalued exchange rate, Israel and Thailand have actually converged on the market determined rate. Israel and Thailand are still classified as currency manipulators due to the various measures used, including a current account surplus greater than three percent of GDP among others. More on these criteria in Section 3.

[8]The number of RTAs increased from around 100 in 1990 to 291 in force as of January 2019 (in total, this number is closer to 467, which includes notifications from WTO members that counts goods, services, and accessions separately) (World Trade Organization, 2011, 2019). This surge in RTAs has doubled intra-RTA trade as a share of global trade between 1990 and 2008, from 28% to 51%. Excluding intra-EU trade, intra-RTA trade as a share of world trade was 18% in 1990 and 35% in 2008 (Bagwell, Bown and Staiger, 2016). Egger et al. 2011 estimates that a RTA leads to a 102% increase in trade between partner countries on average. See also Limão 2016 for a historical survey of regional trade agreements and their economic effects

ment parts of their production process into global supply chains. This trade in intermediate inputs grew at an annual rate of four percent per annum through 2015.

In a globalized economy where firms import many of the inputs that comprise an exported good, a currency depreciation no longer gives a competitive boost to these exports due to the increased cost of the foreign inputs. Indeed, recent studies have found that the elasticity of exports to the real effective exchange rate (REER)—a measure of price competitiveness—has decreased over time, a finding that the authors attribute to supply chain integration (Ahmed, Appendino and Ruta, 2015; Ollivaud, Rusticelli and Schwellnus, 2015; Cheng et al., 2016). The authors' conclusion that currency depreciation (or undervaluation) no longer gives a boost to exports raises questions about the relationship between supply chain integration, exchange rates, and political economy: Will supply chain integration alter firm-level exchange rate preferences? Will these aggregated preferences affect exchange rate policy? I argue that global supply chain integration weakens the traditional preferences of exporting firms for an undervalued exchange rate (cf. Frieden, 2014).

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). I follow the latter the approach in this paper, focusing the theoretical model and supporting analysis on firm-level preferences. 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 increase in supply chain integration will decrease the benefits of an undervalued currency beyond its cost, thus binding governments from manipulating their currencies for competitive gain. I test this model using cross-sectional time-series data covering 61 advanced and emerging market economies over the period 1995-2014, finding strong support that supply chains integration, in particular the share of foreign inputs in gross exports, pushes undervalued exchange rates towards their market-determined rates. I support the use of an OEP approach

within and between countries. Importantly for this study, these trade agreements included protections for multinational corporations investing in foreign markets—beyond the investment protections provided in the bilateral investment treaties (BITs) signed in the decades prior—, which incentivized firms to fragment the production process into global supply chains.

by directly measuring firm-level preferences for exchange rate policy using a cross-national World Bank survey. Together, these findings suggest that global supply chain integration binds governments from engaging in neo-mercantilist practices.

The remainder of the paper proceeds as follows. In the following section, I detail the increasingly important role of supply chains in international trade and survey some of the recent literature on the matter. I then define currency manipulation and overview how scholars have treated this *beggar-thy-neighbor* policy in historical and contemporary contexts. In Section 3 I illustrate the model of currency politics to be tested in Sections 4 and **??**. Section **??** discusses the implications for these findings and Section **??** concludes.

2 Global Supply Chain Integration & Currency Politics

The international financial system established after World War II codified rules for managing the power struggles between countries that lead to the currency wars of the 1930s. However, as markets continued to globalize and capital controls loosened in the 1960s and 70s, the Bretton Woods financial order dissolved, and the fear amongst policymakers of purposive exchange rate depreciations resurfaced. Despite rumblings of a modern currency war following the 2008 global financial crisis,[9] the competitive depreciations seen after the Great Depression went largely unobserved. The explanation I put forth in this paper for the disappearance of this *beggar-thy-neighbor* policy is the interdependence between countries due to global supply chain integration. In this section I overview the evolution of supply chain trade and its role in currency politics.

2.1 Global Supply Chain Linkages

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

[9] See Blanchard 2017.

significant decreases in coordination costs as a result of innovations in communication and transportation. Moreover, hundreds of RTAs containing 'deep provisions' have decreased barriers to trade and provided protections for firms operating in foreign markets. Between 1995 and 2015, the effectively applied tariff rates amongst countries in Europe, North and South America, and East and Southeast Asia[10] decreased from an average of 11.3% to 3.3%.[11] At the same time, inward foreign direct investment (FDI) increased from $583 billion in 1994 to $10.4 trillion in 2017 in developing countries, and in developed countries from $1.72 trillion in 1994 to $20.3 trillion in 2017.[12] Together, this has led to an increase in supply chain participation[13] from 34.7% of gross exports in 1995 to 36.8% in 2014. This seemingly small increase is due to the decrease in forward linkages, or the export of inputs to foreign exporters from 19.1% in 1995 to 16.8% in 2014, with a concurrent increased reliance on foreign inputs (backward linkages) from 15.7% in 1995 to 20.0% in 2014.

The literature on supply chain integration falls along two lines of inquiry: (i) the political or economic setting that lead to these supply chain linkages and (ii) the outcomes these linkages influence or cause. Baldwin and Lopez-Gonzalez (2015) provide a thorough portrait of the evolution of supply chain integration 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 supply chains:

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

Indeed, Büthe and Milner (2008) demonstrate developing countries that belong to the World Trade Organization (WTO) and participate in more RTAs enjoy greater FDI inflows than

[10]Due to data limitations, the following cross-country time-series analysis will focus on a selected group of 61 countries, which make up over 80% of global GDP, between 1995 and 2014.

[11]The most favored nation (MFN) rate decreased from 12.4% to 4.8% between 1995 and 2015. Data from the World Integrated Trade System (WITS) compiled by the World Bank.

[12]UNCTAD (1995) and UNCTAD (2018).

[13]Supply chain participation is calculated as the share of foreign inputs in domestic exports plus the share of domestic inputs that are used by a foreign producer in domestic exports. The data and equations for this calculation are explained in Section 4.

otherwise due to the "deep provisions" embedded in these agreements. In Asia, where the most integration in 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 supply chains in a foreign market. Johns and Wellhausen (2016) demonstrate that tightly-linked firms within a host country enjoy *de facto* property right protections. If a host government decided to break a contract with a foreign firm, it would cause harm to other domestically-linked firms in the supply chain. The domestic firms involved in the supply chain provide the pressure to maintain these property right protections.

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—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 countries that are relatively central or in a well-connected location will tend to attract downstream firms, while more remote locations will attract upstream firms specialized in the production of intermediate inputs. In this paper, the location of a country in the supply chain matters—specifically, how downstream a country is on the supply chain—, as this is a crucial parameter in determining exchange rate preferences.

Supply chain linkages 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 (see e.g., 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 sub-

sequent import competition. They find that increased vertical FDI decreases the likelihood of trade disputes, even in the context of an undervalued currency. Moreover, they conclude that persistent undervaluation is associated with increased intra-firm trade and vertical FDI by U.S. firms in the undervaluing country. [14]

2.2 Currency Manipulation

While tariffs 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 to exporters. In the wake of the 2008 global financial crisis, governments feared a return to the inward-looking policies that proceeded from the Great Depression. In the 1930s, governments had limited tools to respond to economic shocks due to the fixed exchange rates of the gold standard. When the protectionist tariffs governments imposed on imports deepened the depression,[15] some countries abandoned the gold standard, sparking a currency war amongst the largest economies—Japan, U.K., Germany, U.S., and France (in order of abandonment). Countries that abandoned the gold standard early and allowed for a freely-floating exchange rate recovered from the depression faster than those who maintained parity with gold (Eichengreen, 1992). Concern over a modern currency war arose following the unorthodox monetary policy responses of advanced economies to the 2008 crisis. Indeed, in September 2010 when central banks in the U.S., U.K., and Japan engaged in monetary actions that depreciated their respective currencies, thus hurting other economies with relatively stronger currencies, the Brazilian finance minister Guido Mantega warned of an international currency war.

Fear of these competitive devaluations is not confined to times of crisis. As tariffs trend towards obsolescence, there is a growing fear that countries will undervalue their currency as a neo-mercantilist, protectionist measure. NPR's *Planet Money* Podcast aptly named this varietal of protectionism the "secret tariff" (Kestenbaum, 2015). Indeed, Copelovitch and

[14]The role of undervaluation in attracting vertical FDI and supply chain linkages is beyond the scope of this paper, but an interesting topic for future research.

[15]The Smoot-Hawley Tariff Act of 1930 raised tariffs to almost 60% on some 20,000 products. Scholars argue that this protectionist measure and the retaliatory measures from other countries that followed exacerbated the Great Depression. Irwin 2011 provides a thorough survey of events.

Pevehouse (2013) demonstrate that countries with pegged exchange rates who sign a RTA with their "base" country will often transition to a flexible exchange rate in order to maintain monetary and fiscal autonomy, i.e., the ability to utilize this 'secret tariff.'

While protecting against imports, an undervalued currency also promotes exports. The persistent trade surpluses in the Asian Tiger economies—China, Hong Kong, Korea, Taiwan—were predicated on an export-led growth model with undervalued currencies. The maintenance of these undervalued currencies has been an area of consternation of many countries with persistent trade deficits (Bergsten and Gagnon, 2017).

Similar to the literature on supply chain integration, scholars also tend to focus on the economic, political, or institutional context that precedes undervaluation, as well as the outcomes that undervaluation influences. Steinberg (2015) examines the latter and 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 approach to Steinberg, except I condition currency valuation on a country's global supply chain reliance.

The economic and political rationale for maintaining an undervalued currency is to bolster exporting industries and provide protections for import-competing industries. These outcomes, however, come at a cost to other domestic actors. The costs of undervaluation include an increased foreign debt burden (Walter, 2008), reduced purchasing power of consumers and local businesses (Frieden, 2014), and higher domestic borrowing costs for all (Gagnon, 2011). These costs and benefits are determined by how the policy affects certain interest groups—e.g., exporters, importers, consumers—, and thus exchange rate policy decisions are conditional on the aggregation of exchange rate preferences across the economy.[16] In the following section, I layout in more detail my theory of exchange rate politics, which builds upon the seminal works of Frieden (1991, 2014).

[16]See Steinberg and Walter (2012) for an excellent survey of the domestic determinants of exchange rate policy.

3 Theory: Supply Chains and Exchange Rate Politics

The exchange rate regime and level have measurable distributional effects for socioeconomic actors *within* a country—i.e., individuals, firms, and sectors—from which one can deduce exchange rate preferences. In a globalized world, a country's exchange rate also has distributional effects *between* countries: an undervalued/depreciated currency may boost a country's exports, but at the expense of other countries who are crowded out of the international markets due to their more expensive goods. Much like in formulating trade policy, policy makers consider many variables when creating exchange rate policy—e.g., political institutions, domestic and international macroeconomic conditions, and the preferences of socioeconomic actors.

3.1 Exchange Rate Politics

The politics of exchange rates has a close parallel to the politics of trade policy: international exposure dictates the preferences of socioeconomic groups. For example, an import-competing sector should prefer policy that protects its market from imports; this can be achieved via tariffs on imported goods and/or a depreciation/undervaluation of the currency, both of which increase the cost of imports. According to Frieden (2014), exchange rate policy preferences for a firm, sector, or socioeconomic group, are dependent on (1) their international exposure to exchange rate risk, (2) tradability of their goods and/or services, and finally (3) the exchange rate pass-through onto these goods or services (explained in more detail below). All else equal, this implies the following testable implications for exchange rate policy, here focusing on the exchange rate regime (fixed versus floating) and level (depreciated versus appreciated):

1. *International exposure*: the greater a firm's immersion in cross-border trade and investment, the greater its support for a fixed exchange rate.[17]

2. *Tradability*: (1) the larger the share of tradable (nontradable) goods and services in a firm's output (inputs), the stronger its support for a depreciated exchange rate. (2)

[17] Frieden 2014, p. 23.

And conversely, the larger the share of tradable (nontradable) goods and services in a firm's inputs (output), the stronger its support for an appreciated exchange rate.[18]

3. *Pass-through*: this refers to the elasticity of domestic prices to the exchange rate, or the extent to which domestic prices are affected by changes in the exchange rate. 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.[19]

Studies in the field of economics have found that exporting firms with low pass-through—i.e., large movements in the exchange rate have little effect on the price of internationally-traded goods—are more likely to be heavily-reliant on imported inputs (Amiti, Itskhoki and Konings, 2014). According to Frieden (2014, pp. 30-33), a firm with limited pass-through will prefer a flexible exchange rate due to the possibility of gaining market power by crowding out firms who cannot "price-to-market." However, as I argue in this paper, if these firms are heavily-reliant on imported inputs as prior studies have found, then they should actually prefer a more stable exchange rate.

Several studies in political science have tested the predictions on international exposure and tradability, resulting in mixed outcomes (see Steinberg and Walter 2012 for a comprehensive survey of the literature). This leaves open the possibility that adding more nuance to the conditions of international exposure and tradability—specifically, the roll of supply chain integration—may better explain exchange rate preferences, and ultimately, exchange rate outcomes.

3.2 The Chains That Bind

This section outlines my theory about why supply chain integration changes the predicted exchange rate preferences of socioeconomic actors from previous theory and how this relationship has led (and should continue to lead) to exchange rates approaching their market-determined rate. While there are several channels through which exchange rate policy is

[18] *Ibid.*, p. 28.
[19] *Ibid.*, p. 35.

affected—e.g., political institutions and domestic/international macroeconomic conditions—this analysis will focus primarily on the exchange rate preferences of socioeconomic actors, which are guided by exposure to the international economy. Once I establish the exchange rate preferences of these socioeconomic actors, I will explore their effect on exchange rate levels.

My theory on the determinants of exchange rate preferences builds upon the work of Jeffry Frieden (1991, 2014), amending his contributions along two facets: once I condition upon the increasing role of global supply chains, the predictions adjust for (1) international exposure and (2) tradability. First, Frieden proposes that the higher the international exposure of a firm, the stronger the support for a fixed exchange rate. This is illustrated in the bottom two panels of Figure 1; the upper two panels illustrate a firm's preference for a flexible exchange rate if it is relatively shielded from exchange rate risk. Second, the tradability of a firm's outputs and inputs also affects exchange rate preferences, but here for the level of exchange rate, i.e., appreciated or depreciated. As stated above, Frieden argues that the larger the share of tradable goods and services in a firm's output, the stronger its support for a depreciated exchange rate , and conversely , the larger the share of tradable goods and services in a firm's inputs, the stronger its support for an appreciated exchange rate. Translating this to the country level, if an economy is dependent on export markets—i.e., they maintain a high export-to-GDP ratio—, then socioeconomic actors would prefer a relatively depreciated or undervalued currency (this is displayed in the bottom two panels, as fixed but depreciated). Conversely, if an economy is dependent on the cross-border exchange of inputs—i.e., they are dependent on global supply chains—, then socioeconomic actors would prefer an appreciated currency (this is displayed in the right two panels, that is, firms with high supply chain dependence should prefer an appreciated exchange rate). In the framework of supply chain integration, the contradictory predictions are clear in the bottom-right panel: firms that are reliant on international trade prefer a fixed exchange rate that is relatively weak (depreciated/undervalued), while firms that are reliant on tradable inputs prefer a relatively appreciated exchange rate.

My characterization of Frieden's expected preferences is not to insist that he is incorrect in the formation of his model or challenge the findings therein. In fact, Frieden acknowledges

Figure 1: Frieden's Predicted Preferences for International Exposure and Tradability

		Tradability (Supply Chain Dependence)	
		Low	High
Intl. Exposure (Exports/GDP)	Low	Flexible Exchange Rate (Appreciated)	Flexible Exchange Rate (Appreciated)
	High	Fixed Exchange Rate (Depreciated)	Fixed Exchange Rate (Depreciated/Appreciated)

the role of global supply chains in determining preferences over the exchange rate regime: "An enterprise that relies heavily on earnings from exports or foreign production, or is a substantial user of imported inputs or capital, can be hard hit by exchange rate fluctuations" (2014, p. 22). These firms, he asserts, should exhibit greater support for a fixed exchange rate. The issue arises when subsequent empirical studies do not consider the nuances involved in firm production structures, measuring a country's tradability of inputs and outputs separately, rather than as an integrated network as in this paper. My theory on exchange rate preferences addresses this inconsistency by modeling explicitly supply chain integration.

I slightly alter Frieden's prediction that firms with high exposure to international exchange will prefer a fixed exchange rate, instead categorizing this as a fixed or *stable* exchange rate, meaning that if the exchange rate is allowed to float, it will not significantly deviate from its market-determined rate. This is illustrated in the bottom two panels of Figure 2. In contrast to Frieden, I argue that firms heavily engaged in supply chain trade (right two panels) prefer exchange rate stability rather than an appreciated exchange rate. It is important to remind the reader here that I am only predicting domestic preferences. Firms dependent on imported inputs may (and probably would) prefer the source countries to maintain a depreciated/devalued currency; I leave this to future work.

In Figure 2, I also include examples of countries that fit the particular specifications.

For example, Argentina, a country that is not heavily dependent on exports for economic growth (5.3% of GDP is from exports of goods) nor reliant on supply chains (22% of exports involved in a supply chain, more than a standard deviation below the sample mean), should prefer a flexible exchange rate, all else equal. In contrast, an export-dependent country like Thailand that is heavily reliant on supply chains (45.7% of GDP from exports, with 72.3% of these exports involved in supply chains) should prefer exchange rate stability to lower the risk of increased import costs. Likewise, a country with a large domestic market but that is heavily reliant on supply chains such as Japan (10.6% and 58.1%, respectively), would also prefer exchange rate stability, all else equal. Finally, a country with a dependence on exports but with little involvement in supply chains should prefer a fixed, yet depreciated, exchange rate. Singapore is a good example for this category, however, with a caveat. While it is just below the mean in terms of global supply chain dependence (34.0% versus a mean of 35.4%), it is well above the mean when considering all sectors that bring a product to market, i.e. global value chains, due to its shift to more service-based economy. Thus, while it fits the category for this analysis of the manufacturing industry, it would fit a different category for all sectors of the economy. The only other country in the sample that fits this category is Cambodia (25.4% exports/GDP, 30.9% exports in supply chains), a country that is heavily reliant on the U.S. dollar for transactions (Duma, 2011), and thus devaluation does not have much effect on export competitiveness or supply chain trade. The lack of common support for this category raises concerns about potentially biased estimates (Hainmueller, Mummolo and Xu, 2016). I should note that when running empirical specifications using all industries, which does have common support for the moderating variable, the results hold, albeit with a marginally weaker effect (results available upon request).

The argument put forth is quite similar to arguments in the latter decades of the 20^{th} century, when scholars argued that international capital openness would severely limit domestic economic policy options. This interdependence of financial markets could in fact lead to a convergence of macroeconomic policies (see e.g., Garrett and Lange, 1991; Andrews, 1994; Milner and Keohane, 1996). The empirical evidence, however, did not support such predictions, leaving states mostly autonomous in their national economic policy decisions (Bearce, 2009). While I do not test of monetary policy or exchange rate convergence explic-

Figure 2: Predicted Effects for International Exposure and Tradability

Intl. Exposure (Exports/GDP)	**Tradability (Supply Chain Dependence)** Low	**Tradability (Supply Chain Dependence)** High
Low	Flexible e.g., Australia (5.3%, 22.0%)	XR Stability e.g., Japan (10.6%, 58.1%)
High	Fixed/Undervalued* e.g., Singapore (50.0%, 34.0%)	XR Stability e.g., Thailand (45.7%, 72.3%)

Note: Values for each category in parentheses – (Exports as a share of GDP, Percent of exports involved in supply chain).
* – Countries with low supply chain participation but with a high reliance on exports for total GDP will prefer a fixed exchange rate due to the international exposure, but with a preference for undervaluation due to the competitive price effects.

itly in this analysis, the argument herein closely parallels the macroeconomic convergence arguments of the 1990s.

The theory outlined above lends itself to testable hypotheses. I propose a series of hypotheses that underscore the role international exposure and supply chain linkages have in explaining exchange rate valuations, some of which are identical to Frieden's. In particular, these testable hypotheses seek to show how increases in supply chain participation can lead to exchange rate preferences for exchange rate stability over undervaluation.

Hypothesis 1: *The greater an economy's exports as a share of GDP, the stronger the preference for a undervalued/depreciated exchange rate.*

Firm's 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 economy's exports as a share of GDP, the more

the exchange rate will deviate (negatively) from its market-determined rate. This follows from Frieden's proposition on the role of *tradability* in exchange rate preferences. Expected direction of coefficient of interest: negative.

Hypothesis 2: *The greater an economy's participation in supply chain integration, conditional on their export dependence, the weaker the preference for an undervalued/depreciated exchange rate and the smaller the deviation of the exchange rate from its market-determined level.*

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 economy's reliance on exports as a share of GDP and participation in global supply chains, the weaker the preference for an undervalued exchange rate and the less the exchange rate will deviate from its market-determined rate. Expected direction of coefficient of interest: positive. However, the true preference may be uncertain due to the components that make the supply chain index: backward and forward linkages. Thus, I create two more hypotheses for these separate linkages.

Hypothesis 2(a): *The greater an economy's participation in backward linkages, conditional on their export dependence, the weaker the preference for an undervalued/depreciated exchange rate and the smaller the deviation of the exchange rate from its market-determined level.*

Firms that rely heavily on imported intermediate inputs will not prefer an undervalued exchange rate, but rather a stable, equilibrium-level exchange rate. This hedges against the exchange rate risk that comes with international trade. The greater an economy's reliance on exports as a share of GDP and participation in backward linkages, the weaker the preference for an undervalued exchange rate and the less the exchange rate will deviate from its equilibrium level.

Hypothesis 2(b): *The greater an economy's participation in forward linkages, conditional on their export dependence, the stronger the preference for an undervalued/depreciated exchange rate.*

Firms that rely heavily on exporting intermediate inputs behave similarly to firms ex-

porting final goods. A depreciated/devalued exchange rate provides a competitive boost to exports. Thus, the greater an economy's reliance on exports as a share of GDP and participation in forward linkages, the more the exchange rate will deviate (negatively) from its market-determined level.

4 Data: Construction and Transformations

In order to test this theory that global supply chain integration puts upward pressure on undervalued exchange rates towards their market-determined rate, I require a relatively precise calculation of my outcome variable: exchange rate misalignment. The first element in my calculation, the measure of a country's real effective exchange rate (REER), is readily available and the measure chosen easily defended. The REER is an index of a weighted average of bilateral exchange rates adjusted by a measure of prices amongst trading partners. This tends to be a better indicator of the macroeconomic effects of exchange rates than a bilateral measure—e.g., the RMB to USD exchange rate differential only provides an estimate of price competitiveness between China and the U.S., while the RMB REER gives the international competitiveness of the RMB (yuan) with respect to its largest trading partners (in this case, top-30 trading partners). This data comes from the EQCHANGE database (Couharde et al., 2017).

To calculate the second element, a country's market-determined rate, i.e., the equilibrium real exchange rate (ERER), I use the behavioral equilibrium approach in Couharde et al. (2017), which they estimate for 182 economies between 1973 and 2016. The behavioral equilibrium exchange rate (BEER) approach to estimating equilibrium real exchange rates (henceforth, ERERs) considers the ERER as a function of a country's medium- and long-term fundamentals. I use this approach for two key reasons: First and foremost, availability of the data. Couharde et al. (2017) estimate the BEER for the majority of country-year pairs in my sample—not included are the European Monetary Union and Taiwan—and is publicly available in their EQCHANGE database. They also provide the currency misalignment measure by subtracting from this estimate their calculation of a country's REER. The second reason for using this approach is that unlike other approaches that require normative projections

of a country's current account balance—e.g., the macroeconomic balance approach or the external sustainability approach—the BEER approach directly estimates the ERER for each country using medium- and long-term fundamentals of the real exchange rate. 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.

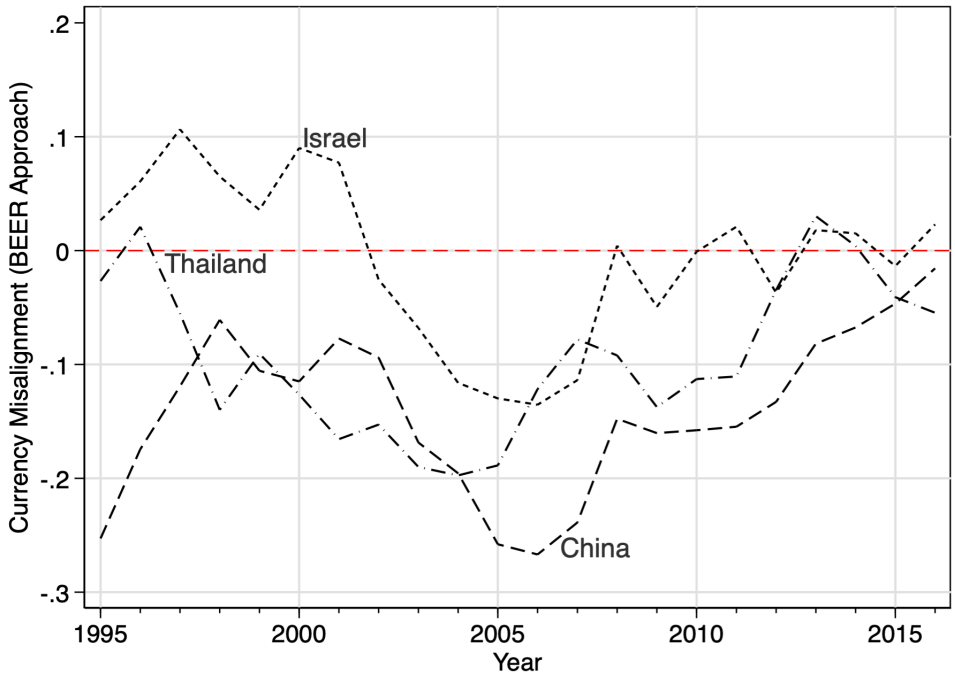
Figure 3 displays a sample of currency misalignment estimates using this approach. Here I display one country that is no longer listed as a manipulator (China) and two that are deemed manipulators but have clearly converged towards their market determined rates (Thailand and Israel). Notably, China maintains an undervalued exchange rate throughout the sample; however, the decision by the People's Bank of China to allow the RMB to appreciate post-2005 is clear by the continuing upward trajectory through 2015. The appreciation of the RMB may be a matter of a shift to a consumption-based economy or a strategic move to become an international currency that challenges the greenback (Cohen, 2018). I take account of these alternative explanations by excluding China from the sample in my robustness checks.

As noted before, the BEER estimates in the EQCHANGE database do not include estimates for Taiwan or the Euro area.[20] Thus, as a robustness check, I also estimate all of my models using the Balassa-Samuelson approach (Balassa, 1964; Samuelson, 1964). I use this as a secondary measure 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. I follow Rodrik's (2008) approach 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),[21] I first calculate the real exchange rate (RER) for each

[20] I use the Euro area 12 (EA12) as my estimate of the eurozone given the numerous additions to the currency bloc during the latter years of the sample period. For robustness checks, I also exclude the EA12 and all EU countries that have or will accede to the eurozone and the results hold. The EA12 consists of Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain.

[21] 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.

Figure 3: Currency Valuation (BEER Approach), Country Sample



Note: The BEER (behavioral equilibrium exchange rate) 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 (red dotted line) denotes an undervalued exchange rate; above zero, an overvalued exchange rate.

of the 51 countries in the sample (50 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; it also makes for an easier interpretation visually. 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, I take the difference between the measured real exchange rate and the Balassa-Samuelson-adjusted exchange rate—i.e., the residual from Equation 1.

The main explanatory variable, global supply chain participation, derives from the OECD-WTO Trade in Value Added (TiVA) database. I construct three measures of a country's supply chain participation, which capture a country's *position*—i.e., upstream or downstream—and its *reliance* on supply chains. Following convention (Koopman et al., 2010), I first calculate a country's position on the supply chain via backward and forward linkages and use these measures to calculate the participation index. The *forward linkage* measures the share of domestic value added in exports that is used by a foreign producer as an intermediate input (Equation 2 below). The *backward linkage* measures the share of foreign value added in export flows that is imported from abroad (Equation 3). The *supply chain participation index* is the sum of these two linkages (Equation 4) and the *supply chain position* is the log ratio of a country's forward linkage to its backward linkage (Equation 5). Finally, to measure a country's exposure to international trade, I include exports and imports as a share of GDP. The explanatory variables of interest are the interaction of a country's exports as a share of GDP with the three measures of supply chain linkages.

1. *Forward linkages*: the indirect value added (IV)—i.e., the value of domestically-produced intermediate inputs—for sector i in country k's gross exports (EXP) to the world or partner country:

$$\text{FWD\_LINK}_{i,k} = IV_{i,k}/EXP_{i,k} \tag{2}$$

2. *Backward linkages*: the foreign value added (FV) for sector i in country k's gross exports (EXP) to the world or partner country:

$$\text{BWD\_LINK}_{i,k} = FV_{i,k}/EXP_{i,k} \tag{3}$$

3. *Supply chain participation index*: this value summarizes the importance of the supply chain for sector i in country k:

$$\text{PARTICIPATION}_{i,k} = IV_{i,k}/EXP_{i,k} + FV_{i,k}/EXP_{i,k} \tag{4}$$

4. *Supply chain position*: this value summarizes the supply chain position of sector i in country k. A negative value indicates that the country is downstream in the supply chain—i.e., they are reliant on foreign value added to produce a final good. A positive value indicates that the country more upstream in the supply chain—i.e., they produce intermediate inputs that are used in foreign countries' exported goods:

$$\textsc{Position}_{i,k} = \ln(1 + IV_{i,k}/EXP_{i,k}) - \ln(1 + FV_{i,k}/EXP_{i,k}) \tag{5}$$

Figure 4 shows the evolution of supply chain integration across countries between 1995 and 2014. Countries with the most growth in supply chain linkages 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 chians—e.g., Slovak Republic, Czech Republic, Hungary, and Poland. The Asian countries who utilized neo-mercantilism as a strategy for export-led growth—e.g., China, Korea, Taiwan, and Thailand—have also become prime locations for this intermediate trade, as well as reliance for intermediate inputs.

While Figure 4 shows the *total* use of supply chains, hidden are the components, which drive the theory. As stated above, I expect the backward linkages, that is the imported inputs, to have the strongest effect on realigning currencies with their market-determined rate. Figure 5 illustrates the evolution supply chain participation *and* position for a group of countries: the G7 economies (Canada, France, Germany, Italy, Japan, United Kingdom, and United States) and the manipulators for manufacturing exports, minus Japan (China, Korea, Israel, Malaysia, Sweden, Thailand, and Taiwan). Note that the countries in the latter category tend to become much more reliant on supply chains over the two decades, but also move more downstream, becoming more reliant on backward linkages. This is the variation I exploit in my empirical analysis in the following section.

Finally, I control for various country-level variables that may also affect currency values. The rationale for including these covariates is because there are many external forces that could affect a country's exchange rate—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-

Figure 4: Supply chain participation (total), 1995 and 2014

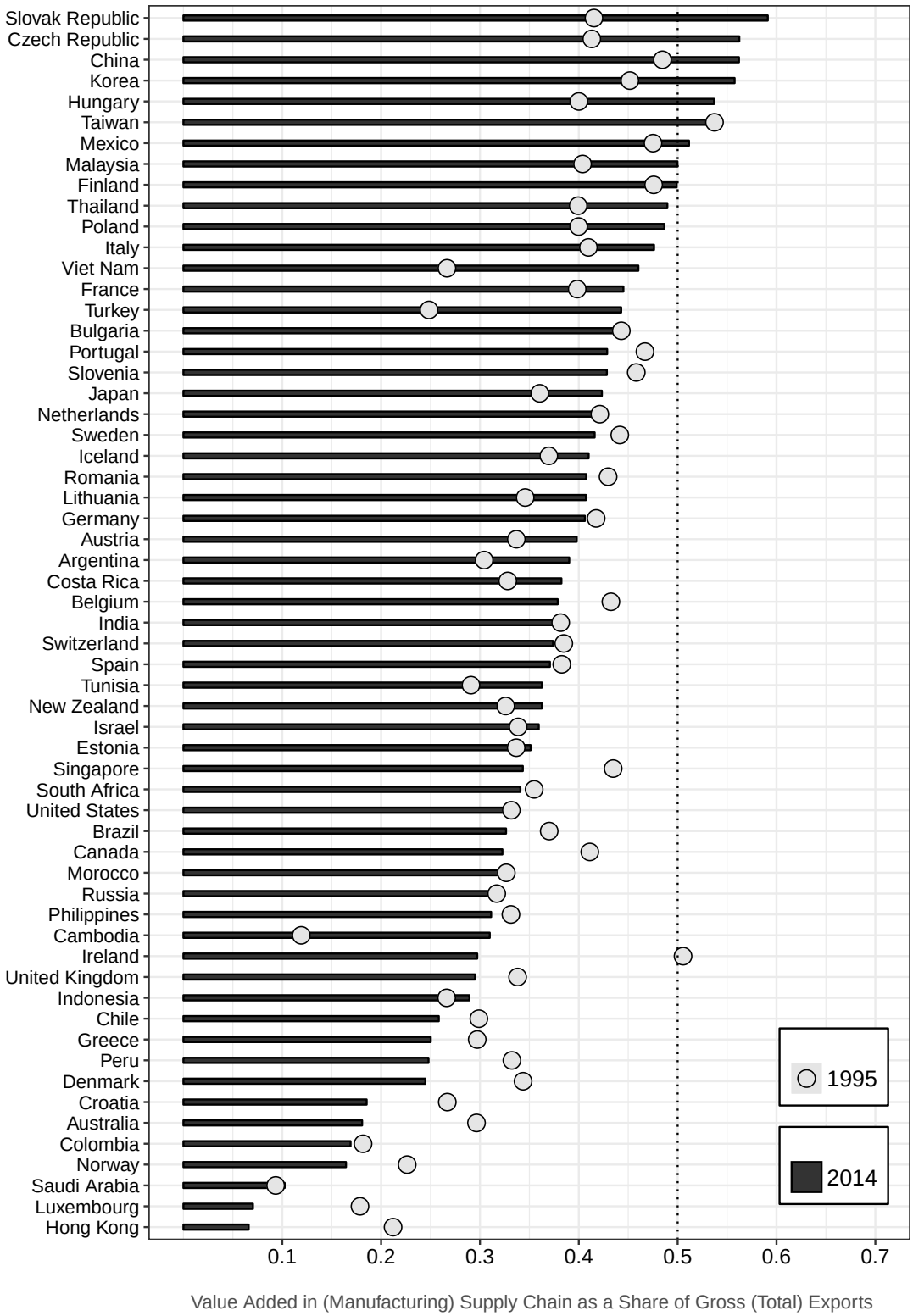
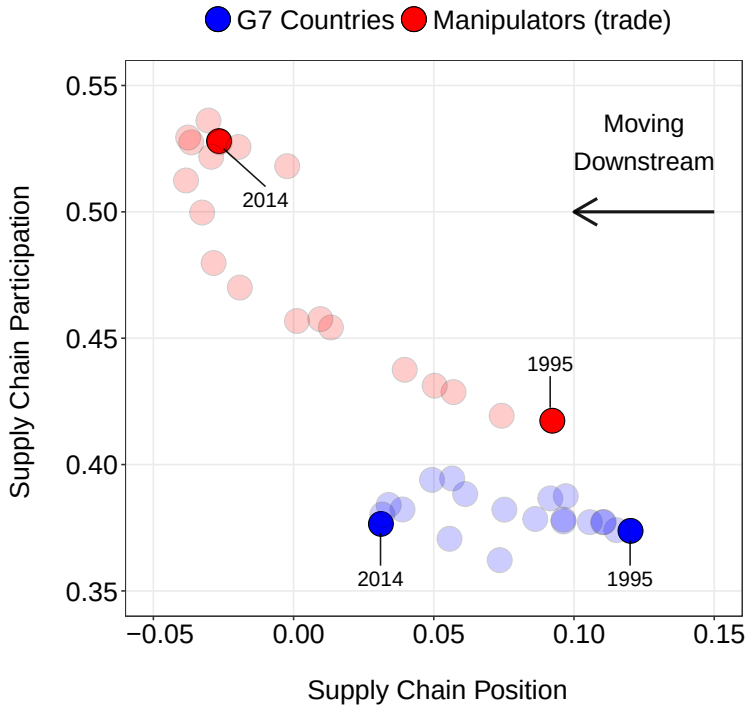


Figure 5: Supply chain participation and position, select countries, 1995-2014



Note: Each circle represents a group-year observation, 1995-2014. G7 countries include Canada, France, Germany, Italy, Japan, United Kingdom, and United States. The group of countries included in the classification of manipulators for trade purposes are China, Korea, Israel, Malaysia, 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.

varying state-level covariates that can affect exchange rates, we can measure purposeful exchange rate movements rather than only market-determined movements. First, a central bank's foreign exchange (FOREX) intervention is measured as the amount of foreign exchange reserves as a share of GDP (source: International Monetary Fund). This is the main policy tool a government will use to influence the level of the exchange rate. 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 capital account openness (CKOPEN): the less open a country's capital flows, the greater leverage it has to control the level of the exchange rate (source: Karcher and Steinberg, 2013). Thus, the predicted sign on the CKOPEN coefficient is positive: the lower the capital openness, the lower the exchange rate. I also control for

the outward stock of foreign direct investment as a share of total GDP (FDI/GDP). 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, which is often associated with an undervalued exchange rate. Financial crises may also have an effect on the exchange rate level, and thus I control for the 2008 global financial crisis (dummy = 1 in years 2008 and 2009) as well as country-specific crisis dummies—e.g., Argentina in 2001. Finally, I include two political controls: whether the executive is controlled by a leftist party as well as the level of democracy as measured by the Polity IV index.Bearce (2003) argues a "party-as-agent" framework where rightest parties will tend to favor the global firms who prefer monetary stability, while leftist parties will tend to favor monetary autonomy that favors domestically-oriented groups. Similarly, Bearce and Hallerberg (2011) argue that democratic regimes tend to support floating regimes, while autocratic regimes a more fixed exchange rate. Summary statistics are provided in Table 1.

5 Empirical Strategy 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 an economy's exports as a share of GDP, the stronger the preference for an undervalued exchange rate (predicted coefficient: negative).

H2: The greater an economy's participation in supply chains, the weaker the preference for an undervalued exchange rate (predicted coefficient: positive).

H2(a): The greater an economy's participation in backward linkages, the weaker the preference for an undervalued exchange rate (predicted coefficient: positive).

Table 1: Summary Statistics: Main Control Variables

	Manipulators†	Non-Manipulators
FOREX Reserves (in billion USD)		
Mean ± SD	315 ± 684	60.8 ± 150
% change, 1995-2014	194.3	152.8
Savings Rate		
Mean ± SD	37.3 ± 8.2	23.0 ± 8.2
% change, 1995-2014	7.1	8.8
Capital Openness		
Mean ± SD	.89 ± 1.6	.85 ± 1.5
% change, 1995-2014‡	—	—
FDI/GDP		
Mean ± SD	71.4 ± 95.5	25.3 ± 87.8
% change, 1995-2014	147	190
Leftist Executive*		
Mean ± SD	0.43 ± 0.5	0.56 ± 0.5
% change, 1995-2014‡	—	—
Polity IV**		
Mean ± SD	4.5 ± 6.3	7.2 ± 4.5
% change, 1995-2014	25.2	12.3

Note:The percent change measures the average of all country-level 19-year percent changes. †: China, Denmark, Hong Kong, Korea, Malaysia, Singapore, Switzerland, Taiwan. ‡: Not enough data points or variation to calculate per cent change. ∗: = 1 if executive is leftist, 0 if rightist, NA otherwise. ∗∗: ranges from -10 (authoritarian) to +10 (democratic).

H2(b): The greater an economy's participation in forward linkages, the stronger the preference for an undervalued exchange rate (predicted coefficient: negative).

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 (i) country fixed effects and (ii) clustered standard errors by country:

$$(REER - \widehat{EREER})_{it} = \alpha + \beta_1 \ln\left(\frac{\text{EXPORTS}_{i,t-1}}{\text{GDP}_{i,t-1}}\right) + \beta X_{i,t-1} + u_{it}, \tag{6}$$

where $X_{i,t-1}$ is a vector of lagged (and log-transformed) control variables as described earlier. I do not report the coefficients on all control variables as they have statistically little effect on the outcome. 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 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 (all results available upon request). 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.[22]

Table 2, columns (1) and (4), present the results from this first hypothesis, with and without controls respectively. Note that the number of countries drops from 51 (50 countries + EA12) to 37 due to a lack of data on several control variables for all countries in the sample (dropped from the sample are Brunei Darussalam, Cambodia, Costa Rica, Hong Kong, Iceland, Malta, Morocco, Peru, Romania, Slovakia, Taiwan, and Tunisia. The results (sans controls) hold with the entire sample (excluding Taiwan, for which BEER data is unavailable). In both specifications I also 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). Turning to the addition of the control variables, of particular note is that the magnitudes increase, as does the significance of each. This should not be surprising as the control variables include predictors of currency misalignment. Of interest is what happens when these effects are conditioned on supply chain dependence, which I turn to next.

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

[22]See Achen 2000 for a review of why including a lagged dependent variable when your outcome variable is stationary and persistent absorbs all variation in the model.

Table 2: Global Supply Chains and Currency Valuations, BEER Approach

	Dependent Variable: $REER - \widehat{EREER}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(\text{Exports/GDP})^*_{t-1}$	−0.19	−0.08	−0.05	−0.28*	−0.25	−0.26
	(0.11)	(0.15)	(0.23)	(0.12)	(0.15)	(0.24)
$\ln(\text{Imports/GDP})^*_{t-1}$	0.10*	0.01	0.00	0.18**	0.08	0.11
	(0.05)	(0.07)	(0.06)	(0.06)	(0.06)	(0.07)
$\ln(\text{Part.})_{t-1} \times \ln(\text{Exp/GDP})^*_{t-1}$		0.24			0.19	
		(0.13)			(0.12)	
$\ln(\text{Participation})^*_{t-1}$		0.92**			0.88**	
		(0.33)			(0.31)	
$\ln(\text{Bwd\_Link})_{t-1} \times \ln(\text{Exp/GDP})^*_{t-1}$			0.17*			0.15*
			(0.07)			(0.06)
$\ln(\text{Bwd\_Link})^*_{t-1}$			0.51**			0.44*
			(0.19)			(0.18)
$\ln(\text{Fwd\_Link})_{t-1} \times \ln(\text{Exp/GDP})^*_{t-1}$			−0.05			−0.10
			(0.10)			(0.09)
$\ln(\text{Fwd\_Link})^*_{t-1}$			0.09			0.07
			(0.15)			(0.15)
$\ln(\text{FDI/GDP})_{t-1}$				0.04	0.04*	0.04*
				(0.02)	(0.02)	(0.02)
Country F.E.?	Yes	Yes	Yes	Yes	Yes	Yes
CSE(country)?	Yes	Yes	Yes	Yes	Yes	Yes
Controls?‡	No	No	No	Yes	Yes	Yes
R^2	0.43	0.50	0.51	0.46	0.53	0.54
Adj. R^2	0.39	0.47	0.47	0.41	0.49	0.49
Observations	613	613	613	548	548	548
Countries	37	37	37	37	37	37

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. All independent and control variables log-transformed and lagged one year, except dummy variables for the 2008-2009 financial crisis, country-specific financial or banking crises, and chief executive election year, as well as the Polity IV measure. * – Data limited to the manufacturing sector, but taken as a share of total GDP across all sectors (for Imports and Exports) or as a share of total gross exports across all sectors (for participation, backward linkage, and forward linkage). ‡ – Control variables included in this analysis, besides FDI/GDP which is reported due to its statistical significance across all models, include the two financial crisis dummies explained above, foreign exchange reserves as a share of GDP, savings rate, capital account openness, Polity IV, and a dummy for if there was an election for the chief executive. Not included here is the party regime type (left or right), which has too many missing observations; the results hold when included and the sample size is reduced.

$$(REER - \widehat{EREER})_{it} = \alpha + \beta_1 \ln(\text{Participation}_{i,t-1}) \times \ln\left(\frac{\text{Exports}_{i,t-1}}{\text{GDP}_{i,t-1}}\right) + \beta X_{i,t-1} + u_{it}, \tag{7}$$

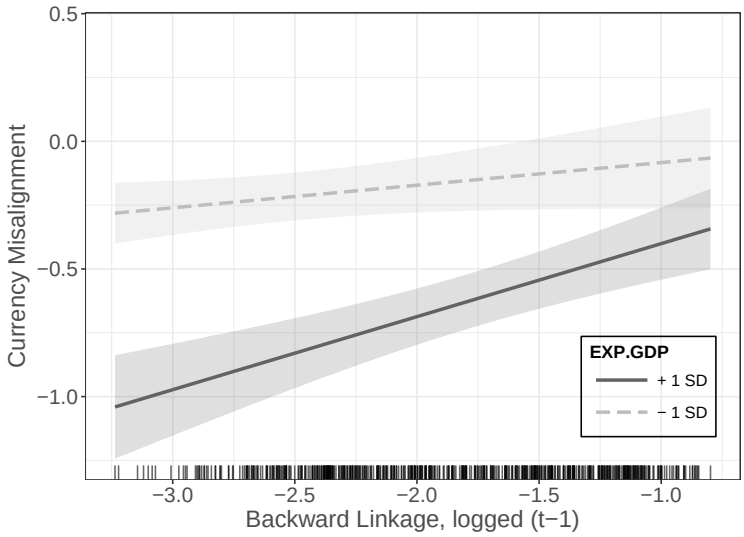
but here include the interaction of the main predictor global supply chain Participation

with the moderating variable EXPORTS/GDP, both log-transformed and lagged one year. The rationale for an interaction term in this model specification stems from the 2×2 matrix that laid out in the theoretical predictions of supply chain integration and currency misalignment (see Figure 2). Recall that a country with high supply chain participation will prefer exchange rate stability regardless of its international exposure, whereas a country with low supply chain participation and low international exposure will prefer a flexible exchange rate. This difference necessitates a moderating effect for EXPORTS/GDP, which calls for the interaction term in the model specification.

Table 2, columns (2) and (5), present the results for *H2*, while columns (3) and (6) present the results for *H2(a)* and *H2(b)*. Beginning with *H2* (column 2), the results show a strong direct effect of supply chain participation on currency realignment, no significant effect when combined with the moderating variable. This holds when including controls (column 5). The potential explanation for this insignificant finding is the opposing effects of the supply chain components. Turning to column 3, we can clearly see a strong direct effect of backward linkages on currency realignment (that is, the greater the foreign inputs as a share of gross exports, the greater the positive effect on currency realignment) and there is also a strong indirect effect when interacted with exports as a share of GDP. The coefficient on the forward linkages matches the predictions, but is a statistically insignificant result. These results hold when all controls are included in the model specification. The overall effects of these values are difficult to interpret, and thus I plot the predicted effects of supply chain participation, moderated by exports as a share of GDP.

Figure 6 plots the predicted effects of the backward linkages on currency misalignment, moderated by manufacturing exports as a share of total GDP. Visually, it is apparent that for countries who do not depend on exports, they tend to have a uniform exchange rate as seen by the light-grey dashed line. Increasing in supply chain dependence does not affect the exchange rate value. However, there is clearly an effect of supply chain dependence for countries heavily reliant on exports (darker line). For those less dependent on foreign inputs, they will still maintain an undervalued exchange rate. However, as predicted by the theory, as countries increase dependence on foreign inputs, there is a revaluation effect, pushing exchange rates closer to their market-determined rate. Note that all of these effects hold

Figure 6: Predicted Effect of Backward Linkages on Currency Misalignment, Moderated by Exports/GDP



Note: Predicted effects calculated from Table 2 column (6). "Rug" plot of the distribution of the predictor variable, global supply chain PARTICIPATION, along the bottom of the figure.

when China is dropped from the model, as well as when the Balassa-Samuelson approach is used for measuring currency misalignment (results to be included in an online appendix).

Next I turn to a firm-level survey analysis to see if this analysis of outcomes, which served as a proxy for firm preferences, actually fits the data on firm's preferences for exchange rate stability.

6 Firm Preferences: Survey Analysis

In order to test the theory that global supply chains condition firm preferences on exchange rate policy, I utilize the 2005 World Bank Enterprise Survey. This survey, which the World Bank implements across a sample of counties, provides information about the country's business environment as experienced by individual firms. Crucially, it asks firms 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. While this does not isolate preferences for exchange rate stability specifically, high inflation tends to be correlated with a depreciated/devalued exchange due to the higher import prices, thus we can assume the two are close substitutes in this question. The survey also asks questions about the percentage of sales from exports—i.e., international exposure— and the percentage of inputs that are imported—i.e., supply chain dependence. I use these measures are my key explanatory variables, estimating the same linear model as before (sans controls) with country fixed effects and clustered standard errors by country. My sample includes 17 countries—Croatia, Czech Republic, Estonia, Hungary, India, Korea, Latvia, Lithuania, Poland, Romania, Russia, Saudi Arabia, Slovak Republic, Slovenia, Turkey, Ukraine, and Vietnam—with skewness towards domestic sales (mean of `sales_export` = 0.12, st.dev. = 0.26) as well as domestic inputs (mean of `inputs_imported` = 0.23, st.dev. = 0.35).

In the first model, I drop all cases where the respondent did not know if macroeconomic stability was an obstacle to its business and regress this on the interaction of percentage of sales from exports and percentage of inputs from aboard. The results are shown in Table 3, column (1). Here we see that the interaction components have strong direct effects on a macroeconomic instability as an obstacle to business operations. The greater the reliance on exports for total sales as well as imported inputs for production, the greater the obstacle that macroeconomic instability becomes. Across all model specifications, the interaction of the two are either weakly significant or not at all. Thus, there tends to be little difference between firms that are heavily reliant on exports for sales and those that sell to the domestic market when conditioning by global supply chain dependence.

Table 3: Survey of Firms

	Outcome variable: exchange rate an obstacle to business?		
	(1)	(2)†	(3)‡‡
Sales from exports (% of total)	0.49***	0.19**	0.03
	(0.06)	(0.07)	(0.03)
Imported Inputs (% of total)	0.31***	0.14***	0.12***
	(0.08)	(0.03)	(0.04)
(Sales/Exports)×(Imported Inputs)	−0.31*	−0.07	0.12
	(0.14)	(0.08)	(0.07)
(Intercept)	2.10***	0.28***	0.26***
	(0.02)	(0.01)	(0.01)
R^2	0.39	0.18	0.15
Adj. R^2	0.39	0.18	0.14
Num. obs.	9366	3914	2127
Countries	17	17	17
Country F.E.?	Yes	Yes	Yes
CSE(country)?	Yes	Yes	Yes
Outcome Variable Scale	[0,4]	[0,1]†	[0,1]†

Note: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$. † – Sample restricted to extremes for outcome variable, e.g., exchange rate is a major obstacle = 1, no obstacle = 0, N/A otherwise. ‡ – Sample restricted to extremes for explanatory variables, e.g., all sales from exports = 1, no sales from exports = 0, N/A otherwise. Same for imported inputs.

In the second model, I restrict the sample so that the outcome variable only captures the extremes in responses—i.e., macroeconomic instability is a major obstacle = 1, not an obstacle = 0, N/A otherwise. Column (2) presents these results, where the interaction is insignificant, but again the direct effects of each component is positive and statistically significant. Finally, in the third model I isolate the explanatory variables to the extremes, i.e., those firms that had either all of their sales from exports (=1) or none (=0), and those who had all of their inputs from abroad (=1) or none (=0). There is a close to equal distribution between the two groupings. Column (3) presents these results. Here we see that sales from exports no longer have a significant effect on preferences for exchange rate stability; however, for those firms with 100% of their inputs coming from abroad, exchange rate instability is a major obstacle to business operations.

While these results do not clearly distinguish a difference from Frieden (2014)—i.e., the

interaction shows that there is no conditional effect of supply chain dependence, only direct effects—they do provide evidence that supply chain dependence should play a more important role when considering firm-level exchange rate preferences, and subsequently, exchange rate outcomes in models of IPE.

7 Discussion of Findings

The evidence so far has provided strong, cross-country support for the theory that supply chain integration has a revaluing effect on exchange rate outcomes, but weaker support for this as a model of firm-level preferences. While firms with a heavy reliance in imported inputs tend to worry more about exchange rate stability than those who rely on the domestic market for these intermediate goods, there is no support that these preferences amongst supply chain dependent firms differ between firms who sell to the domestic market and those who export. One explanation for why I receive this result using firm-level survey data is that I am omitting a crucial variable in the analysis, e.g., one that differentiates the firms who export *and* rely on imported inputs.

Some firms tend to be quite large and only trade within their own partnership, while other supply chains are independent, arm's length transactions. Regardless of size, many of these firms hedge against exchange rate uncertainty by, for example, purchasing foreign exchange derivatives or taking loans in the currency of their main supplier (Garrett, 1998; Knight, 2010). For those with less access to cheap hedging options, or for those who have too much debt in a foreign currency (so-called "natural hedging"), exchange rate uncertainty will be much more of an obstacle to business operations than those firms that can easily hedge against exchange rate movements.

A contemporary example of a firm that hedged "naturally" against exchange rate uncertainty by relying on debt in the supplier's currency is GKN Ltd, an aeronautical engineering and manufacturing firm based out of the U.K. GKN produces aircraft parts, transmissions, and other aeronautical and automobile parts that tend to be exported to plants outside of the U.K. (mostly within the EU), and they receive the majority of their inputs from suppliers in the U.S. and European Union, namely France, Italy, and Spain. In GKN's 2016

annual report, they reported that the majority of their debt is in USD and EUR, which I attribute to this hedging mechanism—financial markets in London are not inferior to those in the U.S. or the eurozone, and GKN is a major defense contractor in the U.K., so securing local credit should not be a major obstacle. Following the June 2016 Brexit vote, the pound sterling quickly depreciated 15%, which should have been a welcoming effect for an exporting firm like GKN; however, due to its contracts for inputs in the eurozone, as well as its foreign-denominated debt, this quickly increased its overall debt burden and depreciated its stock value. Despite pleas from MPs and GKN employees to Theresa May to protect the company, it faced a hostile takeover in early 2018, with the first assets sold off in June 2018.

Clearly the preference for a globally-integrated firm like GKN would be for exchange rate stability, and in the case of a market-induced depreciation, active intervention by the central bank to keep the exchange rate stable. In fact Engel (2014) argues that this sort of foreign exchange intervention to correct currency misalignments may be prudential as a second-order objective for monetary authorities. This leads to a future research agenda, especially amongst the advanced economies, of exchange rate intervention to correct currency misalignment, which ostensibly blurs the trade-off between monetary autonomy and exchange rate stability in the Unholy Trinity.

8 Conclusion

Studying the effect of trade patterns on a country's exchange rate 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 populist message of President Trump against current trade agreements, trade with China, and the already negotiated Trans-Pacific Partnership (TPP). 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 supply chain integration puts upward pressure on undervalued (or depreciated) exchange rates. The supply chain link that drives this effect is the backward linkage as predicted by the theoretical model. There is support that these exchange rate outcomes originate from firm-level preferences, however, the transmission mechanism in this model—between firm preferences and exchange rate outcomes—is absent. A future step to progress this area of research on international trade and exchange rate politics is to investigate the connective tissue between these two components (firms and outcomes) of the political equation.

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