2016

Could tariffs be pro-cyclical?

James Lake

Maia K. Linask
University of Richmond, mlinask@richmond.edu

Could tariffs be pro-cyclical?*

James Lake
Southern Methodist University†

Maia K. Linask
University of Richmond‡

October 22, 2016

Abstract

Conventional wisdom says that tariffs are counter-cyclical. We analyze the relationship between business cycles and applied MFN tariffs using a disaggregated product-level panel dataset covering 72 countries between 2000 and 2011. Strikingly, and counter to conventional wisdom, we find that tariffs are pro-cyclical. Further investigation reveals that this pro-cyclicality is driven by the tariff setting behavior of developing countries; tariffs are acyclical in developed countries. We present evidence that pro-cyclical market power drives the pro-cyclicality of tariffs in developing countries, providing further evidence of the importance of terms of trade motivations in explaining trade policy.

JEL: F13, F14, E32

Keywords: Applied tariff, business cycle, terms of trade, political economy

---

†Department of Economics, Southern Methodist University, 3300 Dyer Street, Suite 301, Umphrey Lee Center, Dallas, TX 75275, email: jlake@smu.edu.

‡Corresponding author: Robins School of Business, University of Richmond, 28 Westhampton Way, Richmond, VA 23173, phone: +01(804)287-6520, fax: +01(804)289-8878, email: mlinask@richmond.edu.
We would like to thank the editor, Robert Staiger, and two anonymous referees for very helpful comments. We would also like to thank Tibor Besedes, Rick Bond, Holger Breinlich, Chad Bown, Richard Chisik, Davin Chor, Meredith Crowley, Martin Davies, Klaus Desmet, Kishore Gawande, Geoffrey Jehle, Tristan Kohl, Dann Millimet, Devashish Mitra, Juan Moreno-Cruz, Martin Richardson, Santanu Roy, Paul Ruud, Peri da Silva, Andrey Stoyanov, Alan Woodland, Mahmut Yasar, Maurizio Zanardi, Ben Zissimos as well as seminar and conference participants at Georgia Tech, the 2014 Fall Midwest Trade Meetings, 2015 SAET conference and 2015 Asia Pacific Trade Seminars for helpful comments and discussion. We also thank Vojin Mitic and Scott Sommers for valuable research assistance.

1 Introduction

Conventional wisdom echoes the introduction of Bagwell and Staiger (2003, p.1): "Empirical studies have repeatedly documented the countercyclical nature of trade barriers." Indeed, this is a long-held view in both the economics and political science literature; see, for example, Takacs (1981, p.687), Gallarotti (1985, p.157), Cassing et al. (1986, p.843), Rodrik (1995, p.687), Costinot (2009, p.1011) and Bown and Crowley (2013a, p.50). While recent empirical evidence by Knetter and Prusa (2003), Bown and Crowley (2013a) and Bown and Crowley (2014) has supported the idea that temporary trade barriers are counter-cyclical, recent empirical evidence by Gawande et al. (2014), Kee et al. (2013) and Rose (2013) suggests instead that applied tariffs are acyclical.

As argued by Bagwell and Staiger (2003, p.1), the theoretical basis for the conventional wisdom on the counter-cyclicality of protection is opaque. The standard explanation is that recessions cause import-competing firms to lobby harder for protection, and policy makers respond by raising tariffs. However, this ignores the role of lobbying by non-import-competing sectors that prefer lower tariffs, such as those that export or rely on imported intermediate inputs, and thus provides no justification for policy makers favoring the interests of import-competing sectors. Indeed, because of this inherent problem, Bagwell and Staiger (2003) move away from domestic political economy considerations as an explanation of applied tariff counter-cyclicality and instead pursue a theory based on terms of trade externalities.

Our paper contributes to the empirical literature questioning the counter-cyclicality of applied tariffs. We build a product-level dataset covering more than 5000 products and 72 developing and developed countries over the years 2000 to 2011. Completely counter to the conventional wisdom that applied tariffs are counter-cyclical, we find that applied tariffs are actually pro-cyclical. Indeed, our results suggest that fluctuations related to the business cycle represent about 11-12% of the average applied tariff change and thus indicate a non-trivial, but modest, role for these fluctuations in explaining the temporal pattern of applied tariffs. The finding that applied tariffs are actually pro-cyclical is robust to the inclusion of numerous control variables that have recently been emphasized in the empirical and theoretical literature as important determinants of tariffs. These include market power at the country-product level, the product-level share of imports sourced from PTA partners, time-varying import surges at the country-product level, and the volatility of import surges at the country-product level. Our results are also robust to various measures of the business cycle and different samples (specifically, excluding the Great Recession or extending the sample back to the beginning of the HS tariff classification system).

To investigate the driving force behind our result that tariffs are pro-cyclical, we first split the sample into developed and developing countries. Importantly, we find that the pro-cyclicality of applied tariffs in the overall sample is driven by developing countries. In contrast, applied tariffs in developed countries are acyclical.

The acyclicality of applied tariffs in developed countries is not surprising given the institutional context. Most developed countries were party to the GATT in 1947. Through successive negotiating rounds, many developed countries had very low bound tariffs by 1995. Indeed, in our dataset, 87% of developed country observations are bound and 27% are bound at 0, while the mean binding overhang is around 5.5% points. This shallow "water in the tariff" severely constrains developed countries' ability to adjust applied tariffs over the business cycle. Conversely, only 80% of developing country observations are bound and less than 3% bound at 0 with mean binding overhang around 19.5% points. This deep "water in the tariff" provides developing countries ample latitude for adjusting applied tariffs. Indeed, as documented by Nicita et al. (2013, p.5), many developing countries did not negotiate their tariff bindings during the Uruguay round but rather submitted their tariff binding schedules after the conclusion of the Uruguay round negotiations.

We further explore the possibility that terms of trade motivations are driving the pro-cyclicality of applied tariffs in developing countries. Terms of trade motivations imply that a country with higher market power sets a higher optimal tariff, equal to the inverse elasticity of export supply, to improve its own terms of trade. One simple mechanism consistent with pro-cyclical tariffs in this context is pro-cyclical market power: pro-cyclical demand shifts the import demand curve up onto a more inelastic part of the export supply curve during booms and, in turn, the importer has more market power and a higher optimal tariff.

We investigate two observable implications to determine whether pro-cyclical tariffs could indeed be driven by terms of trade motives via a pro-cyclical market power mechanism. First, to the extent that cross-country variation in product-level market power is large relative to temporal variation in market power at the country-product level, we expect to observe pro-cyclical tariffs only for country-product pairs that have a high measure of time invariant market power. Using the Nicita et al. (2013) estimates of time-invariant market power, we find strong evidence consistent with this expectation.[1] Tariffs are indeed pro-cyclical in developing countries only for country-product pairs with high values of the Nicita et al. (2013) time-invariant market power measure.

Second, theoretically, an importer's time-varying market power is proportional to its share of world imports. If terms of trade motives are driving pro-cyclical tariffs, then we expect to find temporal tariff fluctuations only in the presence of temporal fluctuations in an

[1] Nicita et al. (2013) have estimated the elasticity of export supply from the perspective of the importer at the HS6 product level for over 100 importing countries.

importer's share of world imports. For developing countries with high time-invariant market power for a given product, we find strong evidence of this link between world import share and tariffs.

Finally, we investigate a possible interpretation based on an empirical implication of Bagwell and Staiger (1990) as identified by Bown and Crowley (2013b). Theoretically, Bagwell and Staiger (1990) show that temporary applied tariff increases can neutralize an importer's incentive to exploit terms of trade motivations, and thus prevent a tariff war, when idiosyncratic shocks increase the incentive to act on terms of trade motivations. Bown and Crowley (2013b) observe a key empirical implication: one should only observe fluctuations in an importer's tariff when *both* (i) imports are fluctuating and (ii) the export supply elasticity faced by an importer and the importer's own import demand elasticity are sufficiently inelastic. That is, a country imposes higher tariffs only if market power is sufficient to activate the terms of trade motivation but the efficiency costs of imposing the tariff are not too high. We find strong evidence in the data that the pro-cyclical tariff result in developing countries only emerges when both criteria are satisfied. The result is thus consistent with the theory that pro-cyclical imports require temporary tariff increases in order to alleviate terms of trade pressures and prevent a tariff war.

In exploring pro-cyclical tariffs and their links to terms of trade motives, our paper relates to the distinct literatures that explore the cyclicality of trade policy and the role played by terms of trade theory in explaining trade policy. It is closely related to Rose (2013) and Gawande et al. (2014), both of which find acyclical applied tariffs.[2,3] Gawande et al. (2014) focus on 7 developing countries and analyze the factors influencing how product-level (HS6) applied tariffs differed in 2009 from the preceding three-year period of 2006-2008. Despite some heterogeneity across countries, their main conclusion is that any effect of additional lobbying for higher tariffs by domestic import-competing firms was offset by domestic users of imported intermediate inputs, an ever-growing group given the rise of vertical specialization and global fragmentation. Our analysis resembles Gawande et al. (2014) because we use disaggregated product-level data but differs because we do not restrict our sample to focus on the Great Recession or on a small subset of developing countries.

[2]An older literature analyzes the cyclicality of protectionism using pre-World War II, and therefore pre-GATT and pre-WTO, data (McKeown (1983), Gallarotti (1985) and Hansen (1990)) and data that spans pre- and post-World War II (Magee and Young (1987), Bohara and Kaempfer (1991a) and Bohara and Kaempfer (1991b)). These studies generally focus on establishing counter-cyclical applied tariffs in the US, Germany, and the UK. Those focusing on pre-World War II data consistently find counter-cyclicality while those with data spanning the war have less consistent findings.

[3]Interestingly, although they do not emphasize this, the results of Bohara and Kaempfer (1991b) indicate a pro-cyclical relationship between real GNP and applied tariffs. Rather, the point of their paper is that macroeconomic variables Granger cause tariffs but not vice-versa.

Rose (2013) analyzes more than 180 countries over a 40-year period through 2010. He examines how different business cycle measures relate to various measures of protectionism including country-level average applied tariffs, multiple measures of temporary trade barriers, and disputes initiated through the WTO. His main finding is straightforward (p.572): "during the post-World War II era, protectionism has not been counter-cyclic." Our analysis resembles Rose (2013) because our panel dataset spans many years (although the time span is shorter than that in Rose) and a broad range of countries, but differs because we use disaggregated product-level data.[4] To our knowledge, ours is the first paper to analyze the cyclicality of applied tariffs after formation of the WTO using a broad range of countries and disaggregated tariff data. Indeed, when we perform aggregate regressions similar to those performed by Rose, we find no robust evidence that tariffs are cyclical which is consistent with Rose's results using aggregate data. Thus, our results suggest that using disaggregated tariff data can reveal cyclical patterns clouded by aggregation.

In contrast to our paper and the aforementioned recent studies emphasizing that applied tariffs are not counter-cyclical, others (see Knetter and Prusa (2003), Bown and Crowley (2013a) and Bown and Crowley (2014)) find that temporary trade barriers (TTBs) are counter-cyclical.[5] This suggests that different mechanisms underlie the cyclicality of TTBs and applied tariffs. Given our evidence that applied tariff pro-cyclicality is driven by pro-cyclical market power, one possible explanation is that the conventional wisdom of policy makers responding to the cyclical preferences of import-competing interests is more important for TTBs than applied tariffs. This seems reasonable since the institutional context of TTBs is designed to respond to the needs of individual import-competing interests while the context of applied tariff setting accommodates opposing interests of multiple industries both inside and outside the import-competing sector.

By showing that time-varying market power appears to drive the pro-cyclical applied tariff behavior observed in developing countries, our paper also contributes to the recent literature emphasizing the role played by terms of trade theory in explaining trade policy. This theory asserts that (i) countries exploit their market power (as measured by the inverse

[4]Kee et al. (2013) compute the "overall trade restrictiveness index" (OTRI) for over 100 countries in 2008 and 2009. The index is a country-level "average tariff" that aggregates bilateral applied tariffs and bilateral anti-dumping duties from the HS6 level using bilateral trade flows and bilateral import demand elasticities. They find no widespread increase in the OTRI across countries, although a small minority of countries did experience relatively minor increases because of spikes in applied tariffs and anti-dumping duties.

[5]Bown and Crowley (2013a) use quarterly data for 5 industrialized countries during the pre-Great Recession period of 1998-2010 and focus on the effects of unemployment, real bilateral exchange rate appreciation and GDP growth declines of bilateral trading partners. Bown and Crowley (2014) undertake a similar analysis using annual, rather than quarterly, data for 13 developing countries between 1995 and 2010. Knetter and Prusa (2003) use more aggregated data and focus on the effects of real exchange rate appreciation for 4 industrialized countries between 1980 and 1998.

export supply elasticity) to improve their terms of trade when setting tariffs and (ii) the purpose of cooperative trade agreements is to internalize the resulting negative terms of trade externalities.

Various approaches have investigated the role played by the terms of trade theory given that, according to this theory, cooperative WTO trade agreements should actually eliminate the imprint of market power on negotiated tariffs. Broda et al. (2008) find that market power influences unilateral tariff setting by *non*-WTO members. Bagwell and Staiger (2011) show that negotiated tariff binding schedules of countries acceding to the WTO exhibit larger *concessions* when the importer had larger market power. Ludema and Mayda (2013) show that the imprint of market power on an importer's applied tariff is stronger when a larger share of world imports originate from exporters who *did not* participate in tariff negotiations. Bown and Crowley (2013b) focus on U.S. temporary trade barriers (TTBs), whose tariffs are *not* cooperatively negotiated, and show that the U.S. is more likely to implement a product-level TTB in years where it has stronger terms of trade motivations.[6]

Alternatively, recent papers have also investigated the relationship between market power and binding overhang (i.e. the difference between negotiated tariff bindings and applied tariffs). In the presence of privately observed political shocks, which create a demand for tariff flexibility via binding overhang, Beshkar et al. (2015) show that an optimal agreement assigns lower tariff bindings to countries with higher market power to minimize the magnitude of realized terms of trade externalities. In turn, as Beshkar et al. (2015) empirically verify, binding overhang will be lower on products where countries have high market power. Nicita et al. (2013) show that, empirically, applied tariffs appear cooperative (i.e. negatively related to market power) when binding overhang is low but non-cooperative (i.e. positively related to market power) when binding overhang is high.

Like our paper, the duration of trade literature (e.g. Besedeš and Prusa (2006)) emphasizes the value of looking at temporal patterns in product level trade. Moreover, the duration literature can add further context to the link between market power, via terms of trade theory, and pro-cyclical applied tariffs. As is well known in the empirical trade literature, differentiated goods tend to have higher market power than homogeneous goods (e.g. Broda et al. (2008)). This suggests that our results may relate more to differentiated than homogeneous products. The duration literature also shows that differentiated products tend to have longer relationships between exporters and importers. To the extent that this reduces the export supply elasticity due to the inflexibility imposed by long-term con-

[6]Nevertheless, Oatley (2015) finds that the real growth rate is positively correlated with, but not a statistically significant determinant of, the annual number of US anti-dumping petitions stretching back to the 1960s.

tracts or exporter-importer relationships, the duration literature provides a complementary interpretation of the relationship between applied tariffs and market power.

Our analysis of pro-cyclical tariffs in developing countries emphasizes terms of trade motivations. The resulting international tension between importing and exporting countries contrasts with the domestic tension between exporting and import-competing sectors underlying the conventional wisdom of counter-cyclical tariffs. One variable that partly captures the domestic distributional implications of applied tariffs is the effective rate of protection. Indeed, Ethier (1977) emphasizes that the effective rate of protection is useful for analyzing distributional issues but not efficiency issues, and Anderson (1998) further argues that it is closely linked with industry lobby power. Nevertheless, while domestic distributional tensions, however manifested, may affect the *degree* of tariff cyclicality, our results suggest terms of trade motivations drive the observed *pro*-cyclicality.

The rest of the paper proceeds as follows. Section 2 introduces our main empirical specifications. Section 3 describes our data and illustrates the variation in the data that drives our empirical results. Section 4 presents and discusses our main empirical results. Section 5 investigates numerous robustness specifications. Section 6 explores the links between applied tariff fluctuations and terms of trade motivations. The final section concludes.

2 Empirical models

Attempting to estimate the cyclicality of tariffs creates a number of issues regarding the estimation technique. Our simplest estimation approach uses fixed effects OLS:

$$\tau_{i,j,t} = \theta BC_{i,t-1} + \mathbf{x}_{i,j,t}\beta + \gamma_t + \gamma_{i,HS4} + \varepsilon_{i,j,t} \tag{1}$$

where $\tau_{i,j,t}$ denotes the MFN applied tariff for product j in country i and year t at the 6-digit HS level. $BC_{i,t-1}$ is a lagged measure of the business cycle in country i, so θ is our primary parameter of interest. Given recent empirical and theoretical work in the literature, we also include a vector of control variables $\mathbf{x}_{i,j,t}$. In our baseline analysis, $\mathbf{x}_{i,j,t} = [MP_{i,j}, PTA\_IM_{i,j,t}, y_{i,t-1}]$ where $MP_{i,j}$ is a measure of market power for importing country i in the market for product j, $PTA\_IM_{i,j,t}$ is the share of country i's imports of product j sourced from preferential trade agreement (PTA) partners in year t, and $y_{i,t-1}$ is country i's lagged trend of log real GDP.[7] Section 5.1 expands the vector of control variables.

As described in Section 3, our primary measure of the business cycle is detrended log

[7]Note that, by construction, $BC_{i,t-1} + y_{i,t-1}$ equals country i's log real GDP in year $t-1$. Thus, our business cycle and trend variables can be viewed as a decomposition of log real GDP.

real GDP obtained via the Hodrick-Prescott (HP) filter. The HP filter decomposes a time series of observed values for, say, log real GDP of country i ($Y_{i,t}$) into a cyclical ($BC_{i,t}$) and trend ($y_{i,t}$) component: $Y_{i,t} = BC_{i,t} + y_{i,t}$. $BC_{i,t} = .01$ means that log real GDP is 0.01 log points, or approximately 1%, above trend log real GDP. Given the central role of the business cycle in our analysis but its infrequent use in the empirical trade literature, we provide some intuition underlying its construction.

Consider two extreme methods for computing the trend $y_{i,t}$, noting that the trend and observed values $Y_{i,t}$ determine the cycle $BC_{i,t}$ via $BC_{i,t} = Y_{i,t} - y_{i,t}$. First, one could choose $y_{i,t}$ to simply minimize $\sum_t BC_{i,t}^2 = \sum_t (Y_{i,t} - y_{i,t})^2$. The complete lack of structure this imposes on the trend $y_{i,t}$ allows the trend to fluctuate in lock-step with $Y_{i,t}$, thereby eliminating any cycle: $BC_{i,t} = 0$ for all t. Alternatively, one could impose a constant linear trend via $y_{i,t} = \delta_0 + \delta_1 t$ so that the trend grows by δ_1 each period. In fact, the HP filter does something in between. Letting $\Delta y_{i,t} = y_{i,t} - y_{i,t-1}$, the HP filter chooses the trend $y_{i,t}$ to minimize $\sum_t (Y_{i,t} - y_{i,t})^2 + \lambda (\Delta y_{i,t} - \Delta y_{i,t-1})$. Thus, the HP filter allows temporal fluctuations in the evolution of the trend but restricts the degree of such fluctuations through the "penalty" parameter λ.[8]

Various recent papers have emphasized the relationship between market power and tariff setting (see Bagwell and Staiger (2011), Bown and Crowley (2013b), Ludema and Mayda (2013), Nicita et al. (2013) and Beshkar et al. (2015)). We follow Nicita et al. (2013) and Beshkar et al. (2015) and measure the market power for importer i in product j, denoted $MP_{i,j}$, as $\ln\left(1/e_{i,j}^x\right)$ where $e_{i,j}^x$ is the export supply elasticity of the rest of the world faced by importer i in the market for product j. Like Nicita et al. (2013) and Beshkar et al. (2015), we treat market power as potentially endogenous and deal with this possibility using the instrumental variables approach of Nicita et al. (2013).

In addition to the role of market power, Ludema and Mayda (2013) also emphasize the importance of controlling for the share of imports sourced from PTA partners. The impact of this variable could arise, e.g., because of pressure from PTA partners to maintain the preferential tariff access they receive relative to non-PTA partners (see Limão (2006), Limão (2007) and Mai and Stoyanov (2015)). Any such mechanism should be stronger when the share of imports sourced from PTA partners is higher. Thus, we include $PTA\_IM_{i,j,t}$ as a measure of the share of product j imports into importing country i sourced from importer i's PTA partners in year t.

Finally, we also control for the lagged trend in log real GDP of country i, $y_{i,t-1}$, as tariff levels may be systematically related to development levels. Given the natural trend present

[8]There exist generally accepted values of λ that depend on the data frequency in the application at hand (Ravn and Uhlig (2002)).

in $y_{i,t-1}$, controlling for $y_{i,t-1}$ also helps control for the downward trend in tariffs over time.

Additionally, fixed effects are embedded within a composite error term $\tilde{\varepsilon}_{i,j,t}$ consisting of an idiosyncratic component $\varepsilon_{i,j,t}$, year fixed effects γ_t and importer-sector fixed effects $\gamma_{i,HS4}$. Year fixed effects γ_t help control for any time-specific factors that affect all countries simultaneously and could be correlated with domestic business cycles. Importer-sector fixed effects $\gamma_{i,HS4}$ define a sector as a 4-digit HS4 category. These control for any time-invariant characteristics of sectors within countries, including importer-sector specific political economy influences that are time-invariant. These importer-sector fixed effects imply that our results are driven by variation within these importer-sector clusters and not by cross-sector variation within a country or by cross-country variation within (or across) sectors.

Notice that the key variable of interest, $BC_{i,t-1}$, is measured at the country level which is more aggregated than the country-product-year level at which the dependent variable is measured. As recognized recently in the trade literature by, for example, Ludema and Mayda (2013, p.1866), it is important that we cluster the standard errors at the country-year level to match the aggregation level of our key regressor. In addition, despite our use of country-HS4 fixed effects, there could be correlation between error terms at the country-HS4 level (either serial correlation for a given HS6 product or correlation between different HS6 products within an HS4 sector). Thus, we use two-way clustered standard errors (Cameron et al. (2011)), clustering at the country-year and country-HS4 level.

Despite its appealing simplicity, OLS suffers an important drawback when analyzing tariffs: it ignores the tariff non-negativity constraint. Previous work (e.g. Beshkar et al. (2015)) has addressed this issue using a Tobit model. However, as is well known, the Tobit model yields inconsistent estimators in the presence of fixed effects (i.e. the incidental parameters problem) and also when the idiosyncratic error term is heteroskedastic (e.g., Greene (2004) and Cameron and Trivedi (2009, p.537)).[9] Partly due to these issues, PPML (Poisson pseudo-maximum likelihood) has become a popular method for dealing with the problem of zeros in the gravity literature (see Silva and Tenreyro (2006)).[10] We also implement PPML estimation to deal with the tariff non-negativity constraint.

Although Poisson estimation is often used to model count or integer data, the gravity literature has recently emphasized that PPML estimation works in more general settings where the conditional mean of the dependent variable given the regressors is an exponential

[9]Not only is the assumption of homoskedasticity crucial for consistent estimation of the parameters in the Tobit model, but so is normality (Cameron and Trivedi (2009, p.537)).

[10]Greene (2004, p.126) is one example emphasizing that the Poisson model is an exception to the rule of thumb that maximum likelihood based models suffer from the incidental parameters problem. However, theory showing that the Poisson model with multiple fixed effects does not suffer from the incidental parameters problem is still evolving. Fernández-Val and Weidner (2013) establishes the case with two fixed effects.

function (see, e.g., Silva and Tenreyro (2006)). In our context, this equates to

$$\tau_{i,j,t} = \exp\left(\theta BC_{i,t-1} + \mathbf{x}_{i,j,t}\beta + \gamma_t + \gamma_{i,HS4}\right) + \varepsilon_{i,j,t} \qquad (2)$$

and the assumption that $\mathrm{E}(\varepsilon_{i,j,t}|BC_{i,t-1}, \mathbf{x}_{i,j,t}, \gamma_t, \gamma_{i,HS4}) = 0$. This implies that $\mathrm{E}(\tau_{i,j,t}|BC_{i,t-1}, \mathbf{x}_{i,j,t}, \gamma_t, \gamma_{i,HS4})$ =$\exp(\theta BC_{i,t-1} + \mathbf{x}_{i,j,t}\beta + \gamma_t + \gamma_{i,HS4})$.

Unfortunately, two-way clustering procedures do not yet exist for PPML. We thus cluster standard errors at the country level when estimating PPML specifications. This is more conservative than our OLS approach because it allows an arbitrary structure of temporal error correlation between *any* two HS6 products that a country imports rather than only allowing such correlation between two products *within* a given HS4 sector. Thus, despite our large sample size, the conservative standard errors imply the threshold for obtaining statistical significance in the PPML specifications that follow is quite demanding. Indeed, the statistical significance of our later results are substantially higher if we use less conservative standard errors that cluster at a more disaggregated level.[11]

3 Data

3.1 Overview

Our baseline dataset has 2,272,198 country-product-year observations for 72 countries (see Table A1 in the Appendix) at the disaggregated product (i.e. 6-digit HS6) level between 2000 and 2011. Table A2 in the Appendix summarizes our data and data sources.

Our primary data source for tariff data is the WTO's Integrated Data Base tariff database via WITS (World Integrated Trade Solution). All bound tariff data come from here. For a small number of country-year combinations where the WTO data were missing, we obtain applied tariffs from the UNCTAD TRAINS database using WITS.[12] Given our focus on changes in tariffs over time for a given country, we restrict our sample to countries for which we are missing no more than two years of tariff data during the pre-Great Recession years of 2000-2009.[13]

[11]Specifically, the $BC_{i,t-1}$ coefficients in column (6) of Panel B in Table 2 and column (0) of Panel A in Table 4 are both statistically significant at the $p < .001$ level when clustering at the country-HS section level (there are 21 HS sections).

[12]For countries with WTO tariff data for a majority of our sample years, we supplement with any available TRAINS data.

[13]For countries that joined the WTO prior to our sample, which begins in 2000, this equates to 8 of the 10 years for 2000-2009. For countries that joined the WTO in or after the first year in our sample, we apply the same rule of allowing only 2 years of missing data for those years in which they were members of the WTO. Later, as a robustness exercise, we exclude all countries that joined the WTO after its creation in

Our business cycle and trend GDP variables require collection of GDP data. For most countries, we obtain this GDP data from the World Bank's World Development Indicators, which stretches back to 1960 for many countries.[14,15] Like Rose (2013), our baseline results measure the business cycle by estimating the cyclical component of log real GDP using the Hodrick-Prescott (HP) filter (Hodrick and Prescott (1997); also see discussion in Section 2). The HP filter has been used to measure the business cycle in a variety of fields ranging from trade (e.g. Rose (2013)) to labor (Chang and Kim (2007)) and environmental economics (Heutel (2012) and Doda (2014)). Moreover, as stated by Ravn and Uhlig (2002, p.371), "... it has withstood the test of time and the fire of discussion remarkably well" and "... although elegant new bandpass filters are being developed (Baxter and King (1999), Christiano and Fitzgerald (2003)), it is likely that the HP filter will remain one of the standard methods for detrending." In the Appendix (Table A5), we analyze robustness of our baseline results to using the Baxter-King and Christiano-Fitzgerald filters.[16]

We set 2000-2011 as our baseline years for three reasons. First, the HP filter suffers from a well known endpoint problem, struggling to distinguish between trend and realized values at the sample endpoints. Thus, we disregard the last three years of the HP filter decomposition 2011-2013. Second, the Uruguay Round, concluded in 1994, led to substantial tariff binding concessions. Thus, we focus on the post-1994 WTO years to avoid an institutional discontinuity. Third, in analyzing the cyclicality of tariffs, it is critical that we avoid reaching conclusions based on the institutional necessity of reducing MFN tariffs to meet these new tariff binding obligations. Thus, we exclude the years during which countries were allowed to gradually phase in tariff reductions to meet their tariff binding obligations. Specifically, the phase-in period was 5 years for industrial products in all countries, 6 years for agricultural products in developed countries, and 10 years for agricultural products in developing countries (Hoda (2001, p.66)). Hence, we exclude the years 1995-1999 in their entirety and agricultural products for the additional relevant years. As a robustness exercise, we later extend the sample back to 1989 despite these issues.

We also account for two other institutional features dictating the timing of applied tariff

1995. If we instead restrict our sample to countries for which we are missing no more than two years of tariff data during the entire sample period (2000-2011), this eliminates only Ghana from our sample and does not change our results in any meaningful way.

[14]For EU real GDP, we aggregate real GDP for the 15 individual EU countries as of 1999. That is, for data purposes, we treat EU membership as time-invariant and dictated by 1999 membership.

[15]WDI data for Qatar starts in 1994, so we use UN data prior to 1994.

[16]Two primary reasons motivate our investigation of robustness to alternative filters. First, by their nature, filters provide statistical procedures to decompose a time series into cyclical and trend components which are not tied to the fundamental data generating process of the underlying time series. Second, unlike the HP filter, the Christiano-Fitzgerald filter is designed to deal with an underlying time series that is a random walk or random walk with drift.

reductions. Countries joining the WTO after 1995 submitted detailed product-by-product schedules for tariff reductions. We obtain the tariff binding and phase-in schedules of all new WTO members and exclude any product-year observations during their phase-in periods. Finally, many countries joined the Information Technology Act (ITA) and have thereby committed to zero tariff bindings on hundreds of information technology products. Again, we collect each country's ITA schedule and exclude any country-product observations during the respective phase-in period.[17]

Until recently, obtaining disaggregated measures of market power at the product level for a large cross-section of countries was not possible. However, Nicita et al. (2013) have estimated export supply elasticities from the view of the importer for over 100 countries and thousands of products at the HS6 level. They use these to construct the market power variable $MP_{i,j} = \ln\left(\frac{1}{e^{x}_{i,j}}\right)$ described in the previous section. Moreover, they also compute import demand elasticities as well as export supply elasticities from the view of the exporter and use world averages of these to instrument for market power. We follow their approach as Peri da Silva kindly provided us with these elasticity data. Additionally, Section 6 utilizes importer-product specific measures of import demand elasticities, $e^{m}_{i,j}$, from Kee et al. (2008).

In order to compute $PTA\_IM_{i,j,t}$, the share of country i's imports in product j in year t that are sourced from PTA partners, we need country i's PTA partners in each year and trade data that splits country i's product-level imports among source countries. For the former, we use the NSF-Kellogg Institute Data Base on Economic Integration Agreements, originally created by Scott Baier and Jeffrey Bergstrand, to extract the countries that have an FTA or a CU in each year of our sample.[18] While Ludema and Mayda (2013) do not treat their PTA import share variable as endogenous, we are concerned that temporal changes in applied tariffs could affect the share of imports coming from PTA partners given that an applied tariff represents a preferential margin that PTA partners enjoy over non-PTA members. To minimize any such endogeneity problem, we use time-invariant trade shares from a year prior to the importing country appearing in our sample when computing $PTA\_IM_{i,j,t}$. Specifically, let $PTA_{i,k,t}$ be a binary variable that indicates whether countries i and k have an FTA or a CU in year t, and let $IM_{i,j,k}$ be country i's imports of product j from country k in some year prior to country i appearing in our sample. Then,

$$PTA\_IM_{i,j,t} = \sum_{k \neq i} \frac{IM_{i,j,k}}{\sum_k IM_{i,j,k}} PTA_{i,k,t}. \quad (3)$$

[17] ITA schedules were obtained from http://www.wto.org/english/tratop_e/inftec_e/itscheds_e.htm.

[18] The database itself is only updated through 2005, but it also provides a list of agreements for 2006-2012 that have not yet been entered into the database. We add these agreements into the database.

With some exceptions, we use 1999 trade data for the trade flows $IM_{i,j,k}$ and we obtain these trade flows from COMTRADE using the WITS database.[19]

In addition to the variables described above, we augment the dataset with additional control variables for the robustness analysis in Section 5.1 and our investigation of a terms of trade explanation in Section 6. First, we add whether country i imposes a temporary trade barrier (TTB) on product j in year t using data on TTBs from the World Bank's Temporary Trade Barriers Database (Bown (2010)). Second, we consider whether product j is an intermediate good or not based on the UN Broad Economic Categories classification system.[20] Third, we include a proxy for the global business cycle from the perspective of the importer. To calculate this proxy, let $IM_{i,k}$ be country i's imports from country k in the year underlying $IM_{i,j,k}$ in (3). Then, we define the trade weighted global business cycle from the perspective of the importing country i as

$$GBC_{i,t-1} = \sum_{k \neq i} \frac{IM_{i,k}}{\sum_k IM_{i,k}} BC_{k,t-1}$$

where k indexes all countries and not only those in our sample. Finally, we also add variables related to imports. Specifically, we utilize (i) country i's lagged log real imports of product j, $IM_{i,j,t-1}$, (ii) country i's lagged share of product j world imports, $IM^{share}_{i,j,t-1}$, and (iii) country i's lagged detrended (i.e. first differenced) log real imports of product j, $\Delta IM_{i,j,t-1}$, and its standard deviation, $sd\Delta IM_{i,j,t-1}$.

As described above, we exclude observations where a country is phasing in its MFN tariff to meet its new tariff binding obligation. We also eliminate observations for a country prior to its joining the WTO because then it was not constrained by any tariff bindings (see Table A1 for WTO membership details). We further exclude outlier observations related to changes in applied tariffs: specifically, we exclude observations if the magnitude of the applied tariff change lies in the top 1% of applied tariff increases or the top 1% of applied tariff decreases. After these exclusions, we have the $2,272,198$ observations noted earlier.

Table A3 presents summary statistics for the overall sample and subsamples by development level.[21] A few points stand out. Overall, countries have significant flexibility to change their applied tariffs up and down over time. For the overall sample, the mean tariff binding is 22.44% while the mean applied tariff is 7.86%. These numbers rise to 29.49% and 10.02% for

[19]Lack of trade data availability causes us to use trade data from 2000 for Qatar and Bahrain. Nevertheless, there is no tariff data for Qatar in 2000.

[20]We use a concordance to map the raw data into HS6 products (see Table A2 in the Appendix).

[21]We use the World Bank's historical classification (see notes to Table A1 and footnote 43) to classify a country as developed (high-income per the World Bank) or developing (not high-income per the World Bank).

developing countries but fall substantially to 8.94% and 3.37% for developed countries. Thus, as one would expect, the implied flexibility is significantly higher for developing countries.

Regarding the covariates, some notable differences also emerge between developing and developed countries. On average, countries are 0.1% below trend GDP over our sample with a standard deviation of 2.0% points. But, on average, the business cycle is weaker in developing countries (0.1% below trend versus 0.05% below trend). Perhaps surprisingly, the variation in the business cycle is similar between developing and developed countries (standard deviation is 2.0% for developing, 1.9% for developed). Not surprisingly, the trend of log real GDP and the mean market power are significantly greater in developed countries.[22]

3.2 Preliminary evidence of pro-cyclical applied tariffs

Before presenting the results of the main empirical analysis, we first illustrate the variation in the data that drives our regression results.

To analyze the cyclicality of applied tariffs, we need to ensure that applied tariffs indeed vary over time and that they both increase and decrease.[23] Panel A of Table 1 summarizes the frequency of tariff changes in our sample. For 11.29% of observations, the applied tariff changed relative to the prior year in our sample, and this is significantly higher in developing than developed countries (13.43% vs. 6.87%). While applied tariff decreases are far more common than applied tariff increases, Panel B shows that applied tariff increases are non-trivial events. When applied tariffs change, Panel B shows that 20.44% of such observations are applied tariff increases. While Panel A shows the average direction of an applied tariff change is negative, unsurprisingly given the relative frequency of applied tariff decreases, Panel B shows the average size of applied tariff increases and decreases is around 3.5-4.5% points both for the overall sample and for the subsample of developing countries.

[Table 1 about here.]

Figure 1 illustrates the pattern of applied tariff changes over time. Panel A shows a noticeable downward trend in the frequency of applied tariff decreases over time with this number falling from around 19% of all observations in the early 2000s to around 5% for 2008-2011. While applied tariff increases accounted for 4.5-5% of observations in the early 2000s, they have remained a steady share of 1-1.5% of observations for 2008-2011. Thus,

[22] As the trend variable is the log of trend real GDP, the difference is substantial. While the inverse export supply elasticity $\frac{1}{e^x_{i,j}}$ ranges from close to 0 to almost 90,000, $MP_{i,j} = \ln\left(\frac{1}{e^x_{i,j}}\right)$ ranges from -11.40 to 21.72 with higher numbers indicating stronger market power.

[23] Using a sample of 10 Latin American countries between 1990 and 2001, Estevadeordal et al. (2008) is one of the few papers that document product level applied tariffs both rising and falling over time.

throughout the sample period, applied tariff increases represent a non-negligible proportion of applied tariff changes.[24]

[Figure 1 about here.]

Panel B of Figure 1 provides one aggregate view of applied tariff cyclicality. Here we plot the global share of applied tariff changes that are applied tariff increases against a measure of the lagged global business cycle that merely averages $BC_{i,t-1}$ across all observations in a given year of our sample. Two noteworthy points emerge. First, the dramatic drop in the average business cycle across countries in 2010 and 2011 clearly indicates that the observations for 2010 and 2011 in our sample correspond to the Great Recession.[25] Second, evidence at this level of aggregation does *not* suggest that the direction of tariff changes are systematically related to the average business cycle across countries.[26,27]

Since aggregation at the national level can conceal much of the product-level variation observed in the data, the empirical analysis in Section 4 focuses on the cyclicality of applied tariffs at the product level. If applied tariffs exhibit cyclicality, there should be products where countries move the applied tariff up and down over the business cycle (in contrast to, for example, permanently raising applied tariffs on some products during booms and permanently lowering applied tariffs on other products during recessions). Panel C of Table 1 illustrates the type of tariff changes that occur over the duration of our sample within country-product clusters. Overall, 58.38% of country-products experience no change in the applied tariff over our sample period with changes much more common in developing than developed countries. A further 26.35% of country-products only experience a decrease in the applied tariff over the sample period, significantly larger than the share of country-products that only experience an applied tariff increase over the sample period. Perhaps surprisingly, 11.24% of country-products experience both an applied tariff increase and an applied tariff

[24]With roughly 5000 HS6 products, this amounts to an average of around 75 products for which the applied tariff increases per country-year. Further, given the emphasis placed on temporary trade barriers in the recent literature, it is worthwhile noting that applied tariff increases are more common than the imposition of new TTBs even among many of the most prolific users of TTBs.

[25]Since our business cycle measure is $BC_{i,t-1}$, the 2010 and 2011 tariff observations relate to 2009 and 2010 GDP data.

[26]This is consistent with Rose (2013) who analyzes aggregate country-level tariffs and finds that they are acyclical.

[27]One might wonder whether the average business cycle for the 2000-2011 period is typical relative to earlier decades. Relative to the variation in a given decade (back to the 1960s), the average business cycle is always very close to zero. However, the volatility in the average business cycle in the 2000-2011 period is about 30-40% lower than any prior decade. Thus, events particular to the 2000-2011 period (e.g. the recovery from the Asian Financial crisis) do not appear to make the period unusual. Moreover, the extent to which the results are relevant to other periods appears to depend on the importance of business cycle volatility on tariff setting in a structural model.

decrease over our sample period, and this share is much greater in developing relative to developed countries (14.01% vs. 5.24%). Thus, there is a significant number of products where countries move the applied tariff up and down over the sample period.[28]

Evidence of tariff cyclicality requires a comparison of product-level tariffs at different points of the business cycle for a given country, that is, a comparison of tariffs *within* a country-product cluster. The empirical analysis throughout the paper implements this idea.

Figure 2 provides a motivating illustration by plotting the difference between the applied tariff for a country-product-year ($\tau_{i,j,t}$) and the mean applied tariff for this country-product ($\tilde{\tau}_{i,j} \equiv \frac{1}{T}\sum_{t=2000}^{2011}\tau_{i,j,t}$) against the difference between the lagged business cycle measure for the country ($BC_{i,t-1}$) and the mean business cycle for the country ($\widetilde{BC}_i \equiv \frac{1}{T}\sum_{t=2000}^{2011} BC_{i,t-1}$); the figure also shows the OLS regression line of $\tau_{i,j,t} - \tilde{\tau}_{i,j}$ on $BC_{i,t-1} - \widetilde{BC}_i$. In panels A-C of Figure 2, the observations are restricted to (i) country-product clusters where the applied tariff moves both up and down over the sample period and (ii) the years within these country-product clusters where the applied tariff changed from the previous year. The figure thus shows how temporal fluctuations in country i's tariff on a given product j correlate with temporal fluctuations in country i's business cycle. The slope of the OLS regression line provides some preliminary evidence suggesting that applied tariffs could indeed be pro-cyclical when pooling all countries and, in particular, for the subsample of developing countries (panel B). It also suggests that tariff cyclicality may differ between developing and developed countries.

Panels D-E of Figure 2 perform a similar exercise to motivate the analysis in Section 6 that explores whether terms of trade motivations could drive the pro-cyclicality in developing countries. To the extent that terms of trade motivations provide an explanation, pro-cyclicality should be pronounced not merely for country-product pairs that have high market power on average but for those years where country-product market power is unusually high or low. Panels D and E both restrict the developing country observations from panel B by only considering country-product pairs with high time-invariant market power.[29] But, panel D focuses on years where the country-product pair has relatively high or low market power as proxied by "unusual" import fluctuations.[30] Conversely, panel E focuses on years where the country-product pair has a typical level of import fluctuations and hence typical market power. The noticeably steeper slope in panel D relative to panel E suggests

[28]For country-product pairs where the applied tariff moves up and down over the sample period, the mean number of tariff changes is 3.53.

[29]Specifically, high market power observations are country-product pairs above the 66^{th} percentile of the market power distribution in our sample.

[30]Specifically, "unusual" import fluctuations means a country-product-year where the lagged change in imports relative to the country-product mean, i.e. $\Delta IM_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011}\Delta IM_{i,j,t-1}$, lies in the extreme terciles of the sample distribution.

the pro-cyclicality in developing countries could be related to situations where developing countries are experiencing unusual fluctuations in market power.

[Figure 2 about here.]

Ultimately, Figure 2 illustrates the variation in data that motivate the empirical analysis in Sections 4 and 6.[31]

4 Empirical Results

4.1 Pro-cyclical applied tariffs

Panel A of Table 2 presents the results from OLS estimation of equation (1). Column (1) includes only the business cycle ($BC_{i,t-1}$) and excludes fixed effects. Columns (2) and (3), respectively, add country-HS4 and year fixed effects. Columns (4), (5) and (6) add the lagged trend of log real GDP ($y_{i,t-1}$), market power ($MP_{i,j}$), and PTA import share ($PTA\_IM_{i,j,t}$) as covariates. Column (7) instruments for market power. For comparison, column (8) performs OLS using the observations from column (7).[32]

[Table 2 about here.]

The pro-cyclicality of tariffs emerges in columns (4)-(6) once the lagged trend of log real GDP is included; the point estimate is positive, statistically significant at the 10% level, and very stable across these specifications. Prior literature has treated market power as endogenous. However, any such endogeneity is unlikely to cause problems in terms of estimating the cyclicality of tariffs because columns (5) and (6) indicate that market power is essentially uncorrelated with the business cycle. Nevertheless, we use instrumental variables (IV) estimation in column (7).[33]

Following Nicita et al. (2013) and similar to Beshkar et al. (2015), we instrument for a country's product-level market power using the average product-level import demand elasticity in the rest of the world and the product-level global average export supply elasticity from

[31] The magnitude of pro-cyclicality suggested by Figure 2 is non-trivial. Based on the procedure used to address economic significance in later sections, the slope point estimate for Panel A suggests that the average business cycle fluctuation between the peak of the boom and the trough of the recession represents about 60% of the average applied tariff fluctuation.

[32] Column (2) has 81 fewer observations than column (1) because of country-HS4 pairs with only one observation over the sample period. An example of these rare occurrences is a country who joined the WTO shortly prior to years subject to major changes in the HS tariff classification (e.g. 2002). Columns (7)-(8) have fewer observations than columns (2)-(6) because of data limitations for the import demand elasticity instrument.

[33] OLS estimation performed using reghdfe (Correia (2014)) and IV estimation performed using xtivreg2 (Schaffer (2015)) in STATA.

the view of the exporter. These instruments appear to do reasonably well based on various specification tests. Based on the Kleibergen-Paap rk LM statistic, we easily reject the null that the effect of market power is unidentified ($p = .011$). However, the Kleibergen-Paap rk Wald F-statistic of 4.667 suggests the instruments are somewhat weak. Nevertheless, we cannot reject the null that the instruments are exogenous based on Hansen's J test of over identification ($p = .088$). Finally, the endogeneity test (based on comparing two Sargan-Hansen statistics) cannot reject the null that market power variable itself is actually exogenous ($p = .981$). Thus, as market power is essentially uncorrelated with our regressor of interest and we cannot reject the null that it is indeed exogenous, we henceforth treat market power as exogenous on efficiency grounds.[34] In any case, IV estimation preserves the sign and also the economic and statistical significance of the coefficients.

To address the economic magnitude of applied tariff cyclicality, note that the average gap between a country's maximum and minimum value of $BC_{i,t-1}$ over our sample period is 0.061 and this gap rises to 0.098 for a country one standard deviation above the mean. These numbers provide measures of the magnitude of business cycle fluctuations and one could, intuitively, think of 0.061 as a proxy for the average fluctuation between the peak of the boom and the trough of the recession. The $BC_{i,t-1}$ point estimate of 7.49 in column (6) then implies that the fluctuation in applied tariffs between the peak of the boom and the trough of the recession is 0.46% points and represents 12.20% of the average magnitude of applied tariff changes.[35] For a country with business cycle fluctuations one standard deviation above the mean, this share becomes 19.59% of the average magnitude of applied tariff changes. From these perspectives, business cycle fluctuations explain a non-trivial, but not overwhelming, portion of temporal applied tariff fluctuations. Thus, the pro-cyclicality evident in Table 2 appears both statistically and economically significant.

Turning to the other covariates, the negative coefficient on the lagged trend of log real GDP in columns (6)-(8) shows the expected downward trend in tariffs over time as trend log real GDP rises. Moreover, while the coefficient for the share of imports from PTA partners is positive as expected given the motivation in Section 2, it is not statistically significant.

While the literature emphasizes the importance of market power in tariff setting (e.g., Bagwell and Staiger (2011), Ludema and Mayda (2013), Nicita et al. (2013)), the statistically insignificant market power coefficients in Table 2 are not necessarily inconsistent with this emphasis. First, while Beshkar et al. (2015) highlight the role of market power, they find that its relationship with MFN tariffs is non-monotonic and depends on the degree of market

[34] Note that omitting an endogenous regressor that is uncorrelated with the key regressor of interest does not bias the estimate of the key regressor.

[35] The average magnitude of applied tariff changes is 3.76% points.

power. Second, Broda et al. (2008) find that market power is not a significant determinant of applied tariffs in the United States. Third, as already discussed, developed countries have very low tariff bindings on average and, hence, little latitude for adjusting tariffs in response to business cycles or market power fluctuations. Since Table 2 pools developed and developing countries as well as high and low market power products, it is not surprising that the relationship between market power and applied tariffs is statistically insignificant. Finally, the results use country-HS4 fixed effects and a measure of market power, $MP_{i,j}$, that is country-product specific but time-invariant. The results thus say that differences in a country's market power across HS6 products within a HS4 sector do not help explain why a country's tariffs for HS6 products differ from the country's average tariff across time and products within the HS4 sector. This differs from prior work (e.g. Bagwell and Staiger (2011), Ludema and Mayda (2013), Beshkar et al. (2015)) that relies on differences in market power across HS6 products within broader two-digit HS2 industries.

As discussed in Section 2, OLS assumes that the dependent variable can take positive and negative values, ignoring the non-negativity constraint imposed on tariffs. Panel B of Table 2 directly addresses this concern via PPML estimation (see estimating equation (2)), with each column having the same interpretation as the analogous column of Panel A.[36,37]

Importantly, Panel B shows that the pro-cyclicality of applied tariffs observed under OLS is not driven by OLS ignoring the non-negativity constraint on tariffs. Specifically, columns (3)-(6) show that PPML estimation preserves applied tariff pro-cyclicality.

PPML and OLS estimation imply a similar magnitude of tariff pro-cyclicality. The business cycle point estimate of 0.875 in column (6) says that the average business cycle fluctuation of 0.061 is associated with a 5.5% change in the applied MFN tariff.[38] Thus, at the mean tariff of 7.86% points, this average business cycle fluctuation would be associated with a tariff change of 0.43% points, which is slightly lower than the OLS estimate of 0.46% points. The more conservative PPML estimates suggest that the non-negativity constraint on applied tariffs may be empirically important.

For other covariates, PPML and OLS tell a similar story. Again, temporal fluctuations in tariffs are not systematically related to market power or the share of imports sourced from PTA partners. Interestingly, lagged trend log real GDP is still negatively correlated with tariffs but no longer statistically significant, although this may arise from the more

[36]Two issues explain the smaller number of observations in column (2) relative to column (1). First, there is the issue of 81 fewer observations as in Panel A. Second, PPML drops country-HS4 clusters where the applied tariff is always zero. Indeed, as is common with PPML estimation, the estimation sample size is then about 20% smaller than OLS.

[37]The reported R^2 for PPML specifications is McFadden's pseudo-R^2. PPML estimation performed using xtpqml (Simcoe (2007)) in STATA.

[38]Specifically, $.054 = \exp(.875 \times .06) - 1$.

conservative PPML standard errors (see discussion in Section 2). Given that PPML takes into account the non-negativity tariff constraint, uses more conservative clustering, and yields similar results to OLS, we henceforth focus our discussion on PPML specifications.[39]

Table 3 analyzes the robustness of our pro-cyclical tariff result by varying the sample. For presentation, column (0) reports the baseline results from column (6) of Table 2. Column (1) excludes agricultural goods. To address the issue that some HS6 codes are actually an average of more disaggregated country-specific HS8 or HS10 tariff lines, column (2) excludes country-HS6 products that have more than one tariff line within the HS6 code. Columns (3) and (4) each exclude some countries in the sample: column (3) excludes countries that joined the WTO after 1995 to ensure that the results are not driven by new WTO members, and column (4) excludes China and the EU.[40] Our pro-cyclical tariff result is robust to these four exclusions. Of particular note is column (3): excluding new WTO members substantially increases the estimated degree of tariff cyclicality. Intuitively, this is perhaps not surprising because, on average, new WTO members have lower tariff bindings than original WTO members (14.37% vs. 23.64%), implying much lower flexibility to vary their applied tariffs.

[Table 3 about here.]

To address the issue of business cycle outliers, column (5) excludes observations that lie in the top or bottom 1% of our sample distribution for $BC_{i,t-1}$. Importantly, the point estimate on our business cycle variable is very stable relative to the baseline specification that does not exclude business cycle outliers. Thus, our pro-cyclical tariff result is not driven by the most extreme business cycle fluctuations. However, our estimates are less precise when excluding the business cycle outliers and fail statistical significance at the 10% level.[41] We return to this issue when investigating a terms of trade explanation for applied tariff pro-cyclicality in Section 6.

Column (6) excludes two groups of observations: (i) observations where the applied tariff exceeds the tariff binding and subsequent observations where the applied tariff is brought back below the tariff binding and (ii) observations with no tariff binding, a zero tariff binding, or a time varying tariff binding.[42] The results are robust to these exclusions.

[39] OLS analogs of remaining tables in the main text can be found in Table A4 in the Appendix and always confirm the important PPML results.

[40] We exclude the EU because EU applied tariffs are decided at the regional level while economic growth is arguably impacted more by country-level variables. We exclude China to ensure that results are not driven solely by its rapid economic growth.

[41] No particular country or year dominates the business cycle outliers.

[42] We exclude these because we are not interested in explaining the rare occurrences related to changes in tariff bindings, countries violating WTO rules by ignoring their tariff bindings, or countries reducing applied tariffs to rectify such violations. Exclusion of unbound tariff lines is partly motivated by recent empirical and

To address any possible structural changes in policies resulting from the Great Recession, column (7) excludes the Great Recession years (tariff observations in 2010 and 2011 and thus GDP observations for 2009 and 2010). The business cycle point estimate is substantially higher than the baseline sample that includes the Great Recession years which suggests the Great Recession years actually mitigated the extent of applied tariff pro-cyclicality.

While the sample period selection reflects our attempt to avoid confounding Uruguay Round phase-in periods with business cycle fluctuations, one might nevertheless wonder whether our results hold when extending the sample period backward. This question may be of particular relevance given that our baseline estimates use a relatively short time period to identify the impact of business cycles on tariff fluctuations within a country-HS4 cluster of observations. We extend our sample backward in two steps.

First, the sample in column (8) begins in 1995 so that the sample period now reflects the entire post-Uruguay Round period. However, given our concerns over confounding phase-in tariff reductions with business cycle-driven fluctuations during this period, we only add observations that, to the extent such inference is possible, appear very unlikely to be associated with phase-in of Uruguay Round negotiations. Specifically, relative to our baseline sample in column (0) and using the same set of sample countries, we add back observations for country-HS6 pairs that *always* exhibit (weakly) positive binding overhang during phase-in years. Doing so increases the sample size by 26.9%. While the business cycle point estimate is smaller, statistical significance remains at the 10% level and actually becomes slightly more precise ($p = .056$ versus $p = .062$).

Second, column (9) stretches our sample back to 1989 which is as far back as we can push our product-level sample using the Harmonized System (HS) of tariff classification. Relative to column (8) and again using the same set of sample countries, we add country-product observations for the period 1989-1994. Relative to the baseline sample in column (0), the sample size is 49.3% larger. Moreover, the business cycle point estimate is now larger and statistically significant at the 5% level ($p = .034$). Ultimately, despite our concerns about extending the sample back to earlier years, the results are robust to this exercise and, at least to some extent, increase the precision of the business cycle estimate.

4.2 Cyclicality and level of development

As discussed in Section 3.1, developing countries enjoy significantly higher tariff bindings and binding overhang than developed countries. Further, the fact that developing countries are much more likely than developed countries to move the applied tariff on a given product

theoretical work including Handley and Limão (2012), Groppo and Piermartini (2014) and Handley (2014). Furthermore, products with a zero tariff binding have no possibility of tariff fluctuation.

up and down over time suggests that they exploit the greater applied tariff flexibility implied by the higher bindings. We therefore investigate whether the cyclicality of applied tariffs depends on the level of development. We classify a country as either developed or developing based on historical categorizations by the World Bank (see Table A1).[43]

Table 4 presents the results and suggests that the cyclicality discussed in Section 4.1 is driven by developing countries. Column (0) of Panels A and B split the baseline sample of Table 2 into developing country (Panel A) and developed country (Panel B) subsamples. Relative to the pooled baseline results, the business cycle point estimate rises somewhat for developing countries and remains statistically significant at the 10% level ($p = .051$). Conversely, the business cycle point estimate for developed countries is small in economic magnitude and very far from conventional levels of statistical significance. That is, applied tariffs appear acyclical in developed countries while the tariff behavior of developing countries drives the pro-cyclical tariff result reported in Table 2.

[Table 4 about here.]

As one may expect, the economic magnitude of tariff pro-cyclicality in the developing country subsample exceeds that in the pooled sample. The business cycle point estimate of 0.933 in column (0) of Panel A says that the average business cycle fluctuation in developing countries of 0.061 is associated with a 5.8% rise in the applied MFN tariff. Thus, at the mean tariff for developing countries of 11.16% points, this average business cycle fluctuation would be associated with a tariff increase of 0.65% points, which is 15.35% of the average applied tariff change in developing countries. Relative to the share of the average applied tariff change in the pooled sample explained by the business cycle, this 15.35% share represents a 33.3% increase in the economic magnitude of the business cycle impact.

With one exception, the remaining coefficient estimates are similar to the baseline results for the pooled sample. Specifically, the point estimate for the PTA import share is positive and statistically significant in developed countries: applied tariffs in developed countries are higher on products where a larger share of imports are sourced from PTA partners. Earlier literature has found similar effects for the US (Limão (2006)) and Canada (Mai and Stoyanov (2015)). Our results show that this phenomenon is a broad pattern across developed countries but does not characterize developing country applied tariffs. Intuitively, high MFN tariffs avoid erosion of tariff preferences for PTA partners. But, given that developing country markets generally account for a small share of developed country exports,

[43] For 5 out of 72 countries in our sample, their development status switches between developed and developing during the sample period. To maximize the time dimension within country-sector clusters, we treat a country as developed (developing) for the entire sample when they appear as developed for more than 50% (less than or equal to 50%) of years in the sample. Panel A of Table A5 in the appendix shows that the baseline results are robust to the alternative time-varying definition of development status.

developed countries may be unconcerned about protecting their PTA tariff preferences in developing country markets. Furthermore, developed countries often obtain non-tariff and even non-trade concessions from developing countries (Limão (2007)). Thus, having extracted non-tariff and/or non-trade concessions, a developed country may be less concerned about maintaining tariff preferences in a small market. Hence, the share of a developing country's imports from its PTA partners may be uncorrelated with MFN tariff rates that maintain these preferences.

Columns (1)-(9) of Table 4 present the same alternative sample robustness checks as Table 3. As in the pooled sample, the business cycle point estimate for developing countries fails statistical significance at the 10% level when excluding the business cycle outliers (column (5)). Nevertheless, again, the point estimate actually increases somewhat relative to the baseline pooled estimate and so the magnitude of pro-cyclicality is not driven by these outliers. Otherwise, the remaining columns in Table 4 confirm the baseline developing country results from column (0). In particular, despite our concerns about extending the sample backward, column (9) shows that the business cycle point estimate becomes statistically significant at the 1% level when extending the sample back to 1989.

5 Extensions

5.1 Sensitivity analysis

We now include additional control variables to further investigate the robustness of our results. Specifically, we consider whether our results are robust to controlling for import surges, the global business cycle, whether a good is an intermediate good, and whether a good is subject to a temporary trade barrier. In the Appendix (Table A5), we use alternative filtering techniques to measure the business cycle.[44] Table 5 presents the results but, for brevity, only displays the business cycle variable and the added control variable(s). The results indicate that the pro-cyclicality of applied tariffs for developing countries is robust.[45]

[Table 5 about here.]

[44]We implement the Baxter-King filter and the Christiano-Fitzgerald filter. For the latter, we use a third order symmetric moving average (which is the STATA default for the Baxter-King filter) to ensure it is robust to second order trends.

[45]Columns (2) and (4) for developed and developing countries, respectively, have the same number of observations as the baseline sample in Table 4. Column (3) has fewer observations because we don't have an intermediate goods classification for all HS6 codes in our sample (e.g. some HS6 codes have a BEC code of 7 which is "not elsewhere specified"). Column (1) has fewer observations because we don't have trade data for all observations in our sample.

Import surges. Recently, the empirical literature has documented the importance of import surges, and their volatility, as a determinant of tariff setting (e.g. Bown and Crowley (2013b)). It is *a priori* plausible that our pro-cyclical applied tariff results could be driven by pro-cyclical import surges (which would then be correlated with our business cycle variable). Columns (1) and (5) of Table 5 control for import surges, $\Delta IM_{i,j,t-1}$, and their volatility, $sd\Delta IM_{i,j,t-1}$ (see Section 3.1) and shows that the results from Tables 2-4 persist.[46]

Global business cycle. Columns (2) and (6) control for a measure of the global business cycle from the perspective of the importer, $GBC_{i,t-1}$, as described in Section 3.1. The point estimates for the main business cycle variable $BC_{i,t-1}$ change only slightly, and the sign and statistical significance remain as in Tables 2-4. The estimated coefficient on the global business cycle variable is not statistically significant for developing countries, but the relationship is positive and statistically significant for developed countries. This provides some evidence suggesting that a developed country raises (lowers) tariffs on its trading partners when its major trading partners are experiencing a boom (recession).[47]

Intermediate goods. Columns (3) and (7) investigate whether the degree of cyclicality depends on whether a good is an intermediate good.[48] We include an indicator variable $Intermed_j$ for whether product j is an intermediate good (according to the UN's Broad Economic Categories classification system) and the interaction term $Intermed_j \times BC_{i,t-1}$. Not surprisingly given the presumed preference of final-good producers for low tariffs on intermediate inputs, the point estimates for $Intermed_j$ are statistically significant for developing and developed countries showing that countries tend to have lower applied tariffs on intermediate goods. The point estimate of cyclicality for non-intermediate goods in developing countries (i.e. $BC_{i,t-1}$) is little changed from the baseline results and the interaction term is far from statistically significant at conventional levels which suggests the degree of cyclicality does not depend on whether a good is an intermediate good or not. The results for developed countries are consistent with the baseline results that tariffs are acyclical.

Temporary Trade Barriers (TTBs). Columns (4) and (8) investigate how our results are affected by recognizing that countries can also impose protection via TTBs. We include an indicator $TTB_{i,j,t}$ for whether country i imposes a TTB on product j in year t and also the interaction term $TTB_{i,j,t} \times BC_{i,t-1}$. In this specification, $BC_{i,t-1}$ represents the cyclicality when a product is not subject to a TTB. The economic and statistical significance of the

[46] Given our empirical specification, one may think we should control for the level of log real imports rather than the change in log real imports. But, given the level of log real imports is trending upward over our sample, one can interpret the change in log real imports as a simple measure of detrended log real imports.

[47] This is counter to the expected results based on the model developed in Bagwell and Staiger (2003) whereby countries keep tariffs lower during booms because they have more to lose if their trade partners retaliate.

[48] Goods that are not intermediate are either primary or final goods.

cyclicality estimate are unaffected by the inclusion of the TTB variables. Given that only about 1% of observations are subject to TTBs (see Table A3), it is unsurprising that the developing country $BC_{i,t-1}$ coefficient estimates are virtually unchanged from the baseline results. While the interaction term fails statistical significance at conventional levels, it is borderline for developing countries ($p = .105$). With this in mind, it is noteworthy that the point estimate for cyclicality on products that are subject to TTBs (i.e. $BC_{i,t-1} + TTB_{i,j,t} \times BC_{i,t-1}$) is close to zero and we cannot reject that it is different from zero at the 10% level of significance. This suggests that tariffs for products subject to TTBs may be acyclical in developing countries. Moreover, the point estimate for $TTB_{i,j,t}$ indicates that products under TTB protection also have higher applied tariffs. Thus, countries appear to impose TTBs on products that have high applied tariffs and, in this sense, applied tariffs and TTBs could be viewed as complements.

5.2 Cyclicality and aggregate applied tariffs

A key difference with our analysis compared to Rose (2013) is our use of highly disaggregated product-level tariff data (and covariates) compared to Rose's aggregate country-level tariff data (and covariates). This difference could potentially help explain why we find pro-cyclical tariffs yet Rose (2013) finds acyclical tariffs. In order to investigate this possibility, we now estimate the relationship between business cycles and aggregate country-level tariffs.

The results, presented in Table 6, indicate that aggregation can obscure the influence of business cycles on product-level applied tariffs. Panel A uses the simple average MFN tariff while Panel B uses the weighted average MFN tariff. Columns (1), (3) and (5) only control for the lagged business cycle while columns (2), (4) and (6) expand the set of covariates to include the country-level analogs of our baseline specification (see Table A2 for definitions).[49] For the pooled sample and the developing country subsample, the business cycle coefficient is positive but not statistically significant regardless of the specification. Thus, like Rose (2013), we cannot reject the null hypothesis of acyclicality.[50] While the business cycle coefficient is positive and statistically significant for developed countries in column (5) of Panel B, this result disappears when controlling for the lagged trend of log real GDP and the share of imports from PTA partners (although the coefficient remains positive) and is non-existent when measuring tariffs using simple average MFN tariffs. Thus, aggregating tariffs at the

[49] Note that Rose (2013) uses the contemporaneous rather than the lagged business cycle variable (although our results in Table 6 are robust to using the contemporaneous business cycle).

[50] The estimated coefficients on the applied tariff variable in Rose (2013, p.577) are generally negative when only the business cycle variable is included but are not statistically significant. When additional covariates are included, the coefficients vary in sign but remain statistically insignificant.

national level appears to conceal cyclicality that emerges at the product level, where decision-making over trade policy typically takes place.

[Table 6 about here.]

6 A terms of trade explanation

So far, we have documented a robust finding that applied MFN tariffs appear pro-cyclical in developing countries. We now explore whether terms of trade motivations can explain this result. To begin, we outline the theoretical motivations guiding our empirical investigation.

6.1 Theoretical motivations

As is well known, the standard formula for a country's (non-cooperative) optimal tariff when maximizing national welfare is to set the ad-valorem tariff equal to the inverse export supply elasticity (e.g. Feenstra (2003, p.220)). Defining market power as the inverse export supply elasticity, optimal tariffs will then be pro-cyclical if and only if market power is pro-cyclical. Intuitively, this pro-cyclical market power could be driven by pro-cyclical shifts of the import demand curve onto more inelastic parts of the export supply curve during booms.

If pro-cyclical tariffs result from the impact of pro-cyclical market power on optimal tariffs, we should observe two relationships in the data. First, to the extent that the variation in market power *across* country-product pairs is large relative to the temporal variation in market power *within* country-product pairs, pro-cyclicality should only be present for country-product pairs with relatively high levels of time-invariant market power. For countries with little market power, any increased market power conferred by booms is likely insufficient to justify raising tariffs, especially if there are costs to changing tariffs (e.g. administrative costs, as argued by Bown and Crowley (2013b, p.1076)).[51]

Second, Nicita et al. (2013, p.13) show that, theoretically, an importing country's product-level market power is proportional to the importing country's product-level share of world imports. This links temporal fluctuations in an importer's share of world imports to temporal fluctuations in an importer's tariff. Indeed, if changing a tariff imposes some cost (e.g. administrative costs) then we expect to empirically observe applied tariff fluctuations only for sufficiently large fluctuations in an importer's share of world imports.

An alternative theoretical perspective to the standard static optimal tariff formula discussed above is the repeated game environment of Bagwell and Staiger (1990). In their model,

[51] In our empirical analysis, we use the time-invariant market power measures of Nicita et al. (2013).

the optimal cooperative tariff balances the tension between a country's myopic incentive to exploit its market power by manipulating its terms of trade and a country's anticipation that doing so will instigate a tariff war. As shown by Bown and Crowley (2013b), the key empirical prediction of the model is that temporal fluctuations in tariffs should be positively related to temporal fluctuations in imports only if a country has sufficiently high market power and tariffs generate sufficiently low efficiency losses. The intuition rests on two ideas. First, import surges strengthen the importing country's motivation to improve its terms of trade by setting an optimal (non-cooperative) tariff. The only way to avoid the resulting tariff war is to neutralize the increased terms of trade incentive by temporarily raising the cooperative applied tariff. Second, the benefit of raising a tariff is higher when the efficiency costs imposed by a tariff are smaller and the terms of trade gain from imposing a tariff is larger. This happens when, from an importer's view, its own import demand curve and the export supply curve it faces are both more inelastic.

The Bagwell and Staiger (1990) model thus offers the third implication investigated below. To the extent imports are pro-cyclical, we expect to observe pro-cyclical tariffs only when (i) imports deviate substantially from their usual level and (ii) the importer faces a sufficiently inelastic export supply curve and has a sufficiently inelastic import demand curve.

6.2 Empirical results

Given the theoretical terms of trade motivations outlined above, we investigate three empirical relationships. Before doing so, we note that imports are indeed pro-cyclical in our sample. Regressing detrended log real imports on the business cycle yields a positive coefficient and reveals the average business cycle fluctuation between the trough of the recession and the peak of the boom explains about 15% of a standard deviation of detrended log real imports.[52] This correlation is important given our intuition behind exploring a terms of trade argument for our pro-cyclical tariff result is driven by the idea of pro-cyclical imports.

First, we consider the link between tariff cyclicality and the Nicita et al. (2013) measure of time-invariant market power. To the extent that the variation in market power across country-product pairs substantially exceeds the temporal variation in market power within a country-product pair, we expect to observe pro-cyclical tariffs only for country-product pairs with high market power. We use the baseline sample to compute thresholds for the 33^{rd} and 66^{th} percentiles of the market power distribution and label country-product pairs in these upper and lower terciles as low and high market power observations, respectively. We then compare cyclicality across these terciles.

[52]The OLS regression of $\Delta IM_{i,j,t-1}$ on $BC_{i,t-1}$, using the same fixed effects and clustering as in our baseline analysis, yields a point estimate on $BC_{i,t-1}$ of 2.52 which is statistically significant at the 1% level.

Columns (1)-(4) of Table 7 present the results of this comparison. Column (2) shows that tariffs are pro-cyclical in developing countries when the time-invariant measure of market power is high. Conversely, the remaining columns show acyclical tariffs for country-product pairs in developing countries with low time-invariant market power and, regardless of market power, country-product pairs in developed countries. Thus, the pro-cyclicality of tariffs in our baseline sample is driven not by all products in developing countries but rather by those country-product pairs that have high values of our time-invariant market power measure.

[Table 7 about here.]

Table 8 further describes these high market power, developing country observations from column (2) of Table 7. Panel A lists the 10 countries with the largest share of such observations. These 10 countries fit well with the empirical stylized fact that larger countries tend to have larger market power (e.g. Broda et al. (2008)).[53] Panel B of Table 8 restricts attention to those developing country observations with market power above the 66^{th} percentile of market power in *developed* countries, thus focusing on a set of products with high market power even by developed country standards. 69% of the observations in column (2) of Table 7 meet this criterion. Panel B of Table 8 lists the 10 most frequent 2-digit HS chapters in this group. Chapters 84 and 85 comprise Section XVI of the HS system: Machinery and Mechanical Appliances; Electrical Equipment. Chapters 72 and 73 represent the steel products portion of Section XV: Base Metals. Chapters 28 and 29 represent the chemical products portion of Section VI: Chemical and Allied Products.

We are not the first to suggest that developing countries may recognize and act upon their international market power. Broda et al. (2008) analyze a sample of 15 non-WTO members, only one of which is developed, and find that market power explains more of the tariff variation in these countries than tariff revenue or lobbying variables. Importantly, as Broda et al. (2008) emphasize, the empirical role of market power is not synonymous with welfare maximizing developing country governments. Rather, it can emerge even in a Grossman and Helpman (1995) setting where governments care *only* about lobbying contributions (alternately, bribes from industry). Moreover, we have shown that (i) numerous large developing countries have product-level market power even by *developed* country standards of high market power (Table 8), (ii) developing countries have enough water in the tariff to allow cyclical changes in applied tariffs (Table A3), and (iii) such changes are not an overly rare occurrence (Table 1). Thus, prior literature, theoretical settings where governments care about market power, and a substantial potential for tariff variation lend credence to our result that pro-cyclical market power could drive pro-cyclical tariffs in developing countries.

[53]Moreover, 7 of the 10 developing countries with the largest shares of low market power observations do not appear in Panel A.

[Table 8 about here.]

Moving beyond the role of time-invariant market power, we now investigate the link between temporal fluctuations in tariffs and temporal fluctuations in market power as proxied by the importer's share of world imports.[54] For developing country-product pairs in the top tercile of time-invariant market power, we expect to find temporal tariff fluctuations for a product only when there are sufficiently large fluctuations in the importer's time-varying market power as measured by their share of world imports for that product.

Letting $IM^{share}_{i,j,t} = \frac{IM_{i,j,t}}{IM_{WORLD,j,t}}$ denote importer i's share of world imports in product j and year t, we define the fluctuation in world import share, $\tilde{m}_{i,j,t} \equiv IM^{share}_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} IM^{share}_{i,j,t-1}$, as the lagged deviation of the share of world imports from its "usual" level.[55] Using this measure, we further separate the high time-invariant market power products in developing countries into two subsamples. First, country-product observations that lie in either the top or bottom terciles of the empirical distribution over $\tilde{m}_{i,j,t}$; these observations are experiencing a substantial temporal deviation in their share of world imports. Second, country-product observations that lie in the middle tercile of the distribution of $\tilde{m}_{i,j,t}$, which are experiencing only a minimal temporal deviation in their share of world imports.

Columns (5)-(7) of Table 7 confirm our expectation. Column (7) clearly shows that, for developing country-product pairs with high time-invariant market power, we cannot reject the null that an importer's tariffs are acyclical when the product is subject to minimal temporal deviations in its share of world imports (i.e. in the middle tercile of the $\tilde{m}_{i,j,t}$ distribution). Conversely, column (6) reveals that the magnitude of pro-cyclicality is more than three times larger for a country-product pair that is experiencing substantial temporal fluctuations in its share of world imports (i.e. in the top or bottom tercile of the $\tilde{m}_{i,j,t}$ distribution) and easily statistically significant at the 5% level ($p = .029$). Thus, tariff pro-cyclicality is evident in the subset of high time-invariant market power products in developing countries that are experiencing large deviations in their share of world imports relative to their country-product average. In turn, the mechanism behind our pro-cyclical tariff result is consistent with a pro-cyclical market power mechanism via the proportionality of time-varying market power and world import share.

The third empirical implication we investigate stems from the Bown and Crowley (2013b) analysis of the Bagwell and Staiger (1990) theoretical model. According to Bown and Crowley (2013b), we should expect temporal fluctuations in imports to influence tariffs only when an importer's import demand curve is sufficiently inelastic and it faces a sufficiently inelastic

[54]Indeed, Beshkar et al. (2015) use an importer's share of world imports as an alternative measure of market power in addition to the Nicita et al. (2013) measures.

[55]T denotes the number of years that country i and product j appear in our sample.

export supply curve. Like Bown and Crowley (2013b), we use the inverse sum of these elasticities $\frac{1}{e^x_{i,j}+|e^m_{i,j}|}$ to capture this idea.[56] Thus, when we look within country-product pairs that have high values of $\frac{1}{e^x_{i,j}+|e^m_{i,j}|}$, we only expect to find temporal fluctuations in tariffs when there are substantial fluctuations in imports. To explore this prediction, we use the overall sample to compute the threshold for the 66^{th} percentile of the distribution over $\frac{1}{e^x_{i,j}+|e^m_{i,j}|}$ and label observations in the top tercile of the distribution as having high values of $\frac{1}{e^x_{i,j}+|e^m_{i,j}|}$. Also using the overall sample, we now redefine $\tilde{m}_{i,j,t} \equiv \Delta IM_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} \Delta IM_{i,j,t-1}$ as importer i's lagged deviation of detrended log real imports for product j in year t from its "usual" level and label observations that lie in either the top or bottom tercile of the empirical distribution over $\tilde{m}_{i,j,t}$ as those experiencing substantial temporal fluctuations in imports.[57]

Columns (8)-(10) of Table 8 present the results and confirm our expectation (per Bown and Crowley (2013b), we also control for $\Delta IM_{i,j,t-1}$ and the volatility of $\Delta IM_{i,j,t-1}$).[58] The point estimate is only statistically significant for observations experiencing substantial temporal deviations in imports (column (9), at the 5% level) and, again, the point estimate for these observations is roughly three times larger than observations experiencing minimal temporal deviations in imports.[59] Thus, our pro-cyclical tariff result in developing countries is consistent with an interpretation of the Bagwell and Staiger (1990) model where pro-cyclical imports lead to temporary increases in applied tariffs that prevent tariff wars.

Columns (2), (6) and (9) of Table 7 focus on the subset of developing country observations where pro-cyclical market power could drive pro-cyclical applied tariffs via terms of trade theory. How does the economic magnitude of the business cycle in these situations compare with the effect in the full developing country subsample in Table 4? Based on column (0) of Table 4, the average movement in developing countries between the peak and trough of the business cycle accounts for 15.35% of the average change in the applied tariff in developing countries. Based on column (2) of Table 7, which only uses products in developing countries with high time-invariant market power, this share rises to 18.49% (a 20.5% increase over the baseline 15.35% share). Based on column (6) which narrows the focus further to observations

[56]Panel B of Table A6 in the Appendix shows the results are robust to alternative functional forms that capture sufficiently inelastic import demand and export supply.

[57]Log real imports exhibit a substantial trend over our sample period and hence we use detrended real imports rather than the level of real imports to determine "unusual" deviations. First differencing is a simple detrending method.

[58]Lack of data on import demand elasticities and trade data in consecutive years causes the number of observations in columns (8)-(10) to drop below that in columns (5)-(7).

[59]Panels A and B of Table 8 document the most frequent countries and HS chapters based on the observations in column (2) of Table 7. An analogous exercise based on column (6) or (9) of Table 7 reveals only minor differences in the dominant countries and chapters.

with large changes in time-varying market power, this share rises to 28.34% (an 84.70% increase over baseline). Finally, based on column (9), which focuses on country-product pairs in developing countries most susceptible to mitigating tariff wars via temporary applied tariff increases, this share rises to 19.99% (a 30.26% increase over baseline). Ultimately, as one would expect from terms of trade theory, the economic magnitude underlying the results in Table 7 is noticeably larger than the full developing country subsample.

Finally, one may be concerned with the robustness of the results in Table 7 given our finding in Tables 3-4 regarding business cycle outliers. While removing business cycle outliers did not alter the estimated degree of tariff pro-cyclicality in Tables 3-4, it did reduce the precision of our estimates such that the business cycle coefficient was not statistically significant at the 10% level. We now revisit this issue given that terms of trade theory provides guidance, confirmed by our empirical results, on where one should expect to find tariff pro-cyclicality. Specifically, we now repeat the analysis in Table 7 but exclude the business cycle outliers. Panel A of Table A6 in the Appendix presents the results. Columns (2), (6) and (9) show that removing business cycle outliers does not diminish the estimated degree of tariff pro-cyclicality; indeed, the estimated degree of pro-cyclicality actually rises by about 16-25%. More importantly, while estimates become less precise, the business cycle coefficient remains statistically significant at the 10% level in columns (2) and (9) and at the 5% level in column (6). Thus, when one looks for tariff pro-cyclicality guided by the above theoretical motivations, the pro-cyclicality is robust to excluding business cycle outliers.

7 Conclusion

Conventional wisdom says that applied tariffs are counter-cyclical. Using a product-level panel dataset with 72 countries over the years 2000-2011, our results suggest the opposite: applied tariffs are pro-cyclical. While our results are consistent with other recent work in various contexts suggesting that applied tariffs are not counter-cyclical (Gawande et al. (2014), Kee et al. (2013) and Rose (2013)), our results go further than previous work because we find evidence of applied tariff pro-cyclicality.

These results are robust to controlling for numerous variables emphasized in the recent theoretical and empirical literature as important determinants of applied tariffs, using alternative samples and sample periods, and using alternative measures of the business cycle. Further, we find that the pro-cyclical applied tariff result is driven by the tariff setting behavior of developing countries, and applied tariffs are actually acyclical in developed countries.

We present evidence that terms of trade motivations drive pro-cyclical tariffs in developing countries. Intuitively, this could arise from pro-cyclical imports shifting the import demand curve up onto a more inelastic part of the export supply curve during booms and thereby generating pro-cyclical market power. First, we only observe pro-cyclicality for country-product pairs with high time-invariant market power. Second, looking within these high market power country-product pairs but using temporal fluctuations in the share of world imports to proxy for time varying market power, we only observe pro-cyclicality in country-product years where a country's share of product-level world imports varies sufficiently to make the tariff change worthwhile. Third, in response to import surges, we observe pro-cyclicality only in country-product-years where both time-invariant market power is high and the efficiency costs of tariffs are low, as one would expect based on Bagwell and Staiger (1990) and Bown and Crowley (2013b). Overall, this evidence adds to a growing literature, in both static and dynamic settings, documenting the impact that terms of trade motivations have on trade policy.

References

Anderson, J. E., 1998. Effective protection redux. Journal of International Economics 44 (1), 21–44.

Bagwell, K., Staiger, R., 2011. What do trade negotiators negotiate about? Empirical evidence from the World Trade Organization. The American Economic Review 101 (4), 1238–1273.

Bagwell, K., Staiger, R. W., 1990. A theory of managed trade. American Economic Review 80, 779–795.

Bagwell, K., Staiger, R. W., 2003. Protection and the business cycle. Advances in Economic Analysis & Policy 3 (1).

Baxter, M., King, R. G., 1999. Measuring business cycles: approximate band-pass filters for economic time series. Review of Economics and Statistics 81 (4), 575–593.

Besedeš, T., Prusa, T. J., 2006. Product differentiation and duration of US import trade. Journal of international Economics 70 (2), 339–358.

Beshkar, M., Bond, E., Rho, Y., 2015. Tariff binding and overhang: theory and evidence. Journal of International Economics 97 (1), 1–13.

Bohara, A. K., Kaempfer, W. H., 1991a. A test of tariff endogeneity in the United States. The American Economic Review 81 (4), 952–960.

Bohara, A. K., Kaempfer, W. H., 1991b. Testing the endogeneity of tariff policy in the US: Further evidence. Economics Letters 35 (3), 311–315.

Bown, C. P., 2010. Temporary trade barriers database. World Bank (July). URL: http://econ. worldbank. org/ttbd.

Bown, C. P., Crowley, M. A., 2013a. Import protection, business cycles, and exchange rates: evidence from the great recession. Journal of International Economics 90 (1), 50–64.

Bown, C. P., Crowley, M. A., 2013b. Self-enforcing trade agreements: evidence from time-varying trade policy. The American Economic Review 103 (2), 1071–1090.

Bown, C. P., Crowley, M. A., 2014. Emerging economies, trade policy, and macroeconomic shocks. Journal of Development Economics 111, 261–273.

Broda, C., Limao, N., Weinstein, D. E., 2008. Optimal tariffs and market power: the evidence. The American Economic Review 98 (5), 2032–2065.

Cameron, A. C., Gelbach, J. B., Miller, D. L., 2011. Robust inference with multiway clustering. Journal of Business & Economic Statistics 29 (2), 238–249.

Cameron, A. C., Trivedi, P. K., 2009. Microeconometrics using STATA. Vol. 5. Stata Press College Station, TX.

Cassing, J., McKeown, T. J., Ochs, J., 1986. The political economy of the tariff cycle. American Political Science Review 80 (3), 843–862.

Chang, Y., Kim, S.-B., 2007. Heterogeneity and aggregation: Implications for labor-market fluctuations. The American Economic Review 97 (5), 1939–1956.

Christiano, L. J., Fitzgerald, T. J., 2003. The band pass filter. International Economic Review 44 (2), 435–465.

Correia, S., 2014. REGHDFE: Stata module to perform linear or instrumental-variable regression absorbing any number of high-dimensional fixed effects. Statistical Software Components, Boston College Department of Economics.

Costinot, A., 2009. Jobs, jobs, jobs: a new perspective on protectionism. Journal of the European Economic Association 7 (5), 1011–1041.

Doda, B., 2014. Evidence on business cycles and CO2 emissions. Journal of Macroeconomics 40, 214–227.

Estevadeordal, A., Freund, C., Ornelas, E., 2008. Does regionalism affect trade liberalization toward nonmembers? The Quarterly Journal of Economics 123 (4), 1531–1575.

Ethier, W. J., 1977. The theory of effective protection in general equilibrium: Effective-rate analogues of nominal rates. Canadian Journal of Economics, 233–245.

Feenstra, R., 2003. Advanced international trade: theory and evidence. Princeton University Press.

Fernández-Val, I., Weidner, M., 2013. Individual and time effects in nonlinear panel models with large N, T. Mimeo.

Gallarotti, G. M., 1985. Toward a business-cycle model of tariffs. International Organization 39 (1), 155–187.

Gawande, K., Hoekman, B., Cui, Y., 2014. Determinants of trade policy responses to the 2008 financial crisis. World Bank Economic Review 29, 102–128.

Greene, W., 2004. Fixed effects and bias due to the incidental parameters problem in the Tobit model. Econometric Reviews 23 (2), 125–147.

Groppo, V., Piermartini, R., 2014. Trade policy uncertainty and the WTO. Mimeo.

Grossman, G. M., Helpman, E., 1995. Trade wars and trade talks. The Journal of Political Economy 103 (4), 675–708.

Handley, K., 2014. Exporting under trade policy uncertainty: Theory and evidence. Journal of International Economics 94 (1), 50–66.

Handley, K., Limão, N., 2012. Trade and investment under policy uncertainty: Theory and firm evidence. NBER Working Paper No. 17790.

Hansen, J. M., 1990. Taxation and the political economy of the tariff. International Organization 44 (4), 527–551.

Heutel, G., 2012. How should environmental policy respond to business cycles? Optimal policy under persistent productivity shocks. Review of Economic Dynamics 15 (2), 244–264.

Hoda, A., 2001. Tariff Negotiations and Renegotiations under the GATT and the WTO: Procedures and Practices. Cambridge University Press.

Hodrick, R. J., Prescott, E. C., 1997. Postwar US business cycles: An empirical investigation. Journal of Money, Credit, and Banking 29 (1), 1–16.

Kee, H. L., Neagu, C., Nicita, A., 2013. Is protectionism on the rise? Assessing national trade policies during the crisis of 2008. Review of Economics and Statistics 95 (1), 342–346.

Kee, H. L., Nicita, A., Olarreaga, M., 2008. Import demand elasticities and trade distortions. The Review of Economics and Statistics 90 (4), 666–682.

Knetter, M. M., Prusa, T. J., 2003. Macroeconomic factors and antidumping filings: Evidence from four countries. Journal of International Economics 61 (1), 1–17.

Limão, N., 2006. Preferential trade agreements as stumbling blocks for multilateral trade liberalization: Evidence for the United States. The American Economic Review 96 (3), 896–914.

Limão, N., 2007. Are preferential trade agreements with non-trade objectives a stumbling block for multilateral liberalization? The Review of Economic Studies 74 (3), 821–855.

Ludema, R. D., Mayda, A. M., 2013. Do terms-of-trade effects matter for trade agreements? Theory and evidence from WTO countries. The Quarterly Journal of Economics 128 (4), 1837–1893.

Magee, S. P., Young, L., 1987. Endogenous protection in the United States, 1900-1984. In: Stern, R. M. (Ed.), US Trade Policies in a Changing World Economy. MIT Press, Cambridge, MA, pp. 145–195.

Mai, J., Stoyanov, A., 2015. The effect of the Canada-US free trade agreement on Canadian multilateral trade liberalization. Canadian Journal of Economics 48 (3), 1067–1098.

McKeown, T. J., 1983. Hegemonic stability theory and 19th century tariff levels in Europe. International Organization 37 (01), 73–91.

Nicita, A., Olarreaga, M., Silva, P., 2013. Cooperation in WTO's tariff waters. Mimeo.

Oatley, T., 2015. A Political Economy of American Hegemony: Buildups, Booms, and Busts. Cambridge University Press, Ch. Deflecting the Costs of Adjustment, pp. 107–126.

Ravn, M. O., Uhlig, H., 2002. On adjusting the Hodrick-Prescott filter for the frequency of observations. Review of Economics and Statistics 84 (2), 371–376.

Rodrik, D., 1995. Political economy of trade policy. Handbook of International Economics 3, 1457–1494.

Rose, A. K., 2013. The march of an economic idea? Protectionism isn't counter-cyclic (anymore). Economic Policy 28 (76), 569–612.

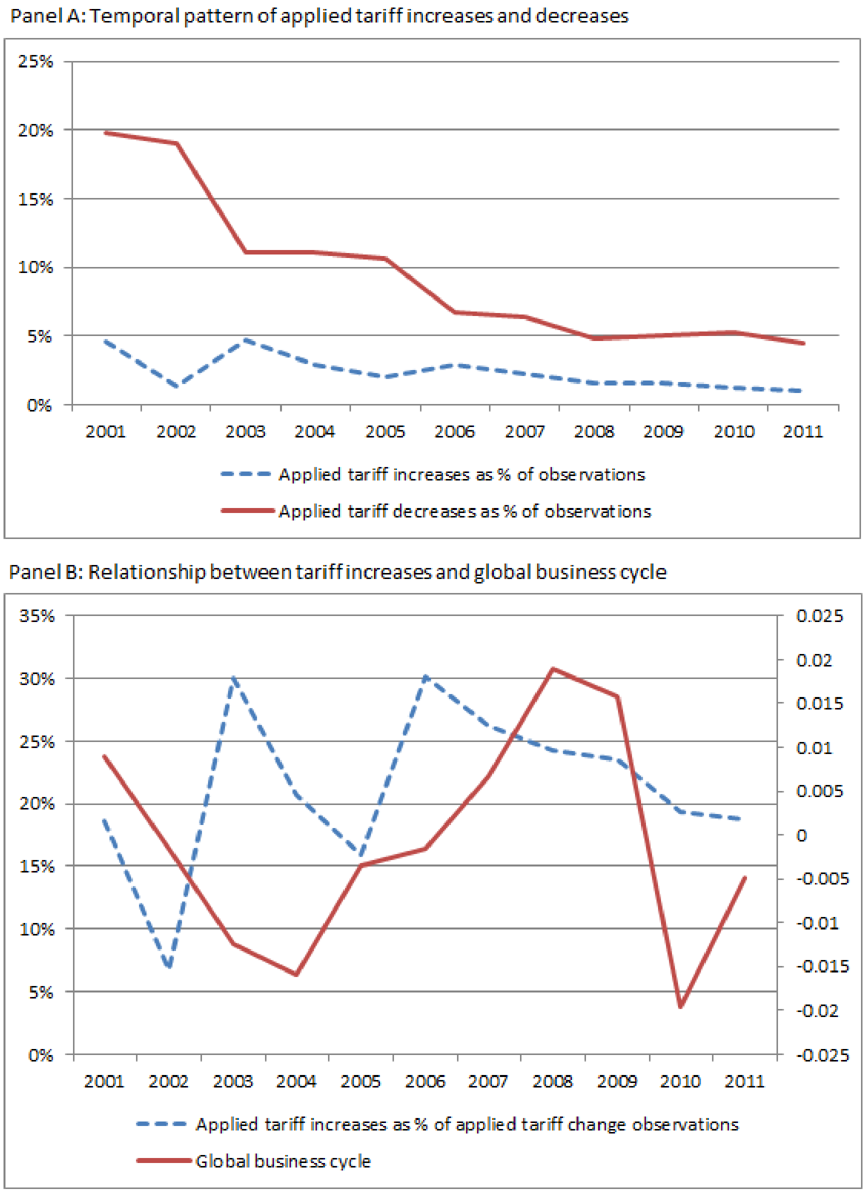
Schaffer, M. E., 2015. xtivreg2: Stata module to perform extended IV/2SLS, GMM and AC/HAC, LIML and k-class regression for panel data models. Statistical Software Components, Boston College Department of Economics.

Silva, J. S., Tenreyro, S., 2006. The log of gravity. The Review of Economics and Statistics 88 (4), 641–658.

Simcoe, T., 2007. XTPQML: Stata module to estimate fixed-effects poisson (quasi-ML) regression with robust standard errors. Statistical Software Components, Boston College Department of Economics.

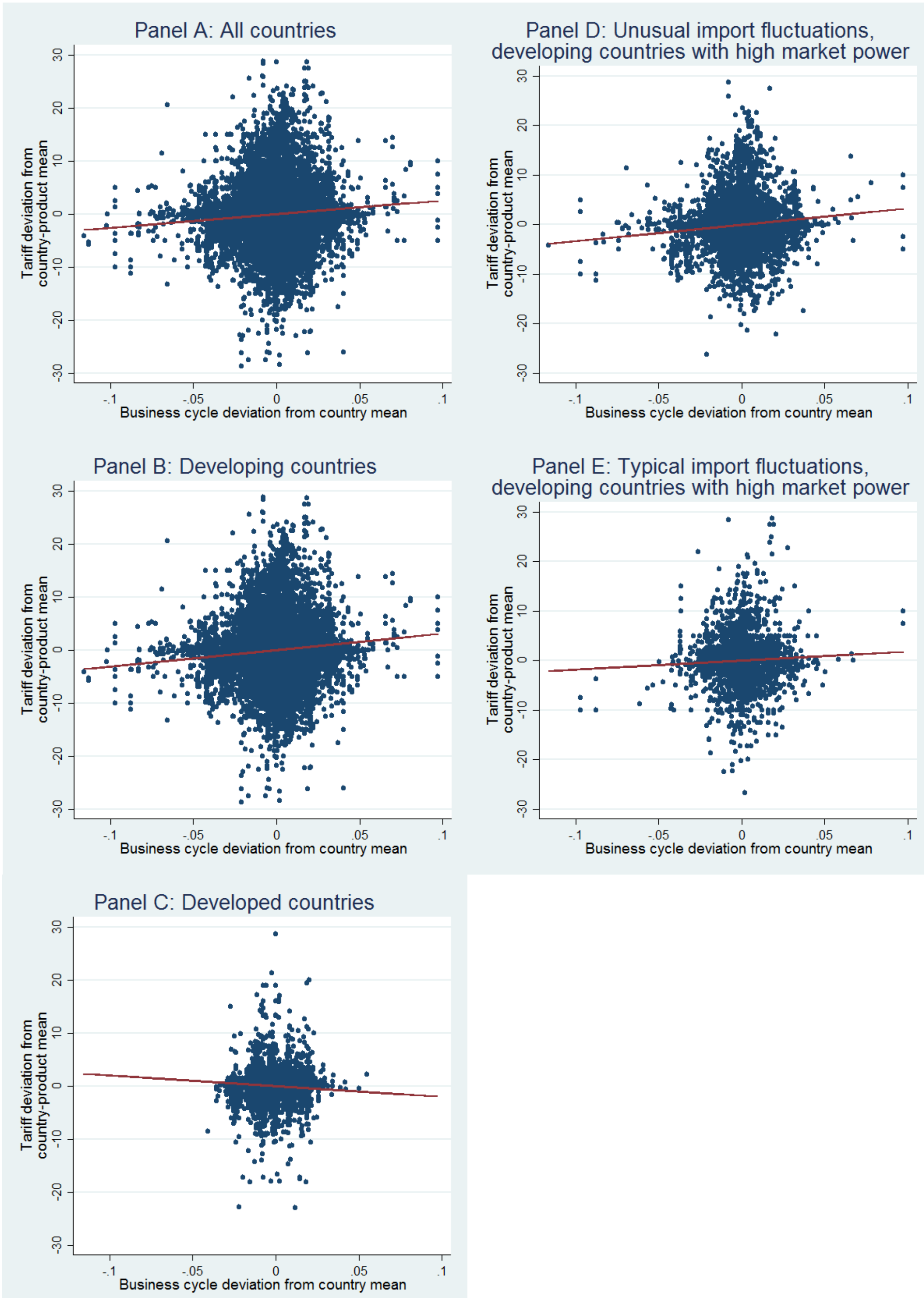
Takacs, W. E., 1981. Pressures for protectionism: An empirical analysis. Economic Inquiry 19 (4), 687–693.

Figure 1: Temporal pattern of applied tariff changes



Notes: The sample used is as described in Section 3.1. The global business cycle in panel B is a simple weighted average of the values of $BC_{i,t-1}$ in the sample.

Figure 2: Preliminary evidence that applied tariffs could be pro-cyclical



Notes: All figures include only observations for products where the applied tariff moves both up and down over the sample period. Only those observations where the applied tariff changed relative to the prior year are included. For the overall sample description, see Section 3.1. For further details, see Section 3.2.

Table 1: Frequency and magnitude of applied tariff changes

A. Frequency and magnitude of applied tariff changes at country-product-year level

	Pooled			**Developing**			**Developed**		
	N	%	**Ave. size**	*N*	%	**Ave. size**	*N*	%	**Ave. size**
Unchanged	1,809,232	88.71		1,190,552	86.57		618,680	93.13	
Changed	230,338	11.29	-2.05	184,703	13.43	-2.30	45,635	6.87	-1.04
Total	2,039,570	100		1,375,255	100		664,315	100	

B. Frequency and magnitude of directional applied tariff changes at country-product-year level

	Pooled			**Developing**			**Developed**		
	N	%	**Ave. size**	*N*	%	**Ave. size**	*N*	%	**Ave. size**
Applied tariff decrease	183,310	8.99	-3.65	146,558	10.66	-4.13	36,752	5.53	-1.73
Applied tariff unchanged	1,809,232	88.71		1,190,552	86.57		618,680	93.13	
Applied tariff increase	47,028	2.31	4.17	38,145	2.77	4.73	8,883	1.34	1.81
Total	2,039,570	100		1,375,255	100		664,315	100	

C. Frequency of directional applied tariff changes at country-product level

	Pooled			**Developing**			**Developed**		
	N	%	**Ave. size**	*N*	%	**Ave. size**	*N*	%	**Ave. size**
Applied tariff only decreases	60,602	26.35	-3.42	48,738	30.97	-3.93	11,864	16.35	-1.66
Applied tariff always unchanged	134,267	58.38		80,961	51.44		53,306	73.45	
Applied tariff only increases	9,243	4.02	3.76	5,641	3.58	5.02	3,602	4.96	1.25
Applied tariff increases and decreases	25,858	11.24	-0.83	22,055	14.01	-0.92	3,803	5.24	-0.28
Total	229,970	100		157,395	100		72,575	100	

Notes: The sample used is that described in Section 3.1.

Table 2: Cyclicality of tariffs

A. Fixed effects OLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$BC_{i,t-1}$	6.969	1.302	5.004	7.512‡	7.512‡	7.490‡	8.277‡	8.350‡
	(9.488)	(3.105)	(4.088)	(4.443)	(4.443)	(4.443)	(4.617)	(4.621)
$y_{i,t-1}$				-4.115†	-4.115†	-4.127†	-5.758*	-5.821*
				(1.663)	(1.663)	(1.665)	(2.106)	(2.108)
$MP_{i,j}$					0.001	0.001	0.018	-0.005
					(0.009)	(0.009)	(1.077)	(0.008)
$PTA\_IM_{i,j,t}$						0.228‡	0.138	0.131
						(0.133)	(0.215)	(0.153)
N	2272198	2272117	2272117	2272117	2272117	2272117	1491752	1491752
R^2	0.0001	0.8528	0.8561	0.8565	0.8565	0.8565		0.8564
Country-HS4 FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Underidentification p-value							0.011	
Weak instrument rk F stat							4.667	
Overidentification p value							0.088	
Regressor endogeneity p-value							0.981	

B. Fixed effects PPML

	(1)	(2)	(3)	(4)	(5)	(6)
$BC_{i,t-1}$	0.893‡	0.167	0.628‡	0.875‡	0.875‡	0.875‡
	(0.520)	(0.285)	(0.378)	(0.469)	(0.469)	(0.469)
$y_{i,t-1}$				-0.546	-0.546	-0.546
				(0.503)	(0.503)	(0.503)
$MP_{i,j}$					0.000	0.000
					(0.001)	(0.001)
$PTA\_IM_{i,j,t}$						0.001
						(0.034)
N	2272198	1821840	1821840	1821840	1821840	1821840
R^2	0.0002	0.6800	0.6867	0.6873	0.6873	0.6873
Country-HS4 FE	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes

Notes: The sample is that described in Section 3.1. OLS standard errors are two-way clustered standard errors, clustering at country-year and country-HS4 level. PPML standard errors clustered at country level. Market power is treated as endogenous in Panel A column (7); the instruments are the average import demand elasticity of other countries and the global average export supply elasticity from the perspective of the exporter.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table 3: Robustness: alternative samples

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$BC_{i,t-1}$	0.875‡	1.019†	0.911†	1.047†	0.928‡	0.967	0.841‡	1.186†	0.649‡	1.018†
	(0.469)	(0.497)	(0.436)	(0.510)	(0.478)	(0.657)	(0.483)	(0.583)	(0.343)	(0.480)
$y_{i,t-1}$	-0.546	-0.583	-0.553	-0.708	-0.665	-0.540	-0.455	-0.618	-0.582‡	-0.820†
	(0.503)	(0.542)	(0.465)	(0.593)	(0.568)	(0.507)	(0.543)	(0.533)	(0.326)	(0.345)
$MP_{i,j}$	0.000	-0.001‡	0.001	0.000	0.000	0.000	0.001	0.000	0.0000	-0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
$PTA\_IM_{i,j,t}$	0.001	-0.010	-0.021	0.002	0.002	0.002	0.000	0.007	-0.011	0.126†
	(0.034)	(0.042)	(0.038)	(0.036)	(0.034)	(0.034)	(0.034)	(0.031)	(0.031)	(0.057)
N	1821840	1679003	1242745	1597500	1737672	1787685	1377853	1509186	2311682	2720272
R^2	0.6873	0.6606	0.7178	0.6983	0.6902	0.6880	0.6418	0.6920	0.6698	0.6584
Country-HS4 FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimation performed by fixed effects PPML. Standard errors clustered at country level. Column (0) reports baseline results from Column (6) of Table 2. Columns (1)-(9) implement the following modifications:
(1) Excludes agriculture.
(2) Excludes HS6 lines with more than one product.
(3) Excludes new WTO members.
(4) Excludes EU and China.
(5) Excludes business cycle observations in the top and bottom 1% of the business cycle distribution.
(6) Excludes observations with (i) negative overhang or observations where the tariff drops back below the binding and (ii) country-product pairs with non-constant binding, no binding or zero binding.
(7) Excludes Great Recession years (2010 and 2011).
(8) Extends sample back to 1995 by adding country-product pairs to baseline sample that always experience weakly positive overhang during country-product specific phase-in years.
(9) Extends sample in (8) by adding country-product-year observations for 1989-1994.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table 4: Cyclicality of tariffs by level of development

A. Developing countries

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$BC_{i,t-1}$	0.933‡	1.086†	0.953†	1.129†	0.995†	1.037	0.931‡	1.243†	0.683‡	1.348*
	(0.479)	(0.504)	(0.438)	(0.512)	(0.486)	(0.685)	(0.504)	(0.598)	(0.355)	(0.464)
$y_{i,t-1}$	-0.710	-0.764	-0.745	-0.984	-0.928	-0.692	-0.633	-0.770	-0.758†	-1.107*
	(0.630)	(0.666)	(0.562)	(0.746)	(0.696)	(0.632)	(0.719)	(0.638)	(0.360)	(0.303)
$MP_{i,j}$	-0.001	-0.001‡	0.000	-0.001	-0.001	-0.001	-0.001	-0.001‡	-0.001‡	-0.001*
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
$PTA\_IM_{i,j,t}$	-0.006	-0.019	-0.030	-0.006	-0.005	-0.005	-0.002	0.000	-0.010	0.140†
	(0.035)	(0.044)	(0.039)	(0.037)	(0.035)	(0.036)	(0.035)	(0.033)	(0.032)	(0.059)
N	1391693	1290034	986096	1186831	1355607	1364167	1059446	1148486	1790695	2021180
R^2	0.6221	0.5960	0.6555	0.6267	0.6249	0.6237	0.6164	0.6270	0.5920	0.5944

B. Developed countries

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$BC_{i,t-1}$	-0.212	-0.371	-0.436	-0.255	-0.254	-0.114	-0.037	0.266	-0.261	-0.958
	(0.484)	(0.533)	(0.566)	(0.543)	(0.510)	(0.586)	(0.410)	(0.619)	(0.532)	(0.640)
$y_{i,t-1}$	0.144	0.187	0.203	0.144	0.225	0.152	0.129	0.107	0.267	0.233
	(0.157)	(0.175)	(0.175)	(0.162)	(0.157)	(0.163)	(0.156)	(0.171)	(0.237)	(0.244)
$MP_{i,j}$	0.003	-0.001	0.007	0.003	0.003	0.003	0.005	0.002	0.003	0.001
	(0.006)	(0.001)	(0.011)	(0.006)	(0.006)	(0.006)	(0.007)	(0.005)	(0.006)	(0.005)
$PTA\_IM_{i,j,t}$	0.079†	0.091*	0.068*	0.080†	0.085†	0.080†	0.048‡	0.081†	0.076‡	0.078‡
	(0.034)	(0.028)	(0.022)	(0.035)	(0.038)	(0.034)	(0.025)	(0.033)	(0.040)	(0.046)
N	430147	388969	256649	410669	382065	423518	318407	360700	520987	699092
R^2	0.7333	0.6892	0.7585	0.7394	0.7437	0.7333	0.6486	0.7326	0.7304	0.6921

Notes: Overall sample, before splitting into developed and developing countries, is same as Table 2. Column (0) reports results for all developing countries (Panel A) and developed countries (Panel B). Columns (1)-(9) mirror those in Table 3 (see Table 3 for descriptions). Estimation performed by fixed effects PPML. Standard errors clustered at country level. All specifications contain country-HS4 and year fixed effects.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table 5: Robustness: alternative covariates

	Developing				Developed			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$BC_{i,t-1}$	1.024†	0.953†	0.953†	0.939‡	-0.381	-0.325	-0.465	-0.213
	(0.505)	(0.471)	(0.462)	(0.486)	(0.479)	(0.490)	(0.500)	(0.483)
$\Delta IM_{i,j,t-1}$	-0.002				-0.002			
	(0.002)				(0.002)			
$sd\Delta IM_{i,j,t-1}$	-0.001				0.056			
	(0.003)				(0.035)			
$GBC_{i,t-1}$		-2.583				5.689‡		
		(2.070)				(3.394)		
$Intermed_j$			-0.102*				-0.070*	
			(0.030)				(0.025)	
$Intermed_j \times BC_{i,t-1}$			-0.045				0.561	
			(0.212)				(0.596)	
$TTB_{i,j,t}$				0.111†				0.043*
				(0.053)				(0.008)
$TTB_{i,j,t} \times BC_{i,t-1}$				-0.903				0.105
				(0.557)				(0.467)
N	1221794	1391693	1351921	1391693	383291	430147	417703	430147
R^2	0.6173	0.6222	0.6246	0.6222	0.7369	0.7334	0.7339	0.7333

Notes: Estimation performed by fixed effects PPML. All specifications include market power, PTA import share and lagged trend of log real GDP as controls and year and country-HS4 fixed effects. Standard errors clustered at the country level.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table 6: Cyclicality of country-level aggregate tariffs

A. Simple average tariff

	Overall		Developing		Developed	
	(1)	(2)	(3)	(4)	(5)	(6)
$BC_{i,t-1}$	0.115	0.406	0.108	0.387	0.405	0.217
	(0.315)	(0.301)	(0.334)	(0.315)	(0.425)	(0.678)
$y_{i,t-1}$		-14.370‡		-18.204‡		1.658
		(8.044)		(9.606)		(4.259)
$PTA\_IM_{i,t}$		-0.264		-0.253		-0.654*
		(0.168)		(0.172)		(0.138)
N	715	715	562	562	153	153
R^2	0.892	0.901	0.848	0.861	0.901	0.981
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

B. Weighted average tariff

	Overall		Developing		Developed	
	(1)	(2)	(3)	(4)	(5)	(6)
$BC_{i,t-1}$	0.441	0.600	0.238	0.502	2.405†	1.719
	(0.470)	(0.462)	(0.484)	(0.471)	(1.146)	(1.228)
$y_{i,t-1}$		-8.407		-16.031		10.467
		(9.219)		(12.136)		(7.990)
$PTA\_IM_{i,t}$		0.064		0.044		-0.017
		(0.182)		(0.187)		(0.391)
N	608	608	461	461	147	147
R^2	0.867	0.869	0.820	0.826	0.878	0.881
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The country-year pairs included in the sample correspond to the country-year pairs in the sample of Table 2. Estimation performed by fixed effects PPML. Standard errors clustered by country.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table 7: Cyclicality of tariffs: market power and import fluctuations

	Low MP	High MP	Low MP	High MP	All	Extreme terciles	Middle tercile	All	Extreme terciles	Middle tercile
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$BC_{i,t-1}$	0.587	1.116‡	-0.118	0.051	1.248†	1.642†	0.585	1.040‡	1.233†	0.432
	(0.389)	(0.574)	(0.645)	(0.400)	(0.609)	(0.756)	(0.506)	(0.612)	(0.584)	(0.803)
$\ln\left(IM^{share}_{i,j,t-1}\right)$					-0.011†	-0.011‡	-0.007†			
					(0.004)	(0.007)	(0.003)			
$\Delta IM_{i,j,t-1}$								-0.001	-0.002	0.026
								(0.002)	(0.002)	(0.032)
$sd\Delta IM_{i,j,t-1}$								-0.012	-0.014†	0.000
								(0.007)	(0.007)	(0.016)
N	539720	373164	85933	217920	343942	228845	108706	274263	183605	87251
R^2	0.6528	0.6664	0.7657	0.7235	0.6628	0.6564	0.7333	0.637	0.6602	0.6643
Definitions										
Overall sample	All developing countries		All developed countries		Country-product pairs in developing countries that lie in top tercile of $MP_{i,j}$			Country-product pairs in developing countries that lie in top tercile of $\left[e^x_{i,j} + \left\|e^m_{i,j}\right\|\right]^{-1}$		
$\tilde{m}_{i,j,t}$	N/A				$IM^{share}_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} IM^{share}_{i,j,t-1}$			$\Delta IM_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} \Delta IM_{i,j,t-1}$		
Extreme terciles	N/A				Observations that lie in top or bottom terciles of $\tilde{m}_{i,j,t}$					
Middle tercile	N/A				Observations that lie in middle tercile of $\tilde{m}_{i,j,t}$					

Notes: Estimation performed by fixed effects PPML. All specifications include market power, PTA import share and lagged trend of log real GDP as controls and year and country-HS4 fixed effects. Standard errors clustered at the country level.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table 8: Developing countries and market power

A. Top 10 developing countries with high market power

Country	% of high market power developing country obs.	Country	% of own obs. as high market power
Mexico	6.97%	China	59.72%
China	5.89%	Mexico	49.98%
Brazil	4.37%	Thailand	37.39%
Indonesia	4.04%	India	33.65%
Thailand	4.00%	Brazil	32.59%
India	3.76%	Indonesia	30.79%
Turkey	3.74%	Turkey	28.22%
Venezuela	3.03%	Bangladesh	27.00%
Philippines	2.99%	Oman	25.75%
Chile	2.95%	Philippines	25.50%

B. Top 10 sectors in developing countries with high market power

HS 2-digit sector	% of high market power developing country obs.	Average market power	% of all HS tariff lines	Sector Description
84	9.52%	0.352	9.81%	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof
85	5.30%	0.206	6.54%	Electrical machinery, equipment, parts; sound recorders, reproducers; television image and sound recorders, reproducers, parts, accessories
29	3.74%	0.309	6.72%	Organic chemicals
73	3.33%	0.078	2.49%	Articles of iron or steel
72	3.00%	0.381	3.82%	Iron and steel
39	2.75%	0.101	2.34%	Plastics and articles thereof
90	2.56%	0.161	3.58%	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof
48	2.06%	0.148	2.45%	Paper and paperboard; articles of paper pulp, of paper or of paperboard
28	1.96%	0.189	3.19%	Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes
87	1.66%	0.090	1.40%	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof

Notes: The overall sample used is that from column (2) of Table 7.

Appendix

[Table A1 about here.]

[Table A2 about here.]

[Table A3 about here.]

[Table A4 about here.]

[Table A5 about here.]

[Table A6 about here.]

Table A1: Countries in our dataset

Developed (16)

All tariff years and all GDP years (7)
Australia, Canada, European Union, Japan, Norway, Singapore, United States

Only missing GDP years (5)
Brunei (1960-1973), Hong Kong (1960-1964), Macao (1960-1981), New Zealand (1960-1976), Switzerland (1960-1979)

Only missing tariff years (2)
Iceland (2002), Israel (2010)

Missing GDP years and tariff years (2)
Qatar (missing GDP years 1960-1969, 2013; missing tariff years 2000-2001),
Saudi Arabia (missing GDP years 1960-1967; missing tariff year 2010; joined WTO 12/11/2005)

Developing (51)

All tariff years and all GDP years (22)
Argentina, Brazil, Chile, Colombia, Costa Rica, Guatemala, Honduras, Indonesia, Madagascar, Malaysia, Mexico, Nicaragua, Paraguay, Peru, Philippines, South Africa, Togo, Turkey, Venezuela,
Ecuador (joined WTO 1/21/1996), Nepal (joined WTO 4/23/2004), Panama (joined WTO 9/6/1997)

Only missing GDP years (7)
Cuba (1960-1969, 2012-2013), Egypt (1960-1964), El Salvador (1960-1964),
Albania (1960-1979; joined WTO 9/8/2000), Georgia (1960-1964, joined WTO 6/14/2000),
Macedonia FYR (1960-1989; joined WTO 4/4/2003), Mongolia (1960-1980; joined WTO 1/29/1997)

Only missing tariff years (17)
Bangladesh (2001), Bolivia (2011), Cameroon (2000), Central African Republic (2000), Cote d'Ivoire (2000), Gabon (2006), Ghana (2005-2006, 2011), Guyana (2004-2005), India (2003), Kenya (2003), Niger (2000), Papua New Guinea (2011), Senegal (2000), Sri Lanka (2002), Uruguay (2003), Zambia (2000),
China (missing tariff year 2011, joined WTO 12/11/2001)

Missing GDP and tariff years (5)
Jordan (missing GDP years 1960-1974; missing tariff year 2011; joined WTO 4/11/2000),
Mali (1960-1966; 2000-01), Mauritius (1960-1975; 2003), Tunisia (1960-1964; 2001, 2007),
Thailand (1960-1964; 2002)

Developed and developing (5)

Antigua & Barbuda (developing 2000-2001, 2003-2004, 2009; developed 2002,2005-2008;
missing GDP years 1960-1978, missing tariff year 2000),
Bahrain (developing 2000; developed 2001-2009; missing GDP years 1960-1979),
Korea (developing 2000; developed 2001-2009),
Oman (developing 2000-2006; developed 2007-2009, missing tariff years 2010-2011; joined WTO 11/9/2000),
Trinidad & Tobago (developing 2001-2005; developed 2006-2008; missing tariff years 2000, 2009)

Notes: Unless otherwise noted, years in parenthesis indicate missing years.
Level of development source: http://siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls, with developed being high-income and developing being not high-income.
New WTO member definition based on Beshkar et. al. (2015) with new members included in our regressions in their first full year of WTO membership.
All tariff years = 2000-2011 and all GDP years = 1960-2013.

Table A2: Variable definitions and sources

Variable	Description	Source
Tariff variables		
$\tau_{i,j,t}$	Applied tariff of country i on product j in year t	WTO Integrated Database and UNCTAD TRAINS database (http://wits.worldbank.org/)
$\bar{\tau}_{i,j,t}$	Tariff binding of country i on product j in year t	WTO Integrated Database (http://wits.worldbank.org/) and new member accession schedules (http://www.wto.org/english/tratop _e/schedules_e/goods_schedules_table_e.htm)
Covariates		
$BC_{i,t-1}$	Cyclical component in year $t-1$ of country i's log real GDP using Hodrick Prescott filter with real GDP measured in local currency units	World Bank's World Development Indicators (http://data.worldbank.org/data-catalog/world-development-indicators);
$y_{i,t-1}$	Trend component in year $t-1$ of country i's log real GDP using Hodrick Prescott filter with real GDP measured in local currency units	UN National Accounts Main Aggregates Database (http://unstats.un.org/unsd/snaama/introduction.asp); Penn World Tables (https://pwt.sas.upenn.edu/)
$MP_{i,j}$	Natural log of $1/e^x_{i,j}$ where $e^x_{i,j}$ is the export supply elasticity of product j from the perspective of the importer i	Nicita et. al (2013)
$PTA\_IM_{i,j,t}$	Weighted share of country i's imports of product j in year t sourced from countries who are FTA or CU partners of country i. The (time-invariant) weights use import shares in product j from a year prior to country i appearing in sample.	COMTRADE (http://wits.worldbank.org/); NSF-Kellogg Institute Data Base on Economic Integration Agreements (http://kellogg.nd.edu/faculty/fellows/bergstrand.shtml)
$Intermed_j$	$=1$ if product j is an intermediate product, $=0$ otherwise	WITS (http://wits.worldbank.org/data/public/concordance/Concordance_HS_to_BE.zip); RIETI (http://www.rieti.go.jp/en/projects/) rieti-tid/pdf/1503.pdf)
$TTB_{i,j,t}$	$=1$ if product j is under a TTB in country i, year t, $=0$ otherwise	Bown (2010)
$GBC_{i,t-1}$	Trade weighted average of $BC_{k,t-1}$ in countries other than country i. The (time-invariant) weights are import shares for the same year as the (time-invariant) weights for $PTA\_IM_{i,j,t}$	Same as for $BC_{i,t-1}$; COMTRADE (http://wits.worldbank.org/)
$\Delta IM_{i,j,t-1}$	Change in country i log real imports of product j between $t-1$ and $t-2$ (100's million 2010 USD)	COMTRADE (http://wits.worldbank.org/); http://data.worldbank.org/indicator/FP.CPI.TOTL
$sd\Delta IM_{i,j,t-1}$	Standard deviation of $\Delta IM_{i,j,t-1}$ over sample period	
$IM^{share}_{i,j,t-1}$	Country i 's share of world imports of product j in year t	
Instruments		
$\eta^{IM}_{i,j}$	Global average of rest of the world (excluding country i) product j import demand elasticity	Nicita et. al. (2013)
η^{EX}_j	Global average of product j export supply elasticity from perspective of exporters	
Other		
$Unbound_{i,j,t}$	$=1$ if country i has no tariff binding on product j in year t, $=0$ otherwise	WTO Integrated Database (http://wits.worldbank.org/)
$ZeroBinding_{i,j,t}$	$=1$ if country i's tariff binding on product j in year t is zero, $=0$ otherwise	
$e^m_{i,j}$	Import demand elasticity for importer i, product j	Kee et. al. (2008)
Aggregate Data		
$\tau^{simple}_{i,t}$	Simple average applied tariff of country i in year t	WTO Integrated Database (http://wits.worldbank.org/)
$\tau^{weighted}_{i,t}$	Weighted average applied tariff of country i in year t	
$PTA\_IM_{i,t}$	Weighted share of country i's imports in year t sourced from countries who are FTA or CU partners of country i. The (time-invariant) weights use import shares from a year prior to country i appearing in sample.	Same as for $PTA\_IM_{i,j,t}$

Table A3: Summary statistics

	All countries				
	N	**Mean**	**St. Dev.**	**Min.**	**Max.**
Tariff variables					
$\tau_{i,j,t}$	2272198	7.861	14.334	0	3000
$\bar{\tau}_{i,j,t}$	1876855	22.441	22.984	0	3000
Covariates					
$BC_{i,t-1}$	2272198	-0.001	0.020	-0.135	0.089
$y_{i,t-1}$	2272198	27.767	3.024	21.486	35.381
$MP_{i,j}$	2272198	-2.722	3.116	-11.401	21.723
$PTA\_IM_{i,j,t}$	2272198	0.287	0.364	0	1
$Intermed_j$	2209301	0.559	0.497	0	1
$TTB_{i,j,t}$	2272198	0.012	0.107	0	1
$GBC_{i,t-1}$	2272198	0.000	0.013	-0.050	0.032
$\Delta IM_{i,j,t-1}$	2006312	0.056	1.015	-14.094	16.299
$sd\Delta IM_{i,j,t-1}$	2197317	0.821	0.796	0.000	15.318
$IM^{share}_{i,j,t-1}$	2085867	0.017	0.050	0	1
Instruments					
$\eta^{IM}_{i,j}$	1559363	1.559	2.202	0	28.906
η^{EX}_{j}	1618600	36.696	170.840	0.442	6800.288
Other					
$Unbound_{i,j,t}$	2272198	0.174	0.379	0	1
$ZeroBinding_{i,j,t}$	2272198	0.105	0.307	0	1
$e^{m}_{i,j}$	1707777	-3.396	15.043	-372.246	0.000
Aggregate data					
$\tau^{simple}_{i,t}$	763	8.637	5.483	0.000	33.710
$\tau^{weighted}_{i,t}$	656	6.467	4.246	0.000	24.540
$BC_{i,t-1}$	763	-0.001	0.020	-0.114	0.089
$y_{i,t-1}$	763	27.262	2.962	21.517	35.381
$PTA\_IM_{i,t}$	763	0.290	0.255	0.000	0.896

Table A3 (cont): Summary statistics by level of development

	Developed					Developing				
	N	**Mean**	**St. Dev.**	**Min.**	**Max.**	N	**Mean**	**St. Dev.**	**Min.**	**Max.**
Tariff variables										
$\tau_{i,j,t}$	737790	3.374	9.499	0	800.300	1534408	10.018	15.701	0	3000
$\bar{\tau}_{i,j,t}$	643606	8.940	14.520	0.000	800.300	1233249	29.487	23.434	0.000	3000
Covariates										
$BC_{i,t-1}$	737790	0.000	0.019	-0.114	0.070	1534408	-0.001	0.020	-0.135	0.089
$y_{i,t-1}$	737790	28.388	3.028	21.752	34.768	1534408	27.469	2.976	21.486	35.381
$MP_{i,j}$	737790	-1.654	3.901	-10.913	21.723	1534408	-3.236	2.500	-11.401	20.734
$PTA\_IM_{i,j,t}$	737790	0.332	0.367	0	1	1534408	0.265	0.360	0	1
$Intermed_j$	717318	0.546	0.498	0	1	1491983	0.565	0.496	0	1
$TTB_{i,j,t}$	737790	0.016	0.126	0	1	1534408	0.009	0.097	0	1
$GBC_{i,t-1}$	737790	0.000	0.012	-0.036	0.025	1534408	0.000	0.014	-0.050	0.032
$\Delta IM_{i,j,t-1}$	658324	0.034	0.796	-13.774	14.047	1347988	0.067	1.106	-14.094	16.299
$sd\Delta IM_{i,j,t-1}$	719470	0.626	0.669	0.000	15.318	1477847	0.916	0.835	0.000	14.467
$IM^{share}_{i,j,t-1}$	681344	0.038	0.075	0.000	0.999	1404523	0.007	0.027	0.000	1.000
Instruments										
$\eta^{IM}_{i,j}$	551396	1.525	2.221	0.000	28.904	1007967	1.577	2.191	0.017	28.906
η^{EX}_{j}	558589	43.539	216.145	0.442	6800.288	1060011	33.090	141.101	0.442	6800.288
Other										
$Unbound_{i,j,t}$	737790	0.128	0.334	0	1	1534408	0.196	0.397	0	1
$ZeroBinding_{i,j,t}$	737790	0.270	0.444	0	1	1534408	0.026	0.160	0	1
$e^{m}_{i,j}$	519215	-4.617	19.752	-366.046	0.000	1188562	-2.862	12.402	-372.246	0.000
Aggregate data										
$\tau^{simple}_{i,t}$	201	3.250	2.793	0.000	12.600	562	10.563	4.892	0.910	33.710
$\tau^{weighted}_{i,t}$	195	2.630	2.251	0.000	10.360	461	8.090	3.828	0.850	24.540
$BC_{i,t-1}$	201	-0.001	0.021	-0.114	0.070	562	-0.001	0.020	-0.108	0.089
$y_{i,t-1}$	201	27.767	3.133	21.752	34.768	562	27.082	2.881	21.517	35.381
$PTA\_IM_{i,t}$	201	0.374	0.268	0.000	0.850	562	0.260	0.244	0.000	0.896

Notes: See Table A2 for a description of variables and data sources.

Table A4: Robustness: OLS specifications

A: Alternative samples

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$BC_{i,t-1}$	7.490‡	8.726‡	7.951‡	9.571‡	7.821‡	9.657	7.387‡	14.511*	6.214‡	10.211
	(4.443)	(4.690)	(4.254)	(5.016)	(4.517)	(6.216)	(4.390)	(5.124)	(3.674)	(6.567)
$y_{i,t-1}$	-4.127†	-4.407†	-3.975*	-5.032†	-4.557†	-4.490†	-3.833‡	-5.066†	-4.378*	-12.801*
	(1.665)	(1.791)	(1.518)	(1.997)	(1.872)	(1.783)	(1.977)	(2.087)	(1.266)	(3.879)
$MP_{i,j}$	0.001	-0.007†	0.009	0.000	0.001	0.001	0.005	-0.002	0.0000	-0.006
	(0.009)	(0.003)	(0.011)	(0.010)	(0.009)	(0.009)	(0.014)	(0.008)	(0.008)	(0.007)
$PTA\_IM_{i,j,t}$	0.228‡	0.174	0.081	0.278‡	0.250‡	0.241‡	0.145	0.228‡	0.105	1.332*
	(0.133)	(0.146)	(0.132)	(0.147)	(0.136)	(0.134)	(0.142)	(0.133)	(0.136)	(0.408)
N	2272117	2082096	1650786	2029182	2179932	2229259	1561159	1885955	2783768	3102717
R^2	0.8565	0.7693	0.9249	0.8623	0.8564	0.8564	0.8916	0.8482	0.8426	0.7519

B. Cyclicality of tariffs by level of development: developing countries

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$BC_{i,t-1}$	10.530‡	11.955†	10.894†	14.798†	11.367†	12.828‡	9.592‡	17.170*	8.336‡	15.404†
	(5.571)	(5.788)	(5.325)	(6.351)	(5.637)	(7.762)	(5.193)	(6.013)	(4.708)	(7.737)
$y_{i,t-1}$	-7.763†	-8.129†	-8.080*	-12.498*	-10.533*	-7.669†	-6.197‡	-8.923†	-8.367*	-20.711*
	(3.374)	(3.505)	(2.998)	(4.498)	(3.932)	(3.418)	(3.466)	(3.802)	(2.173)	(5.363)
$MP_{i,j}$	-0.008	-0.009‡	0.001	-0.010	-0.008	-0.008	-0.009	-0.010	-0.009	-0.016*
	(0.006)	(0.005)	(0.005)	(0.008)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$PTA\_IM_{i,j,t}$	0.206	0.125	0.001	0.284	0.213	0.230	0.221	0.177	0.139	2.165*
	(0.167)	(0.179)	(0.166)	(0.186)	(0.166)	(0.169)	(0.169)	(0.168)	(0.170)	(0.547)
N	1534359	1425235	1127800	1312011	1496961	1505698	1152466	1268588	1886512	2075337
R^2	0.8693	0.7335	0.9359	0.8774	0.8698	0.8695	0.9198	0.8560	0.8533	0.7678

C. Cyclicality of tariffs by level of development: developed countries

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$BC_{i,t-1}$	-0.258	-0.419	-0.210	-0.348	-0.263	0.141	-0.323	2.071	-0.182	-1.162
	(1.250)	(1.391)	(1.233)	(1.272)	(1.252)	(1.884)	(2.206)	(1.580)	(1.485)	(2.603)
$y_{i,t-1}$	0.549†	0.587†	0.507‡	0.555†	0.701†	0.556‡	0.563	0.357	0.539‡	-0.235
	(0.268)	(0.291)	(0.273)	(0.270)	(0.276)	(0.306)	(0.441)	(0.382)	(0.277)	(0.690)
$MP_{i,j}$	0.011	-0.005	0.019	0.011	0.011	0.011	0.033	0.008	0.011	0.005
	(0.018)	(0.003)	(0.025)	(0.018)	(0.018)	(0.018)	(0.039)	(0.016)	(0.018)	(0.014)
$PTA\_IM_{i,j,t}$	0.283*	0.320*	0.233*	0.284*	0.289*	0.286*	0.215*	0.283*	0.300*	0.423*
	(0.054)	(0.047)	(0.043)	(0.054)	(0.057)	(0.055)	(0.072)	(0.056)	(0.068)	(0.092)
N	737758	656861	522986	717171	682971	723561	408693	617367	897256	1027380
R^2	0.7436	0.8310	0.7728	0.7434	0.7413	0.7429	0.6938	0.7537	0.7275	0.6716

Table A4 (cont.). Robustness: OLS specifications

D. Alternative covariates

	Developing				Developed			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
$BC_{i,t-1}$	11.920‡	11.090†	10.877†	10.572‡	-0.445	-0.364	-0.571	-0.258
	(6.080)	(5.617)	(5.430)	(5.550)	(1.356)	(1.276)	(1.290)	(1.249)
$\Delta IM_{i,j,t-1}$	-0.021				-0.003			
	(0.015)				(0.011)			
$sd\Delta IM_{i,j,t-1}$	-0.009				0.187			
	(0.020)				(0.140)			
$GBC_{i,t-1}$		-34.571				16.822†		
		(22.064)				(7.715)		
$Intermed_j$			-0.808*				-0.178*	
			(0.102)				(0.056)	
$Intermed_j \times BC_{i,t-1}$			-0.588				0.615	
			(2.441)				(0.798)	
$TTB_{i,j,t}$				1.278*				0.166†
				(0.366)				(0.083)
$TTB_{i,j,t} \times BC_{i,t-1}$				-8.753				0.3170
				(11.553)				(2.351)
N	1343566	1534359	1491929	1534359	657218	737758	717282	737758
R^2	0.8602	0.8693	0.8716	0.8693	0.7343	0.7436	0.7392	0.7436

E. Aggregate regressions: simple average tariff

	Overall		Developing		Developed	
	(1)	(2)	(3)	(4)	(5)	(6)
$BC_{i,t-1}$	1.212	3.409	1.394	4.162	1.083	0.410
	(4.100)	(4.116)	(5.481)	(5.415)	(1.562)	(1.601)
$y_{i,t-1}$		-85.470*		-187.920*		6.817
		(25.557)		(42.924)		(6.948)
$PTA\_IM_{i,t}$		-0.810		-1.561		0.470
		(0.871)		(1.089)		(0.416)
N	763	763	562	562	201	201
R^2	0.896	0.898	0.83	0.837	0.987	0.987

F. Aggregate regressions: weighted average tariff

	Overall		Developing		Developed	
	(1)	(2)	(3)	(4)	(5)	(6)
$BC_{i,t-1}$	3.074	3.585	2.910	4.743	5.441	3.734
	(3.842)	(3.880)	(5.305)	(5.319)	(3.326)	(3.361)
$y_{i,t-1}$		-42.837‡		-125.945*		15.310
		(24.763)		(46.857)		(15.046)
$PTA\_IM_{i,t}$		1.320‡		0.881		1.515‡
		(0.795)		(1.017)		(0.869)
N	656	656	461	461	195	195
R^2	0.877	0.878	0.804	0.808	0.911	0.915

Table A4 (cont.). Robustness: OLS specifications

G. Cyclicality of tariffs: market power and import fluctuations

	Low MP	High MP	Low MP	High MP	All	Extreme terciles	Middle tercile	All	Extreme terciles	Middle tercile
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$BC_{i,t-1}$	5.703	12.720‡	-0.089	0.099	14.298†	19.518†	5.816	11.806‡	13.191†	8.063
	(4.788)	(6.675)	(1.184)	(1.307)	(7.168)	(9.112)	(5.339)	(6.840)	(6.070)	(8.690)
$\ln\left(IM^{share}_{i,j,t-1}\right)$					-0.141*	-0.146*	-0.084*			
					(0.027)	(0.039)	(0.028)			
$\Delta IM_{i,j,t-1}$								-0.01	-0.017	0.234
								(0.016)	(0.015)	(0.239)
$sd\Delta IM_{i,j,t-1}$								-0.096	-0.117†	0.003
								-0.059	-0.056	-0.119
N	615347	422058	145320	346623	387016	258244	125108	308443	208441	97574
R^2	0.8945	0.9227	0.8709	0.8077	0.9239	0.8784	0.9823	0.8129	0.8245	0.8194

Definitions	(1)–(2)	(3)–(4)	(5)–(7)	(8)–(10)
Overall sample	All developing countries	All developed countries	Country-product pairs in developing countries that lie in top tercile of $MP_{i,j}$	Country-product pairs in developing countries that lie in top tercile of $\left[e^x_{i,j} + \left\|e^m_{i,j}\right\|\right]^{-1}$
$\tilde{m}_{i,j,t}$	N/A		$IM^{share}_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} IM^{share}_{i,j,t-1}$	$\Delta IM_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} \Delta IM_{i,j,t-1}$
Extreme terciles	N/A		Observations that lie in extreme terciles of $\tilde{m}_{i,j,t}$	
Middle tercile	N/A		Observations that lie in middle tercile of $\tilde{m}_{i,j,t}$	

Notes: Estimation performed by fixed effects OLS. Panel D and G controls include market power, PTA import share and lagged trend of log real GDP. Panels A-D and G include year and country-HS4 fixed effects, Panels E-F include country and year fixed effects. Panels A-D and G use two-way clustered standard errors, clustering by year and country-HS4 sectors. Panels E and F cluster standard errors at the country-level. See analogous table in main text for further details.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table A5: Robustness: alternative definitions

	Developing	Developed	Developing		Developed	
	(1)	(2)	(3)	(4)	(5)	(6)
$BC_{i,t-1}$	0.957†	-0.290	1.089†	1.022†	-0.172	-0.377
	(0.487)	(0.384)	(0.518)	(0.474)	(0.492)	(0.447)
$y_{i,t-1}$	-0.721	0.183	-0.743	-0.683	0.141	0.144
	(0.640)	(0.132)	(0.642)	(0.618)	(0.157)	(0.146)
$MP_{i,j}$	-0.001	0.003	-0.001	-0.001	0.003	0.003
	(0.001)	(0.006)	(0.001)	(0.001)	(0.006)	(0.006)
$PTA\_IM_{i,j,t}$	-0.006	0.083*	-0.006	-0.006	0.080†	0.080†
	(0.036)	(0.031)	(0.036)	(0.036)	(0.034)	(0.034)
N	1377737	443353	1391693	1391693	430147	430147
R^2	0.6210	0.7384	0.6222	0.6221	0.7333	0.7333
Definitions						
Development	Time varying		Time invariant			
BC variable	HP		BK	CF	BK	CF

Notes: Estimation performed by fixed effects PPML. Standard errors clustered at the country-level. HP = Hodrick-Prescott filter, BK = Baxter-King filter, CF = Christiano-Fitzgerald filter. See text for further details.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$

Table A6: Terms of trade explanations: additional specifications

A. Excluding business cycle outliers

	Low MP	High MP	Low MP	High MP	All	Extreme terciles	Middle tercile	All	Extreme terciles	Middle tercile
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$BC_{i,t-1}$	0.571	1.364‡	0.071	0.160	1.463‡	2.085†	0.560	1.244	1.499‡	0.603
	(0.588)	(0.796)	(0.847)	(0.489)	(0.835)	(1.031)	(0.687)	(0.889)	(0.882)	(1.014)
$\ln\left(IM^{share}_{i,j,t-1}\right)$					-0.012*	-0.012‡	-0.007†			
					(0.004)	(0.007)	(0.003)			
$\Delta IM_{i,j,t-1}$								-0.002	-0.002	0.030
								(0.002)	(0.002)	(0.032)
$sd\Delta IM_{i,j,t-1}$								-0.011	-0.014†	0.000
								-0.007	-0.007	-0.016
N	538992	372565	72704	210085	342628	227301	110423	269647	179830	86384
R^2	0.6541	0.6672	0.7816	0.7271	0.6638	0.6573	0.7335	0.6384	0.6624	0.6649
Definitions										
Overall sample	All developing countries		All developed countries		Country-product pairs in developing countries that lie in top tercile of $MP_{i,j}$			Country-product pairs in developing countries that lie in top tercile of $\left[e^x_{i,j} + \left\|e^m_{i,j}\right\|\right]^{-1}$		
$\tilde{m}_{i,j,t}$	N/A				$IM^{share}_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} IM^{share}_{i,j,t-1}$			$\Delta IM_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} \Delta IM_{i,j,t-1}$		
Extreme terciles	N/A				Observations that lie in top or bottom terciles of $\tilde{m}_{i,j,t}$					
Middle tercile	N/A				Observations that lie in middle tercile of $\tilde{m}_{i,j,t}$					

B. Alternative functional forms

	All	Extreme terciles	Middle tercile	All	Extreme terciles	Middle tercile
	(1)	(2)	(3)	(4)	(5)	(6)
$BC_{i,t-1}$	1.028‡	1.225†	0.420	1.122‡	1.295†	0.532
	(0.607)	(0.580)	(0.789)	(0.642)	(0.604)	(0.836)
$\Delta IM_{i,j,t-1}$	-0.002	-0.002	0.003	-0.001	-0.002	-0.006
	(0.002)	(0.002)	(0.025)	(0.002)	(0.002)	(0.020)
$sd\Delta IM_{i,j,t-1}$	-0.015*	-0.016*	-0.009	-0.017*	-0.020*	0.000
	(0.006)	(0.005)	(0.014)	(0.006)	(0.006)	(0.013)
N	276795	185162	88186	287323	191992	91883
R^2	0.6380	0.6608	0.6662	0.6359	0.6577	0.6644
Definitions						
Overall sample	Country-product pairs in developing countries that lie in top tercile of $\left[e^x_{i,j} \times \left\|e^m_{i,j}\right\|\right]^{-1}$			Country-product pairs in developing countries that lie in top tercile of $\left[\ln\left(e^x_{i,j}\right) + \ln\left(\left\|e^m_{i,j}\right\|\right)\right]^{-1}$		
$\tilde{m}_{i,j,t}$	$\Delta IM_{i,j,t-1} - \frac{1}{T}\sum_{t=2000}^{2011} \Delta IM_{i,j,t-1}$					
Extreme terciles	Observations that lie in top and bottom terciles of $\tilde{m}_{i,j,t}$					
Middle tercile	Observations that lie in middle tercile of $\tilde{m}_{i,j,t}$					

Notes: Estimation performed by fixed effects PPML. All specifications include controls for market power, PTA import share and lagged trend of log real GDP and include year and country-HS4 fixed effects. Standard errors clustered at country-level.
‡ $p < 0.10$, † $p < 0.05$, * $p < 0.01$