Aggregate Estimates of Price Effects from Tariffs

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Abstract

This paper uses an aggregate price equation to estimate the effects of tariffs on the non farm price deflator. The Trump tariffs are estimated to have increased the deflator by about 2.2 percent by the first quarter of 2026. A sustained increase in tariffs of $100 billion is estimated to increase the deflator by about 1.4 percent after four quarters.

1 Introduction

It is difficult to estimate price effects from tariffs because of so many details. Only a subset of goods is taxed; tariff rates differ by type of good and country source; timing is sometimes hard to pin down; pass throughs likely differ across goods; and prices may change for other reasons than just tariffs. It is difficult to model all these details. I take a different approach in this paper and ask whether an aggregate price equation can pick up the sum of all the effects. I have used the aggregate price equation in my US macroeconometic model (Fair (2024)). In the latest version of this equation there is a custom cost variable that is the ratio of custom (mostly tariff) revenue divided by nominal imports. Custom revenue will be denoted $CUST$, and $CUST$ divided by nominal imports will be denoted $RCUST$. $CUST$ is from

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Actual Values of $CUST$

Qtr.	$CUST$
2024.1	82.3
2024.2	78.9
2024.3	85.9
2024.4	87.2
2025.1	97.0
2025.2	267.7
2025.3	331.4
2025.4	364.3
2026.1	346.2

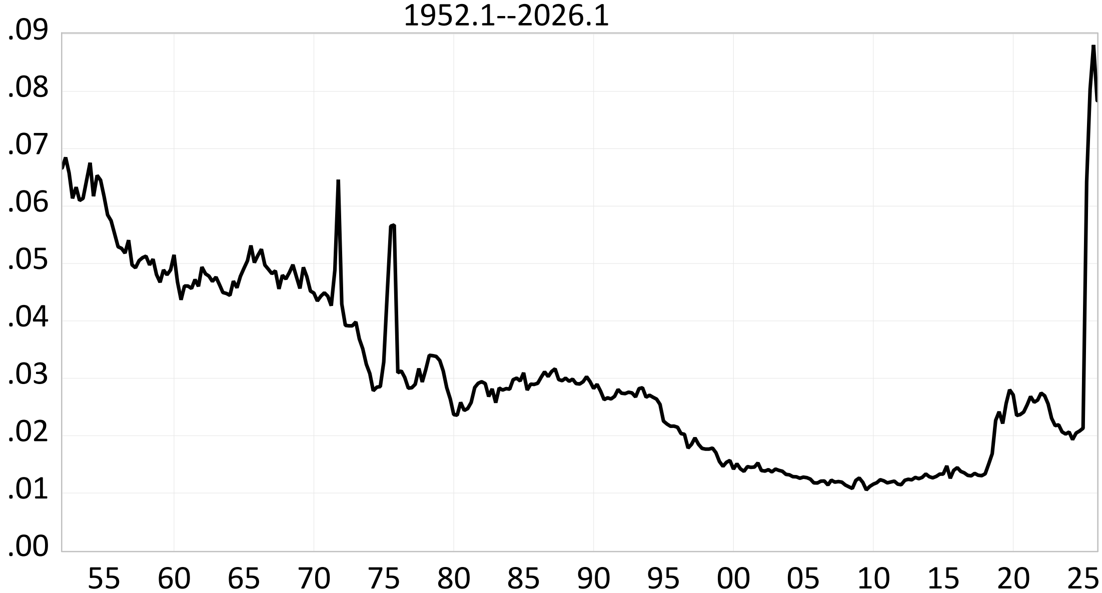
Billions of dollars at an annual rate

the National Income and Product Accounts (NIPA), Table 3.2, line 6. $RCUST$ is statistically significant in the price equation and allows one to compute tariff effects on the aggregate price level.

The values of $CUST$ are listed above for the 2024.1–2026.1 period, and $RCUST$ is plotted in Figure 1 for the 1952.1–2026.1 period. The Trump tariffs stand out in the last four quarters. The two other periods in which tariffs were noticeably increased are the last half of 1971 and 1975. In 1971 this was part of the "Nixon Shock," where on August 15, 1971, a ten percent import surcharge was imposed. The increase in 1975 was part of the Trade Act of 1974, which was implemented in 1975. The aim in this paper is to estimate what the aggregate price level would have been had there been no increase in tariffs in the last three quarters of 2025 and in 2026.1, i.e., had the plot in Figure 1 been flat from 2025.1 on.

As discussed below, the price variable explained is the private non farm price deflator in the NIPA. The question asked is whether tariffs affect the prices that domestic firms charge for their goods and services. Tariffs increase the cost of various imported inputs to domestic firms, and the question is whether firms respond to this by increasing their own (domestic) prices. Tariffs on imported goods that

Figure 1
Custom Revenue/Nominal Imports
1952.1--2026.1



are directly sold to consumers go directly into the consumer price index (CPI) if they are passed on. (The CPI includes imported goods, contrary to the non farm price deflator.) The question here is different. If there are tariffs on imported input goods sold to firms, do firms increase their prices in response and by how much? Since not all of the value of $CUST$ in a given quarter is an input cost to firms, a key assumption in this analysis is that the fraction of input costs in $CUST$ is constant across time.

2 The Literature

As far as I know, there is no study doing what I am doing in this paper. Cavallo et al. (2025) examine the effects of the Trump tariffs on consumer prices. High frequency online price data are collected, both before and after a major tariff event.

These prices include any tariffs. The actual price change in a product after the event is attributed to tariffs or if there is a pre-tariff trend the price change attributed to tariffs is relative to the trend. These estimated price changes can be then be used to estimate the effects of the tariffs on the CPI. Cavallo et al. (2025) estimate that by September 2025, six months after the tariffs began, the CPI was 0.7 percentage points higher. A similar approach is followed in Barbiero and Stein (2025) and Minton and Somale (2025), where generally all of the price change or all of the price change relative to a pre tariff trend is attributed to tariffs. This is obviously a strong identifying assumption since prices move for many reasons, and so the results must be interpreted with caution.

Amiti et al. (2026) estimate the size of the pass through of tariffs to U.S. buyers. They regress the twelve-month log change in import prices exclusive of tariffs (foreign export prices) on the twelve-month log change in one plus the tariff rate using data at the 10-digit Harmonized Tariff Schedule-country level from January 2023 through November 2025. The regression includes product fixed effects and country-date fixed effects. A similar procedure is followed in Gopinath and Neiman (2025), Hinz et al. (2026), and Fajgelbaum and Khandelwal (2026). These studies find that almost all the tariffs are passed through, that the coefficient estimate on the tariff rate variable is close to zero. These studies do not estimate how much of the tariff cost to US buyers is born by consumers versus firms.

3 The Price Equation

A widely cited price deflator in the media is the price deflator for personal consumption expenditures, PCE. This is the price deflator targeted by the Fed. If, however, one is interested in explaining the pricing behavior of agents in the U.S. economy, PCE is not appropriate because it includes import prices (as well as excluding export prices). The same is true of the CPI. Import prices (before tariffs) reflect decisions of foreign agents and the behavior of exchange rates, which are not decision variables of domestic agents. The price deflator used here is the non farm price deflator from the National Income and Product Accounts, denoted PF. It reflects private, domestic decisions.

It is common in the literature to estimate price equations where the LHS variable is the rate of inflation. I have found, however, that the data do not support this specification. The dynamics are wrong. The data support price equations specified in (log) level form.[1] In the price equation considered here, which is in log form,[2] the LHS variable is $\log PF$.

This level specification is consistent with a theory in which the decision variable of a monopolistically competitive firm is the level of its price. If a firm's market share is a function of the ratio of its price to the average price of other firms, the objective of the firm is to choose the optimizing price level. This is the theory behind the price equation.

The price equation includes as explanatory variables the lagged price level, a resource utilization variable, and cost shock variables. The resource utilization variable is the reciprocal of the unemployment rate. Phillips curves are usually specified using the level of the unemployment rate, but it seems likely that there is a nonlinear effect. It is likely that the lower is the unemployment rate the larger is the effect on inflation or the price level from a decrease in the unemployment rate. I have found better results using the reciprocal.

The cost shock variables are the nominal wage rate inclusive of the employer social security tax rate, the price of imports, and $RCUST$ discussed above. The price of imports variable does not include tariffs. The wage rate variable has subtracted from it a measure of potential labor productivity.

The estimated price equation is presented in Table 1. It is equation 10 in my US model. Notation is presented at the bottom of the table. The estimation period

[1] This is documented in Fair (2022) and Fair (2024, Chapter 4), and this discussion will not be repeated here.

[2] Although the variables in the equation are logged, for ease of discussion "log of" will not usually be used when mentioning the variables.

Table 1
Estimated Price Equation: PF
LHS Variable is $\log PF$

RHS Variable	Coef.	t-stat.
$\log PF_{-1}$	0.84824	58.31
$\log[WF(1 + D5G)/LAM]$	0.07611	5.44
constant	-0.01614	-1.22
T	0.00031	11.14
$\log PIM$	0.05196	16.93
$1/UR$	0.00062	7.05
$\log[CUST/(PIM * IM)]$	0.00497	4.19
RHO1	0.27181	4.51
SE	0.00368	
R^2	0.999	

Estimation period is 1954.1-2026.1.
Estimation method is NL2SLS.
Eight dummy variables added, 2020.1–2021.4.

First Stage Regressors

$\log PF_{-1}$, $\log[[WF(1 + D5G)/LAM]_{-1}$, constant, T, $\log PIM_{-1}$, $1/UR_{-1}$, UR_{-1}, $\log[(COG + COS)/POP]_{-1}$, $\log[(TRGH + TRSH)/(POP \cdot PH)]_{-1}$, $\log(EX/POP)_{-1}$, $\log PF_{-2}$,$\log[CUST/(PIM \cdot IM)]_{-1}$, $\log[CUST/(PIM \cdot IM)]_{-2}$

Notation

COG = real purchases of consumption and investment goods, federal government.
COS= real purchases of consumption and investment goods, state and local governments.
$CUST$= nominal custom duties.
$D5G$ = federal employer social security tax rate.
EX = real exports.
IM = real imports.
LAM = potential output per worker hour.
PF = private non farm price deflator.
PH = price deflator for consumption expenditures and housing investment.
PIM = import price deflator.
POP = noninstitutional population 16+.
$RHO1$ = first order serial correlation coefficient.
T = linear time trend.
$TRGH$ = nominal transfer payments, federal government to households.
$TRSH$ = nominal transfer payments, state and local governments to households.
UR = civilian unemployment rate.
WF = average hourly wage rate of workers in the firm sector.

is 1954.1–2026.1. Although the estimates are not presented in the table, eight dummy variables are added to the equation to account for the pandemic. For each quarter between 2020.1 and 2021.4 a dummy variable was constructed that was 1 in that quarter and zero otherwise. The equation is estimated under the assumption of first order serial correlation of the error term. The estimate of the first order serial correlation coefficient is 0.27050 with a t-statistic of 4.49.

The equation is estimated by non linear two-stage least squares (NL2SLS)(non linear because of the serial correlation coefficient). The first stage regressors (FSRs) are listed at the bottom of Table 1. The wage rate, the price of imports, the unemployment rate, and $RCUST$ are all taken to be endogenous. This is to avoid possible contemporaneous correlation between these variables and the error term in the equation. The FSRs are variables in my US model. The FSRs are all lagged at least one quarter and can be assumed to be uncorrelated with the error term left after serial correlation is removed. This is an important point. The NL2SLS coefficient estimates are consistent as long as the lagged values are uncorrelated with the contemporaneous error term in the equation after removal of serial correlation.

The variables are all significant. The wage variable has a t-statistic of 5.44, the price of imports has a t-statistic of 16.93, and $RCUST$ has a t-statistic of 4.19. The reciprocal of the unemployment rate has a t-statistic of 7.05.

The time trend, T, is meant to pick up any trend effects on the price level not captured by the other variables. Adding the time trend to an equation like this is similar to adding the constant term to an equation specified in terms of changes rather than levels. The time trend will also pick up any trend mistakes made in constructing LAM, the measure of potential labor productivity.

The price of imports is a key explanatory variable in the equation. It rose substantially in the 1970's, which explains much of the inflation in this period. A common view in the literature is that price equations (in particular Phillips curves) "broke down" in the 1970's when there was stagflation. In fact, the high inflation in the 1970's is well explained by cost shocks, particularly oil price shocks, which are picked up here by the price of imports. Also, the relative price of imports fell in the 1980's, which is a factor leading to the falling inflation in the 1980's aside from aggregate demand effects. Volcker was help by favorable cost shocks during this period.

One might think that the significance of $RCUST$ is due to the last three quarters of 2025 and 2026.1, but this is not the case. When the equation is estimated only for the 1954.1–2025.1 period, the results are very close. The coefficient estimate of $\log RCUST$ is 0.00554 versus 0.00497 in Table 1, with t-statistics of 3.03 and 4.19 respectively.

The coefficient estimate of the lagged price level in Table 1 is 0.84824 with a t-statistic of 58.31, or a standard error of 0.01455. The t-statistic for the hypothesis that the coefficient is equal to 1.0 is 10.43, which is a strong rejection of the equation in first difference form. This result is robust. When the one-quarter lagged values of the wage rate, the price of imports, the reciprocal of the unemployment rate, and $RCUST$ are added to the equation (to allow them to be in change form), the coefficient estimate of the lagged price level is 0.88418 with a t-statistic of 38.69 and a standard error of 0.02285. The t-statistic for the hypothesis that the coefficient is 1.0 is 5.07.

4 Estimated Tariff Price Effects

One can use the estimates in Table 1 to estimate the effects of the tariffs on the aggregate price level. This can be done by simply changing $CUST$ and examining the effects on PF. The experiment is as follows. From the estimated equation one has estimated residuals for each quarter. Add the estimated residuals to the equation for the 2025.2–2026.1 period and take them to be exogenous. This means that when the equation is solved dynamically for this period using the actual values of all the right hand side variables there is a perfect tracking solution. Now take for the values of $CUST$ for 2025.2–2026.1 the actual value in 2025.1, before the Trump tariffs (97.0 above). Keep the other variables at their actual values except for $\log PF_{-1}$, which is generated dynamically after the first quarter. Solve the equation dynamically using these values. For each quarter the difference between the solution value and the actual value is the estimated effect of the change on PF.

Results are presented in the left half of Table 2. For the four quarters the price level is higher by 0.50 percent in the 2025.2, 1.03 percent in 2025.3, 1.53 percent in 2025.4, and 1.92 percent in 2026.1.

Some of the right hand side variables in the price equation are endogenous. This has been taken into account in the estimation of the equation, but not in the solution. One needs to embed the PF equation in a complete model to account for this. I have done this using my US model. The exact model used is on my website and is estimated through 2026.1. The price equation is part of the model.

The experiment is the same as above except now with the full model. The estimated residuals are added to all the equations in the model for the 2025.2–2026.1 period. This results in a perfect tracking solution using the actual values of all the exogenous variables in the model, including $CUST$. The experiment is then to take for the values of $CUST$ for 2025.2–2026.1 the actual value in 2025.1, before the Trump tariffs. Solve the model dynamically using these values for $CUST$ and the actual values for all the other exogenous variables. For each quarter the difference between the solution value and the actual value is the estimated effect of the change on PF.

The results are presented in the second half of Table 2. As can be seen, the price change is somewhat higher using the full model. The values for the four quarters are 0.54 versus 0.50, 1.14 versus 1.03, 1.73 versus 1.53, and 2.22 versus 1.92.

Regarding these differences, there are two offsetting effects at work using the full model. First, the increased price level (and inflation) triggered by the tariffs leads the Fed to raise the interest rate (through an estimated interest rate rule).

Table 2
Estimated Effects of Trump Tariffs on PF
Percent Deviation in Percentage Points

	Individual	Full Model
2025.2	0.50	0.54
2025.3	1.03	1.14
2025.4	1.53	1.73
2026.1	1.92	2.22

This is contractionary, lowering output and raising the unemployment rate. The higher unemployment rate has a negative effect on PF in the price equation and leads, other things being equal, to a lower price level when the full model is used. Second, there is a wage equation in the model, where prices affect wages and vice versa. This leads, other things being equal, to a higher price level when the full model is used because of the wage/price nexus. The net effect is that the second effect dominates the first, and so the price level is higher when the full model is used.

The price equation can also be used to estimate the effects on an increase in tariffs of a particular amount over time. Say beginning in 2024.4 there is a sustained increase in $CUST$ of \$100 billion. How will this affect PF for the next eight quarters, 2024.4–2026.1? The experiment is the following. Add the estimated residuals to the price equation and take them to be exogenous, resulting in a perfect tracking solution. Then add \$100 billion to $CUST$ for each of the eight quarters and solve dynamically keeping all other variables the same. For each quarter the difference between the solution value and the actual value is the estimated effect of the change on PF. This experiment can also be performed using the whole model, as discussed above. Results for both experiments are presented in Table 3.

Table 3
Estimated Effects of Tariffs on PF
Sustained $100 billion Increase in $CUST$
Percent Deviation in Percentage Points

	Individual	Full Model
2024.2	0.41	0.44
2024.3	0.73	0.81
2024.4	1.00	1.14
2025.1	1.21	1.40
2025.2	1.18	1.42
2025.3	1.13	1.41
2025.4	1.08	1.38
2026.1	1.05	1.36

As in Table 2, the increases in PF in Table 3 are somewhat larger when the full model is used. The full model shows that after four quarters the increase in PF is about 1.4 percent.

5 Conclusion

The NIPA values on tariff revenue ($CUST$) are aggregate estimates for the whole economy. They are the sums of millions of individual tariffs paid. It turns out that this variable is significant in explaining the aggregate price level, assumed to be an input cost variable to firms setting prices. An advantage of the aggregate work here is that one does not have to estimate what is taxed and by how much. In the end it is just the sum of all the taxes.

The variable explained is the private non farm price deflator, PF. It is the appropriate price variable to examine if one is interested in prices set by domestic firms. The results in Table 2 show that the Trump tariffs are estimated to have increased PF by 2.22 percent by 2026.1 (using the full model).

The results also show that a sustained \$100 billion increase in $CUST$ leads to an increase in the non farm price deflator of about 1.4 percent after four quarters.

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