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THE IMPACT OF GLOBALIZATION ON INFLATION IN DEVELOPING COUNTRIES

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This paper examines the impact of globalization on inflation in developing and emerging economies. We estimate both traditional and open-economy versions of the Phillips curve for all developing economies by incorporating both domestic and foreign output gaps. We find mixed results: whether globalization has significantly affected domestic inflation in developing countries depends on the measure of inflation. Under GDP deflator inflation, there has been a significant change in the output-inflation tradeoff, but CPI inflation suggests otherwise. This highlights the importance of paying closer attention to the measure of inflation implemented, which is something that the current literature neglects to do.

Keywords: Inflation, Phillips Curve, Developing Countries
JEL Classification: E31, F41, F10, F30, O11

1. INTRODUCTION

Over the past two decades there has been significant evidence that the inflation process has been changing in various countries across the world. Inflation has become much lower and more stable, and some even argue that inflation has gradually become less responsive to measures of economic activity. Several potential explanations for this phenomenon have been conjectured by researchers in the field: perhaps monetary policy has become more effective, which is further supported by institutional reforms such as central bank independence, or perhaps central bankers have become more anti-inflationary in their policy motives? Furthermore, it is possible that greater transparency of monetary policy communications and improved monetary control capabilities have also contributed to the stabilization of global inflation.

While some or maybe all of these hypotheses may partially explain the improvement in inflation performance in countries around the world, a recent literature has emerged that argues that traditional models of inflation are too "country-centric" as Borio and

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Filardo (2007) phrase it. In other words, most current models of inflation do not take sufficient account of the role that global factors may play in the inflation process, particularly in a world where we have seen a significant increase in international trade and international economic integration, also known as "globalization."

There are several definitions of globalization such as the increase of financial integration between different nations of the world, as well as the simple definition of the increase in the degree of international trade between countries over time. Either way the data clearly show that globalization has surged in the past few decades, which suggests that examination of globalization's effect on inflation has become an increasingly crucial area of research. Indeed, this is something that has even been fiercely debated by key central bankers in recent years: Greenspan (2005) said that globalization "would appear to be (an) essential element of any paradigm of explaining the events of the past ten years," while Bernanke (2007) said "there seems to be little basis for concluding that globalization overall has significantly reduced inflation in the United States in recent years; indeed, the opposite may be true." The jury is clearly still out on what impact globalization has had on worldwide inflation.

To that end, several scholars have researched whether globalization has truly had an impact on domestic countries' inflation processes in recent years. In a primarily non-technical survey of the data, Rogoff (2003) argues that globalization has lowered trend inflation in various countries around the world by reducing price levels as well as making prices more flexible. However econometric examination of the evidence by Ball (2006) instead finds that globalization has had little impact on inflation in the advanced countries of the world, a claim that is further supported by Ihrig et al. (2007). That being said, others have expanded the set of industrial countries that are examined, such as Borio and Filardo (2007) and Eijffinger and Qian (2010), and find that foreign measures of economic activity actually have considerable explanatory power towards domestic inflation, which suggests that globalization has significantly affected the output-inflation tradeoff in these nations.

While this current literature has several interesting debates and insights as to how globalization has impacted inflation, there is one striking area that has been surprisingly ignored by existing researchers. That is, how has globalization affected inflation in the developing countries of the world? Out of the key papers in the prevailing literature, we find no focus on the emerging and developing economies, but instead research on this topic is heavily centered around the advanced and industrialized countries of the world. However, globalization has had an equally large impact on developing countries as it has on advanced economies, which makes the lack of attention paid to these economies an alarming feature that has been omitted by the literature. Indeed, many would argue that the impact of increased international trade may have had an even larger impact on developing economies than advanced ones if the former are more reliant on exports to fuel higher levels of national income.

Therefore this paper seeks to fill this void that exists in the current literature by examining the impact of globalization on inflation in the emerging and developing

economies of the world. Specifically, we estimate Phillips curves for a panel of 146 developing countries from 1970 to 2009 both with and without foreign measures of economic activity. Indeed, we implement the idea of country-specific foreign output gaps as opposed to a generic fixed global output gap which is what current researchers typically do. In addition, we also extend upon current work by estimating both traditional and open-economy versions of the Phillips curve.

The results we get are mixed. In particular, the findings are heavily dependent on which measure of inflation is used in the model. When the consumer price index (CPI) measure of inflation is used, we find that globalization has had very minimal impact on the inflation processes of developing countries. However, when GDP deflator inflation is used we instead find that globalization has had a very large impact on the changes in price levels in the emerging economies of the world. This finding has important interpretations from both theoretical and practical perspectives. Namely, this finding suggests that traditional models of inflation that focus only on domestic measures of economic activity need to be reconsidered. Additionally, if developing economies' inflation rates are reliant on foreign activity variables, this has important practical implications for monetary policymakers in emerging economies.

Our results clearly beg the question as to which inflation measure is most reliable, both in theory and practice. If we think that the GDP deflator is the most accurate way of measuring aggregate prices, then the evidence suggests that developing countries' domestic inflation rates are significantly affected by globalization, whereas if we use CPI inflation then the results show that domestic inflation are still best explained by domestic measures of economic activity. Regardless of which measure of inflation we implement, one thing is clear: the results we get are sensitive to the inflation measure used, which means that at the very least the existing literature must go back and re-assess their evidence in light of both of these measures of inflation since currently researchers focus on only the CPI measure of inflation.

2. BACKGROUND

2.1. Existing Literature

The debate between scholars as to whether globalization has affected inflation is broadly divided into two groups: those who believe that increased trade and financial integration on an international scale has impacted the domestic inflation process, and those who believe that domestic inflation rates are still a function of domestic measures of economic slack.

Rogoff (2003) was one of the first papers in the literature to address this question, where he argues that inflation has been substantially reduced across the world due to globalization. Figure 1 displays the weighted average annual global inflation rate of 189

countries in the world from 1970 to 2009.[1] The figure shows that following the spikes in inflation in the late 1980s and early 1990s, inflation has become substantially lower and more stable in the range of 1 to 2 percent in the 2000s. Rogoff's hypothesis for this pattern is that competition tends to reduce price levels as well as make prices more flexible. This in turn gives central banks less incentive to inflate their own domestic economies, which is why globalization has lowered trend inflation. Rogoff (2003) provides excellent motivation for the topic of globalization and inflation, however his treatment of this subject does not include any econometric examination of the available evidence.

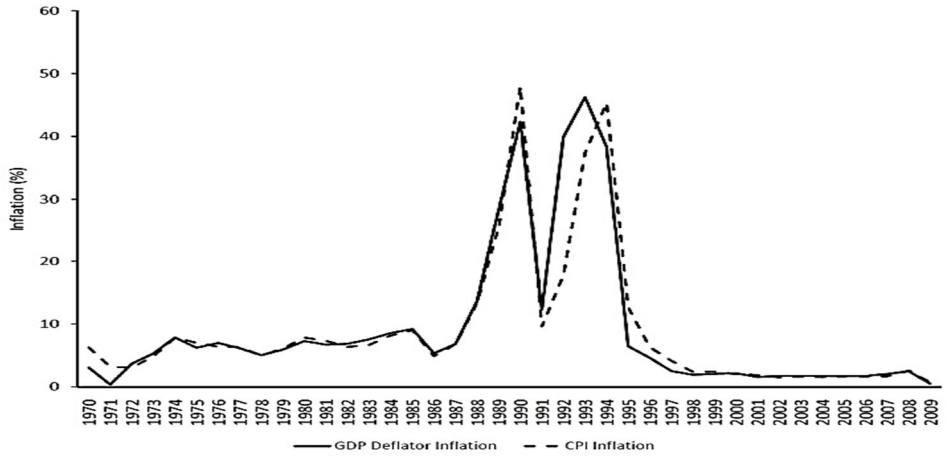

Figure 1. Global Inflation Rates, 1970-2009

Borio and Filardo (2007) tackle the issue more rigorously by estimating the Phillips curve with lagged domestic and foreign output gaps (plus a set of proxies for oil prices, import prices, and other commodity prices) for 16 advanced economies and the Euro area across the time periods of 1972-1992 and 1985-2005 by using pooled generalized least squares and country by country regressions.[2] They find that foreign economic slack has considerable explanatory power towards describing domestic inflation rates, and further still there are some cases where the role of the foreign measure of economic activity exceeds the role of the domestic measures of slack. Badinger (2009) examines 91 countries with a particular focus on OECD nations to examine the output-inflation

[1] Weighted by shares of world real GDP.

[2] Borio and Filardo (2007) do include 12 emerging economies in their measure of the foreign output gap but ignore over 100 other emerging economies, not to mention that emerging economy inflation is not considered.

tradeoff over the period of 1985-2004. Although this paper does not actually estimate the Phillips curve, but rather regresses the log of output on a lag, time trend, and growth rate of output, the author still finds that higher trade and financial openness reduces central banks' inflation bias while simultaneously leading to a larger output-inflation tradeoff. In addition, Eijffinger and Qian (2010) estimate the Phillips curve for OECD nations using ordinary least squares (OLS) and instrumental variables (IV) estimation with a control for the effect of trend inflation on the slope of the Phillips curve, examined for the period of 1970-2000. They find that globalization has significantly changed major industrial nations' output-inflation tradeoffs when time series analysis is conducted, whereas cross-country studies provide contrasting results.

However there are also many researchers who find that globalization has not impacted inflation such as Ball (2006) who estimates the Phillips curve both with and without foreign output gaps for 14 industrialized countries over the period of 1985-2005 using pooled OLS.[3] Ball (2006) concludes that globalization has had little impact on inflation on the major economies of the world, and that the addition of a foreign output gap to a traditional Phillips curve adds a negligible amount to the fit of the model. Similarly, Ihrig et al. (2007) estimate a Phillips curve with domestic and foreign output gaps plus import price inflation for 11 industrial countries of the OECD over the time period of 1977-2005, where estimation is conducted by country-by-country OLS as well as pooled OLS. Ihrig et al. (2007) find that globalization has not increased the role of international factors on domestic inflation rates. In fact, the authors determine that the foreign output gap in the Phillips curve often is either insignificant or of the wrong sign. Additionally, they find that domestic inflation rates are not more responsive to import price inflation. Guilloux and Kharroubi (2008) adopt an intra-industry trade approach to estimating the Phillips curve for OECD nations for the period of 1980-2005 using panel generalized methods of moments (GMM) estimation. Guilloux and Kharroubi (2008) conclude that the volume of trade has not had a big impact on inflation, although there is some evidence that the change in the nature of goods traded is a way in which globalization can affect inflation. Finally, Calza (2009) conducts OLS estimation of the Phillips curve with lagged domestic and foreign output gaps for predominantly Euro area and advanced nations, while also checking for potential breaks in the model from 1979-2003. He finds limited evidence that global capacity constraints have explanatory power for domestic inflation. Thus his policy recommendation is that central banks should not react to global output gaps.

Whichever side of the debate sounds more convincing, two notable themes emerge from the literature. First, there is an almost exclusive focus on advanced or industrial economies of the world, with little-to-no attention given to emerging and developing economies. Second, all of these papers mentioned above use the CPI price index to construct measures of inflation, and almost no attention is given to inflation measured with the GDP deflator price index. However, examination of papers that look at inflation

[3] Ball (2006) also estimates a Phillips curve with trade, which does not produce strong results.

dynamics within a country (such as in the New Keynesian Phillips curve literature, for example Gali and Gertler, 1999, and Mazumder, 2010), GDP deflator inflation is frequently considered as the primary measure of inflation. At the very least, GDP deflator inflation is conspicuous in its absence in the literature concerning globalization and inflation.

2.2. Globalization in Developing Countries

The impact of globalization in developing countries is not something that has gone without any attention in the economic development literature. For instance, Solimano (2001) and Rogoff et al. (2004) emphasize the importance of reshaping institutions in developing countries in order to reduce macroeconomic volatility that might result from increased global economic integration. Likewise Schmukler (2004) stresses the importance of a well regulated financial system in developing nations for the purpose of enjoying the benefits of globalization instead of suffering from it. Goldberg and Pavcnik (2007) address the issue of income inequality in developing countries in light of globalization, while Rudra (2002) examines the impact of globalization on welfare spending in emerging economies. In terms of globalization's effect on incomes, Yusuf (2003) argues that international economic integration is highly beneficial for developing nations since it allows them to improve technologies to increase per capita income.

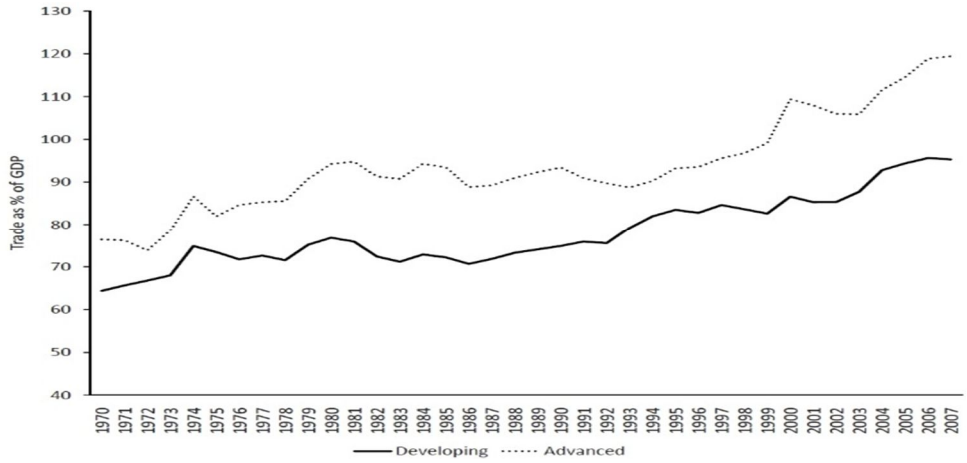

Figure 2. Advanced & Developing Economies Trade-to-GDP Ratios, 1970-2007

On the other hand, Nunnenkamp and Spatz (2002) find that increases in foreign direct investment in emerging markets due to globalization are modest at best. While many other such authors have examined changes in developing economies in response to

globalization, none have investigated the impact on inflation in these nations.

Our motivation for examining the impact of globalization on inflation in developing and emerging economies is straightforward once we examine the evidence of increased international trade since the 1970s. Figure 2 shows the trade-to-GDP ratios of 189 countries from 1970 to 2007, where the data are gathered from the Penn World Tables (PWT 6.3), where countries are divided into advanced and emerging/developing economies, using the groupings set in place by the International Monetary Fund's (IMF) World Economic Outlook database (IMF, 2010), which gives us 146 developing countries in our sample.

The figure shows that although the level of trade-to-GDP is certainly higher in advanced countries, the growth rate and general upward trend of the data have been approximately the same between the two groups. Specifically trade-to-GDP ratios have increased by 48 percent in developing countries and by 56 percent in advanced economies over the time period examined. This can be seen even more clearly if we plot the de-meaned trade-to-GDP ratios separately (seen in Figure 3), where we see how similarly international trade has grown between advanced and developing economies over the past forty years. This in turn implies that it is just as important to investigate the impact of globalization on inflation in developing countries as it is in advanced countries, not to mention that those developing nations that are reliant on exports for their national income are very sensitive to changes in patterns of trade. Hence we may also see that those developing economies that are heavily reliant on trade may have experienced a larger impact from globalization on their domestic inflation rates.

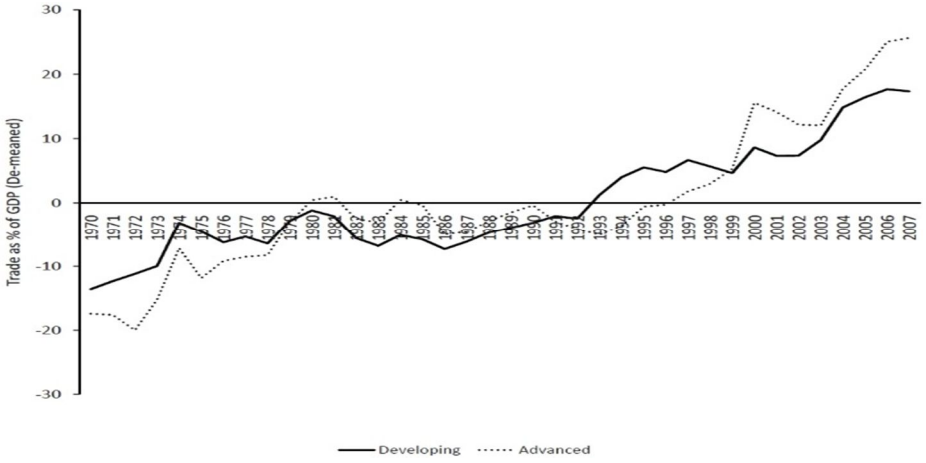

Figure 3. Advanced & Developing Economies Trade-to-GDP Ratios (De-meaned), 1970-2007

3. THE PHILLIPS CURVE

The baseline theoretical model (which we refer to as the 'domestic Phillips curve') that we examine in this paper is the same Phillips curve as outlined in Ball (2006):

$$\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \varepsilon_t, \quad (1)$$

where π_t is the domestic inflation rate, $\Delta\pi_t = \pi_t - \pi_{t-1}$, y_t is the domestic output gap, and ε_t is the error term. In addition we estimate the model with the foreign output gap, y_t^f ('foreign Phillips curve'), and with both domestic and foreign output gaps simultaneously ('global Phillips curve'):

$$\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \varepsilon_t, \quad (2)$$

$$\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \alpha_2 y_t^f + \varepsilon_t. \quad (3)$$

By comparing (3) with (1) and (2), not only can we draw inferences from the relevant t-statistics, but we can also see how much the foreign output gap adds to the fit of the model in terms of the increase in $\bar{R}^2$.[4] In addition to estimating the model as in (1), (2), and (3), we also estimate open-economy versions of the Phillips curve which adds the first difference of the real exchange rate, Δe_t, as an explanatory variable.

Finally, we also allow for the fact that the output gap (both domestic and foreign) could impact domestic inflation with a lag, as is assumed to be the case in Borio and Filardo (2007) and Calza (2009). Therefore we repeat the same estimations as described above, but also include one lag of the domestic output gap and/or the foreign output gap.

4. Data & Estimation Methodology

Data for the GDP deflator index, CPI price index, real GDP, and real exchange rates for 189 countries from 1969 to 2009 are obtained from the International Macroeconomics Data Set of the United States Department of Agriculture (USDA), who in turn compile their data from the World Bank's World Development Indicators, the IMF's International Financial Statistics, and the USDA's Economic Research Service. As mentioned in section 2.2, 146 of these countries are counted as 'developing and emerging economies' as classified by the IMF's current World Economic Outlook database. In addition, data on import and export volumes are obtained from the IMF. Table 1 contains a full description of the data used and their sources.

[4] Note that we refer to the class of models without real exchange rates as the traditional Phillips curve.

Table 1. Data Description

Variable	Description	Source
π_t	GDP Deflator Inflation-the % change in annual GDP Deflator index	USDA
π_t	Consumer Price Index (CPI) Inflation-the % change in annual CPI index	USDA
y_t	Domestic Output Gap. HP Detrended Log Real GDP	USDA
y_t^f *(ver. 1)*	Foreign Output Gap (country-specific). Weighted average of domestic output gaps (excluding country in question) weighted by each country's share of world real GDP	USDA
y_t^f *(ver. 2)*	Foreign Output Gap (country-specific). Weighted average of domestic output gaps (excluding country in question)	USDA, IMF
Δe_t	First difference of real exchange rate between each country and the U.S.	USDA

Inflation is defined as the percentage change in the annual price index that is used, while the domestic output gap is the HP detrended log of real GDP. The foreign output gap computed in this paper is country-specific, unlike the fixed global output gap that is used by the majority of the literature (for example, Ihrig et al. (2007) estimate a time-varying weighted average of domestic output gaps for a fixed group of 35 trading partners). The foreign output gap is the weighted average of domestic output gaps, where two different weighting schemes are applied.[5] First we weight domestic output gaps by each country's share of world real GDP, and second we weight by each country's share of world trade. For each country considered, their foreign output gap is therefore the weighted average of the other 188 countries' domestic output gaps, where the country whose foreign output gap we are computing is excluded. This process is then applied to all 189 countries in the sample.

The models mentioned in section 3 are then estimated using pooled OLS, in keeping with what the majority of the literature uses.[6] While some authors such as Eijffinger and Qian (2010) estimate the Phillips curve with IV estimation, we find their reasoning for doing so to be weak. In particular these authors argue that there is potential for reverse causality between inflation and the output gap. However arguing that low inflation can spur an increase in the deviation of actual output from its potential is not obvious and without any theoretical support. For this reason we estimate the model with pooled OLS as is typically done in the literature, and do not use instrumental variables.

[5] These weighting schemes are used by Borio and Filardo (2007) as well, who also consider three other weighting schemes for which we do not have data to implement in this paper.

[6] White robust standard errors are used, with an AR(1) correction for serial correlation. In addition, variables are tested for unit roots on a country-by-country basis, where we find no evidence of non-stationarity.

5. RESULTS

5.1. GDP Deflator Inflation

The evidence based on GDP deflator prices suggests that globalization has had a big impact on inflation in developing nations. Consider the results in Table 2 which estimates the traditional Phillips curve with no lags of the output gap. In the case of the domestic Phillips curve (Table 2 (a)) we find that the coefficient on y_t is barely significant at the 10 percent level, while the R^2 achieved is extremely low at 0.0611. Nonetheless we find the coefficient on the output gap (and the foreign output gap in the global Phillips curve) to be positive in all regressions, matching our a priori expectations. Contrasting this to the foreign Phillips curve, we see that the foreign output gap does much better both in terms of the $\bar{R}^2$ obtained and t-statistics on the output gap coefficient.

Table 2. GDP Deflator Inflation, Phillips Curve Results, No Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.6214	0.8322	25.3759	3.4201	-1.1751
	(1.2339)	(1.1231)	(1336.960)	(14.9280)	(3.7768)
α_1	0.0732*	1.1447***	0.3853***	0.1127***	0.1097***
	(0.0441)	(0.3261)	(0.0998)	(0.0435)	(0.0413)
α_2				1.1857***	0.3981***
				(0.3207)	(0.0941)
Adj-R^2	0.0611	0.1976	0.3334	0.3028	0.4622
% Increase in Adj-R^2 vs. (a)		223.40%	445.66%	395.58%	656.46%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^f + \varepsilon_t$. Pooled OLS with White robust standard errors are used. An AR(1) correction is also applied to correct for serial correlation. *, **, and *** denote 10, 5, and 1% levels of significance for all tables in this paper.

Indeed, if we consider how the addition of y_t^f impacts the domestic Phillips curve (global Phillips curve in Table 2 (c)), we see that adding the foreign output gap significantly changes the output-inflation tradeoff. With the GDP share-weighted measure of y_t^f, the $\bar{R}^2$ improves by 395.6%, while the domestic and foreign output gaps have t-statistics of 2.59 and 3.70 respectively. Moreover, the magnitude of the coefficient on y_t^f far outweighs that of y_t suggesting that the foreign output gap not only achieves a higher level of statistical significance, but that it also is more economically significant as well. In particular, these results show that a percentage point increase in the foreign output gap increases domestic inflation in developing countries by over one percentage point, while a percentage point increase in the domestic output

gap increases domestic inflation by a shade higher than a tenth of one percentage point. We get even stronger results if we consider the trade-weighted measure of y_t^f where the $\bar{R}^2$ increases by a massive 656.5%, with t-statistics for y_t and y_t^f of 2.65 and 4.23 respectively. Therefore these results strongly suggest that if the GDP deflator measure of inflation is used, that the output-inflation tradeoff has significantly changed in response to foreign measures of economic slack. In other words, globalization has significantly impacted inflation in the emerging and developing economies of the world.

Examining the results with lagged output gaps in the model (Table 3) we see that some lags of the output gaps are statistically significant, but overall we do not find any new inferences to those obtained with the case of contemporaneous output gaps. However, we do find that the range of improvement in the $\bar{R}^2$ by adding y_t^f and y_{t-1}^f to the domestic Phillips curve increases even more: adding these regressors improves the $\bar{R}^2$ by 618.9 and 947.9% respectively for the GDP share- and trade-weighted measures of the foreign output gap; both of which are clearly very large improvements in the coefficient of determination.

Table 3. GDP Deflator Inflation, Phillips Curve Results, Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	0.1982	0.1934	0.1896	0.1702	0.1323
	(0.2120)	(0.2510)	(0.2848)	(0.2124)	(0.2275)
α_1	0.0795*	1.1685***	0.3862***	0.1080**	0.1080**
	(0.0465)	(0.3425)	(0.1010)	(0.0463)	(0.0460)
α_2	0.1022**	0.8869	0.3537**	0.1289***	0.1294***
	(0.0451)	(0.5416)	(0.1519)	(0.0459)	(0.0458)
α_3				1.3233***	0.4123***
				(0.3463)	(0.1042)
α_4				1.0993***	0.4435***
				(0.4363)	(0.1286)
Adj-R^2	0.0407	0.1779	0.3105	0.2926	0.4265
% Increase in Adj-R^2 vs. (a)		337.10%	662.90%	618.92%	947.91%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \alpha_2 y_{t-1}^f + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \alpha_3 y_t^f + \alpha_4 y_{t-1}^f + \varepsilon_t$.

Lastly if we consider the open-economy versions of the model, both with and without lagged output gaps (Tables 4 and 5), we find that the addition of Δe_t is still not important to the model. This indicates that the open-economy extension to the traditional Phillips curve is not as important as several authors have conjectured to be the case All of the results obtained with GDP deflator inflation, both the traditional and open-economy versions of the model and with and without lags, suggest that globalization has been an important factor when it comes to domestic inflation processes

in developing countries. In other words, increasing international trade and financial integration has significantly impacted the output-inflation tradeoff that exists in these economies. Theoretically, these results point towards macroeconomic models of inflation that do not only consider domestic measures of economic activity, but foreign measures also. While from a practical perspective, monetary policymakers in developing countries must pay greater attention to global factors when conducting their own domestic monetary policies.

Table 4. GDP Deflator Inflation, Open-Economy Phillips Curve Results, No Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.6214	0.8322	25.2728	3.4211	-1.1752
	(1.2340)	(1.1232)	(1326.024)	(14.9405)	(3.7775)
α_1	0.0732*	1.1447***	0.3853***	0.1127***	0.1097**
	(0.0441)	(0.3261)	(0.0998)	(0.0435)	(0.0413)
α_2	-0.0004	0.0015	0.0146	1.1857***	0.3981***
	(1.2712)	(1.8682)	(1.5945)	(0.3207)	(0.0941)
α_3				-0.0186	0.0044
				(1.6437)	(1.4774)
Adj-R^2	0.0431	0.1796	0.3154	0.2848	0.4442
% Increase in Adj-R^2 vs. (a)		316.71%	631.79%	560.79%	930.63%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 \Delta e_t + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \alpha_2 \Delta e_t + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^f + \alpha_3 \Delta e_t + \varepsilon_t$.

Table 5. GDP Deflator Inflation, Open-Economy Phillips Curve Results, Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	0.1983	0.1935	0.1897	0.1704	0.1324
	(0.2121)	(0.2510)	(0.2849)	(0.2125)	(0.2276)
α_1	0.0795*	1.1685***	0.3862***	0.1080**	0.1081**
	(0.0466)	(0.3426)	(0.1010)	(0.0463)	(0.0460)
α_2	0.1022**	0.8862	0.3537**	0.1289***	0.1294***
	(0.0451)	(0.5416)	(0.1519)	(0.0459)	(0.0458)
α_3	0.0666	0.0678	0.0285	1.3223***	0.4123***
	(2.2636)	(2.3151)	(2.3062)	(0.3463)	(0.1042)
α_4				1.0995**	0.4435***
				(0.4364)	(0.1286)
α_5				0.0915	0.0418
				(2.2768)	(2.2972)
Adj-R^2	0.0222	0.1594	0.2920	0.2742	0.4081
% Increase in Adj-R^2 vs. (a)		618.02%	1215.32%	1135.14%	1738.29%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \alpha_3 \Delta e_t + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \alpha_2 y_{t-1}^f + \alpha_3 \Delta e_t + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \alpha_3 y_t^f + \alpha_4 y_{t-1}^f + \alpha_5 \Delta e_t + \varepsilon_t$.

5.2. CPI Inflation

Next let us consider the results we get with the CPI measure of inflation. Table 6 contains the pooled OLS results for 146 developing countries' traditional Phillips curve, assuming that the output gaps enter contemporaneously into the model. Unsurprisingly as Table 6 (a) shows, the domestic Phillips curve that regresses the change in domestic in inflation on the domestic output gap produces a positive and significant coefficient on the output gap. In other words, there is significant output-inflation tradeoff when domestic output and inflation are considered.

Table 6. CPI Inflation, Phillips Curve Results, No Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.0225***	-0.0825**	-0.1161**	-0.0577	-0.0839
	(0.0080)	(0.0373)	(0.0491)	(0.0366)	(0.0524)
α_1	0.2063**	-0.6379*	0.1978**	0.2000**	0.2017**
	(0.0826)	(0.3426)	(0.0928)	(0.0823)	(0.0841)
α_2				-0.3211	0.1173
				(0.3295)	(0.1018)
Adj-R^2	0.1300	0.1287	0.1286	0.1298	0.1298
% Increase in Adj-R^2 vs. (a)		-0.98%	-1.01%	-0.09%	-0.09%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^f + \varepsilon_t$.

Table 7. CPI Inflation, Phillips Curve Results, Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.0406***	-0.1689***	-0.0866***	-0.0953	0.0565
	(0.0152)	(0.0604)	(0.0298)	(0.0595)	(0.0653)
α_1	-0.5043	-0.0155	0.2265*	-0.5203	-0.5294
	(0.4313)	(0.3993)	(0.1313)	(0.4416)	(0.4486)
α_2	0.9525*	1.1970**	-0.0736	0.9595*	0.9793*
	(0.5536)	(0.5543)	(0.1145)	(0.5676)	(0.5721)
α_3				0.6499	0.3139
				(0.6063)	(0.2284)
α_4				-0.1261	-0.4350
				(0.7828)	(0.3095)
Adj-R^2	0.1435	0.1289	0.1285	0.1433	0.1437
% Increase in Adj-R^2 vs. (a)		-10.17%	-10.44%	-0.12%	0.15%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \alpha_2 y_{t-1}^f + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \alpha_3 y_t^f + \alpha_4 y_{t-1}^f + \varepsilon_t$.

If we then consider the foreign Phillips curve where the foreign output gap alone is considered as the regressor (Table 6 (b)), we find that the coefficient on y_t^f is actually negative and significant for the GDP share-weighted measure of the foreign output gap. When using the trade-weighted measure instead, we obtain the correct positive sign and also see statistical significance is achieved. If we then examine the contribution of y_t^f to the basic domestic model (Table 6 (c)) we find that adding the foreign output gap does not improve upon the domestic Phillips curve. In particular, the domestic Phillips curve achieves an $\bar{R}^2$ of 0.1300, but in the global Phillips curve the $\bar{R}^2$ actually falls by a small amount, and the coefficient on the foreign output gap is statistically indistinguishable from zero. These results strongly suggest that domestic inflation rates in developing nations are best described by domestic measures of economic slack, and therefore globalization has not had an impact on inflation in these economies.

Indeed, we find similar inferences when we consider the model with the addition of lagged output gaps, as seen in Table 7. In these results we see that adding lags at best only marginally improves the fit of the model as compared to Table 6. For instance adding a lag of the domestic output gap increases the $\bar{R}^2$ by a mere 0.0135. Moreover we find that the domestic output gap or its lag often produces the wrong coefficient sign in these results, although these coefficients are never statistically significant and can thus be discounted. This suggests to us that using the lagged output gap in place of the contemporaneous output gap is not an important issue, at least from an empirical perspective. Once again we also see that adding either the GDP share-weighted or trade-weighted measure of the foreign output gap to the domestic Phillips curve does not do too much to improve the fit of the model. In the former case, $\bar{R}^2$ falls and in the latter case it rises by a negligible 0.0002 (or 0.15%). Furthermore y_t^f and y_{t-1}^f do not produce significant coefficients in the global Phillips curve.

Finally if we consider the open-economy results (both with and without lags-Tables 8 and 9), we see that the coefficient on Δe_t is never statistically significant, just as was the case with CPI inflation.

For robustness, we also take the main results of the paper (Tables 2 and 6) and re-estimate these regressions using fixed effects estimation (with country fixed effects). These results can be seen in Table 10, where we obtain virtually identical inferences as we get with the pooled OLS regressions. The primary results in this paper are therefore quite robust to the estimation method implemented.

With the GDP deflator measure of inflation, globalization has had a massive impact on inflation in emerging economies. The role of foreign measures of economic slack appear to far outweigh the importance of domestic measures of economic activity, and contribute a large amount to the fit of the model to the data. However, the results we get under the CPI measure of inflation are starkly different to those obtained under GDP deflator inflation. With CPI inflation, globalization appears not to have impacted inflation in developing countries.

Table 8. CPI Inflation, Open-Economy Phillips Curve Results, No Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.0230***	-0.0829**	-0.1165**	-0.0580	-0.0843
	(0.0080)	(0.0373)	(0.0492)	(0.0365)	(0.0525)
α_1	0.2063**	0.6377*	01979**	0.2000**	0.2017**
	(0.0826)	(0.3426)	(0.0928)	(0.0823)	(0.0841)
α_2	-0.1710	-0.1599	-0.1907	0.3210	0.1173
	(0.2348)	(0.2206)	(0.2168)	(0.3295)	(0.1018)
α_3				-0.1584	-0.1742
				(0.2346)	(0.2319)
Adj-R^2	0.1298	0.1285	0.1285	0.1297	0.1297
% Increase in Adj-R^2 vs. (a)		-0.98%	-1.01%	-0.09%	-0.09%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 \Delta e_t + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \alpha_2 \Delta e_t + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^f + \alpha_3 \Delta e_t + \varepsilon_t$.

Table 9. CPI Inflation, Open-Economy Phillips Curve Results, Lags

	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.0411***	-0.1692***	-0.0871***	-0.0958	0.0560
	(0.0154)	(0.0603)	(0.0298)	(0.0594)	(0.0652)
α_1	-0.5043	-0.0155	0.2265*	-0.5203	-0.5294
	(0.4313)	(0.3993)	(0.1313)	(0.4416)	(0.4486)
α_2	0.9525*	1.1968**	-0.0736	0.9595*	0.9793*
	(0.5536)	(0.5543)	(0.1145)	(0.5676)	(0.5722)
α_3	-0.2220	-0.1034	-0.1854	0.6499	0.3139
	(0.2843)	(0.2174)	(0.2168)	(0.603)	(0.2284)
α_4				-0.1264	-0.4350
				(0.7830)	(0.3096)
α_5				-0.2055	-0.1961
				(0.2914)	(0.2829)
Adj-R^2	0.1433	0.1287	0.1283	0.1432	0.1435
% Increase in Adj-R^2 vs. (a)		-10.18%	-10.46%	-0.12%	0.15%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \alpha_3 \Delta e_t + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \alpha_2 y_{t-1}^f + \alpha_3 \Delta e_t + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_{t-1} + \alpha_3 y_t^f + \alpha_4 y_{t-1}^f + \alpha_5 \Delta e_t + \varepsilon_t$.

Table 10. GDP Deflator and CPI Inflation, Fixed Effects Results

GDP Deflator Inflation					
	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.5815	0.8312	22.0595	3.9791	-1.0840
	(1.1189)	(1.1208)	(1007.113)	(20.3080)	(3.3700)
α_1	0.0726	1.1448***	0.3854***	0.1127***	0.1097***
	(0.0441)	(0.3260)	(0.0998)	(0.0435)	(0.0413)
α_2				1.1812***	0.3967***
				(0.3203)	(0.0940)
Adj-R^2	0.0006	0.0020	0.0034	0.0031	0.0048
% Increase in Adj-R^2 vs. (a)		215.71%	432.35%	383.98%	639.66%
CPI Inflation					
	Regression (a)	Regression (b)		Regression (c)	
Foreign Output Gap:		GDP-share weighted	Trade-Weighted	GDP-share weighted	Trade-Weighted
α_0	-0.0226	-0.0825	-0.1161	-0.0576	-0.0839
	(0.4201)	(0.4264)	(0.4367)	(0.4258)	(0.4361)
α_1	0.2065***	-0.6379	0.1979	0.2002***	0.2020***
	(0.0689	(0.6198)	(0.2217)	(0.0700)	(0.0695)
α_2				-0.3206	0.1172
				(0.6287)	(0.2232)
Adj-R^2	0.1066	0.1053	0.1052	0.1065	0.1065
% Increase in Adj-R^2 vs. (a)		-1.23%	-1.27%	-0.11%	-0.11%

Notes: (a) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \varepsilon_t$, (b) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t^f + \varepsilon_t$, (c) $\Delta\pi_t = \alpha_0 + \alpha_1 y_t + \alpha_2 y_t^f + \varepsilon_t$.

6. DISCUSSION

The results presents in sections 5.1 and 5.2 then clearly beg the question: which of GDP deflator or CPI inflation do we think most accurately measures prices? Basic macroeconomic theory suggests that there is a subtle difference between how the two indexes measure general price levels in an economy. We know that the basic CPI measure looks at the price changes for a fixed basket of goods and services (a Laspeyres index), and examines the changes in prices for the given basket from year to year. On the other hand, the GDP deflator looks at the ratio of nominal to real GDP, which implicitly uses a flexible basket of goods and services that depend on the quantities of goods and services produces within a given year, while the price of these commodities are fixed (a Paasche index).

Therefore three notable differences emerge from the GDP deflator and CPI measures of the price level. First, the GDP deflator measures the price of all goods and services, whereas the CPI measures the prices of only goods and services purchased by consumers. From this standpoint, one can easily argue that the GDP deflator is the superior measure of prices. Indeed this may be one of the reasons why we get

contrasting results from CPI and GDP deflator inflation; perhaps the inclusion of non-consumer prices in the GDP deflator price index is picking up important changes in the price level that is ignored by the CPI. Second, the GDP deflator includes only goods produced domestically, something which is accounted for in the CPI. In other words, purchases of goods and services from overseas are not included in GDP deflator prices. From this perspective, it appears that CPI may be the better measure of prices. This certainly suggests that one primary mechanism that explains the difference between our GDP deflator and CPI inflation results is imported goods. The behavior of import prices, and indeed the possible role of exchange rate pass-through may be driving some of the results we find in this paper. Third, is the way in which these measures weight goods and services: the CPI imposes fixed weights, while the GDP deflator assigns changing weights. In practice, since statistical agencies often update the typical basket of goods and services purchased by consumers, the differences caused by these weighting schemes are often very small.

Thus the theory tells us that the GDP deflator and CPI measures of prices both have advantages and disadvantages associated with them. From a practical perspective, what then is the difference between the two measures? Consider Figure 1 again, which displays the weighted average inflation rates for developing counties from 1970 to 2009. At first glance it appears that both of these measures of inflation are very similar; indeed the correlation between the two series is 0.9331. However closer inspection of the data reveals that there is some dispersion between the CPI and GDP deflator measures of inflation in the first half of the 1990s. This therefore is a good candidate as to why we get such different results between the two measures of inflation tested in this paper: that is, the behavior of changing prices in the early 1990s may be key as to how globalization has affected inflation in emerging and developing economies. In addition, since this figure shows us the weighted average of inflation rates, we must also acknowledge that there are in-country deviations of CPI and GDP deflator inflation measures that have been smoothed away in this figure, which might explain the divergence in our results between the alternative measures of inflation.

One issue that might be of particular relevance with regards to the differences between GDP deflator and CPI prices for developing nations is measurement errors. Typically GDP deflators tend to put greater weight on the price of investment goods and prices of government spending, whereas CPI measures may be overly biased towards urban consumers. This might be even further exaggerated in emerging and developing economies. Future research is certainly needed to understand this issue further, and investigate what biases are inherent in the two alternative measures of aggregate prices in developing countries.

Lastly, we can also consider the type of inflation measure that is typically used by inflation researchers. In the New Keynesian Phillips Curve (NKPC) literature that estimates short- run inflation dynamics assuming rational expectations, we see that for economies such as the United States, the GDP deflator is usually used as the price index from which inflation is derived. Indeed some of the key papers in the NKPC literature,

such as Gali and Gertler (1999) and Sbordone (2002), measure inflation as the percentage change in the GDP deflator and do not even consider the CPI measure of inflation. Thus it seems strange to us that when it comes to the existing research that examines globalization's impact on inflation, that only the CPI measure of inflation is used. At a minimum, the findings of this paper provide strong evidence that the existing literature on this topic must go back and check whether their conclusions are robust to the GDP deflator measure of inflation.

7. CONCLUSION

Over the past four decades globalization has had a large impact in the international economic integration of countries all over the world. In particular, the evidence shows us that both advanced and developing economies have seen increases in their trade-to-GDP ratios of approximately fifty percent from 1970 to 2009. In light of this increasing interdependency between different economies, many macroeconomic researchers have conjectured that traditional models of inflation that state that domestic inflation depends on domestic measures of economic slack may no longer hold. In other words, globalization implies that foreign measures of economic activity could be playing an ever-increasing role in the determination of short-term domestic inflation rates. This topic has been the subject of a lot of recent research, with several scholars supporting the importance of globalization on inflation while others yet deny its significance.

However this whole body of existing research has neglected to examine the impact of globalization on inflation in the emerging and developing economies of the world. This is where this paper extends the literature: by estimating both traditional and open-economy Phillips curves for 146 developing countries from 1970 to 2009, by including country-specific measures of the foreign output gap. We find mixed results emerge from the data: if we consider the consumer price index as our measure of price levels, then globalization appears not to have had much impact on domestic inflation in developing nations. However if we use the GDP deflator measure of the price index a strongly contrasting result emerges: globalization actually seems to have had a large impact on domestic inflation processes in emerging economies.

Therefore whether we think globalization has impacted inflation in developing countries or not, is dependent on what measure of prices we select. At the very least, this paper shows that the existing literature should not rely only on the CPI measure of inflation, but instead they must go back and check the sensitivity of their results to alternative measures of inflation. If they also find their results to differ according to what price indexes are used, this must re-open the global debate as to whether globalization has changed inflation in recent years.

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