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The Global Slack Hypothesis

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In recent years, a number of monetary policymakers have addressed the question of whether greater global economic integration, or globalization, has had a significant impact on inflation in the United States. Focusing on just one dimension of this integration, as the first Chart in your handout shows, imports as a share of GDP have gone from just over 4 percent during the 1950s and 1960s, to more than 18 percent at the most recent peak. While there appears to be broad agreement on the importance of globalization as a real phenomenon - that is, as a phenomenon that affects the location and pattern of real economic activity, along with relative prices and real factor returns - there is less agreement on what globalization means for inflation dynamics and monetary policy in a country as large as the U.S. On one hand there are those who argue that the gap concept that is now relevant for thinking about U.S. inflation is a world-wide measure rather than a domestic one. On the other hand there are those who argue that with a flexible exchange rate regime, the impact of foreign price developments on U.S. inflation is minimal.

Whether greater openness then has implications for inflation, over the medium to long term, depends very much on how monetary policy responds to these developments. Globalization does not alter the fact that at longer horizons, inflation is ultimately determined by the actions of monetary policymakers. Our remarks this morning will focus on the so-called global slack hypothesis, the notion that as a result of globalization, the concept of slack that is most relevant for thinking about short-run trade-offs between domestic inflation and real activity is global

¹ This presentation is based on a longer paper "The Global Slack Hypothesis" by Enrique Martinez-Garcia and Mark Wynne which is forthcoming as a Federal Reserve Bank of Dallas *Staff Paper* in early 2010.

rather than local. We argue that the global slack hypothesis has analytical content even under a floating exchange rate regime in the context of at least one widely-used framework for thinking about inflation dynamics in open economies, and furthermore, is consistent with what we see in the data. The evidence is fragile, to be sure, but it suggests that the hypothesis cannot be dismissed outright.

In an open economy, as can be seen in slide 5 of the handout, the final consumption basket will consist of both domestically produced and foreign produced goods, and consequently the overall rate of consumer price inflation will be a weighted average of the rates of increase of the prices of these goods. When price changes are infrequent and asynchronous, the rate of change of the prices of domestically produced goods can be written as a function of the expected future rate of change of these prices and the real marginal costs of producing them. The rate of change of the prices of foreign produced goods sold in the domestic market can be written analogously.

Substitution of the equations for domestically produced and foreign produced goods into the domestic CPI then gives us a general expression for the open economy Phillips Curve. Domestic CPI inflation is related to expected future domestic CPI inflation and a weighted average of domestic and foreign real marginal costs. By invoking additional assumptions about the labor markets and firms' pricing behavior it is possible to re-write the Phillips Curve in a more standard form in terms of domestic and foreign output gaps.

Suppose that firms that engage in international trade set prices in their own currency, and adjust them infrequently. Under what is referred to as producer currency pricing, the law of one price holds and exchange rate pass-through is complete. In this case, there is a relatively

straightforward mapping from real marginal costs to output gaps that allows us to write the domestic Phillips Curve in terms of an average of the domestic and foreign output gaps (as can be seen in slide 6 in the handout). The foreign output gap matters not only as a proxy for foreign marginal costs and their effects through import prices, but also because of its influence on domestic pricing decisions. In fact, theory suggests that domestic marginal costs (and, therefore, domestic producer prices) will in general depend on the foreign gap as well because: (a) domestic firms export their products abroad, so higher foreign demand will force them to pay higher domestic wages; and (b) variations in the terms of trade will affect their domestic market share and consequently their domestic costs. Likewise, foreign marginal costs will depend on foreign as well as domestic output gaps.

What if instead firms that are engaged in international trade set prices in the currency of the market to which they are exporting, which is arguably the case for most foreign firms selling in the U.S.? Under what is referred to as local currency pricing, the law of one price no longer holds and exchange rate pass-through is incomplete. However, we can still derive an expression for domestic CPI inflation in terms of domestic and foreign output gaps, but the Phillips Curve now includes an additional expression reflecting the impact of deviations of the law of one price on inflation dynamics. Those deviations, in turn, can be tied to the easily observable real exchange rate (net of terms of trade effects).

Under both assumptions about pricing behavior, the composite coefficients on the domestic and foreign output gaps are identical functions of the underlying structural parameters. Most importantly, as we show in our background paper, the coefficient on the domestic output gap declines as imported goods become more important in the consumption bundle, while the coefficient on the foreign output gap increases. That is, as foreign goods become more important

in the consumption bundle, the strength of the relationship between the foreign output gap and domestic inflation will increase, while the relationship between the domestic output gap and domestic inflation will become weaker.

Even prior to the recent flurry of work on globalization, a number of Federal Reserve economists had looked into the potential impact of foreign slack on U.S. inflation. These earlier analyses generally found that the estimated coefficients on measures of foreign slack were not statistically significant in traditional backward looking Phillips Curve regressions. In these earlier studies, the “rest of the world” was usually assumed to be the “rest of the G7.” Claudio Borio and Andrew Filardo revived the debate in a widely-cited paper that examined whether global slack now played a greater role in the determination of domestic inflation than domestic slack. They found a statistically significant role for the foreign output gap in explaining U.S. inflation, and a declining role for the domestic output gap. Subsequent work by researchers at the Board of Governors cast doubt on the robustness of Borio and Filardo's results.

The New Keynesian analytical framework that we have presented provides an account of inflation dynamics around a (possibly time-varying) steady state. Hence, when looking for patterns in the data, it seems appropriate to focus on the cyclical components of the variables. If we define the world as consisting of just the G7 economies (as much of the older empirical literature had done), ordinary least squares estimates of simple open economy Phillips Curve regressions suggest that there is a more significant relationship (in a statistical sense) between slack in the other economies of the G7 and the cyclical component of inflation in the U.S., than between slack in the U.S. and inflation in the U.S. But while the G7 group still accounts for a significant share of world GDP and of U.S. imports, these shares are declining, as we show in Figure 2 in your handout. A more comprehensive empirical evaluation of the hypothesis would

look at a larger group of countries. Slide 10 in the handout reports some of the results we obtain estimating simple versions of our Phillips Curve specifications. For three of the four specifications, the estimated coefficient on the foreign output gap is statistically significant at the 1% level, and exceeds the estimated coefficient on the U.S. output gap in magnitude. The evidence is far from overwhelming, to be sure, but it does suggest that the idea is worth taking seriously and exploring further.

This suggests that the global slack hypothesis has some empirical content, although the evidence is fragile. There are a number of possible reasons for this, mostly having to do with the conceptual and measurement challenges associated with estimating Phillips Curves in terms of domestic and foreign output gaps. But we should note that it is possible to completely eliminate foreign slack variables from the Phillips Curve. That is, the effects of foreign slack on domestic inflation can be fully captured in principle by movements in a terms of trade gap. Interestingly, when written this way it turns out that the slope of the Phillips Curve with respect to domestic slack is exactly the same in the open economy and closed economy specifications (as can be seen in slide 11 in the handout). The equivalence between these two approaches to capturing the relationship between foreign slack and domestic inflation also means that much of the earlier empirical work on this issue probably needs to be reconsidered.

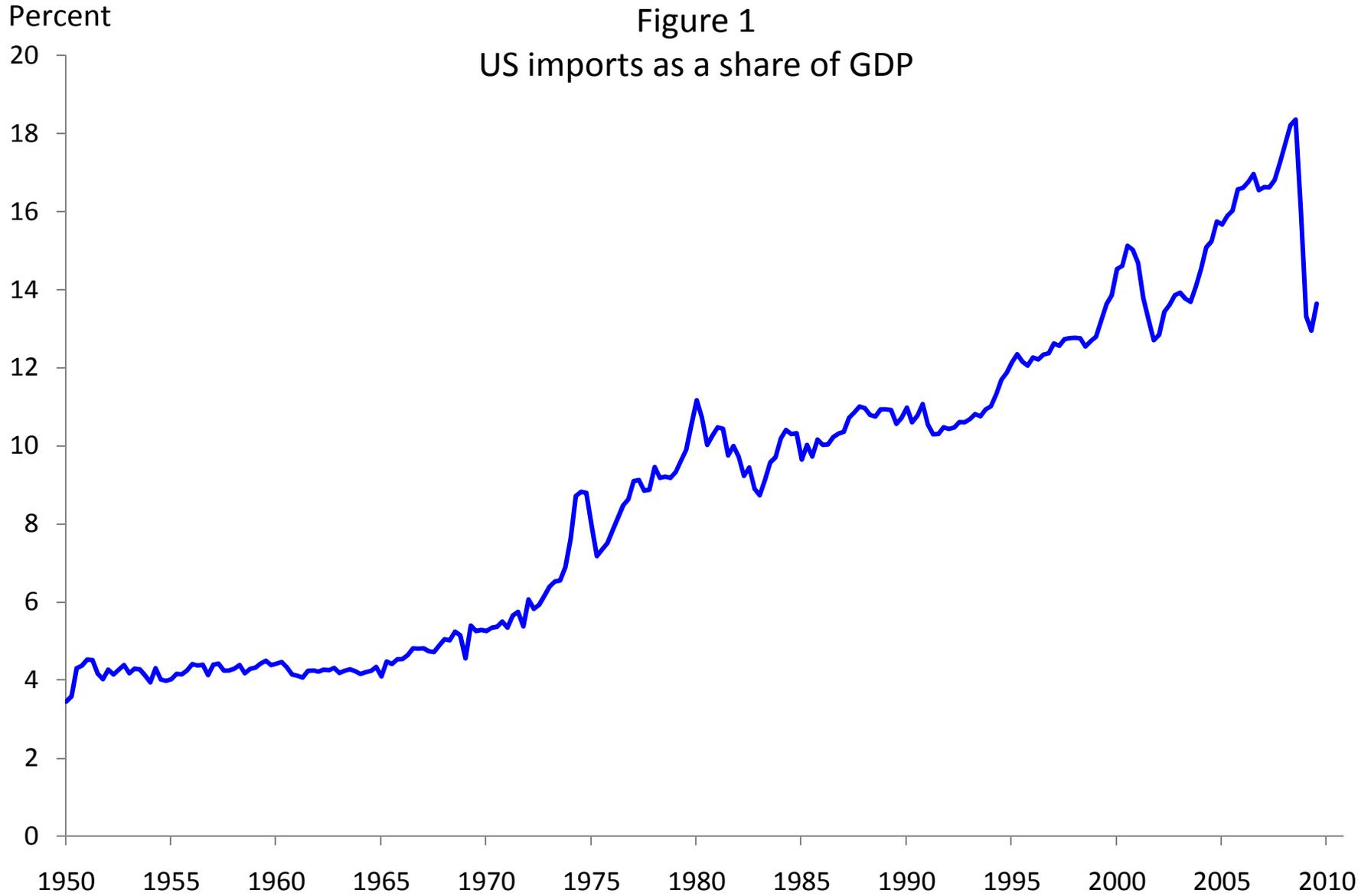
To sum up, there are sound analytical and empirical reasons for believing that globalization - and, in particular, the greater openness of the U.S. economy - has had important implications for inflation dynamics. However, there are well known conceptual and measurement issues associated with the use of output gaps. A terms of trade gap can in principle capture the effects of the foreign output gap on domestic inflation developments. It remains to be

seen how well a global slack perspective can improve our ability to forecast inflation and understand the trade-offs that monetary policy faces.

*Material for Briefing on
The Global Slack Hypothesis*

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Figure 1
US imports as a share of GDP



Global slack hypothesis

- Does globalization matter for U.S. inflation dynamics?
- Important as a real phenomenon
- Implications for monetary policy?
 - Yes: Global slack rather than domestic slack
 - No: Flexible exchange rates insulate domestic price developments from foreign influences

Globalization does matter...

- ...for inflation over the long term
 - Impact on “inflation bias” under discretionary monetary policy making
- ...for short term inflation dynamics
 - Open economy Phillips Curve differs from that of a closed economy

Open economy pricing

$$\underbrace{\hat{\pi}_t}_{\text{Rate of CPI inflation}} = \underbrace{\xi \hat{\pi}_t^H + (1 - \xi) \hat{\pi}_t^F}_{\text{Weighted average of the rate of increase of the prices of Home and Foreign goods}}$$

$$\underbrace{\hat{\pi}_t^H}_{\text{Rate of increase of the prices of Home goods}} = \beta \underbrace{E_t \hat{\pi}_{t+1}^H}_{\text{Expected rate of increase of the prices of Home goods next quarter}} + \lambda \underbrace{(\widehat{mc}_t - \hat{p}_t^H)}_{\text{Real marginal cost of producing Home goods}}$$

$$\underbrace{\hat{\pi}_t^F}_{\text{Rate of increase of the prices of Foreign goods}} = \beta \underbrace{E_t \hat{\pi}_{t+1}^F}_{\text{Expected rate of increase of the prices of Foreign goods next quarter}} + \lambda \underbrace{(\widehat{mc}_t^* - \hat{p}_t^F + \hat{s}_t)}_{\text{Real marginal cost of producing Foreign goods}}$$

The open economy Phillips Curve

$$\underbrace{\widehat{\pi}_t}_{\text{CPI inflation this quarter}} = \underbrace{\beta E_t \widehat{\pi}_{t+1}}_{\text{Expected CPI inflation next quarter}} + \lambda \left[\underbrace{\Psi_{\pi,x} x_t}_{\text{Domestic output gap}} + \underbrace{\Psi_{\pi,x^*} x_t^*}_{\text{Foreign output gap}} + \underbrace{\varepsilon \Psi_{\pi,rp} (\xi - \xi^*) \widehat{tot}_t}_{\text{Terms of trade}} - \underbrace{\varepsilon \Psi_{\pi,rp} \widehat{rs}_t}_{\text{Real exchange rate}} \right]$$

Domestic output gap term declines in importance as share of foreign goods in consumption basket increases

Terms of trade and real exchange rate terms only appear if some fraction ε of foreign firms engage in local currency pricing

Foreign output gap term grows in importance as share of foreign goods in consumption basket increases

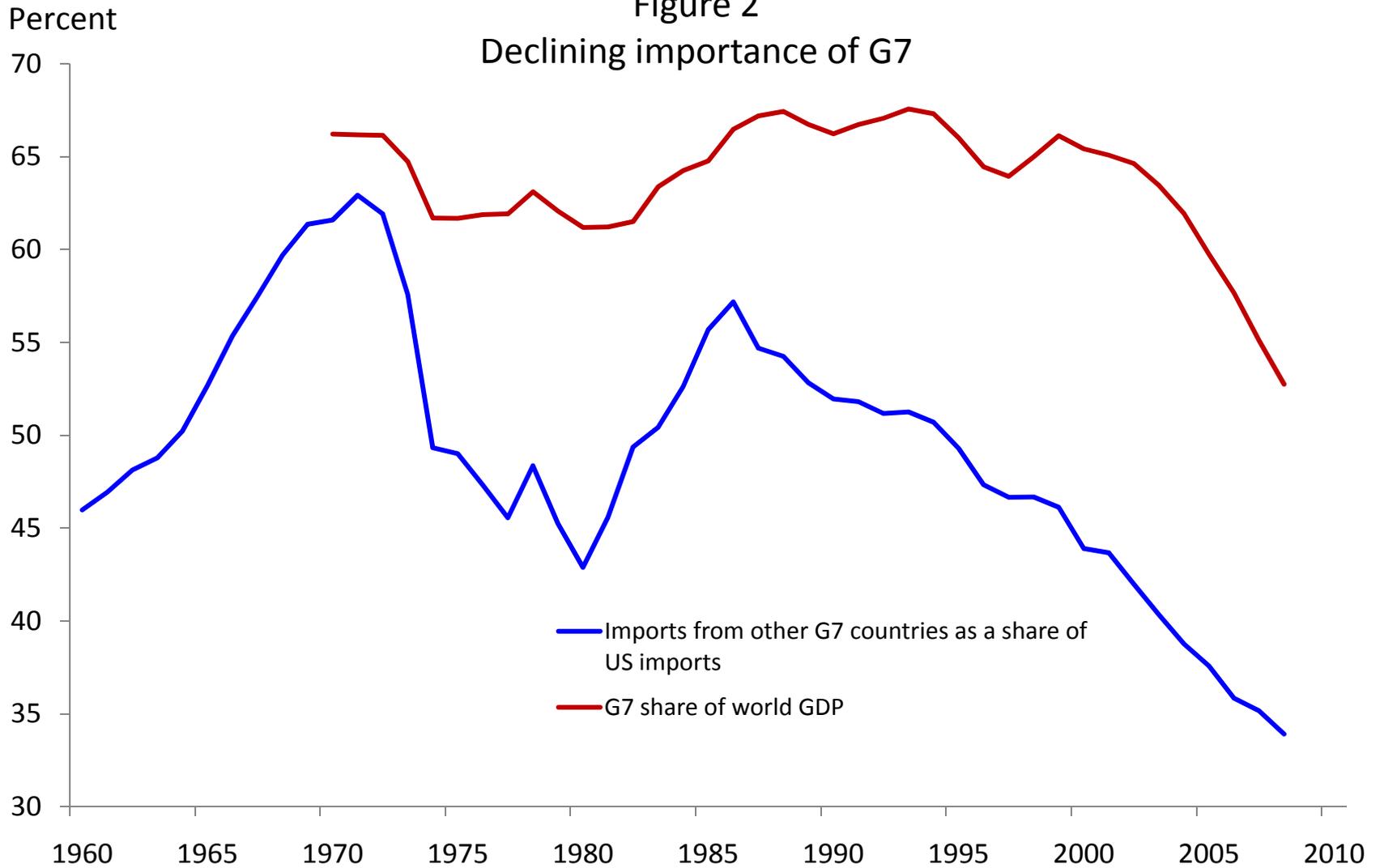
Is the Global Slack Hypothesis consistent with the data?

- Early studies
 - Orr (1994), Garner (1994), Tootell (1998)
 - No role for foreign slack
 - Focus on G7
- Revived debate
 - Borio and Filardo (2007): foreign slack matters
 - Ihrig, et al. (2007): no it doesn't

Our approach

- Focus on cyclical components of inflation etc.
- Start with G7 group of countries
 - Measures of foreign slack (unemployment, capacity utilization in mfg., output gaps) seem to matter
- Changing trade patterns
 - Look at broader group of countries

Figure 2
Declining importance of G7



Foreign slack appears to matter...

$$(1) \quad \hat{\pi}_t = \underset{(0.165)^{***}}{0.765} E_t \hat{\pi}_{t+1} + \underset{(0.143)^*}{0.276} \hat{y}_t^{US} + \underset{(0.113)^{***}}{0.379} \hat{y}_t^{G26}$$

$$(2) \quad \hat{\pi}_t^{Core} = \underset{(0.153)}{-0.100} E_t \hat{\pi}_{t+1}^{Core} + \underset{(0.046)^{**}}{0.111} \hat{y}_t^{US} + \underset{(0.037)^{***}}{0.202} \hat{y}_t^{G26}$$

$$(3) \quad \hat{\pi}_t = \underset{(0.183)^{***}}{0.573} E_t \hat{\pi}_{t+1} + \underset{(0.167)^{***}}{0.472} \hat{y}_t^{US} + \underset{(0.181)}{0.242} \hat{y}_t^{G26} + \underset{(0.088)}{0.101} \widehat{tot}_t - \underset{(0.056)^{**}}{0.121} \widehat{rer}_t$$

$$(4) \quad \hat{\pi}_t^{Core} = \underset{(0.222)}{-0.363} E_t \hat{\pi}_{t+1}^{Core} + \underset{(0.055)}{0.076} \hat{y}_t^{US} + \underset{(0.080)^{***}}{0.400} \hat{y}_t^{G26} + \underset{(0.042)^{***}}{0.124} \widehat{tot}_t - \underset{(0.026)^{**}}{0.102} \widehat{rer}_t$$

The open economy Phillips Curve...

Under producer currency pricing:

$$\underbrace{\hat{\pi}_t}_{\text{CPI inflation this quarter}} = \underbrace{\beta E_t \hat{\pi}_{t+1}}_{\text{Expected CPI inflation next quarter}} + \underbrace{\lambda[(\varphi + \gamma)x_t]}_{\text{Domestic output gap term}} - \underbrace{\Psi_{\pi, x^*} \Gamma(\widehat{tot}_t - \widehat{tot}_t^*)}_{\text{Terms of trade gap term}}$$

Slope of the Phillips Curve with respect to domestic output gap does not change as the share of foreign goods in the consumption basket increases if we rely on the terms of trade gap to capture the effects of the foreign output gap

Key points

- The global slack hypothesis, the idea that foreign slack plays a role commensurate with domestic slack in short-term inflation dynamics, has analytical content
- The data are also consistent with the global slack hypothesis
- Accurate measurement of slack, both domestic and foreign, remains a challenge
 - Data availability & quality
 - Conceptual problems
- The terms of trade (in gap form) may adequately capture foreign influences