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OUTPUT TRADEOFFS

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ABSTRACT

With capital account liberalization the representative household is able to smooth fluctuations in consumption, and thus becomes relatively insensitive to fluctuations in the output gap. With trade liberalization the economy tends to specialize in production but not in consumption. The correlation between fluctuations in the output gap and aggregate consumption is therefore weakened by trade openness; hence presumably a smaller weight on the output gap in the utility-based loss function, compared to the closed economy situations. In the context of a New Keynesian open economy macro model we analyze the effect of openness on the utility-based quadratic loss function to validate these propositions. The analysis demonstrates how capital account and trade account liberalizations help reduce inefficiencies associated with the fluctuations in the output gap, relative to inefficiencies associated with the fluctuations in inflation. It also provides a re- interpretation of evidence on the effect of openness on the inflation-output tradeoff.

A key implication of the theory is that globalization forces could induce monetary authorities to put a greater emphasis on reducing the inflation rate than on narrowing the output gaps. We provide a re- interpretation of the evidence on the effect of openness on the sacrifice ratio which support the prediction of the theory.

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Globalization and Inflation-Output Tradeoffs[1]

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Abstract

With capital account liberalization the representative household is able to smooth fluctuations in consumption, and thus becomes relatively insensitive to fluctuations in the output gap. With trade liberalization the economy tends to specialize in production but not in consumption. The correlation between fluctuations in the output gap and aggregate consumption is therefore weakened by trade openness; hence presumably a smaller weight on the output gap in the utility-based loss function, compared to the closed economy situations. In the context of a New Keynesian open economy macro model we analyze the effect of openness on the utility-based quadratic loss function to validate these propositions. The analysis demonstrates how capital account and trade account liberalizations help reduce

inefficiencies associated with the fluctuations in the output gap, relative to inefficiencies associated with the fluctuations in inflation. It also provides a re- interpretation of evidence on the effect of openness on the inflation-output tradeoff.

A key implication of the theory is that globalization forces could induce monetary authorities to put a greater emphasis on reducing the inflation rate than on narrowing the output gaps. We provide a re- interpretation of the evidence on the effect of openness on the sacrifice ratio which support the prediction of the theory.

I. Introduction

Global inflation dropped from 30 percent a year to about 4 percent a year in the 1990s. At the same time massive globalization process has swept emerging markets in Latin America, European transition economies, and the East Asian emerging economies. The establishment in 1992 of the single market, and the formation of the single currency area in 1999 in Europe, are landmarks of globalization that also took place in this period. Thus, globalization and disinflation seem to go hand in hand. Indeed, Ken Rogoff (2003, 2004), who was among the first to observe the linkage between globalization and disinflation, elaborates on some favorable factors that have been helping to drive down global inflation in the 1990s. A

[1] We thank Robert King, Philip Lane, Chris Pissarides, Andrew Scott, and Ken West for useful comments.

hypothesis, which he put forth, is that the "globalization—interacting with deregulation and privatization—has played a strong supporting role in the past decade's disinflation". [2]

Empirical investigation of the effect of openness on the output-inflation tradeoff begins with Romer (1993), who based his interpretation of the cross-country evidence on the Barro-Gordon inflation-biased paradigm. Romer (1993, 1998), and Lane (1997) show that inflation and trade liberalization are negatively, and significantly, correlated in large (flexible exchange rate) OECD economies. Chen, Imbs and Scott (2004) investigate empirically the competitive effects of increased international trade in goods and services on prices, productivity and markups. Using disaggregated data for EU manufacturing over the period 1988-2000 they find that increased openness exerts a negative and significant impact on sectors prices. Increased openness lowers prices by reducing markups and by raising productivity. Their results suggest that the increase in the trade volume could account for as much as a quarter of European disinflation over the sample period.

This paper explores the effects of globalization (opening of a country to trade in goods, and liberalization of its international capital markets) on the inefficiencies associated with fluctuations in the output gap and the inflation rate in a sticky price, new Keynesian, model. The analysis shows how globalization alters the relative *weights* applied to the output gap and inflation in a utility-based loss function. The utility based loss function is derived in a new Keynesian set up. The mechanism at play , not yet addressed in the existing literature,

[2] See Appendix 1 for a description of globalization trends in monetary policy and openness in the last two decades.

features the consumption-smoothing properties of capital market integration, and the de-linking of the commodity composition of consumption from the commodity composition of domestic output that characterize specialization under goods market integration. It turns out that these features of openness help reduce inefficiencies associated with output gap fluctuations, relative inflation fluctuations.

We also provide a new way of interpreting the evidence of the effect of openness on the sacrifice ratio. In addition, we illustrate the implication with evidence on the effect of globalization on the sacrifice ratio that lead to changes in the utility-based loss function.

A key implication is that globalization forces could induce monetary authorities, guided in their policies by the welfare criterion of a representative household, putting a greater emphasis on reducing the inflation rate than on narrowing the output gaps.

The organization of the paper is as follows. Section II describes the model. Section III provides a derivation of the closed-economy utility-based loss function from the conventional expected utility of the representative household. Sections IV and V extend the derivation of the utility-based loss function to open economies. Section VI reviews existing evidence on the effect of openness on the output-inflation tradeoffs. Section VII provides fresh evidence on the effect of globalization on the output-inflation tradeoffs. Section VIII concludes.

II. ANALYTICAL FRAMEWORK

The analytical framework draws on the new Keynesian macroeconomics literature. The main features of the model are:

(1) A representative household whose utility is defined over consumption and leisure, as in the standard micro-based welfare analysis.

(2) Domestic economy produces a continuum of varieties; decisions of the representative household are governed by Dixit-Stiglitz preferences over varieties (generating fixed elasticities); Purchasing power parity condition prevails; and foreign firms' prices are exogenous.

(3) A proportion of producers set domestic currency denominated prices one period in advance; the proportion of all the rest of the domestic producers set flexibly the domestic currency denominated prices, so that markets clear for these goods.

(4) A quadratic loss function, which depends on the output gap and inflation surprise is derived from a standard welfare criterion of a representative individual, which depends on consumption and work effort.

III. The Model

Assume that the welfare criterion, from which a quadratic utility-based loss function is to be derived, is standard expected utility of a representative household, given by:

$$\boldsymbol{E}\left(\sum_{t=0}^{\infty}\boldsymbol{\beta}^{t}\boldsymbol{U}_{t}\right),$$

Where,

$$U_t = \left[u(C_t;\xi_t) - \int_0^n w(h_t(j);\xi_t)dj\right] .$$

Aggregate consumption, C_t is an index of differentiated products:

$$C_t = \left[\int_0^1 c_t(j)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}} .$$

Labor supply for product variety j is denoted by $h_t(j)$. The production function of variety j is given by $A_t f(h_t(j))$. The vector (A_t, ξ_t) represents productivity and preference shocks. The $u(C_t;\xi_t)$ - function is concave in C, so that the consumer wants to smooth consumption fluctuations. The $w(h_t(j);\xi_t)$ –function is convex in h, so that the consumer prefers equality in the supply of labor for different varieties to dispersion in the labor supply. The number of varieties produced at home is n < 1 and the number of varieties consumed at home is equal to one. (In a closed economy, n = 1.)

Aggregate domestic output is specified as

$$Y_t = \left[\int_0^n y_t(j)^{\frac{\theta-1}{\theta}} dj\right]^{\frac{\theta}{\theta-1}},$$

If the economy is open to trade in goods, the number of domestically produced varieties is less than the number of domestically consumed varieties. Thus, the commodity composition of the consumption basket is different than the commodity composition of the output basket. As a result, the correlations between fluctuations in output and consumption, which is perfect in the case of a closed economy, are less than perfect if the economy is opened to trade in goods. As standard, when the economy is financially open output fluctuations are inter-temporally separated from consumption fluctuations due to the consumption-smoothing property of international capital flows. Therefore the two types of openness de-link output fluctuations from consumption fluctuations; the later are the object of welfare evaluations, but not the former.

III.1 Price Setting

Firms behave *monopolistically* in the goods markets, and, at the same time, *monopsonistically* in the labor market (because producer *j* as the sole demander for labor of type-j and household supply of type-j labor is perfectively competitive). A fraction γ of the monopolistically competitive firms sets their prices flexibly at p_{1t}, supplying y_{1t}; whereas the remaining fraction 1 - γ sets their prices one period in advance (in period t – 1) at p_{2t}, supplying y_{2t}. In the former case, the price is marked up above the marginal cost, s, by the factor

$$\mu = \left(\frac{\theta}{\theta - 1} > 1 \right),$$

So that,

$$\frac{p_{1t}}{P_t} - \mu s(k_t, y_{1t}, Y_t; \xi_t, A_t) = 0.$$

In the later case, p_{2t} is set so as to maximize expected discounted profit

$$E_t\left[\left(\frac{1}{1+i_{t-1}}\right)(p_{2t} y_{2t} - w_t h_t)\right] = E_{t-1}\left\{\left(\frac{1}{1+i_{t-1}}\right)\left[Y_t P_t^{\theta} p_{2t}^{1-\theta} - w_t f^{-1}\left(Y_t P_t^{\theta} p_{2t}^{\theta}\right)\right]\right\},$$

Which yields a price-setting rule for p_{2t} is as follows.

$$E_{t-1}\left\{\left(\frac{1}{1+i_{t-1}}\right) Y_t P_t^{\theta-1}\left[\frac{p_{2t}}{P_t} - \mu s(y_{2t}, Y_t, \xi_t, A_t)\right]\right\} = 0 \quad .$$

The notation i_{t-1} stands for lagged nominal rate of interest. [3]

[3] In the special case of perfect certainty, this is nothing but the standard equation describing price as a mark-up over marginal cost. With uncertainty, it can be interpreted as a weighted average of price mark-ups over marginal cost. This expected value is equal to zero. With preset pricing, the price is determined by expectations of next period demand and costs, but the firm is committed to supply according to the actual realizations of demands and costs. That is, realization of the shocks will affect actual output, with negative shocks leading to excess capacity and positive shocks to over-capacity. The model predicts that the mark-ups of the producers who pre-set their prices will be counter-cyclical. Negative demand shocks will induce the flex-price firms to adjust their prices downward, attracting demand away from, and thus lowering the marginal costs and jacking up the price mark-ups of the fixed-price firms.

Figure 1 describes equilibrium in one such market. The downward-sloping, marginal-productivity curve is the demand for labor. Supply of labor, S_h, is implicitly determined by the utility-maximizing condition for *h*. The upward-sloping marginal factor cost curve is the marginal cost change from the producer point of view. It lies above the supply curve because, in order to elicit more hours of work, the producer has to offer a higher wage not only to that (marginal) hour but also to all the (infra-marginal) existing hours. Equilibrium employment occurs at a point where the marginal factor costs is equal to the marginal productivity. Equilibrium wage is given by B, with the worker's real wage marked down below her marginal product by the distance AB.[4]

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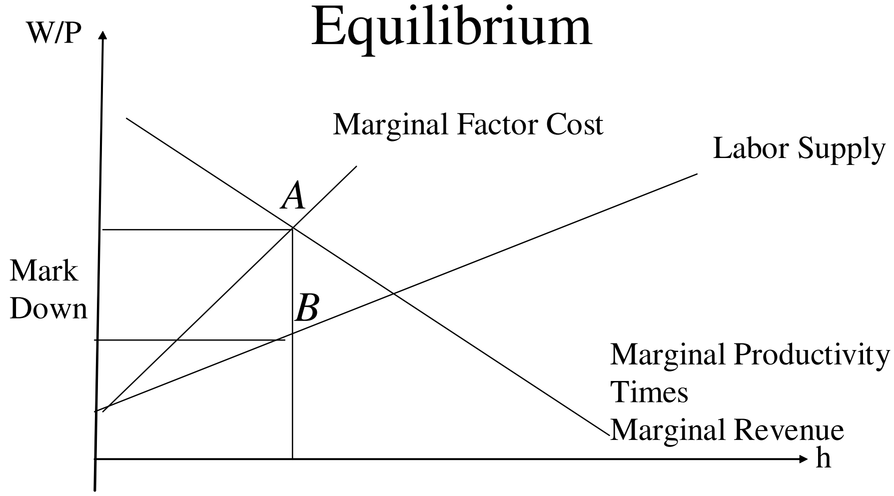
[4] Full employment obtains because workers are offered a wage according to their supply schedule. This is why the aggregate supply curve will be stated in terms of excess capacity (product market version) rather than unemployment (labor market version). In fact, the model can also accommodate unemployment by introducing a labor union, which has monopoly power to bargain on behalf of the workers with the monopsonistic firms over the equilibrium wage. In such case, the equilibrium wage will lie somewhere between S_h and $M P_h$, and unemployment can arise – so that the labor market version of the Phillips curve can be derived as well. To simplify the analysis, we assume in this paper that the workers are wage-takers. In the limiting case where the producers behave perfectly competitive in the labor market, the real wage becomes equal to the marginal productivity of labor and the marginal cost of labor curve is not sensitive to output changes. Thus, with a constant mark-up, $\frac{\theta}{\theta - 1}$ the aggregate supply curve becomes flat, i.e., no relation exists between inflation and excess capacity.

Figure 1: The Labor Market Equilibrium



III.2 Transformed Utility Function

To derive the quadratic loss function from a standard welfare criterion of a representative household we follow Woodford (2003).[5] We first transform the labor disutility function to $\nu(y_t(j)) \equiv w(f^{-1}(y_t(j)\frac{1}{A_t}))$. We employ the production function, $\boldsymbol{y_t(j) = A_t f(h_t(j))}$ and transform the utility function, as follows.

$$U_t = \left[u(C_t;\xi_t)) - \int_0^1 \nu(y_t(j);\xi_t, A_t)dj \right].$$

The transformed the real marginal costs is given by:

[5] See a closed economy derivation in Appendix II.

$$s(y(j),Y;\xi,A)=v_y(y(j);\xi,A)/u_c(Y;\xi),$$

Where, v_y and u_c denote the marginal disutility of labor and the marginal utility of consumption, respectively. The elasticity of $v_y(y(j);\xi,A)$ with respect to y is denoted by

$$\omega=\frac{\bar{Y}v_{yy}(\bar{Y})}{v_y(\bar{Y})}.$$

The elasticity of real marginal cost s with respect to Y is denoted by

$$\sigma^{-1}=-\frac{\bar{C}u_{cc}}{u_c}>0;$$

where, all the elasticities are evaluated at a no-shock steady state $C_t=\bar{C}, Y_t=\bar{Y}, \beta=\frac{1}{1+\bar{r}}$, and $\bar{r}$ is the world rate of interest.

III.3 Output Gap

We specify the conventional concept of the output gap by

$$\boldsymbol{x}_t=\hat{\boldsymbol{Y}}_t-\hat{\boldsymbol{Y}}_t^N.$$

Where, a "hat" denotes a proportional deviation from steady state, and a superscript N indicates flexible price equilibrium. That is, $\hat{\boldsymbol{Y}}_t$ is equal to deviations of actual output from its steady state level and $\hat{\boldsymbol{Y}}_t^N$ is equal to deviations of potential output from its steady state level. Potential output is defined as the level of output the economy would produce if all prices and wages are fully flexible.

Yet, another concept of output gap has to do with the monopolistic-competition distortion.

In a shock-free steady state, the level of output, $\bar{Y}$, is implicitly given by:

$$s(\bar{C},\bar{Y};0,1) = v_y(\bar{Y};0,1)/u_c(\bar{C};0) = \frac{1}{\mu},$$

As is standard in the Dixit-Stiglitz setup, the mark up is defined in terms of the cross-variety elasticity of substitution, $\mu = \frac{\theta}{\theta - 1}$. However, the efficient (zero mark up) output in the shock-free steady state, Y^*, is implicitly given by:

$$s(C^*,Y^*;0,1) = 1.$$

The other output gap concept is defined by the ratio of the flexible price (steady state) monopolistic-competition output and the efficient (steady state) output, given by $\bar{Y}/Y^*$. A log-approximation of the ratio yields:

$$x^* = \log(\bar{Y}/Y^*) = -(\omega + \sigma^{-1})\frac{1}{\mu}.$$

Thus, the monopolistic output gap in logs, x^* , is an increasing function of the markup, with a zero bound (reached in the limiting case where the mark up shrinks to zero.

IV. Globalization and Efficiency of Equilibrium

As is well known, the economy tends to specialize in production and to diversify in consumption as it opens up. This means the number of domestically produced varieties is equal to n, less than the number of domestically consumed varieties which is equal to one, when the economy trade goods in the international markets. Consequently, the commodity composition of the consumption basket and the composition of the output basket, that were identical in a closed economy, would diverge when international trade opens up. As a result, the correlation between fluctuations in output and consumption, which is equal to one in the case of a closed economy, falls short of one if the economy is opened to international trade in goods. When the economy becomes also financially open, domestic consumption spending and domestic output typically diverge for a separate reason. That is household would smooth aggregate consumption through international borrowing and lending. In so doing the aggregate output path diverges from the aggregate consumption path. . The upshot is that in both cases of openness, albeit for different reasons, the correlation between the fluctuations in the output gap and the fluctuations in aggregate consumption are reduced. Because consumer welfare depends on consumption, not on output, the weight of the output gap in the loss function falls with trade and capital openness. In what follows we formalize this intuition.

IV.1. Capital Mobility and Goods' Mobility

If capital is perfectly mobile, then the domestic agent has a costless access to the international financial market. As a consequence, household can smooth consumption similarly in the rigid price and flexible price cases[6]:

$$\hat{C}_t = \hat{C}_t^N .$$

Thus when the capital market is open perfect consumption smoothing is achieved; the equilibrium proportional deviations of consumption from a common steady state are identical in the fixed-price and flexible-price cases.

If goods are perfectly mobile the number of product varieties is reduced from the closed-trade number of one to n.

The approximate utility-based loss function for open-capital and open- trade regimes is:

[6] Recall that we assume that the subjective discount factor is equal to the world market discount factor; hence perfect consumption smoothing with zero growth of consumption in the steady state.

$$L_t = (\pi_t - E_{t-1}\pi_t)^2 + \frac{1}{\theta}\frac{\gamma}{1-\gamma}\frac{n\varpi}{1+\varpi\theta}(x_t - x^*)^2 + exogenousterm$$

$$x^* = (\omega + \sigma^{-1})^{-1}\frac{1}{\mu}$$

.

. To provide intuition we note that inefficiencies of the new Keynesian economy could be grouped into two types:

(i) Because according to the original welfare criterion consumption fluctuations are welfare reducing, output gap fluctuations in the derived loss function are also welfare reducing.

(ii) It is efficient that the allocation of the supply of labor across product varieties is the same, because varieties have the same technologies and preferences concerning varieties are symmetric. Cross variety output dispersion is therefore welfare reducing. An increase in unanticipated inflation rates, given that some prices are set in advance, would raise output dispersion. Hence, unanticipated inflation is welfare reducing.

We note that the relative weight that is placed upon the output gap term, in terms of quadratic deviations of the inflation rate, is also equal to the slope of the aggregate supply (the sacrifice ratio), times the inverse of the cross-variety elasticity of substitution, which is proportional to the mark up of the flexible price firms.

Naturally, the quadratic approximation to the utility function is derived from some optimizing equilibrium conditions. The efficiency-sensitive preferences, and optimizing conditions, underlying the loss function are embedded with the equality between the marginal rate of substitution between the inflation and output gap to the marginal rate of transformation between inflation and output gap (derived from the aggregate supply relationship). A utility-based loss function would naturally reflect some of constraints on optimizations that are associated from the aggregate supply relationship. This means that there is a direct relationship between the sacrifice ratio (the inverse of the slope of the aggregate supply schedule) and the relative weight of the output gap term in the loss function. The associated aggregate supply relationship (see Razin and Yuen (2002) is:

$$\pi_t - E_{t-1}\pi_t = \frac{\gamma}{1-\gamma}\left[\frac{n\omega}{1+\omega\theta}(\hat{Y}_t^h - \hat{Y}_t^N) + \frac{(1-n)\omega}{1+\omega\theta}(\hat{Y}_t^f - \hat{Y}_t^N)\right] + \frac{1-n}{n}\left(\frac{1}{1-\gamma}\hat{e}_t - E_{t-1}\hat{e}_t\right);$$

The term $\hat{e}$ is a proportional deviation of the real exchange rate from its corresponding steady state level, and $\hat{Y}_t^f$ is a proportional deviation of the rest-of-the-world output from its corresponding steady state level. Because n denotes the number of domestically produced goods, 1-n denotes the number of imported goods. .

IV.2. Closed Capital Account but Open Trade Account

If the domestic economy does not participate in the international financial market, then there is no possibility of consumption smoothing. That is, $\hat{C}_t = \hat{Y}_t ; \hat{C}_t^N = \hat{Y}_t^N$. Open trade account implies n<1.

The approximate utility-based loss function is given by[7]:

$$L_t = (\pi_t - E_{t-1}\pi_t)^2 + \frac{1}{\theta}\frac{\gamma}{1-\gamma}\frac{n\omega + \sigma^{-1}}{1+\omega\theta}(x_t - x^*)^2 + exogenoust\, erm$$

.

IV.3. The Closed Economy

Under trade and financial autarky, all the goods in the domestic consumption index are produced domestically, which means that n = 1, because commodity composition of the output and the consumption baskets are the same, and $\hat{C}_t = \hat{Y}_t ; \hat{C}_t^N = \hat{Y}_t^N$. This is because consumption spending must equal output in the fixed price and the flexible price economies.

The approximate utility-based loss function is given by:

$$L_t = (\pi_t - E_{t-1}\pi_t)^2 + \frac{1}{\theta}\frac{\gamma}{1-\gamma}\frac{\omega + \sigma^{-1}}{1+\omega\theta}(x_t - x^*)^2 + exogenousterm$$ [8]

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7 In this case, the aggregate-supply curve is:

$$\pi_t - E_{t-1}\pi_t = \frac{\gamma}{1-\gamma}\left[\frac{n\omega+\sigma^{-1}}{1+\omega\theta}(\hat{Y}_t^h - \hat{Y}_t^N) + \frac{(1-n)\omega}{1+\omega\theta}(\hat{Y}_t^f - \hat{Y}_t^N)\right] + \frac{1-n}{n}\left(\frac{1}{1-\gamma}\hat{e}_t - E_{t-1}\hat{e}_t\right).$$

8 The aggregate supply schedule is: $\pi_t - E_{t-1}\pi_t = \frac{\gamma}{1-\gamma}\left[\frac{\omega+\sigma^{-1}}{1+\omega\theta}(\hat{Y}_t^h - \hat{Y}_t^N)\right].$

V. Comparing Weights in the Loss Function

The relative output-gap weight (the unexpected-inflation weight is normalized to one) in each one of the openness scenarios is given by:

(i) $\psi_1 = \frac{1}{\theta}\frac{\gamma n\omega}{(1-\gamma)(1+\theta\omega)}$ (Perfect International Capital and Goods Mobility)

(ii) $\psi_2 = \frac{1}{\theta}\frac{\gamma(n\omega+\sigma^{-1})}{(1-\gamma)(1+\theta\omega)}$ (Closed Capital Account and Open Trade)

(iii) $\psi_3 = \frac{1}{\theta}\frac{\gamma(\omega+\sigma^{-1})}{(1-\gamma)(1+\theta\omega)}$ (Fully Closed economy)

One can verify that $\psi_1 < \psi_2 < \psi_3$.[9]

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[9] Note we implicitly assume that the price-setting fractions $(\boldsymbol{\gamma}, 1-\boldsymbol{\gamma})$ across the different openness scenarios are the same; empirically this assumption can be relaxed. Also, the open economy steady state elasticities are assumed to be equal to the closed economy steady state elasticities. There is however no theory that can explain the fixed-flexible pricing structure for a closed economy; or one that can rationalize how the pricing structure changes in the presence of globalization. Thus we also do not know how globalization affects the structure of price setting behavior by firms. The globalization proposition we just proved is therefore conditional on exogenous determination of the price-setting fractions $(\boldsymbol{\gamma}, 1-\boldsymbol{\gamma})$ across the different openness scenarios.

This means that successive rounds of opening of the current and capital accounts reduce the output-gap weight in the utility-based loss function. This result has consumption-smoothing and trade-specialization intuition that we presented in the previous subsection.

A simple one-period optimization problem of the central bank can serve to illustrate our findings. Assume that the central bank minimizes the level of the utility-based quadratic loss function, subject to the aggregate supply constraint. The first order condition implies:

$$(\pi_t - E_{t-1}\pi_t) = -\frac{1}{\theta}(SR)(x_t - x^*)$$

Where, SR denotes the sacrifice ratio; for example, SR is equal to $\frac{\gamma n\omega}{(1-\gamma)(1+\theta\omega)}$ in the case of perfect international mobility of capital and goods.

That is, for any given level of the output gap, the inflation rate is lower as the SR gets larger. This optimizing monetary rule implies that the central bank would become more aggressive with respect to inflation, as the economy opens up to trade in goods and flows of capital.

VI. Globalization and the Sacrifice Ratio: Empirical Literature

Romer (1993) finds a negative relationship between trade openness and anticipated inflation. Loungani, Razin, and Yuen (2001) find a positive relationship between trade and capital account openness. Using Ball's sacrifice ratio estimates in a cross-country analysis, and trade openness measures (based on import-output ratios) Temple (2002) finds weak relationship between trade openness and the sacrifice ratio. However, the use of non-instrumented import-output ratio as openness measures in the regressions raises acute issues of endogeneity. Indeed, Daniels, Nourzad, and Vanhoose (2005), augment the cross-country data of Temple (2002) with a measure of central bank independence, which allows them to account for the interaction between the central bank independence and his measure of trade openness. Their empirical results indicate that once this interaction is taken into account, there is a positive and statistically significant relationship between trade openness and the sacrifice ratio. The evidence has been interpreted in the existing literature in terms of the slope of the Phillips curve, but we can reinterpret this evidence also differently. The de-facto output-inflation tradeoff characterizes the relative weight in the loss function which the policy maker put on inflation. This consideration enables us to use the estimated general-equilibrium sacrifice ratio as an indicator for the de-facto weight of the output gap in the unobserved utility-based loss function.

VII. Evidence on Inflation-Output Ratio and Openness

In this section we provide an additional piece of evidence for the effect of openness on the de-facto weight of the output gap in the unobserved utility-based loss function. Because the relative weight of the output gap term in the utility-based loss function is equal to $\frac{1}{\theta}$ times the sacrifice ratio, a key empirical assumption that we make in order to connect the analysis to the utility based loss function is that the parameter $\frac{1}{\theta}$ is uncorrelated, across the disinflation episodes, with the measures of openness.

Sacrifice ratios and their determinants

Our regressions focus on explaining the determinants of sacrifice ratios as measured by Ball. He starts out by identifying disinflations, episodes in which the trend inflation rate fell substantially. Ball identifies 65 disinflation episodes in 19 OECD countries, over the period 1960 to 1987. For each of these episodes he calculates the associated sacrifice ratio. The denominator of the sacrifice ratio is the change in trend inflation over an episode. The numerator is the sum of output losses, the deviations between output and its trend ("full employment") level.

We also take from Ball the data on the determinants of the sacrifice ratios such as the initial level of inflation, the change in inflation over the course of the episode and the length of the disinflation episode.

Restrictions on trade and capital Accounts

Measuring the degree of openness of trade and capital accounts is always a heroic task. Since 1950, the IMF has issued an annual publication, which tries to describe the controls that its member countries have in place on various current account capital account transactions. However, as Cooper (1999, p. 111) notes, these descriptions are very imperfect measures of the extent of restrictions, particularly in the case of the capital account:

> "… Restrictions on international capital transactions … come in infinite variety. Therefore an accurate portrayal requires knowledge not only of the laws and regulations in place, but also of how they are implemented—which often requires much official discretion—and of how easily they are circumvented, either legally or illegally. The IMF reports the presence of restrictions, but not their intensity or their impact."

Quinn (1997) takes the basic IMF qualitative descriptions on the presence of restrictions and translates them into a quantitative measure of restrictions using certain coding rules. This translation provides a measure of the intensity of restrictions on current account transactions on a (0, 8) scale and restrictions on capital account transactions on a (0, 4) scale; in both cases, a higher number indicates fewer restrictions. We use the Quinn measures, labeled CURRENT and CAPITAL, respectively, as our measures of restrictions. We also use the sum of the two measures, as an overall measure of the degree of restrictions on the openness of the economy; this measure is labeled OPEN. The econometrics advantage of using rule-based openness dummies over trade flows (e.g., the import to output ratios) and capital flows in the regression analysis has to with the endogeneity of the latter measures and the absence of good instruments.

For each disinflation episode identified by Ball, we use as an independent variable the current account and capital account restrictions that were in place the year before the start of the episode. This at least makes the restrictions pre-determined with respect to the sacrifice ratios, though of course not necessarily exogenous.

Regressions

The sources of data on the sacrifice ratio is Ball (1993, 1994); and the source of data on the restrictions on trade in goods and capital account transactions is Quinn (1997).

The first column of Table 1 reports a regression of the sacrifice ratio on initial inflation, the length of the episode (measured in quarters) and the change in inflation over the course of the episode. Not surprisingly, as all the data were taken from Ball's study, the results are qualitatively similar and quantitatively virtually identical to regressions reported in his paper. The key finding is that sacrifice ratios are smaller the quicker is the speed with which the disinflation is undertaken. The change in inflation also enters with the predicted sign and is significant (t=1.8, p-value=.076). Initial inflation is insignificant (and has the wrong sign from the perspective of the theory).

Now consider the impacts of adding the measures of openness, which are shown in the next three regressions. Ball's findings continue to hold. The length of the episode and the decline in inflation become more significant, while initial inflation remain insignificant. The measures of openness enter with the positive sign predicted by the theory. The effect of openness on the sacrifice ratio is statistically significant, as reflected also in the perking up of the adjusted R-square of the three regressions when compared to the first. The restrictions on the current account appear statistically more significant than the restrictions on the capital account. When we enter both CURRENT and CAPITAL in the regression, CURRENT remained significant but CAPITAL was not. The correlation between the two variables is almost 0.5; hence, our inability to tease out separate effects is not entirely surprising.

Table 1: Sacrifice Ratios and Restrictions on Current Account and Capital Account

Independent Variables	(1)	(2)	(3)	(4)
Constant	-0.001 (0.012)	-0.059 (0.025)	-0.033 (0.022)	-0.058 (0.026)
Initial Inflation	0.002 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)
Length of Disinflation Episode	0.004 (0.001)	0.004 (0.001)	0.004 (0.001)	0.004 (0.001)
Change in Inflation during Episode	-0.006 (0.003)	-0.007 (0.003)	-0.006 (0.003)	-0.007 (0.003)
CURRENT Index of current account restrictions	.	0.008 (0.003)	.	.
CAPITAL Index of capital account restrictions	.	.	0.010 (0.006)	.
OPEN Sum of CURRENT and CAPITAL	.	.	.	0.006 (0.002)
Adjusted R-square	0.16	0.23	0.19	0.23
Number of observations	65	65	65	65

Note: Numbers in parentheses are standard errors.				

Thus, the regressions in Table 1 provide some additional support to the notion that that relative weight of the inflation in the loss function increases with trade, capital, and overall openness.[10]

VIII. Conclusion

This paper brings forth an efficiency argument (supplementing the competition-discipline argument) for putting heavier weight on inflation, relative to output gap, in a utility-based loss function, as the economy opens up. The theory provides also a new way to interpret existing evidence of the empirical relationships between openness and the sacrifice ratio. The theory is based on a mechanism that has not yet been addressed in the existing literature of how globalization forces induce monetary authorities, guided in their policies by the welfare criterion of a representative household, to put greater emphasis on reducing the inflation rate than on narrowing the output gaps. With capital account liberalization the representative household is able to smooth fluctuations in consumption, and thus becomes relatively insensitive to fluctuations in the output gap. With trade liberalization the economy tends to specialize in production but not in consumption. The correlation between fluctuations in the output gap and aggregate consumption is therefore weakened by trade

[10] Results are consistent with Loungani, Razin, and Yuen (2001) and Daniels, Nourzad, and Vanhoose (2005). See also Appendix 1 for indirect evidence on the linkage between globalization and tightness of monetary policy.

openness; hence a smaller weight on the output gap in the utility-based loss function, compared to the closed economy situations.

We cite existing evidence on openness and the sacrifice ratio, and provide reinterpretation of the evidence, in light of the theory. The evidence, although cannot sharply discriminate between alternative hypotheses, is consistent with the theory prediction that goods and capital markets openness increases the distortion associated with fluctuations in inflation and decreases the distortions associated with fluctuations in the output gap.

We observe also that the theory has an important implication for the incentive of a central bank to deviate from its pre-announced monetary rule (as in the Kydland and Prescott (1977), Barro and Gordon (1983), and Rogoff (1985)). Globalization lessens such temptation that leads to inflation bias, because the central banker is less sensitive to output gap fluctuations.

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Appendix I: Globalization and Disinflation--Recent Trends

Sgherri (2002) reports the parameter estimates for a monetary model for the U.S. economy, both for the high inflation period (1970Q1–1982Q1, hereafter the 1970s) and the subsequent move to the low inflation (1982Q2 onward) period. Similar results are obtained for other industrial countries with independent monetary policies included in the sample (Canada, Germany, and the United Kingdom). The parameter estimates indicate that—since 1982—policymakers have become significantly more aggressive on inflation, less responsive to the output gap, and more gradualist in adjusting their policy instruments.
Benati (2004) investigates the changing nature of the Phillips relationship in the United Kingdom, with a flattening taking place in the 1980s and particularly high degree of stability since the adoption of inflation targeting. International financial integration and the making of the single European market are other possible contributing factors.

Trade openness, as measured by a reduction in levels of assistance afforded to domestic industries through protectionist trade policies have raised: the protectionist policies have gradually fallen over the past 40 years. The average level of tariffs and the incidence of use of NTBs in most OECD countries for which data is available reached relatively low levels by the mid-1990s. Trends in the use of NTBs, as measured by incidence and frequency of use of NTBs, are shown in Table 1.

Table 1. Pervasiveness of non-tariff barriers

Per cent

	Frequency ratio (a)			Import coverage ratio (b)		
	1988	1993	1996	1988	1993	1996
United States	25.5	22.9	16.8	16.7	17.0	7.7
European Union	26.6	23.7	19.1	13.2	11.1	6.7
Japan	13.1	12.2	10.7	8.6	8.1	7.4
Canada	11.1	11.0	10.4	5.7	4.5	4.0
Norway	26.6	23.7	4.3	13.8	11.1	3.0
Switzerland	12.9	13.5	7.6	13.2	13.2	9.8
Australia	3.4	0.7	0.7	8.9	0.4	0.6
New Zealand	14.1	0.4	0.8	11.5	0.2	0.2
Mexico	2.0	2.0	14.6	18.6	17.4	6.9

Source: OECD (1998), **Trends in market openness**
OECD Economic Outlook, June, 1998 .

Controls on cross-border capital flows encompass a diversified set of measures. Typically, capital controls take two broad forms: (1) "administrative", involving outright prohibitions; and (2) "market based that attempt to discourage particular capital movements by making them more expensive, through taxation. Kaminsky and Schmukler (2001) study the progress of financial liberalization (reducing policy barriers to the purchase and sale of assets across national borders) over 1972-99 periods in both the G-7 industrial economies and various regional sub-groups in the developing world. They prepared a composite index of liberalization of various segments of financial markets, including the capital accounts, domestic financial systems, and stock markets. They found that during the period under review removal of financially repressive measures was slow but continuous globally. They also concluded that the G-7 industrial economies were the first and the rapidest to liberalize their financial sectors. The rise in financial flows among industrial countries has enabled the United States to become both the world's largest creditor and its largest debtor, while financial flows to developing countries have remained steady at about 4 percent of the developing country GDP.

Blanchard and Giavazzi (2002) observe that Both Portugal and Greece, which have been running large current account deficits, with no effect on their financial ratings. Starting from this observation, they argue that Portugal and Greece are in fact representative of a broader evolution: Increasing goods and financial market integration is leading to an increasing decoupling of saving and investment within the European Union, and even more so within the Euro area. In particular, it is allowing poorer countries to invest more, save less, and run larger current-account deficits. The converse holds for the richer countries.

APPENDIX II: Closed Economy Quadratic Loss Function

In a closed economy, a quadratic approximation of the utility function, around the steady state is given by:

$$
\begin{aligned}
U_t &= -\frac{\bar{Y}u_c}{2}\left\{(\omega+\sigma^{-1})(x_t - x^*)^2 + (\omega+\theta^{-1})\,\mathrm{var}_j\,\hat{y}_t(j)\right\} \\
\hat{y}_t(j) &\equiv \log\left(\frac{y_t(j)}{\bar{Y}}\right); x_t \equiv \hat{Y}_t - \hat{Y}_t^{\,n}; \hat{Y}_t = \log(Y_t/\bar{Y}) \\
x^* &= \log\left(\frac{Y^*}{\bar{Y}}\right) \qquad . \qquad (1) \\
\mathrm{var}_j\,\hat{y}_t(j) &= \gamma[\hat{y}_t(1) - E_j\,\hat{y}_t(j)]^2 + (1-\gamma)[\hat{y}_t(2) - E_j\,\hat{y}_t(j)]^2 \\
E_j\,\hat{y}_t(j) &= \gamma\,\hat{y}_t(1) + (1-\gamma)\,\hat{y}_t(2)
\end{aligned}
$$

The terms $\mathrm{var}_j\,\hat{y}_t(j)$ and $E_j\,\hat{y}_t(j)$ denote cross-variety output variance and average output, respectively. (A derivation of the quadratic utility is included in Appendix II).

Equation (1) can be rewritten as:

$$
\boldsymbol{U_t} = -\frac{\bar{\boldsymbol{Y}}\boldsymbol{u}_c}{2}\left\{(\boldsymbol{\omega}+\boldsymbol{\sigma}^{-1})(\boldsymbol{x_t} - \boldsymbol{x}^*)^2 + (\boldsymbol{\omega}+\boldsymbol{\theta}^{-1})\,\mathrm{var}_j\,\hat{\boldsymbol{y}}_{\boldsymbol{t}}(\boldsymbol{j})\right\}. \qquad (2)
$$

Note that the term $(\boldsymbol{\omega}+\boldsymbol{\sigma}^{-1})(\boldsymbol{x_t} - \boldsymbol{x}^*)^2$ originates from the sub-utility $\left[\boldsymbol{u}(\boldsymbol{Y_t};\boldsymbol{\xi_t}))\right]$;

The term $(\boldsymbol{\omega}+\boldsymbol{\theta}^{-1})\,\mathrm{var}_j\,\hat{\boldsymbol{y}}_{\boldsymbol{t}}(\boldsymbol{j})$ originates from the sub-utility $\int_0^1 \boldsymbol{\nu}(\boldsymbol{y_t}(\boldsymbol{j});\boldsymbol{\xi_t},\boldsymbol{A_t})\boldsymbol{dj}$.

Approximate $\frac{\boldsymbol{Y_t}}{\bar{\boldsymbol{Y}}} = 1 + \hat{\boldsymbol{Y}}_{\boldsymbol{t}} + (\hat{\boldsymbol{Y}}_{\boldsymbol{t}})^2$. Then,

$$\hat{u}(Y_t;\xi_t,A_t) = \bar{u} + u_c\bar{Y} + u_\xi\hat{\xi}_t + \frac{1}{2}u_{cc}(\tilde{Y}_t)^2 + u_{c\xi}\bar{Y}\xi_t + \frac{1}{2}(\hat{\xi}_t,A_t)'u_{\xi\xi}(\hat{\xi}_t,A_t)$$
$$= \bar{u} + u_c\bar{Y} + (\hat{Y}_t + \frac{1}{2}(\hat{Y}_t)^2) + u_\xi\hat{\xi}_t + \frac{1}{2}(\bar{Y})^2u_{cc}(\hat{Y}_t)^2 + u_{c\xi}\bar{Y}\hat{\xi}_t\hat{Y}_t + \frac{1}{2}(\hat{\xi}_t,A_t)'u_{\xi\xi}(\hat{\xi}_t,A_t)$$
$$= \hat{Y}_t u_c\bar{Y} + \frac{1}{2}(\bar{Y}u_c + \bar{Y}^2u_{cc})(\hat{Y}_t)^2 - \bar{Y}^2u_{cc}g_t(\hat{Y}_t)^2$$
$$= \bar{Y}u_c[\hat{Y}_t + \frac{1}{2}(1-\sigma^{-1})(\hat{Y}_t)^2] + \sigma^{-1}g_t(\hat{Y}_t)$$
$$\bar{u} = u(\bar{Y};0,1); \hat{Y}_t = Y_t - \bar{Y}$$

$$g_t \equiv -\frac{u_{c\xi}\hat{\xi}_t}{\bar{Y}u_{cc}}$$

Using $v_y(\bar{Y};0,1)/u_c(\bar{Y};0) = \frac{1}{\mu}$ we get an approximation for the term: $\hat{v}(y_t(j);\xi_t)$

$$\hat{v}(y_t(j);\xi_t) = \bar{v} + \bar{u}_c\bar{Y}[\hat{y}_t(j) + \frac{1}{2}(1+\omega)(\hat{y}_t(j))^2 - \omega q_t\hat{y}_t(j)]$$
$$= u_c\bar{Y}[(1-\frac{1}{\mu})\hat{y}_t(j) + \frac{1}{2}(1+\omega)(\hat{y}_t(j))^2 - \omega q_t\hat{y}_t(j)]$$
$$\hat{y}_t(j) = \log(\frac{y_t(j)}{\bar{Y}}); q_t \equiv -\frac{v_{y\xi}\hat{\xi}_t}{\bar{Y}v_{yy}}$$
$$\int_0^1\hat{v}(y_t(j);\xi_t) = u_c\bar{Y}[(1-\frac{1}{\mu})E_j\hat{y}_t(j) + \frac{1}{2}(1+\omega)[E_j(\hat{y}_t(j))^2 + \text{var}\,\hat{y}_t(j)] - \omega q_tE_j\hat{y}_t(j)]$$
$$= \bar{Y}u_c[(1-\frac{1}{\mu})\hat{Y}_t + \frac{1}{2}(1+\omega)[(\hat{Y}_t)^2 - \omega q_t\hat{Y}_t] + \frac{1}{2}[(\theta^{-1}+\omega)\text{var}_j\,\hat{y}_t(j)]$$
$$\text{var}_j\,\hat{y}_t(j) = \gamma[\hat{y}_t(1) - E_j\hat{y}_t(j)]^2 + (1-\gamma)[\hat{y}_t(2) - E_j\hat{y}_t(j)]^2$$
$$E_j\hat{y}_t(j) = \gamma\hat{y}_t(1) + (1-\gamma)\hat{y}_t(2)$$

, where, $E_j(\hat{y}_t(j))$ is the mean value of $\hat{y}_t(j)$ across all differentiated goods, and $\text{var}\,\hat{y}_t(j)$ is the corresponding variance.

Finally, going back to U, we get:

$$U_t = \bar{Y}u_c[(\frac{1}{\mu})\hat{Y}_t - \frac{1}{2}(\sigma^{-1}+\omega)[(\hat{Y}_t)^2 + (\sigma^{-1}g_t + \omega q_t)(\hat{Y}_t) - \frac{1}{2}[(\theta^{-1}+\omega)\operatorname{var}_j \hat{y}_t(j)] =$$

$$-\frac{\bar{Y}u_c}{2}\left\{(\sigma^{-1}+\omega)(x_t - x^*)^2 + (\theta^{-1}+\omega)\operatorname{var}_j \hat{y}_t(j)\right\}$$

$$x_t = \hat{Y}_t - \hat{Y}_t^n$$

$$\hat{Y}_t^n = \frac{\sigma^{-1}g_t + \omega q_t}{\sigma^{-1}+\omega}$$

$$\Rightarrow \log(\frac{\bar{Y}}{Y^*}) = -(\sigma^{-1}+\omega)^{-1}\frac{1}{\mu}$$

The familiar Dixit-Stigliz preferences over the differentiated goods (varieties) imply

$$y_t(j) = Y_t\left(\frac{p_t(j)}{P_t}\right)^{-\theta}.$$

Log approximation yields:

$\log y_t(j) = \log Y_t - \theta(\log p_t(j) - \log P_t)$. The derived cross-variety variance is:

$\operatorname{var}_j \log y_t(j) = \theta^2 \operatorname{var}_j \log p_t(j)$. We can now substitute these derivations in equation (1) to get:

$$\boldsymbol{U_t = -\frac{\bar{Y}u_c}{2}\left\{(\omega+\sigma^{-1})(x_t - x^*)^2 + \theta(1+\omega\theta)\operatorname{var}_j \log p_t(j)\right\}}. \qquad (1')$$

The approximate utility is seen in equation (2) to be a function of the output gap and price dispersion across varieties.

We now exploit the rational-expectation property that

$$\log p_t^{(2)} = E_{t-1}\log p_t^{(1)}$$
$$\log P_t = \gamma \log p_t^{(1)} + (1-\gamma)\log p_t^{(2)}.$$

These equations imply that:

$$\pi_t - E_{t-1}\pi_t = \gamma[\log p_t^{(1)} - E_{t-1}\log p_t^{(1)}]$$
$$= \gamma[\log p_t^{(1)} - \log p_t^{(2)}]$$

This step, in turn, yields:

$$\text{var}_j \log p_t(j) = \gamma(1-\gamma)[\log p_t^{(1)} - \log p_t^{(2)}]^2$$
$$= \frac{1-\gamma}{\gamma}[\pi_t - E_{t-1}\pi_t]^2$$

Substituting this relationship into equation (2) we get the closed economy loss function:

$$L_t = (\pi_t - E_{t-1}\pi_t)^2 + \frac{1}{\theta}\frac{\gamma}{1-\gamma}\frac{\sigma^{-1}+\omega}{1+\theta\omega}(x_t - x^*)^2 + exogenousterm \qquad (3)$$

Where, $x^* = (\omega + \sigma^{-1})^{-1}\frac{1}{\mu}$, and the $exogenousterm$ is a function of other variables.[11].

[11] In general the terms in the loss function, aside for the output gap and inflation terms, are a function of the world demand, real exchange rate, etc. We collapse these terms into the *linearterm*. See Benigno and Benigno (2003), De Paoli (2004), and Gali and Monacelli (2005).