Testing Globalization-Disinflation Hypothesis

Mauricio Calani

Central Bank of Chile

19. August 2007

Testing the Globalization-Disinflation Hyphotesis

Mauricio Calani*
Pontificia Universidad Católica de Chile
Central Bank of Chile

September 8, 2007

Preliminary

Abstract

This paper addresses the globalization - disinflation hypothesis from the perspective of a open economy neo keynesian framework. This hypothesis proposes that globalization has changed the long-run inflation process, resulting in a global *disinflation*. If true, it makes us wonder about the merit of central banks in this phenomenon. Even more, challenges our knowledge that long-run inflation is ultimately a monetary issue. This paper explicitly addresses this hyphotesis, analyzing how different degrees of *globalization* change the response of output and inflation to supply shocks. To accomplish this, the use of a general equilibrium approach in which we can *identify* and isolate shocks and openness is a must. Globalization is however, a complex process. In this paper I explicitly model globalization just as an openness process. Simulation results suggest that as long as there is one distortion - free market for assets, the discussion about the changed values of price stickiness measures which would affect the long-run inflation process is of reduced importance. It is also suggested that financial integration, and not trade or competition, is key to understanding the link between globalization and inflation.

*Economist, Economic Research Department, Central Bank of Chile. I thank very insightful comments and discussion from J. Pablo Medina and specially from Jordi Galí and Klaus Schmidt-Hebbel. The views expressed herein are those of the author and are not necessarily those of the Central Bank of Chile or Catholic University of Chile. Agustinas 1180, Santiago, Chile. Phone:(562) 6702772. e-mail:mcalani@bcentral.cl

1 Introduction

Why should globalization be an interesting topic to relate with inflation dynamics? In the last couple of years there has been an outburst of papers which propose a link between globalization and the inflationary process, theoretically as well as empirically. It would be accurate to say that Kenneth Rogoff began this debate proposing what was later to be called the *Globalization-Disinflation Hypothesis*, which basically says that globalization has played a strong role in the disinflation process that began in the mid 80's. Why exactly? The are several features of globalization that would operate in this direction; increased competition makes margins drop marginally, but the aggregate effect is large, it also makes it more likely to substitute non tradables for importables which would lead to more flexible prices and after all, when thinking about globalization it is impossible to not think about China and India. Thus, this globalization-led disinflation may have made the task easier for central banks around the world. Data seems to support this idea. In fact, strong central banks as well as very irresponsible and fiscally-dependent central banks have reached one-digit inflation. At this point of history, chronic inflation has been practically wiped out and now, deflation has caught the attention of researchers.

It is hard to rebate that long-run inflation is indeed a monetary phenomenon, and that it is ultimately determined by the chosen monetary framework. It is so, because long-run inflation is orthogonal to short-run deviations, and it is actually *chosen* by the monetary authority. If this is true, then only a variable that can affect the very inflation dynamics process, apart of central banking, should be behind this disinflation trend. Otherwise its' effect would revert in the short-run. And it is tempting to attribute this effect to a popular variable: *globalization*. In order to affect the inflationary process, it should somehow affect the output inflation trade-off. Rogoff (2003) uses the Barro-Gordon (1983) model to argue that increased price flexibility has made the short run Phillips curve steeper, which changes the inflation - output rate of substitution faced by central banks, making it more costly to push real activity through inflation. Thus he finds a new way in which the classical inflation bias can be eliminated, besides **not** trying to attain above-normal output or his previous suggestion: a conservative central banker. The conclusion is clear in the context of this model, if prices are indeed more flexible then it is harder to pursue above normal output, and the optimal solution is not to do so. However nothing is said about the magnitude of realistic degrees of increased price flexibility, and even more, globalization is a recent phenomenon that begun after central banks understood the Friedman-Phelps expectations augmented Phillips Curve. Therefore, the coefficient multiplying the positive desired output gap, is actually multiplying zero. This makes less obvious that globalization had something to do with disinflation in countries like the United States or Chile in its openness process in the nineties. And it also makes it less interesting topic to study. However it is interesting to study the implication beyond the non-active inflation bias, in an economy that chooses to pursue an openness process together with firm commitment to price stability.

From the standpoint of the modern monetary theory, inflation dynamics is ultimately a set of decisions taken by price-setting firms. Then, any variable behind long-run inflation should influence the choice firms make or the frequency in which they do so. The level of prices firms set, is based on their expectations about marginal costs and desired mark ups, therefore, something must be lowering them systematically for globalization to influence long-run inflation. Put differently, globalization should create expectations of lower future marginal costs for firms to set lower present prices or diminish systematically desired markups through increased competition. The second possibility is that prices are adjusted more frequently than before, because of global competition, a point I will address later.

In this paper I examine carefully these features in a simple model economy that uses the tools of modern monetary theory. I model a economy as simple as possible, keeping only the most basic ingredients that globalization is supposed to change.

I find results that suggest that tariff removal has a relative price adjustment process that reduces short-run inflation but that does not change the inflation-process. These results also suggest that while reduced mark ups have an effect on long-run inflation, its magnitude reveals that this reduction cannot be behind global disinflation. The same is true about the frequency of price adjustment.

I use the framework of the New Keynesian paradigm because it provides micro foundations to the inflation process. Besides, it is around this framework that the debate has evolved. This framework seems appropriate and natural to analyze monetary issues since it explicitly deals with price setting, optimal mark ups and sticky prices in a sophisticated and simplified way. However, even this simple models are extremely difficult to solve analytically, thus I use a perturbation method solution proposed by Schmitt-Grohé and Uribe (2004). Next section briefly reviews previous work on the *globalization-disinflation* debate, section 3 explains the model, section 4 presents results of simulations and section 5 briefly concludes.

2 Previous Work

In this section I begin summarizing the debate around the hypothesis that the inflation process has changed due to globalization, and the possibility that this has brought down inflation around the globe. Then I mention recent empirical work that leads to conflicting conclusions, which motivate the idea of dealing with this issue more analytically.

2.1 The debate on the Phillips Curve

Over the past ten years, global inflation has dropped from nearly 30% to low one digit percentages. It has been widely accepted that this trend in inflation is due to improved monetary theory implementation. Enhanced central bank independence, considerable research on monetary theory and increased public attention to inflation have made central banks around the globe improve their practice of monetary policy. Even more, exchange rate crisis have made it clear price stability can only be attained systematically through a solid monetary scheme that commits monetary authority in a credible way.
When it comes to inflation, central banks must never stop questioning themselves about new interesting links between price level determination and other variables. First because it is desirable for them to do so, since that is the only way monetary theory can evolve. And second, because low inflation is a requisite for high sustainable economic growth.
In recent years an alternative -although not conflicting- hypothesis emerged. It argues that it is possible that other favorable factor could be behind this global disinflation. It is well known that productivity growth in the U.S. led to non-inflationary growth in the nineties. Natural output grew, so inflation was not triggered. Perhaps something similar has happened to the very inflation determining process. Rogoff (2003a, 2003b) proposes that globalization-interacting with deregulation and privatization- has played a **strong** role in the past decade's disinflation. He argues that increased competition, drives inflation down by reducing markups and monopolistic power, this leads to an equilibrium in which monetary authorities know it is costly to push the economy beyond its natural level (in terms of inflation), therefore doing so would be sub-optimal. Rogoff (2003a) inserts his argument in the Barro-Gordon (1983) model and explains that as prices become more flexible, the Phillips Curve gets steeper, thus making it more costly to attain higher levels of output. He demonstrates that the parameter multiplying the output wedge in the Barro Gordon model is inversely related to price flexibility. However he misses that successful central banks that attained one digit inflation in the nineties had already abandoned pursuing this output wedge before globaliza-

tion began a generalized phenomenon. Therefore he is right in his conclusion about the possibility of a steeper Phillips Curve, however it is not clear how this affects inflation in an economy that does not try to attain above-natural output, through systematically expansive monetary policy. This paper seeks to analyze this relation, assuming the model economy does not try to attain a wedge between effective and natural output.

An eloquent answer to Rogoff's idea was proposed by Ball (2006). He argues that globalization has not reduced the long-run level of inflation, nor has it affected the structure of inflation dynamics. Ball performs analysis to test if the Phillips Curve has actually gotten steeper. He finds that the Phillips Curve in the United States has indeed changed, but in the opposite direction. His estimates are similar to those of Kohn (2006) and he proposes that we should be talking about a flattened Phillips Curve, not a steeper one. In the case of Chile, Céspedes and Soto (2007) find that price rigidity has increased in recent years, and that price indexation to past inflation has decreased. They attribute this finding (flattened Phillips Curve) to increased credibility on Central Bank of Chile's commitment to price stability. Furthermore, Galí *et al.*(2005) estimate New Keynesian Phillips curves relating inflation to real marginal cost and inflation expectations for the United States. They find robust results on their estimations and no evidence of structural change.

Thus, who should we believe? Even though Phillips Curves estimations is a common exercise, it is hard to do so; because after all, it entails trying to identify one side of the process that ultimately determines output and inflation. The other component being Aggregate Demand or the Dynamic IS. Even more, the task only gets harder if we consider that this relations vary with productivity shocks. Imagine, for example, aggregate demand is fixed, and the Phillips Curve slope makes it almost vertical; then, if several and large enough productivity shocks move natural output, data would show a group of observations around a determined level of inflation, and estimates of Phillips Curves would suggest a flattened relationship.

Given the uncertainty of the real Data Generating Process, it is hard to tell which estimates are correct[1]. This is the basic reason of choosing a more analytical framework to analyze the extend to which globalization can affect inflation and output dynamics.

In section 4 I examine analytically diverse channels through which globalization could affect the output-inflation trade-off sufficiently to explain the global disinflation phenomenon. I discuss the role of mark ups, competition,

[1]It is worth mentioning, however, that evidence that supports an unchanged or flattened PC uses more sophisticated econometric techniques that deal with simultaneity. However, natural level of output remains unknown. On the other hand, a steeper PC seems more plausible theoretically.

price flexibility and tariff removal as possible sources for this phenomenon. Thus it is important to make a few comments on the output-inflation trade-off (if it exists at all) which I do next.

2.2 Choosing (non) neutrality of money

The Keynesian economics development during the 80's was an attempt to provide micro foundations to key Keynesian features and assumptions. Models in this literature suggest non-neutrality of money. Menu Costs, Staggered Contracts, and other models were widely studied to explain money short run non-neutrality. However these models were static and made no connection with other features of the economy. On the other hand, the Real Business Cycle literature emphasized the irrelevance of monetary policy and proposed technology as the main source of economic fluctuation. Money could be included but it remained neutral. The New Keynesian counter revolution was a natural result of this lines of research. NK models emphasize the role of price setting and money non-neutrality adopting the RBC methodology.
As mentioned before, the debate on the effects of globalization on inflation process has focused attention in key structural parameters of the New Keynesian Framework, this it is natural to use it to examine such propositions. Real Business Cycle work has been previously done for Chile, worthy examples are Duncan (2005) and Ochoa and Valenzuela (2005). Models in this literature included money, but it remained neutral. This is a natural result of including a Sidrausky-type utility function and no nominal rigidities. Indeterminacy of price level is also a characteristic of this type of models. Woodford (2003) makes an excellent analogy for the price level indeterminacy. He says that in the classical growth model, real variables can be thought of as a pendulum, which after shocks returns to the initial steady state level; however, nominal variables can be thought of as a cylinder that once moved, can reach an indeterminate new steady state.
In this paper it is important to take features of the New Keynesian literature. Otherwise, it would not be feasible to asses the variables that are supposed to be changing the inflationary process. The choice of this framework, is a methodological decision. Nevertheless, the trade-off between inflation and output remains a relevant topic of discussion for Business Cycle Theorists. Notice that it is impossible to relate monetary policy and the business cycle unless we admit the existence of a trade-off. Furthermore, recent research claims to have stable relationships between inflation, expectations and real activity. In this paper I choose to include several features of the New Keynesian framework as well as features of perfectly competitive markets. Next section gives details on the model.

3 The Model

The dynamic stochastic general equilibrium model to be used has to explicitly consider several features in the transmission mechanism of the monetary policy. I model the Chilean economy as stationary. It is not difficult to show that results are not different from those obtained from a model with trend exogenous growth, since we can always de-trend the equilibrium paths of endogenous variables. Furthermore, Chilean growth dynamics are more likely to to be consistent with deterministic trends, and thus exogenous growth models, as shown by Chumacero and Fuentes (2006). Besides, there is no reason to think that trend growth has a relation with inflation, since if there is any relation at all between these, we should suspect inflation to be related to the business cycle and not to the trend. The framework I use departs from the Real Business Cycle literature assuming nominal and real rigidities that make monetary policy non neutral. This model also incorporates distortions, which make the steady state inefficient. However, I suppose the monetary authority does not try to solve this inefficiency through systematically expansive monetary policy since it is not realistic and it is not the focus of this paper.

3.1 Households

This economy is inhabited by a representative, infinitely lived household that maximizes

$$E_t \sum_{i=0}^{\infty} \beta^t U(c_{m,t}, c_{h,t}, \frac{M_t}{P_{ht}}) \tag{1}$$

where E_t denotes the mathematical expectations operator conditional on information available at time t, $\beta \in (0,1)$ represents a subjective discount factor, and U is a period utility index assumed to be strictly increasing in its arguments, and strictly concave. Specifically, $c_{m,t}$ represents the consumption of importable goods, $c_{h,t}$ is the level of consumption of the composite non tradable goods and M_t is the quantity of money held by the household in period t. Of course, $P_{h,t}$ is the price level of the non tradable composite good. The consumption good is assumed to be a composite made up of a continuum of differentiated goods $c_{h,t}(i)$ indexed by $i \in [0,1]$ via the CES aggregator

$$c_{h,t} = [\int_0^1 c_{h,t}(i)^{1-\frac{1}{\eta}} di]^{\frac{1}{1-\frac{1}{\eta}}} \tag{2}$$

where the parameter $\eta > 1$ denotes the intra temporal elasticity of substitution across varieties composing this good. Since this household behaves optimally, it will seek to maximize the level of $c_{h,t}$ given a total expenditure $\int_0^1 p_{h,t}(i)c_{h,t}(i)di$, therefore it solves

$$\max c_{h,t} = [\int_0^1 c_{h,t}(i)^{1-\frac{1}{\eta}} di]^{\frac{1}{1-\frac{1}{\eta}}} + \mu[z_t - \int_0^1 p_{h,t}(i)c_{h,t}(i)di] \tag{3}$$

where the first order condition associated is

$$c_{h,t}^{\frac{1}{\eta}} c_{h,t}(i)^{\frac{-1}{\eta}} = \mu p_{h,t}(i) \tag{4}$$

that must hold for all $c_{h,t}(i)$ and also for the basket as a whole: $c_{h,t}$, obtaining

$$c_{h,t}(i) = \left(\frac{p_{h,t}(i)}{p_{h,t}}\right)^{1-\eta} c_{h,t} \tag{5}$$

Remember that total expenditure is given by $z_t = \int_0^1 p_{h,t}(i)c_{h,t}(i)di$ and if there is an index so that $z_t = p_{h,t}c_{h,t}$ then

$$\begin{aligned} c_{h,t}(i) &= \left(\frac{p_{h,t}(i)}{p_{h,t}}\right)^{-\eta} \left(\frac{z_t}{p_{h,t}}\right) \\ \int_0^1 p_{h,t}(i)c_{h,t}(i)di &= \int_0^1 \left(\frac{p_{h,t}(i)}{p_{h,t}}\right)^{1-\eta} z_t di \\ p_{h,t} &= \left[\int_0^1 p_{h,t}(i)^{1-\eta} di\right]^{\frac{1}{1-\eta}} \end{aligned} \tag{6}$$

Thus, once the demand for the composite good c_{ht} is determined, it is easy to obtain demand for variety i.

The budget to which the consumer is constrained is given by

$$\begin{aligned} & p_{m,t}(1+\tau_{m,t})c_{m,t} + p_{h,t}c_{h,t} + (1+\tau_{m,t})p_{m,t}i_t + \\ \frac{b_{t+1}}{1+r_t} &+ (1+R_t)(1+e_t)D_t^* + M_{t-1} \leq v_t p_{m,t}(1+\tau_{m,t})K_t + M_t \\ & +b_t + D_{t+1}^* + \Upsilon_t + \Phi_h + \Phi_x \end{aligned} \tag{7}$$

where $\tau_{m,t}$ represents the import tariff, $c_{m,t}$ is the consumption of importables, i_t investment, b_t stands for total government bonds (nominal) held by households, r_t is the nominal interest rate, R_t is the external interest rate, e_t is the appreciation (depreciation) of the nominal exchange rate, D_t^* represents external debt, M_t represents total money holding in period t, Υ_t are lump sum taxations (subsidies), finally, Φ_h and Φ_x represent profits from the non-tradable good technology and exportable good technology respectively. The capital law of motion is given by

$$K_{t+1} = (1-\delta)K_t + i_t \tag{8}$$

The problem of the representative consumer can be summarized by the value function that satisfies:

$$V(s_h) = \max\left(U(c_{h,t}, c_{m.t}, \frac{M_t}{P_h, t}) + \beta E[V(s_{h+1})]\right) \tag{9}$$

subject to (7) and (8) and the perceived law of motion of the state variables.

if the functional form of the instant utility function is given by

$$U(c_{m,t}, c_{h,t}, \frac{M_t}{P_{h,t}}) = \frac{1}{1-\sigma}\left[c_{m,t}^{\varphi} c_{h,t}^{\gamma}\left(\frac{M_t}{P_{h,t}}\right)^{1-\varphi-\gamma}\right]^{1-\sigma} \tag{10}$$

where σ is the constant relative risk aversion coefficient [2]. Then the first order conditions for the consumer are given by

$$\begin{aligned}
1 &= \frac{\varphi}{\gamma}\frac{c_{m,t}p_{m,t}(1+\tau_{m,t})}{c_{h,t}p_{h,t}} \\
M_t &= \frac{1-\varphi-\gamma}{\varphi}c_{m,t}p_{m,t}(1+\tau_{m,t})\left(\frac{r_t}{1+r_t}\right)^{-1} \\
\beta(1+r_t) &= \frac{c_{h,t+1}p_{h,t+1}}{c_{h,t}p_{h,t}} \\
(1+r_t) &= (1+R_t)(1+e_t) \\
1+v_{t+1}-\delta &= \frac{1}{\beta}\frac{c_{m,t+1}}{c_{m,t}}
\end{aligned} \tag{11}$$

The first equation is the intra temporal condition, the second relates money to consumption and interest rate. There are two observations worth mentioning about this condition, first, it comes from a Sidrausky-type utility function in which money is held as a store of wealth, which is simpler than modeling cash-in-advance constraints; second, money demand depends inversely of $\frac{r_t}{1+r_t}$, which is consistent to the observation Easterly *et. al* make, arguing this is the true cost of money in contrast to typical money demand equations that relate M_t to $log(r_t)$ or simply to r_t. The third condition is the Euler equation, the fourth is the uncovered interest parity condition. Finally, the last condition relates the marginal gain of investing in capital and the inter temporal rate of substitution.

[2] In this case I assume $\sigma = 1$

3.2 Firms

As one can notice, the consumer's budget constraint includes two types of goods that are not the same as those in the instant utility function (10) because the consumer does not consume exportable goods, but sells them abroad and perceives a rent for them. The production of these goods will be determined by foreign demand, more specifically, by the observed international price. Both, exportable and non tradable goods are produced with a technology that requires only capital, which as Chumacero *et al.* (2004) notice is consistent with a model in which labor is sector specific. This assumptions greatly reduces computational work and is not determinant to the results, since there is no obvious way globalization affects or is affected by labor dynamics. In practice, labor market is important to inflation forecasting because labor costs tend to be a leading indicator of inflationary pressure, however in this model I explicitly model marginal cost, thus there is no loss of generality and simplicity is kept. Importables are not produced in the country, I assume the sector that substitutes importables for national production is nil.

3.2.1 Non Tradables

Each good's variety $i \in [0, 1]$ is produced by a single firm in a monopolistically competitive market. Each firm i produces output using only capital, $k_{i,t}$ with a production function given by

$$e^{z_{h,t}} F(k_{i,t})$$

where I assume F to be concave, and strictly increasing in capital. The variable $z_{h,t}$ denotes an stochastic productivity shock common to all firms in this sector. The firm takes into account the monopolistic competition environment when deciding price setting. Each variety is produced by a firm, therefore every firm faces a demand (absorption) equal to $a_{h,t}(i) = c_{h,t}(i) + \chi g_t(i)$, where again, $g_{h,t}(i) = \left(\frac{p_{h,t}(i)}{p_{h,t}}\right)^{-\eta} \chi g_t$

$$a_{h,t}(i) = \left(\frac{p_{h,t}(i)}{p_{h,t}}\right)^{-\eta} a_{h,t}$$

thus, every firm must maximize

$$\phi_{h,t}(i) = p_{h,t}(i) \left(\frac{p_{h,t}(i)}{p_{h,t}}\right)^{-\eta} a_{h,t} - v_t(1 + \tau_{m,t})(p_{m,t})k_{h,t}$$

but it also knows that prices are sticky à la Calvo. More specifically only a fraction $1-\theta$of firms are allowed to adjust prices optimally every period. Thus the actual objective function to maximize is the discounted profit subject to the constraint that every firm must satisfy demand in every period.

$$\max E_s \sum_{s=t}^{\infty} \left(\frac{1}{1+r_{t,s}}\right)^{s-t} \theta^{s-t} \Big\{ p^*_{h,t} Y_{s|t} - v_s(1+\tau_{m,s}) p_{m,s} k_{h,s} + \bar{mc} \left(e^{z_{h,s}} k^{\alpha_h}_{h,s}(i) - (\frac{p^*_{h,t}}{p_{h,s}})^{-\eta} a_{h,s}(i) \right) \Big\} \tag{12}$$

The first order condition associated to $p_{h,t}$ and $k_{h,t}$

$$\begin{aligned} \sum_{s=t}^{\infty} \left(\frac{1}{1+r_{t,s}}\right) \theta^{s-t} Y_{s|t} \left(\frac{p^*_{h,t}}{p_{h,s}} - \frac{\eta}{\eta-1} mc_s\right) &= 0 \\ v_t(1+\tau_{m,t}) p_{m,t} - p_{h,t} mc_t \alpha_h e^{z h_t} k^{\alpha_h - 1}_{h,t} &= 0 \end{aligned} \tag{13}$$

It is clear from these equations that the price setting decisions taken by firms depend on the expectation of mark ups, which depend on the expectation of future prices and marginal costs. The first condition in (13) can be expressed in two parts, x^1_t and x^2_t, where $x^1_t = \sum_{s=t}^{\infty} \left(\frac{1}{1+r_{t,s}}\right) \theta^{s-t} \left(\frac{p_{h,t}(i)^*}{p_{h,s}}\right)^{1-\eta} a_{h,s}$ and $x^2_t = \sum_{s=t}^{\infty} \left(\frac{1}{1+r_{t,s}}\right) \theta^{s-t} \left(\frac{p_{h,t}(i)^*}{p_{h,s}}\right)^{-\eta} a_{h,s} \mathcal{M}MC_s$, holding $x^1_t = x^2_t$ at all times. Notice that this auxiliary variables can be recursively expressed as $x^1_t = \left(\frac{p^*_{h,t}}{p_{h,t}}\right)^{1-\eta} a_t + \left(\frac{p^*_t}{p^*_{t+1}}\right)^{1-\eta} \left(\frac{\theta}{1+r}\right) x^1_{t+1}$ and $x_t r = a_t \mathcal{M}MC_t \left(\frac{p^*_{h,t}}{p_{h,t}}\right)^{-\eta} + \frac{\theta}{1+r} \left(\frac{p^*_{h,t}}{p^*_{h,t+1}}\right)^{-\eta} x^2_{t+1}$. Since the probability that each firm re-sets prices is $1-\theta$, then

$$p^{1-\eta}_{h,t} = \theta p^{1-\eta}_{h,t-1} + (1-\theta) p^{1-\eta}_{h,t} \tag{14}$$

3.2.2 Tradable Goods

The technology in this sector

$$f(z_{x,t}, k_{x,t}) = e^{z_{x,t}} k^{\alpha_x}_{x,t} \tag{15}$$

So the problem to solve by this firm (which doesn't face monopolistic competition) is;

$$\max \phi_x = (1-\tau_{x,t}) q e^{z_{x,t}} k^{\alpha_x}_{x,t} - v_t p_{m,t} (1+\tau_{m,t}) k_x \tag{16}$$

The first order associated condition is

$$(1-\tau_{x,t}) q e^{z_{x,t}} \alpha_x k^{\alpha_x - 1}_x = v_t (1+\tau_{m,t}) \tag{17}$$

Notice that there are neither nominal nor real rigidities in this sector. In the Chilean case there is vast literature analyzing whether or not copper industry has any monopolistic position in world market and most studies tend to use terms like *modest* or *limited*, therefore I choose to model this sector of the economy as perfectly competitive, facing terms of trade. I assume that the productivity shocks(z_i) follow AR(1) processes:

$$\begin{aligned} z_{j,t+1} &= (1-\rho_j)\bar{z}_{j,t+1} + \rho_j z_{j,t} + \upsilon_{j,t+1} \\ \upsilon_{j,t+1} &\sim \mathcal{N}(0,\sigma_j^2) \end{aligned} \tag{18}$$

3.3 Government

Government is composed by two separate institutions, fiscal government and a monetary authority.

3.3.1 Fiscal Authority

I model fiscal authority in a very simple and popular way. Government does not try to influence the economy through subsidies or taxes meant to solve for the monopolistic competition inefficiency. It limits itself to fulfill

$$\tau_{m,t}(c_{m,t} + i_t) + \frac{b_{t+1}}{1+r} - b_t \geq g_t + \Upsilon_t \tag{19}$$

I assume there is a fiscal component that is predetermined. I follow Chumacero *et al.* (2004) assuming the following autoregressive process:

$$\begin{aligned} \ln g_{t+1} &= (1-\rho_g)\bar{g}_{t+1} + \rho_g \ln g_t + \upsilon_{g,t+1} \\ \upsilon_{g,t+1} &\sim \mathcal{N}(0,\sigma_g^2) \end{aligned} \tag{20}$$

3.3.2 Monetary Authority

Monetary Policy is modeled in a widely accepted way, to concentrate on the issues of the openness and not the rule chosen.

$$\begin{aligned} \ln(1+r_{t+1}) = \rho_{MP}\ln(1+r_t) + (1-\rho_{MP})(\ln(1+\bar{r}) + \\ \rho_\pi \ln(\frac{ph_{t+1}}{ph}) + \rho_y \ln(\frac{Y_t}{Y^n})) \end{aligned} \tag{21}$$

3.4 External Sector

I follow Schmitt-Grohé and Uribe (2003) to determine the external rate $R_t = \bar{R} + p(\tilde{d})$ in which stationarity is induced by assuming that the interest rate faced by domestic agents, R_t, is increasing in the aggregate level of foreign debt, $\tilde{d}$. Specifically I assume the functional form assumed by Chumacero *et al.* (2004)

$$
\begin{aligned}
R_{t+1} &= (1-\rho_r)\bar{R}_{t+1} + (1-\rho_r)\Omega(\frac{D_t^*}{y_t}) + \rho_r R_t + \upsilon_{R,t+1} \\
\upsilon_{R,t+1} &\sim \mathcal{N}(0,\sigma_R^2)
\end{aligned} \tag{22}
$$

I also assume that terms of trade are exogenously given.

$$
\begin{aligned}
\ln q_{t+1} &= (1-\rho_q)\overline{q}_{t+1} + \rho_q \ln q_t + \upsilon_{q,t+1} \\
\upsilon_{q,t+1} &\sim \mathcal{N}(0,\sigma_q^2)
\end{aligned} \tag{23}
$$

3.5 Market Clearing

The capital market must empty. In this highly stylized economy all capital is imported and is demanded only by the two sectors that produce final goods: The non tradable sector and the exportable sector.

$$K_t = k_{x,t} + k_{h,t} \tag{24}$$

Notice the relation between current account and capital account: $-D_{t+1}^* + D_t^* = (1-\tau_x)qy_x - c_{m,t} - (1-\chi)g_t - k_{t+1} + (1-\delta)k_t - R_t D_t^*$ There is no need to empty the exportable sector since the price (terms of trade) has been exogenously given. However it is necessary to empty the non tradable market. Remember that the composite good $c_{h,t}$ is aggregated according to $c_{h,t} = [\int_0^1 {c_{h,t}^i}^{1-\frac{1}{\eta}} di]^{\frac{1}{1-\frac{1}{\eta}}}$ and that the market for every variety $i \in [0,1]$ must empty: $f(z_{h,t}, k_{h,t}(i)) = a_{h,t}\left(\frac{p_{h,t}(i)^*}{p_{h,t}}\right)^{-\eta}$ where, as was previously defined: $a_{h,t} = (c_{h,t}(i) + \chi g_{h,t}(i))$ If we define $y_{h,t} = \int_0^1 f(\cdot)(i)$ then,

$$
\begin{aligned}
f(z_{h,t}, k_{h,t}) &= a_{h,t}\int_0^1 \left(\frac{p_{h,t}(i)^*}{p_{h,t}}\right)^{-\eta} di \\
s_t &= \int_0^1 \left(\frac{p_{h,t}(i)^*}{p_{h,t}}\right)^{-\eta} di
\end{aligned} \tag{25}
$$

However, it is useful to remember that Calvo prices can be understood as the sum of optimal adjusted prices weighted by the probability of having been changed in certain period. Since there there is inter temporal independence in the price signaling mechanism, then we can have a measure for distortion

s_t of the form:

$$s_t = (1-\theta)\left(\frac{p_{h,t}(i)^*}{p_{h,t}}\right)^{-\eta} + (1-\theta)\theta\left(\frac{p_{h,t-1}(i)^*}{p_{h,t}}\right)^{-\eta} + \theta^2(1-\theta)\left(\frac{p_{h,t-2}(i)^*}{p_{h,t}}\right)^{-\eta} + \cdots \quad (26)$$

And once again it is possible to obtain a recursive expression to model the variable s_t. As Schmitt-Grohé and Uribe (2007) notice, this variable is a measure of price dispersion that is in the unity neighborhood. Sadly, most work done in this framework assume that this dispersion term can be accurately approximated to unity. However, since it modifies the aggregation condition, small deviations create big distortions that can seriously change results. Thus I choose not to approximate it.

$$s_{t+1} = (1-\theta)\left(\frac{p_{h,t}(i)^*}{p_{h,t}}\right)^{-\eta} + \theta\left(\frac{p_{h,t}}{p_{h,t+1}}\right)^{-\eta} s_t \quad (27)$$

3.6 Calibration

Since the objective of this paper is analytical, I consider important to follow well accepted parameter values for the Chilean economy. This way, it is less likely that criticism around parameter values causing results take place. There are several contributions to real business cycle literature for the Chilean economy. Perhaps the most important ones are Chumacero *et al.* (2004), Chumacero and Fuentes (2006), Caputo *et al* (2007), Bergoeing and Soto (2002) and Duncan (2005). Microeconomic studies are scarce, and is is worth emphasizing recent work by Medina *et al* (2006) on micro - price dynamics.

Symbol	Value
β	0.992
η	5.7
φ	0.6813
γ	0.2187
δ	0.025
α_x	0.45
α_h	0.3
$\bar{z}_x$	4.90
$\bar{z}_h$	2.76
$\bar{R}$	0.008

Symbol	Value
$\bar{g}$	1.773
$\bar{q}$	0.25
τ_m	0.02
τ_x	0.051
χ	0.92

Parameters were taken from previous studies and modified when necessary to make them consistent to quarterly model. AR(1) processes described in this section are assumed to have the following parameters: $\rho_R = 0.9$; $\rho_g = 0.8$; $\rho_q = 0.86$; $\rho_x = 0.9$, $\rho_h = 0.9$. Most of this AR(1) parameters were taken from Chumacero *et al* (2004) which is one of the few studies that calibrate parameters to analyze openness in Chile. Finally, $\sigma_x = 0.001$, $\sigma_h = 0.01$, $\sigma_q = 0.01$, $\sigma_R = 0.001$. Next section presents the results of some simulations and insights that can be drawn from them

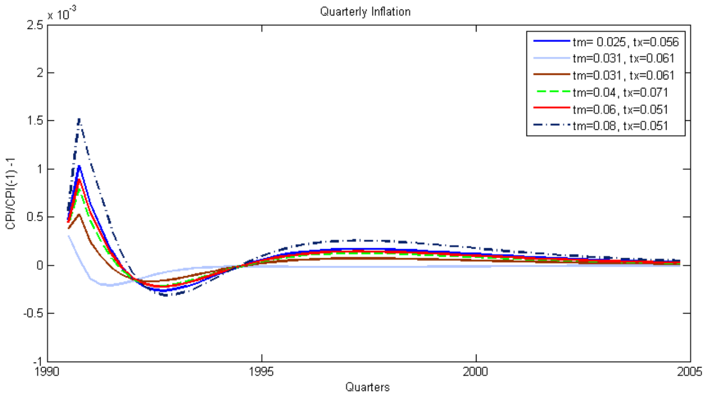
4 Results

As I argued previously, I do not use log linearizations to solve the model numerically. I however, use a perturbation method proposed by Schmitt-Grohé and Uribe (2004), which has been proven to outperform usual linear quadratic method solutions. The equations that determine the equilibrium in the model can be expressed in two groups, x_t is a vector of predetermined variables (endogenous and exogenous) and y_t represents not predetermined variables. The same is true about x_{t+1} and y_{t+1}. All first order conditions can be expressed in a system that takes the form:

$$E_t f(y_{t+1}, y_t, x_{t+1}, x_t) = 0,$$

where E_t denotes the mathematical expectations operator conditional on information available at time t. Policy functions, as usual, depend only on state variables: $y_t = g(x_t)$, $x_{t+1} = f(x_t)$. Next, I present the results of some exercises done with this economy. I stress the fact that I leave the classical inflation bias topic aside, since modern central banks have understood their role, and even more, the Central Bank of Chile or other commited monetary authorities do not pursue systematically expansive monetary policy, so the exercise of relating inflation bias to globalization is uninteresting. What is in fact interesting is to have a measure of the influence openness can have in the inflationary process when the economy is hit by supply shocks, with a price-stability-commited monetary authority. It is in this line that I develop following exercises.

Figure 1: Impulse response functions CPI to cost push shock



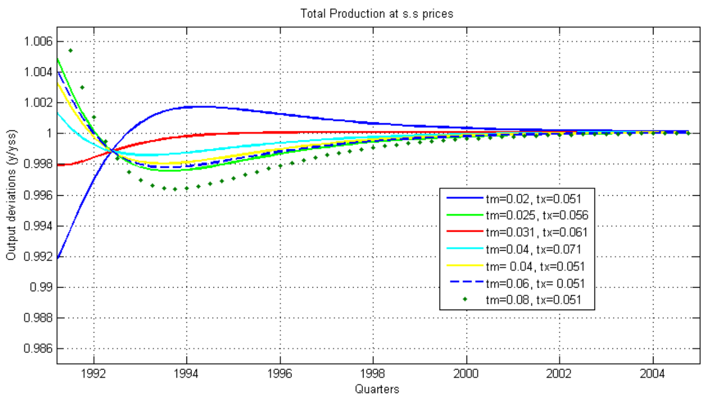
Source: Author's calculation
Quarterly inflation of consumer prices (includes nontradables and importables weighted by their spending share in total consumption)

4.1 Supply shocks and tariff removal

If different degrees of openness can affect the inflation dynamics process, then the same supply shock, everything else equal (included the monetary regime), should have a different impact on the economy. Furthermore, inflation dynamics should be particularly sensitive to openness to be able to explain inflation downwards trend. Figure (1) shows different responses of inflation dynamics to the equivalent of a one percent shock to marginal cost. This shock hits the productivity of non-tradable technology with a one standard-deviation negative shock. As can be seen from figure 1, it is true that different combinations of tariffs can have an effect in inflation dynamics, but since these affects mostly relative prices and resource assignation, openness has more relation to the very steady state and not so much with the dynamics when the economy is hit by cost push shocks[3]. Thus, the inflationary process is affected by the degree of openness. The more open the economy (in term of tariffs) the smaller the impact is on the consumer price index. The relation is not linear though, since the mechanism is complex. It is important to notice the differences though. Very closed economies (8% of import tariff) do not exhibit larger enough responses than very open economies (2, 5% of import tariff). This is not surprising, since tariffs affect **relative prices**, not the general level of prices, that is captured by CPI. Even more, as I mentioned in

[3]Cost push shocks are chosen, because these entail a "trade off" for the economy", in contrast to demand shocks, where the answers is more obvious

Figure 2: Impulse response functions of output deviation to cost push shock



Source: Author's calculation
Deviation from natural level of output for different degrees of openness

the introduction. For a variable to influence the inflation dynamics process it should have some influence on the prices firms set or the frequency they do so. Tariffs have no relation with the schedule of price setting, and have a limited effect on the prices firms set. Therefore tariff removal and trade growth, while having a huge impact on welfare and efficiency[4], have no effect on long-run inflation. Figure 2 shows the impulse response functions for output[5]. An interesting caveat is in place. China and India have gained protagonism in world trade. This has led many authors to say that they are exporting deflation and globalization has made it easier for other countries to benefit from it. I believe this is theoretically wrong. China and India are countries characterized for having low labor cost which enables them to export low cost final goods. In the "accountability" perspective of inflation this leads to cheaper consumer baskets and to lower inflation. However this is a relative price matter. Imagine a world in which there are no countries but individual producers. One of them discovers a way to make one good cheaper. Of course CPI in the near future will be lower, because relative prices have changed, but they do so until they find their new equilibrium in which marginal rates of substitution equal new relative prices. Relative prices, however, cannot change systematically downwards or upwards. Thus the China phenomenon

[4]Excellent studies about the gains from increased trade in Chile are Chumacero *et al.* (2004), Coeymans and Larraín(1994) and Harrison (2005)

[5]Notice that the effect on output of a cost push shock has no linear relation to openness, since a lot of factors determine the optimal path. Among these, the ratioτ_m/τ_x can change the dynamics of output

has indeed some effect on global "accounting inflation" but has not changed **at all** the inflationary process, which is ultimate source of long-run inflation. Summarizing, trade removal has effects on relative prices and not the inflationary process. Furthermore, this effect is small enough not to be relevant in the disinflation trend many countries have experienced. Next sub-section examines another feature of globalization: Increased Variety and its relation to marginal costs.

4.2 Variety, Marginal Costs and Inflation dynamics

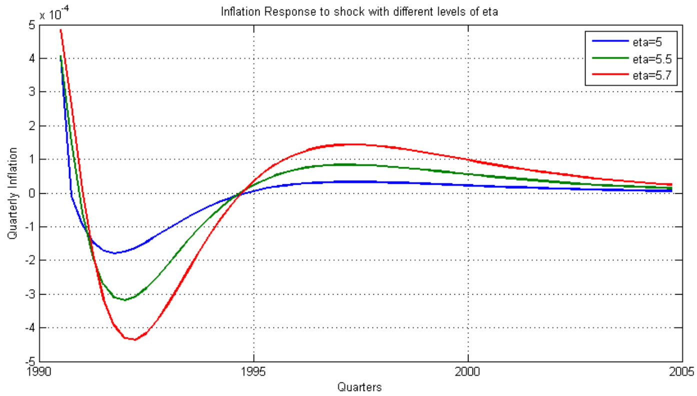
In this section a similar experiment is done. However, the changing parameter is η. Remember that in steady state the optimal markup for nontradable firms is given by $\mathcal{M}$. This comes from the first order condition associated to decision of price setting.

$$\sum_{s=t}^{\infty}\left(\frac{1}{1+r_{t,s}}\right)\theta^{s-t}Y_{s|t}\left(\frac{p^{*}_{h,t}}{p_{h,s}}-\mathcal{M}MC_s\right)=0$$

In steady state $\frac{p^{*}_{h,t}}{p_{h,s}}$ equals 1. Therefore $MC_s\mathcal{M}=1$ should hold. In steady state, no firm wants to change prices, thus $\mathcal{M}$ is the desired mark up. As mentioned before, $\mathcal{M}=\frac{\eta}{\eta-1}$ depends on the elasticity of substitution in the CES aggregator. When $\eta(>1)$ approaches ∞ non tradable varieties are more likely to substitute one another when prices change. In microeconomic principles, the larger η is, the larger the ratio $\frac{\partial \ln(c_i/c_j)}{\partial \ln(p_j/p_i)}$, meaning the easier it is to substitute one variety for another.
Why should η change? Recall the Hotelling analogy, in which monopolistic competition takes place by differentiated products that are distant one another. If variety has increased, the distance between one variety and another is reduced, and the possibility to substitute one good for another is increased. How can we introduce this feature in the model? By changing the parameter η upwards. This has another implication. If η is higher, then $\mathcal{M}$, the desired mark up falls. $\frac{\partial\mathcal{M}}{\partial\eta}=\frac{1}{(\eta-1)^2}$. This result is consistent intuitively and theoretically.

As seen by figure (3) the lower η is, the higher the desired markup is too. This creation of variety is indeed making the NKPC steeper. And proper values of η change inflation dynamics. Thus, after all, globalization does change inflation dynamics. However it is important to notice that $\frac{\partial^2\mathcal{M}}{\partial\eta^2}=-\frac{2}{(\eta-1)^3}$ and that elasticity η can not change but marginally. Thus, even if globalization does make a difference to inflation dynamics through increased variety, it can not accomplish a global disinflation, because sooner than later

Figure 3: Impulse response functions of output deviation to cost push shock



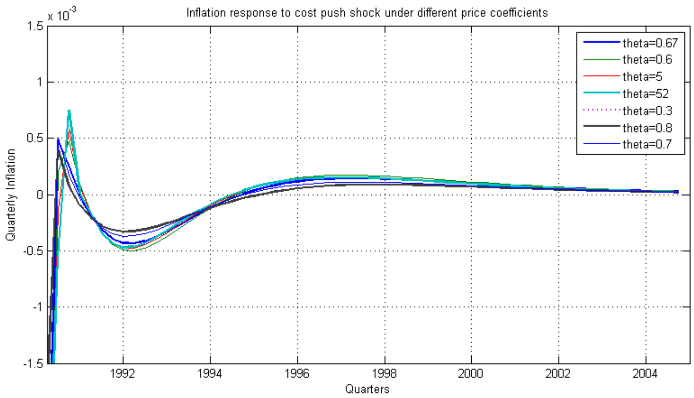
Source: Author's calculation
Quarterly inflation in response to supply shock and different levels of elasticity of substitution across non tradable varieties.

the effect on inflation would dissapear. What is left then? The most obvious parameter in the neo keynesian framework: θ. Next I analyze its effects.

4.3 Price stickiness and Capital Account

The same experiment is done to different values of θ. This is the Calvo coefficient that is a measure of price stickiness. Every period a firm set a new price with probability equal to $1-\theta$. On average, a firm re-sets its price every $\frac{1}{1-\theta}$ periods. A very accepted value for the Chilean economy is 0.667, which means that in average firms re set their prices every three periods (quarters). Figure (4) shows inflation dynamics for different values of θ. It can be seen that there is higher variation in inflation dynamics than in previous experiments. Although it is not as high as it is expected from a traditional neo-keynesian framework. In the closed economy model the parameter measuring price stickiness θ has huge effects on price dynamics. However, this is not the case in this model. There is a very simple reason to explain that all previous experiments did not fulfill popular expectations; the possibility of foreign borrowing. Price stickiness is less relevant when there is not stickiness in all markets. Price of nontradables will remain hardly changed, however other prices (interest rates) and other quantities (debt) will respond quickly to shocks making the stickiness parameters of reduced importance. Figure (5) shows deviation of ratio of debt to GDP in this model. Variations are indeed considerable, and this is not surprising. Since prices cannot move, quantities must move. The shock I consider is a one standard-deviation (negative) of

Figure 4: Impulse response functions of inflation to cost push shock with different degrees of price stickiness

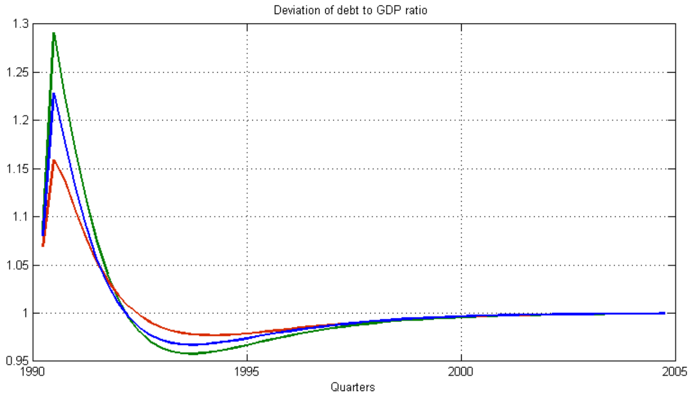


Source: Author's calculation
Quarterly inflation in response to supply shock and different levels of θ.

the stochastic component of productivity in the non-tradable sector. This magnitude explains the big variations on debt to output ratio. This effect is magnified by the incapability of prices to adjust quickly to optimal levels.

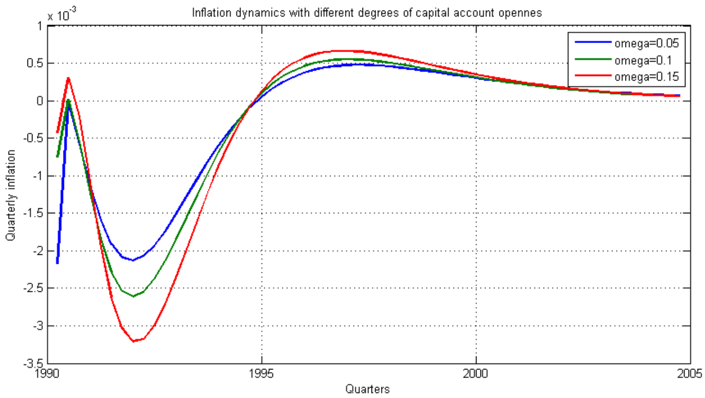
Thus if **one** market is competitive and distortion-free, then the discussion about the possible large effects of small variations in the Neo Keynesian framework parameters is less relevant. It is not naive to think that asset prices adjust instantaneously, as they do in this model. Of course a proper analysis of asset holding variation should incorporate more sophisticated mechanisms to incorporate risk-premium, uncertainty, and risk heterogeneity. However, for the analysis of long-run inflation and its link to trade, it is sufficient to assume the existence of such assets. Next I present a simple result that follows the same logic of the experiments above. Notice that from calibration, risk premium is an increasing function in total debt to GDP ratio. A key parameter measuring risk premium is Ω, the larger this value is, the harder it is for the economy to borrow from foreigners. Figure(6) shows inflation dynamics under marginally different values of Ω. The evident result is that financial isolation (higher Ω) leads to higher inflation variation. This is an obvious result. Households and firms cannot adjust to optimal values of consumption and production through financial markets, therefore, even the very sticky prices must move. And the effect is considerably larger than in previous experiments. Also, it can be seen that foreign debt will more likely deviate from steady state values whenever the value of Ω is smaller. This effect is shown in figure(7).

Figure 5: Debt / GDP ratio variation



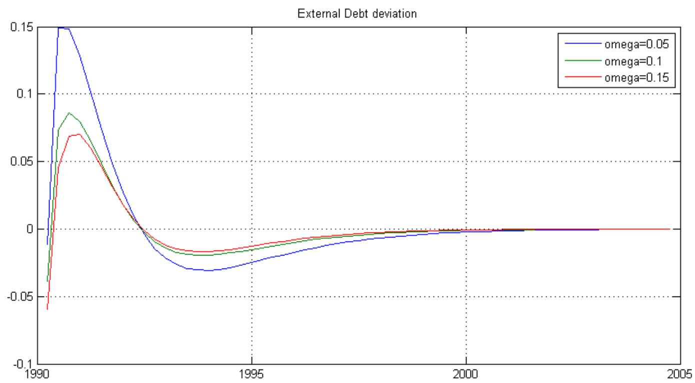
Source: Author's calculation
Quarterly inflation in response to supply shock and different levels of θ.

Figure 6: Inflation dynamics under different levels of financial openness



Source: Author's calculation
Quarterly inflation in response to supply shock and different values of ω.

Figure 7: Foreign debt under different levels of financial openness



Source: Author's calculation
Deviation from steady state in response to supply shock and different values of ω.

Notice that the largest effects obtained so far, were those of variations of price stickiness coefficient. However very **low** variations on the coefficient Ω, measuring financial openness, can accomplish variations in inflation 10 times larger. Thus it is not surprising that the Mundell Fleming model emphasized the importance of capital account openness without the use of a DSGE.

5 Concluding Remarks

Globalization-Disinflation debate has evolved around the premise that globalization leads to diminished mark ups, to increased competition and price flexibility. Proponents have also argued that increased trade from low price countries could be behind global disinflation. A careful examination at the theory of long-run inflation suggests that trade should not matter in the long-run inflation process, but remains inconclusive about reduced mark ups and price flexibility. Intuition suggests that these features should have big influence on inflation dynamics. In this paper, a New Keynesian model is proposed to examine such features. Results suggest that reduced mark ups not only do not have a large enough effect on inflation dynamics, but is also bounded for plausible values of elasticities of substitution between varieties in the non tradable sector. It is also shown that increased flexibility does have a theoretical effect on the determination of inflation dynamics, but this effect is not large enough to explain global disinflation. A feature, mostly forgotten, is shown to be determinant on the inflation dynamics process; asset markets. Financial integration not only has a considerably larger effect on inflation but also makes other factors of less importance. This result comes from the assumption that asset market has no nominal rigidities, an assumption that is difficult to rebate. The question of the relevance of monetary policy less controversial in this scenario. Open Capital Account influences long-run inflation by allowing intra temporal substitution of consumption and investment. Through an open capital account, excess demand pressures and productivity shocks can be distributed across periods. The result is smoothed output and inflation dynamics. Globalization has indeed an effect on financial openness, and through it on inflation. However innovative channels are of nil influence compared to the stabilization role financial integration plays in an open economy. The model in this paper provides hints that reinforce this basic intuition and gives magnitudes of importance for monetary authorities.

References

[1] Ball, L. 2006. "Has Globalization Changed Inflation". *NBER Working Paper* 12687.

[2] Barro, R. and D. Gordon. 1983. "A Positive Theory of Monetary Policy in a Natural Rate Model". *Journal of Political Economy* 91(4):589-610.

[3] Batini, N., D. Laxton. 2007. "Under What Conditions can Inflation Targeting be Adopted? The Experience of Emerging Markets. In *Monetary Policy under Inflation Targeting*", edited by F. Mishkin and K. Schmidt-Hebbel, 1-22. Santiago: Central Bank of Chile.

[4] Batini, N., R. Harrison, S. Millard. 2003. "Monetary policy rules for an open economy". *Journal of Economic Dynamics & Control* 27: 2059-2094.

[5] Belaygorod, A. and M. Dueker. 2005. "Discrete Monetary Policy Changes and Changing Inflation Targets in Estimates Dynamic Stochastic General Equilibrium Models". *Federal Reserve Bank of St. Louis Review*",87(6), 719-33.

[6] Bergoeing, R. y R. Soto. 2002. "Testing Real Business Cycle Models in an Emerging Economy." Working paper 159. Central Bank of Chile.

[7] Calvo,Guillerno. 1983. "Staggered Prices in a Utility Maximizing Framework" *Journal of Monetary Economics* 12:383-398.

[8] Caputo, R. F. Liendo and J. P. Medina. 2007. "New Keynesian Models for Chile in the Inflation-Targeting Period. In *Monetary Policy under Inflation Targeting*", edited by F. Mishkin and K. Schmidt-Hebbel, 1-22. Santiago: Central Bank of Chile.

[9] Céspedes, L. and C. Soto. 2007. "Credibility and Inflation Targeting in Chile". In *Monetary Policy under Inflation Targeting*", edited by F. Mishkin and K. Schmidt-Hebbel, 1-22. Santiago: Central Bank of Chile.

[10] Chumacero, R. and R. Fuentes. 2006. "Chilean growth dynamics". *Economic Modelling*, 23: 197-214.

[11] Chumacero, R. 2005. "A Toolkit for Analyzing Alternative Policies in the Chilean Economy". In *General Equilibrium Models for the Chilean Economy*", edited by R. Chumacero and K. Schmidt-Hebbel, 261-301.Santiago: Central Bank of Chile.

[12] Chumacero, R., J.R. Fuentes, K. Schmidt-Hebbel. 2004. "Chile's Free Trade Agreements: How Big is the Deal?." *Working Paper 264*. Central Bank of Chile.

[13] Coeymans, J.E. y F. Larran. 1994. "Efectos de un Acuerdo de Libre Comercio entre Chile y Estados Unidos: Un Enfoque de Equilibrio General" *Cuadernos de Economía*, Vol. 31, No. 94, pp. 357-400.

[14] Duncan, R. 2005. "How Well Does a Monetary Dynamic Equilibrium Model Account for Chilean Data?". *General Equilibrium Models for the Chilean Economy*", edited by R. Chumacero and K. Schmidt-Hebbel, 261-301.Santiago: Central Bank of Chile.

[15] Gali, J., M. Gertler, J. López-Salido. 2005. Robustness of the estimates of the hybrid New Keynesian Phillips curve. *Journal of Monetary Economics* 52: 1107-1118.

[16] Ihrig, J. S. Kamin, D. Lindner, J. Marquez. 2007. "Some simple Tests of the Globalization and Inflation Hypothesis". *Internacional finance Discussion Papers, 891.* Federal Reserve System.

[17] Mankiw, G. 2001. "The Inexorable and Mysterious Tradeoff Between Inflation and Unemployment". *The Economic Journal*, 111, May.

[18] Mishkin, F. and K. Schmidt-Hebbel. 2007. "Monetary Policy under Inflation Targeting: An Introduction". In *Monetary Policy under Inflation Targeting*", edited by F. Mishkin and K. Schmidt-Hebbel, 1-22. Santiago: Central Bank of Chile.

[19] Mishkin, F. and K. Schmidt-Hebbel. 2007. "Does Inflation Targeting Make a Difference". In *Monetary Policy under Inflation Targeting*", edited by F. Mishkin and K. Schmidt-Hebbel, 1-22. Santiago: Central Bank of Chile.

[20] Ochoa, M. and P. Valenzuela. 2004. "Impactos de un Shock Externo en un Modelo Estocástico de Equilibrio General para una Economía Abierda: El caso de Chile". *manuscript, Universidad de Chile.*

[21] Schmitt-Grohé, S. and M. Uribe. 2003. "Closing Small Open Economies". *Journal of International Economics* 61:163:185.

[22] Schmitt-Grohé, S. and M. Uribe. 2004. "Optimal Simple and Implementable Monetary and Fiscal Rules". *NBER Working Paper* 10253.

[23] Schmitt-Grohé, S. and M. Uribe. 2004. "Solving dynamic general equilibrium models using a second-order approximation to the policy function". *Journal of Economic Dynamics & Control*" 28:755-775.

[24] Schmitt-Grohé, S. and M. Uribe. 2007. "Optimal Inflation Stabilization in a Medium-Scale Macroeconomic Model", In *Monetary Policy under Inflation Targeting*", edited by F. Mishkin and K. Schmidt-Hebbel, 1-22. Santiago: Central Bank of Chile.

[25] Rogoff, K. 2003a. "Globalization and Global Disinflation". Paper prepared for the Federal Reserve Bank of Kansas City, Jackson Hole.

[26] Rogoff, K. 2003b. "Disinflation: An Unsung Benefit of Globalization?". *Finance and Development 2003*. IMF.

[27] Taylor, J. 2006. "Implications of Globalization for Monetary Policy". *Academic Consultants Meeting. Federal Reserve Board*.