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The Implications of Trade Barriers for Sectoral Diversification and Macroeconomic Stability in Developing Economies

Gabriel Srour

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The Implications of Trade Barriers for Sectoral Diversification and Macroeconomic Stability in Developing Economies

Prepared by Gabriel Srour[1]

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Abstract

The paper examines the implications of lower trade barriers for sectoral diversification and macroeconomic stability in developing economies with a large primary goods sector. It shows that lower trade barriers can have ambiguous effects on macroeconomic stability. It shows also that diversification, in the form of equal distribution of resources between nonprimary sectors, may be counterproductive. In fact, investment in the nonprimary sector with lower trade barriers unambiguously enhances macroeconomic stability in a developing economy that is subject to substantial primary shocks.

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Author(s) E-Mail Address: gsrour@imf.org

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I. Introduction

Developing countries typically rely on exports of primary commodities and goods that are low in the production chain, to generate foreign currency. As a consequence, they are highly vulnerable to the frequent and persistent shocks that afflict these industries.[2] A natural and often-proposed remedy is to diversify the economy. But while some countries have made progress in this direction, diversification remains a difficult challenge for many others. Indeed, in the present environment of globalization, as countries are becoming increasingly integrated with the rest of the world, the strategy pursued to diversify the economy is becoming more important than ever. In this paper, we examine the relationship between economic integration, sectoral diversification, and macroeconomic stability in developing economies.

We use a two-country, three-sector model with nominal wage rigidity and trade barriers between the countries. One sector is thought of as the primary sector, and the other two are sectors in which the country can diversify. Monetary policy is designed to replicate the outcome of the real economy that would obtain under perfectly flexible prices and wages. We show that economic integration, in the form of lower trade barriers between the countries, can have ambiguous effects on macroeconomic stability, depending on which sectors of the economy are becoming more or less integrated. Thus, we show that lower trade barriers on primary goods increase the impact of primary shocks on aggregate real variables and the exchange rate, whereas lower trade barriers on domestic nonprimary goods do the opposite. Lower trade barriers on foreign nonprimary goods enhance exchange rate stability while it increases the volatility of the aggregate real variables.

Similarly, we show that diversification can have ambiguous effects, depending on the form of diversification pursued. Not surprisingly, diversification in the form of a relatively smaller primary sector reduces volatility in the economy stemming from primary shocks. However, diversification in the form of equal allocation of resources between the nonprimary sectors may be counterproductive. In fact, everything else being equal between the two nonprimary sectors, investment in, or a shift of resources to, the nonprimary sector which is more integrated with the rest of the world unambiguously enhances macroeconomic stability. Accordingly, developing countries that are subject to frequent shocks to their primary sectors can be better off investing in a single nonprimary sector.

These results extend those in Srour (2004). There it was shown that economic integration characterized by a higher elasticity of substitution between domestic and foreign nonprimary goods enhances macroeconomic stability, whereas when characterized by a higher volume of trade, economic integration has ambiguous effects depending on the source of the higher trade. However, the aforementioned characterizations represent the possible outcomes of economic integration, and not its fundamental determinants. In that sense, the analysis in Srour (2004) was incomplete. Moreover, the earlier work assumed the law of one price to hold. This made the

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[2] See for instance Cashin, Liang, and McDermott (2000), Collier, Gunning, and associates (2000), Collier and Dehn (2001), Cashin, McDermott, and Scott (2002), and Cashin and McDermott (2002).

analysis much more tractable, but it is counterintuitive to the idea of economic integration (or rather the lack of it). In contrast, the present paper allows prices between countries to differ as a result of trade barriers, and it characterizes economic integration directly as a decline in the level of these barriers.

The paper contributes to the literature in two other ways. Whereas the large body of recent work focuses on the effects of integration in capital markets and capital market liberalization,[3] this paper examines the effects of integration in the goods markets. Also, it investigates issues of trade theory within the framework of the new Open-Economy literature made popular by Obstfeld and Rogoff (1995, 1996) and Betts and Devereux (1996).[4] This literature has for the most part focused on monetary and exchange rate policy issues, and has neglected to examine questions of trade or the interrelation between trade and policy.[5]

The rest of the paper is organized as follows. Section II describes the baseline model. Section III solves the equilibrium under flexible prices and wages, while the effects of economic integration on diversification are analyzed in Section IV. Section V introduces nominal wage rigidity into the model and examines the behavior of the exchange rate when monetary policy is designed to reproduce the outcome under flexible wages. Section VI summarizes the results and offers suggestions for future research. The Appendix outlines the model in more detail.

II. The Baseline Model

A developing country, labeled 0, trades with the rest of the world, labeled 1. Its economy consists of a *primary* sector, *X*, which stands for oil or other primary commodities, such as agriculture or textiles, and two *nonprimary* sectors, *A* and *B*, that are symmetric in everything except the trade barriers they may face. Home-produced and foreign-produced primary goods are assumed to be perfect substitutes for each other, whereas nonprimary goods are differentiated according to the country of origin. Given the fundamental role that the primary sector usually plays in developing economies, we will be mostly concerned with the effects of shocks to this sector.

A. Households

A household's utility function is

$$\frac{1}{1-\sigma}C^{1-\sigma} - \frac{1}{1+\phi}L^{1+\phi} + \chi Ln(\frac{M}{P}),$$

[3] See for instance Edison (2002).

[4] See Lane (2001) and Bowman and Doyle (2003) for excellent reviews of the literature.

[5] See Obstfeld (2001) for a broad review of international macroeconomics, and Tille (1999, 2002) for papers akin to ours.

$$C = \left(\frac{C_X}{\gamma_X}\right)^{\gamma_X} \left(\frac{C_A}{\gamma_A}\right)^{\gamma_A} \left(\frac{C_B}{\gamma_B}\right)^{\gamma_B},$$

$$C_i = \left[\gamma_0^{\frac{1}{\eta}} C_{0i}^{\frac{\eta-1}{\eta}} + \gamma_1^{\frac{1}{\eta}} C_{1i}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}, \quad i = A, B,$$

$$\gamma_X + \gamma_A + \gamma_B = 1, \quad \gamma_0 + \gamma_1 = 1,$$

where L is the number of hours worked, $\frac{M}{P}$ are real money balances held, C_X denotes consumption of primary goods, and C_{li}, ($l = 0,1,\ i = A, B$), denotes consumption of nonprimary goods produced in country *l*, sector *i*. The elasticity of substitution, η, between domestic and foreign nonprimary goods is assumed to be greater than or equal to the elasticity of substitution between goods across sectors, which equals 1. Money is included in the utility function to permit a discussion of monetary policy under nominal wage rigidity in Section V. Otherwise, it is neutral and plays no role. All the results will continue to hold if we let the weight, χ, on money balances go to 0.

Households are subject to the budget constraint

$$P_X C_X + \sum_{li} P_{li} C_{li} + M = R + \Pi + T + M_{-1}$$

where Π denotes dividends, M_{-1} is the initial stock of money balances held, *T* is lump-sum transfers,[6] P_X and P_{li} ($l = 0,1,\ i = A, B$) are the prices of the corresponding goods, and *R* is the household's income from labor, all in local currency.

Standard optimization implies:

$$P_i C_i = \gamma_i PC, \quad (i = X, A, B),$$

$$P_{li} C_{li} = \gamma_l \left(\frac{P_{li}}{P_i}\right)^{1-\eta} P_i C_i, \quad (l = 0,1, i = A, B)$$

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[6] For our purposes, T can be assumed equal to the authorities' earnings from seignorage. In other words, $T = M - M_{-1}$.

$$\frac{M}{P} = \chi C^{\sigma}$$

where

$$P_i = \left[\gamma_0 P_{0i}^{1-\eta} + \gamma_1 P_{1i}^{1-\eta} \right]^{\frac{1}{1-\eta}}, \ \ (i = A, B),$$

and

$$P = P_X^{\gamma_X} P_A^{\gamma_A} P_B^{\gamma_B} ,$$

B. Production

Production requires a continuum of differentiated types of labor uniformly distributed over the unit interval. Specifically,

$$Y_i = \frac{1}{1-\alpha} L_i^{1-\alpha} , \ \ 0 \le \alpha < 1 ,$$

$$L_i = \left(\int_0^1 l_i(j)^{\frac{\lambda-1}{\lambda}} dj \right)^{\frac{\lambda}{\lambda-1}} , \ \ \lambda \ge 1 ,$$

where Y_i denotes output by a firm in sector *i*, and $l_i(j)$ is labor input of type j.

Firms take prices and wages as given and choose their volume of output after shocks are realized. Profit maximization therefore implies that demand for labor by a firm in sector *i* is

$$L_X = \left[\frac{P_X}{W_X} \right]^{\frac{1}{\alpha}} , \ L_A = \left[\frac{P_{0A}}{W_A} \right]^{\frac{1}{\alpha}} , \ L_B = \left[\frac{P_{0B}}{W_B} \right]^{\frac{1}{\alpha}} , \ l_i(j) = \left[\frac{W_i}{W_i(j)} \right]^{\lambda} L_i ,$$

$$W_i = \left(\int_0^1 W_i(j)^{1-\lambda} dj \right)^{\frac{1}{1-\lambda}} ,$$

where $W_i(j)$ is the wage for labor of type j employed in sector *i*, and W_i is a wage-index for labor employed in sector *i*..

C. Wage Setting

Households fix their wages *after* shocks are realized, so that wages are flexible. Maximization of utility then implies

$$\frac{W(j)}{P}=\frac{\lambda}{\lambda-1}C(j)^{\sigma}l(j)^{\phi}.$$

III. EQUILIBRIUM

We focus on symmetric equilibriums, whereby all firms within a sector have identical outcomes, and all households earn the same wage, *W*, supply the same amount of labor, *L*, and consume the same baskets of goods, *C*.[7]

In equilibrium, total supply of labor must equal total demand, and total expenditures must equal total income:

$$L=n_X L_X+n_A L_A+n_B L_B,$$

and

$$PC=n_X P_X Y_X+n_A P_{0A} Y_A+n_B P_{0B} Y_B,$$

where n_i is the number of firms in sector *i*. Substituting the expressions found earlier for labor demand, L_i, and output, Y_i, by a firm in sector *i*, it follows,

$$L=\Omega\left[\frac{P}{W}\right]^{\frac{1}{\alpha}},$$

$$C=\frac{1}{1-\alpha}\Omega\left[\frac{P}{W}\right]^{\frac{1-\alpha}{\alpha}},$$

and

[7] One rationale is that households of the same type share equally all their resources and jointly fix their wages.

$$\frac{M}{P}=\frac{\chi}{(1-\alpha)^{\sigma}}\Omega^{\sigma}\left[\frac{P}{W}\right]^{\frac{\sigma(1-\alpha)}{\alpha}},$$

where

$$\Omega=n_X\left[\frac{P_X}{P}\right]^{\frac{1}{\alpha}}+n_A\left[\frac{P_{0A}}{P}\right]^{\frac{1}{\alpha}}+n_B\left[\frac{P_{0B}}{P}\right]^{\frac{1}{\alpha}}.$$

Note that up to this point, the assumption of flexible wages has not been used. Substituting now the expression for wages, $\frac{W}{P}=\frac{\lambda}{\lambda-1}C^{\sigma}L^{\phi}$, it follows

$$\left(\frac{W}{P}\right)^{\Theta}=\left(\frac{1}{1-\alpha}\right)^{\alpha\sigma}\left(\frac{\lambda}{\lambda-1}\right)^{\alpha}\Omega^{\alpha(\phi+\sigma)},$$

$$C^{\Theta}=\left(\frac{1}{1-\alpha}\right)^{\alpha+\phi}\left(\frac{\lambda-1}{\lambda}\right)^{1-\alpha}\Omega^{\alpha(1+\phi)},$$

$$L^{\Theta}=(1-\alpha)^{\sigma}\left(\frac{\lambda-1}{\lambda}\right)\Omega^{\alpha(1-\sigma)},$$

$$\left(\frac{M}{P}\right)^{\Theta}=\chi^{\Theta}\left(\frac{1}{1-\alpha}\right)^{\sigma(\alpha+\phi)}\left(\frac{\lambda-1}{\lambda}\right)^{\sigma(1-\alpha)}\Omega^{\sigma\alpha(1+\phi)},$$

$$\Theta=\alpha+\phi+\sigma(1-\alpha).$$

IV. Economic Integration and Diversification

It is apparent from the equilibrium expressions above that the behavior of the macro variables is governed by the behavior of Ω alone. To a first-order approximation, Ω can be written

$$\alpha\hat{\Omega}=\alpha_X\,\hat{p}_X+\left(\alpha_{0A}\,\hat{p}_{0A}-\alpha_{1A}\,\hat{p}_{1A}\right)+\left(\alpha_{0B}\,\hat{p}_{0B}-\alpha_{1B}\,\hat{p}_{1B}\right),$$

where hat superscripts denote log-deviations from steady state, α_X is the share of exports of primary goods in total income, and α_{0i} and α_{1i} ($i=A,B$) are, respectively, the shares of exports and imports of nonprimary goods (details in the Appendix). In other words, $\alpha\hat{\Omega}$ amounts to the effect of price changes on income from foreign trade.

To further analyze the behavior of the economy, we need to specify how prices are determined. We consider below a scenario that is most relevant for our purposes, but the arguments can be easily adapted to alternative scenarios.

Given that the home economy is small and developing, and technologies are identical across sectors, we assume that market prices of all goods sold abroad are equal in the long run. The law of one price may not hold, however, and domestic and foreign prices may differ on account of trade barriers that are independent of shocks and do not generate direct revenues. The level of these barriers measures the degree to which the various sectors are integrated with the rest of the world. More formally, we assume

$$sP_X = P_X^f (1+T_X)$$

$$sP_{li} = P_{li}^f (1+T_{li}),\ (l=0,1,\ i=A,B),$$

where s is the nominal exchange rate (expressed as the price of a unit of domestic currency in foreign currency), f superscripts denote world market prices in foreign currency, and the T 's (positive if associated with foreign goods and negative if associated with domestic goods) represent the level of trade barriers. The world prices of primary goods and foreign goods, P_X^f and P_{1i}^f $(i=A,B)$, but not necessarily those of domestic nonprimary goods, are determined in the world market and exogenously given.

It follows that

$$\alpha\hat{\Omega} = \alpha_X\,\hat{p}_X^f + \left(\alpha_{0A}\,\hat{p}_{0A}^f - \alpha_{1A}\,\hat{p}_{1A}^f\right) + \left(\alpha_{0B}\,\hat{p}_{0B}^f - \alpha_{1B}\,\hat{p}_{1B}^f\right),$$

and if we let T_i and T denote the indexes

$$1+T_i = \left[\gamma_0\left(1+T_{0i}\right)^{1-\eta} + \gamma_1\left(1+T_{1i}\right)^{1-\eta}\right]^{\frac{1}{1-\eta}},\ i=A,B,$$

$$1+T = \left(1+T_X\right)^{\gamma_X}\left(1+T_A\right)^{\gamma_A}\left(1+T_B\right)^{\gamma_B},$$

then, at steady state,

$$\bar{\Omega} = n_X\left[\frac{1+T_X}{1+T}\right]^{\frac{1}{\alpha}} + n_A\left[\frac{1+T_{0A}}{1+T}\right]^{\frac{1}{\alpha}} + n_B\left[\frac{1+T_{0B}}{1+T}\right]^{\frac{1}{\alpha}}.$$

Naturally, the lower the trade barriers, the better the terms of trade, the higher the value of $\bar{\Omega}$, and, hence, the more well-off is the home country in terms of steady-state consumption and real wages.[8] However, as the expression of $\hat{\Omega}$ shows (and as shall be demonstrated in more detail), lower trade barriers may heighten the volatility in the economy.

A. All Prices Exogenously Given

We suppose in this section that the world prices of *all* goods, including domestic nonprimary goods, are exogenously given and subject to shocks that are sector-wide and uncorrelated across sectors.

Consider the effects of a shock in the primary sector on the domestic economy. As can be readily seen formally from the expression of $\alpha\hat{\Omega}$, (e.g., $\alpha\hat{\Omega} = \alpha_X \hat{p}_X^f$, if one abstracts from nonprimary shocks), and the equilibrium expressions of the aggregate variables in terms of Ω, a drop in the world price of primary goods entails a drop in income from exports of that good and, hence, a drop in real wages and aggregate consumption. The lower cost of labor induces output and employment in the nonprimary sectors to increase and thus to partly offset the negative primary shock.

The larger the relative size of the primary sector (in other words, the less diversified the domestic economy) and the lower the trade barriers on goods in that sector, the larger the share of exports, α_X, in total income, the greater the impact of primary shocks on Ω and, hence, on income and real wages, and the higher the volatility in the economy stemming from the volatility of these shocks.

In contrast, lower trade barriers on domestic nonprimary goods lowers the share of primary exports, α_X, in total income and, hence, the direct impact of primary shocks. Accordingly, the allocation of more capital (i.e., firms) to the nonprimary sector with lower trade barriers (improves the steady-state outcome and) curbs the volatility in the economy stemming from primary shocks. Note, however, that the channel by which these effects take place is the change in the relative income of primary and nonprimary exports, and not a change in the economy's capacity to adjust to shocks. Thus, trade barriers on foreign nonprimary goods have no bearing, in this case, on the volatility stemming from primary shocks, since they do not affect income or the share of primary exports.[9] Neither does the allocation of resources between the nonprimary sectors if the same barriers apply to both.

The analysis above focused on the volatility in the economy stemming from primary shocks, as these usually dominate in developing economies. The effects on *overall* volatility in the

[8] And overall welfare as measured by the utility function.

[9] This depends, however, on the unit elasticity of substitution between primary and nonprimary goods. Otherwise, lower trade barriers on nonprimary goods, which imply lower prices for these goods, entail a lower share of primary consumption and a higher share of primary exports.

economy would be different to the extent that shocks to the other sectors are significant, and depend on the relative magnitude of the various shocks and their correlation. For simplicity, prices of foreign goods are kept constant from now on.

B. Prices of Domestic Nonprimary Goods Endogenous

Suppose now that prices of home-produced nonprimary goods are determined endogenously, and that foreign demand for domestic nonprimary goods is

$$C_{0i}^{f} = v_{0i}\left(\frac{P^{flevel}}{P_i^f}\right)\left(\frac{P_{0i}^f}{P_i^f}\right)^{-\eta}, \; (i = A, B),$$

where v_{0i} denotes the steady-state volume of exports in sector *i*, and P^{flevel} is the exogenously given foreign price level. Note that foreign demand for domestic nonprimary goods is more price-elastic than domestic demand.

In equilibrium, the prices of domestic nonprimary goods adjust to equate demand with supply:

$$C_{0i} + C_{0i}^{f} = n_i Y_i, \; (i = A, B).$$

Taking log-deviations from steady state, this system can be solved for $\hat{p}_{0A}^f$ and $\hat{p}_{0B}^f$ and, hence, $\hat{\Omega}$, in terms of $\hat{p}_X^f$. One finds

$$\alpha\hat{\Omega} = \mathrm{K}\hat{p}_X^f,$$

(see the Appendix for detail) where the coefficient K depends on the model's parameters: the larger is *K*, the larger the volatility in the economy stemming from primary shocks.

The effects of a negative primary shock on the economy are similar to those described in the exogenous price scenario above: a lower price for primary goods entails a drop in income from exports, which causes real wages to drop and output and employment in the nonprimary sectors to rise. There is, however, one additional effect in the present case. Whereas in the exogenous price scenario, by assumption, any amount of domestic output can be exported at the prevailing world prices, in the present case, the larger supply of domestic nonprimary goods following the negative primary shock requires a drop in the relative price of domestic to foreign nonprimary goods, $\frac{P_{0i}}{P_i}$, to equate demand. This effect introduces a new channel through which the nonprimary sectors' own capacity to absorb shocks, rather than its share of income, can affect the volatility in the economy. One can show:

1. As in the exogenous case, diversification in the form of a relatively smaller primary sector lowers the volatility in the economy stemming from primary shocks, whereas lower trade barriers in that sector increases volatility.

A smaller primary sector, or higher trade barriers, implies a relatively smaller volume of trade in that sector. From the expression of $\hat{\Omega}$, e.g., $\alpha\hat{\Omega} = \alpha_X \hat{p}_X^f + \alpha_{0A} \hat{p}_{0A}^f + \alpha_{0B} \hat{p}_{0B}^f$, a shift in size from α_X to α_{0A} or α_{0B} lowers the volatility of $\hat{\Omega}$ because $\hat{p}_{0A}^f$ and $\hat{p}_{0B}^f$ vary less than $\hat{p}_X^f$ following a primary shock.

2. All else being equal between the two nonprimary sectors, the aggregate variables are less volatile when resources (i.e., firms) are concentrated in one nonprimary sector.

Numerically, K is largest when the two nonprimary sectors have equal size and decreases as one grows relatively larger. The reason is that the nonprimary sector with more capital exports a larger share of its output. Since exports are more price-elastic than local consumption, firms in that sector need to lower prices by relatively less to sell more output. The opposite holds true for the other sector. The result, however, is that income from trade will be less affected by a primary shock.

3. Lower trade barriers on foreign nonprimary goods increases volatility, whereas lower trade barriers on domestic nonprimary goods lowers volatility.

Lower trade barriers on foreign nonprimary goods entail a lower domestic consumption of domestic nonprimary goods, hence a higher volume of exports of these goods. Since foreign demand is more price-elastic, prices of domestic nonprimary goods will be less sensitive to primary shocks. Consistent with the opposing views in the literature regarding the effect of trade openness, lower trade barriers on foreign nonprimary goods have, therefore, two opposite effects on volatility. On the one hand, since prices are less sensitive, primary shocks will have a smaller impact on income. On the other hand, the impact on income will be higher since the volume of exports is higher. However, the latter effect dominates, because the magnitude by which the impact of a primary shock on nonprimary prices falls is smaller than that by which the volume of exports increase (see formal details in the Appendix).

Lower trade barriers on domestic nonprimary goods have similar effects on the price elasticity and volume of exports of these goods. But, they also entail a higher total income and, hence, a drop in the share of primary exports, by an amount which offsets the other effects and leads to a lower volatility.

4. Nonetheless, all else being equal between the nonprimary sectors, a shift of resources to the nonprimary sector with lower (higher) trade barriers on either type of nonprimary goods unambiguously lowers (raises) volatility in the economy.

The reason is related to that explained in point 3 above. A shift of resources to one sector increases the share of exports in that sector and makes prices in that sector less sensitive to primary shocks, while it has the opposite effect on the other sector. Since the sector with lower trade barriers has a bigger share of exports to begin with, the impact of primary shocks on income would decrease if resources are shifted to that sector, and would increase in the opposite case.

It follows also from point 2 above that if resources were initially concentrated in the sector with higher trade barriers, then volatility may deteriorate before it improves as capital is reallocated to the sector with lower barriers. (Numerically, K traces a bell shape.)

V. RIGID WAGES

Of course, the assumption that all prices and wages are flexible is unrealistic. Under this assumption, money is neutral and can be adjusted to anchor any nominal variable, without impinging on the real economy. In this sense, the behavior of the nominal variables is trivial.[10] This section offers a partial analysis of the case where wages are rigid, with a particular focus on the behavior of the exchange rate.

Specifically, leaving the rest of the model unchanged, we now assume that wages are fixed at the beginning of the period, before shocks are realized. Maximization of expected utility then implies that the wage of a household is

$$W = \frac{\lambda}{\lambda - 1} \frac{E\left[L^{1+\phi}\right]}{E\left[\dfrac{L}{PC^{\sigma}}\right]},$$

where E is the expectation operator.

Equilibrium conditions lead to the same expressions for L, C, and $\frac{M}{P}$ in terms of Ω and $\frac{P}{W}$ found earlier in Section III. Of course now, W is predetermined, and money is not neutral. The amount of money supplied ex post affects the markup of prices over wages, $\frac{P}{W}$, and, hence, labor and consumption. In other words, the equilibrium outcome depends on the choice of monetary policy.

In principle, policymakers would choose the monetary policy rule that optimizes welfare. Solving for the optimal policy rules, and the ensuing equilibrium outcomes, under alternative parametrizations is, however, outside the scope of this paper.[11] Rather, we assume that

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[10] It is, however, of some interest, and an easy exercise, to examine the effects of diversification and integration on the money supply, the exchange rate, and prices, once one of these variables is fixed.

[11] A more substantive reason for sidestepping optimal rules is that the model is too simplistic to begin with, and omits a multitude of factors that affect welfare. In particular, this model cannot realistically represent the true welfare costs of volatility. Relying on the optimal rules may therefore bias the policy implications. In a more complex model that does incorporate such

(continued…)

policymakers choose a monetary policy rule that approximates the outcome that would obtain if wages were flexible. (An alternative approach is to assume that policymakers pursue specific objectives, such as inflation targeting. Our analysis below can be easily adapted to tackle these questions.)

From the equilibrium expressions for L and C as functions of Ω and $\frac{P}{W}$, it is apparent that for monetary policy to reproduce the outcome under flexible wages, it suffices that it reproduces the level of real wages, e.g.,

$$\left(\frac{W}{P}\right)^{\Theta} = \left(\frac{1}{1-\alpha}\right)^{\alpha\sigma} \left(\frac{\lambda}{\lambda-1}\right)^{\alpha} \Omega^{\alpha(\phi+\sigma)} .$$

This can be achieved if monetary policy follows the rule (detailed in the Appendix),

$$\hat{m} = \frac{\alpha\phi(\sigma-1)}{\Theta}\hat{\Omega} ,$$

or, equivalently, since $\hat{p}_X = \hat{p}_X - \hat{w}$ and $\hat{s} = \hat{p}_X^f - \hat{p}_X$, if the exchange rate policy follows the rule

$$\hat{s} = \hat{p}_X^f + \left(\hat{w} - \hat{p}_X\right),$$

which in turn can be written

$$\hat{s} = \gamma_X \hat{p}_X^f + \gamma_A \gamma_{0A} \left(\frac{1+T_{0A}}{1+T_A}\right)^{1-\eta} \hat{p}_{0A}^f + \gamma_B \gamma_{0B} \left(\frac{1+T_{0B}}{1+T_B}\right)^{1-\eta} \hat{p}_{0B}^f + \left(\hat{w} - \hat{p}\right).$$

We focus attention on the endogenous prices scenario, the exogenous case being straightforward.[12] Substituting $\hat{p}_{0i}^f$ $(i = A, B)$ and the real wage by their equilibrium expressions when wages are flexible, the exchange rate policy rule above takes the form

$$\hat{s} = \mathrm{H}\hat{p}_X^f ,$$

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factors, one would be hard-pressed to come up exactly with an optimum monetary policy rule that is meaningful.

[12] The exchange rate policy rule reduces to $\hat{s} = \left(\gamma_X + \frac{(\phi+\sigma)}{\Theta}\alpha_X\right)\hat{p}_X^f$ in the exogenous case.

where H is a positive coefficient that depends on the model's parameters, and its behavior can be examined numerically. The higher is H, the higher the needed adjustment in the exchange rate following a primary shock, and the higher the exchange rate volatility.

Not surprisingly, since the home country is assumed to be a net exporter of primary goods, this policy rule calls for a depreciation of the local currency following a negative primary shock. This is intended to raise the price level above its steady state and achieve the downward adjustment in real wages that would obtain if wages were flexible. Note from the first expression of the exchange rate rule that the smaller the drop in the markup of prices over wages in the primary sector or, put differently, the more wages would adjust downward if they were flexible (and hence the smaller the drop in employment in that sector), the larger the needed exchange rate depreciation under nominal wage rigidity. The second expression of the exchange rate rule implies that the larger the impact on prices and the larger the impact on real wages, the larger the needed exchange rate depreciation. One further shows:

1. The larger the relative size and the lower the trade barriers in the primary sector, the greater the required adjustments in the exchange rate following primary shocks, and the greater the need for a flexible exchange rate.

This is because these conditions entail a larger share of primary exports in total income, and hence a larger impact of primary shocks on real wages and prices.

2. Whether a greater concentration of resources in one nonprimary sector calls for a more or less flexible exchange rate depends on the model's parameters.[13]

The ambiguity arises because, while greater concentration reduces the impact of primary shocks on real wages, it also accentuates the impact on prices.

3. Lower trade barriers on domestic or foreign nonprimary goods lower exchange rate volatility.

In the case of domestic nonprimary goods, this is because lower trade barriers reduces the impact of primary shocks on real wages (if wages were flexible) as well as prices. In the case of foreign nonprimary goods, lower trade barriers have opposite effects on real wages and prices. The claim is shown numerically.[14]

4. A shift of resources to the nonprimary sector with lower (higher) trade barriers on either domestic or foreign nonprimary goods unambiguously lowers (raises) exchange rate volatility.

[13] For example, a higher concentration of resources in one sector typically increases the volatility of the exchange rate if $\sigma < 1$.

[14] The claim can be shown algebraically for $\sigma < 1$.

As we saw in the previous section, such a shift makes both real wages and prices less sensitive to primary shocks.

VI. Conclusion

The paper examines the implications of economic integration in the form of lower trade barriers for sectoral diversification and macroeconomic stability in developing economies. More specifically, in a three-sector model with nominal wage rigidity, whereby one sector is thought of as the primary sector, the paper examines conditions under which the developing country should promote one nonprimary sector over the other.

It is shown that lower trade barriers and diversification can have ambiguous effects on macroeconomic stability. Lower trade barriers on primary goods increases volatility in the economy stemming from primary shocks, whereas lower trade barriers on domestic nonprimary goods have the opposite effects. Lower trade barriers on foreign nonprimary goods enhances exchange rate stability while it increases the volatility of the aggregate variables. Diversification in the form of a relatively smaller primary sector reduces volatility in the economy stemming from primary shocks. Diversification in the form of equal distribution of resources between the nonprimary sectors may be counterproductive.

In fact, investment in the nonprimary sector with lower trade barriers is shown to unambiguously promote macroeconomic stability (and income). This conclusion extends the results in Srour (2004), where economic integration was defined in terms of exogenous changes in the elasticity of substitution between domestic and foreign goods, or, alternatively, in terms of the volume of trade.

The paper can be extended in various directions. A more complete analysis should derive the welfare-optimizing monetary policy, rather than assume that it is designed to reproduce the outcome under flexible wages. It would also be useful to examine the same issues in the context of a general equilibrium two-country model. Finally, quantitative assessments of some of the effects illustrated above can enhance the conclusions.

APPENDIX: THE MODEL

A. Long-Run Prices and Shares of Trade

Since prices of all goods sold in the foreign country are assumed to be equal in the long run, in steady state, we have

$$s\bar{P}_i = \bar{P}^f (1+T_i),$$

$$s\bar{P} = \bar{P}^f (1+T),$$

$$\bar{Y}_X = (1+T_X)^{\frac{1-\alpha}{\alpha}} \bar{Y},$$

$$\bar{Y}_i = (1+T_{0i})^{\frac{1-\alpha}{\alpha}} \bar{Y}, \ (i = A, B),$$

$$\bar{C} = (1+T)^{\frac{1-\alpha}{\alpha}} \bar{\Omega}\bar{Y},$$

$$\bar{C}_i = \gamma_i \frac{1+T}{1+T_i} \bar{C}, \ \ (i = X, A, B),$$

$$\bar{C}_{li} = \gamma_l \left(\frac{1+T_{li}}{1+T_i}\right)^{-\eta} \bar{C}_i, \ \ (l = 0,1),$$

$$1+T_i = \left[\gamma_0 (1+T_{0i})^{1-\eta} + \gamma_1 (1+T_{1i})^{1-\eta}\right]^{\frac{1}{1-\eta}},$$

$$1+T = (1+T_X)^{\gamma_X} (1+T_A)^{\gamma_A} (1+T_B)^{\gamma_B},$$

$$\bar{Y} = \left(\frac{1}{1-\alpha}\right)^{\frac{\alpha+\phi}{\Theta}} \left(\frac{\lambda-1}{\lambda}\right)^{\frac{1-\alpha}{\Theta}} \left(\frac{1}{1+T}\right)^{\frac{1-\alpha}{\alpha}} \bar{\Omega}^{-\frac{(\phi+\sigma)(1-\alpha)}{\Theta}},$$

$$\bar{\Omega} = n_X \left[\frac{1+T_X}{1+T}\right]^{\frac{1}{\alpha}} + n_A \left[\frac{1+T_{0A}}{1+T}\right]^{\frac{1}{\alpha}} + n_B \left[\frac{1+T_{0B}}{1+T}\right]^{\frac{1}{\alpha}},$$

where bar superscripts denote steady-state values.

The (long-run) share of net exports of primary goods in total output is therefore

$$\alpha_X \equiv \frac{n_X \bar{P}_X \bar{Y}_X - \bar{P}_X \bar{C}_X}{\bar{P}\bar{C}} = \frac{n_X \left(1+T_X\right)^{\frac{1}{\alpha}}}{n_X \left(1+T_X\right)^{\frac{1}{\alpha}} + n_A \left(1+T_{0A}\right)^{\frac{1}{\alpha}} + n_B \left(1+T_{0B}\right)^{\frac{1}{\alpha}}} - \gamma_X = \frac{n_X \left(1+T_X\right)^{\frac{1}{\alpha}}}{\bar{\Omega}\left(1+T\right)^{\frac{1}{\alpha}}} - \gamma_X .$$

The lower the trade barrier, T_X, in the primary sector (which is negative), and the higher the trade barriers in the nonprimary sectors, the higher the relative domestic price of primary goods, the higher the output of primary goods, and the larger the share of exports, α_X.

Likewise, the share of exports of nonprimary goods is

$$\alpha_{0i} \equiv \frac{n_i \bar{P}_{0i} \bar{Y}_i - \bar{P}_{0i} \bar{C}_{0i}}{\bar{P}\bar{C}} = \frac{n_i \left(1+T_{0i}\right)^{\frac{1}{\alpha}}}{\bar{\Omega}\left(1+T\right)^{\frac{1}{\alpha}}} - \gamma_0 \gamma_i \left(\frac{1+T_{0i}}{1+T_i}\right)^{1-\eta},$$

and the share of imports of nonprimary goods is

$$\alpha_{1i} = \frac{\bar{P}_{1i}\bar{C}_{1i}}{\bar{P}\bar{C}} = \gamma_1 \gamma_i \left(\frac{1+T_{1i}}{1+T_i}\right)^{1-\eta}, \ (i = A, B).$$

Since there is only one period, the share of total imports of nonprimary goods, α_M, must balance the share of total exports

$$\alpha_{1A} + \alpha_{1B} = \alpha_X + \alpha_{0A} + \alpha_{0B}. \tag{1}$$

B. Derivation of $\hat{\Omega}$

$$\Omega \equiv n_X \left[\frac{P_X}{P}\right]^{\frac{1}{\alpha}} + n_A \left[\frac{P_{0A}}{P}\right]^{\frac{1}{\alpha}} + n_B \left[\frac{P_{0B}}{P}\right]^{\frac{1}{\alpha}}.$$

Hence, to a first-order approximation, in terms of log-deviations from steady state,

$$\alpha\hat{\Omega} = \frac{1}{n_X \bar{P}_X^{-\frac{1}{\alpha}} + n_A \bar{P}_{0A}^{-\frac{1}{\alpha}} + n_B \bar{P}_{0B}^{-\frac{1}{\alpha}}} \left[n_X \bar{P}_X^{-\frac{1}{\alpha}} (\hat{p}_X) + n_A \bar{P}_{0A}^{-\frac{1}{\alpha}} (\hat{p}_{0A}) + n_B \bar{P}_{0B}^{-\frac{1}{\alpha}} (\hat{p}_{0B}) \right] - \hat{p}$$

$$= \frac{1}{n_X \bar{P}_X^{-\frac{1}{\alpha}} + n_A \bar{P}_{0A}^{-\frac{1}{\alpha}} + n_B \bar{P}_{0B}^{-\frac{1}{\alpha}}} \left[n_X \bar{P}_X^{-\frac{1}{\alpha}} (\hat{p}_X) + n_A \bar{P}_{0A}^{-\frac{1}{\alpha}} (\hat{p}_{0A}) + n_B \bar{P}_{0B}^{-\frac{1}{\alpha}} (\hat{p}_{0B}) \right]$$

$$-\left[\gamma_X \hat{p}_X + \gamma_A \gamma_0 \left(\frac{1+T_{0A}}{1+T_A} \right)^{1-\eta} \hat{p}_{0A} + \gamma_X \gamma_1 \left(\frac{1+T_{1A}}{1+T_A} \right)^{1-\eta} \hat{p}_{1A} + \gamma_B \gamma_0 \left(\frac{1+T_{0B}}{1+T_B} \right)^{1-\eta} \hat{p}_{0B} + \gamma_B \gamma_1 \left(\frac{1+T_{1B}}{1+T_B} \right)^{1-\eta} \hat{p}_{1B} \right]$$

$$= \alpha_X \hat{p}_X + \left(\alpha_{0A} \hat{p}_{0A} - \alpha_{1A} \hat{p}_{1A} \right) + \left(\alpha_{0B} \hat{p}_{0B} - \alpha_{1B} \hat{p}_{1B} \right)$$

C. All Prices Exogenously Given

The markup of prices over wages in the primary goods sector, in log-deviation from steady state (with prices of nonprimary goods kept constant) is

$$\hat{p}_X - \hat{w} = \hat{p}_X^f - \hat{p}^f + \hat{p} - \hat{w} = \left(1 - \gamma_X - \frac{\phi+\sigma}{\Theta} \left(\frac{n_X}{n} - \gamma_X \right) \right) \hat{p}_X^f . \qquad (18)$$

If $\sigma \le 1$, then $\frac{\phi+\sigma}{\Theta} = \frac{\phi+\sigma}{\phi+\sigma+\alpha(1-\sigma)} \le 1$, hence $0 \le 1 - \gamma_X - \frac{\phi+\sigma}{\Theta} \left(\frac{n_X}{n} - \gamma_X \right) \le 1$, and $\hat{p}_X - \hat{w}$ has the same sign as $\hat{p}_X^f$ but of a smaller magnitude. In other words, a drop in the price of primary goods induces a smaller drop in wages. It follows that, in this case, output and labor in the primary goods sector, as well as aggregate labor, unambiguously decrease with a decrease in the relative price of primary goods.

If $\sigma > 1$, however, then $\frac{\phi+\sigma}{\Theta} > 1$ and the sign of $\hat{p}_X - \hat{w}$ is ambiguous. Simple derivatives show that the larger is α, the smaller is ϕ, and the larger is σ, the larger is $\frac{\phi+\sigma}{\Theta}$, and, hence, the smaller is $1 - \gamma_X - \frac{\phi+\sigma}{\Theta} \left(\frac{n_X}{n} - \gamma_X \right)$, the larger the drop in wages, and the more likely are $\hat{p}_X - \hat{w}$ and $\hat{p}_X^f$ of opposite signs.

Likewise, the larger the share of exports of primary goods, $\alpha_X = \frac{n_X}{n} - \gamma_X$, the smaller is $1 - \gamma_X - \frac{\phi+\sigma}{\Theta} \left(\frac{n_X}{n} - \gamma_X \right)$, the smaller the drop (if any) in labor and output in the primary goods sector, and the more likely is labor and output in this sector to actually increase following a decline in the relative price of primary goods.

D. Prices of Domestic Nonprimary Goods Endogenous

Equality between supply and demand of home-produced nonprimary A-goods imply

$$\gamma_{0A}\gamma_A\left(\frac{P_{0A}}{P_A}\right)^{-\eta}\frac{P}{P_A}C+v_{0A}\left(\frac{P_{0A}^f}{P_A^f}\right)^{-\eta}\left(\frac{P^{flevel}}{P_A^f}\right)=n_A\frac{1}{1-\alpha}\left(\frac{P_{0A}}{P}\right)^{\frac{1-\alpha}{\alpha}}\left[\frac{P}{W}\right]^{\frac{1-\alpha}{\alpha}}.$$

Substituting the equilibrium expressions for C and $\frac{P}{W}$ in terms of Ω (see section 3),

$$\left(\frac{W}{P}\right)^{\Theta}=\left(\frac{1}{1-\alpha}\right)^{\alpha\sigma}\left(\frac{\lambda}{\lambda-1}\right)^{\alpha}\Omega^{\alpha(\phi+\sigma)},$$

$$C^{\Theta}=\left(\frac{1}{1-\alpha}\right)^{\alpha+\phi}\left(\frac{\lambda-1}{\lambda}\right)^{1-\alpha}\Omega^{\alpha(1+\phi)},$$

$$\Theta=\alpha+\phi+\sigma(1-\alpha),$$

and the volume of exports at steady state,

$$v_{0i}=\frac{\alpha_{0i}\bar{P}\bar{C}}{P_{0i}}=\alpha_{0i}\frac{1+T}{1+T_{0i}}\left(\frac{1}{1-\alpha}\right)^{\frac{\alpha+\phi}{\Theta}}\left(\frac{\lambda-1}{\lambda}\right)^{\frac{1-\alpha}{\Theta}}\bar{\Omega}^{\frac{\alpha(1+\phi)}{\Theta}},$$

it follows

$$\gamma_{0A}\gamma_A\left(\frac{P_{0A}}{P_A}\right)^{-\eta}\frac{P}{P_A}\Omega^{\frac{\alpha(1+\phi)}{\Theta}}+\alpha_{0A}\frac{1+T}{1+T_{0A}}\bar{\Omega}^{\frac{\alpha(1+\phi)}{\Theta}}\left(\frac{P_{0A}^f}{P_A^f}\right)^{-\eta}\left(\frac{P^{flevel}}{P_A^f}\right)=n_A\left(\frac{P_{0A}}{P}\right)^{\frac{1-\alpha}{\alpha}}\Omega^{\frac{\alpha(1+\phi)}{\Theta}-1}.$$

Taking log-deviations from the steady state,

$$\frac{\gamma_{0A}\gamma_A\bar{\Omega}\left(\frac{1+T_{0A}}{1+T_A}\right)^{1-\eta}}{n_A\left(\frac{1+T_{0A}}{1+T}\right)^{\frac{1}{\alpha}}}\left[\hat{p}-\hat{p}_A-\eta\left(\hat{p}_{0A}-\hat{p}_A\right)+\left(\frac{\alpha(1+\phi)}{\Theta}\right)\hat{\Omega}\right]+\frac{\alpha_{0A}\bar{\Omega}}{n_A\left(\frac{1+T_{0A}}{1+T}\right)^{\frac{1}{\alpha}}}\left[\left(\hat{p}^{flevel}-\hat{p}_A^f\right)-\eta\left(\hat{p}_{0A}^f-\hat{p}_A^f\right)\right]$$

$$=\frac{1-\alpha}{\alpha}\left(\hat{p}_{0A}-\hat{p}\right)+\left(\frac{\alpha(1+\phi)}{\Theta}-1\right)\hat{\Omega}$$

Likewise, one derives a symmetric equation for B-goods. Thus, after substituting the expression for $\hat{\Omega}$, expanding the various price indexes,

$$\hat{p} = \gamma_X \hat{p}_X + \gamma_A \hat{p}_A + \gamma_B \hat{p}_B ,$$

$$\hat{p}_i = \gamma_0 \left(\frac{1+T_{0i}}{1+T_i} \right)^{1-\eta} \hat{p}_{0i}^f + \gamma_1 \left(\frac{1+T_{1i}}{1+T_i} \right)^{1-\eta} \hat{p}_{1i}^f , \ (i = A, B),$$

and using the fact that the foreign price-level, $\hat{p}^{flevel}$, is insignificantly affected by the shocks under consideration, with prices of nonprimary goods kept constant, one deduces a system of two linear equations in $\hat{p}_X$, $\hat{p}_{0A}$, and $\hat{p}_{0B}$. The system can then be solved to provide $\hat{p}_{0A}$, and $\hat{p}_{0B}$, and hence $\hat{\Omega}$, as linear functions of $\hat{p}_X$, e.g.,

$$\alpha\hat{\Omega} = \mathrm{K}\hat{p}_X^f$$

where K depends on the model's parameters, and the behavior of which is examined numerically.[15]

E. Rigid Wages

From the equilibrium expressions for *L* and *C* as functions of Ω and $\frac{P}{W}$, it is apparent that for monetary policy to reproduce the outcome under flexible wages, it suffices that it reproduces the level of real wages, e.g.,

$$\left(\frac{W}{P} \right)^{\Theta} = \left(\frac{1}{1-\alpha} \right)^{\alpha\sigma} \left(\frac{\lambda}{\lambda-1} \right)^{\alpha} \Omega^{\alpha(\phi+\sigma)} .$$

This, in turn, is achieved if the money supply is set so that

$$P^{-\Theta} = \left(\frac{1}{1-\alpha} \right)^{\alpha\sigma} \left(\frac{\lambda}{\lambda-1} \right)^{\alpha} \Omega^{\alpha(\phi+\sigma)} W^{-\Theta} ,$$

hence, substituting this expression in that of real money balances,

[15] The numerical estimations are available from the author upon request.

$$M^{\Theta}=\chi^{\Theta}\left(\frac{1}{1-\alpha}\right)^{\sigma\phi}\left(\frac{\lambda-1}{\lambda}\right)^{\alpha+\sigma(1-\alpha)}\Omega^{\alpha\phi(\sigma-1)}W^{\Theta}.$$

Or, in log-deviations,

$$\hat{m}=\frac{\alpha\phi(\sigma-1)}{\Theta}\hat{\Omega}.$$

Alternatively, taking log-deviations for *P*, substituting the expression for $\hat{\Omega}$, and using the representation of P as a price index,

$$\hat{p}=-\alpha\frac{(\phi+\sigma)}{\Theta}\hat{\Omega}=-\frac{(\phi+\sigma)}{\Theta}\left[\alpha_X\,\hat{p}_X+\left(\alpha_{0A}\hat{p}_{0A}-\alpha_{1A}\hat{p}_{1A}\right)+\left(\alpha_{0B}\hat{p}_{0B}-\alpha_{1B}\hat{p}_{1B}\right)\right],$$

$$\hat{p}=\gamma_X\,\hat{p}_X^f+\gamma_A\gamma_0\left(\frac{1+T_{0A}}{1+T_A}\right)^{1-\eta}\hat{p}_{0A}^f+\gamma_A\gamma_1\left(\frac{1+T_{1A}}{1+T_A}\right)^{1-\eta}\hat{p}_{1A}^f+\gamma_B\gamma_0\left(\frac{1+T_{0B}}{1+T_B}\right)^{1-\eta}\hat{p}_{0B}^f+\gamma_B\gamma_1\left(\frac{1+T_{1B}}{1+T_B}\right)^{1-\eta}\hat{p}_{1B}^f-\hat{s}$$

the monetary policy rule above can be expressed in the form of an exchange rate policy rule,

$$\begin{aligned}\hat{s}&=\gamma_X\,\hat{p}_X^f+\gamma_A\gamma_0\left(\frac{1+T_{0A}}{1+T_A}\right)^{1-\eta}\hat{p}_{0A}^f+\gamma_A\gamma_1\left(\frac{1+T_{1A}}{1+T_A}\right)^{1-\eta}\hat{p}_{1A}^f+\gamma_B\gamma_0\left(\frac{1+T_{0B}}{1+T_B}\right)^{1-\eta}\hat{p}_{0B}^f+\gamma_B\gamma_1\left(\frac{1+T_{1B}}{1+T_B}\right)^{1-\eta}\hat{p}_{1B}^f-\hat{p}\\&=\left(\gamma_X+\frac{(\phi+\sigma)}{\Theta}\alpha_X\right)\hat{p}_X^f+\left(\gamma_A\gamma_{0A}\left(\frac{1+T_{0A}}{1+T_A}\right)^{1-\eta}+\frac{(\phi+\sigma)}{\Theta}\alpha_{0A}\right)\hat{p}_{0A}^f+\left(\gamma_B\gamma_{0B}\left(\frac{1+T_{0B}}{1+T_B}\right)^{1-\eta}+\frac{(\phi+\sigma)}{\Theta}\alpha_{0B}\right)\hat{p}_{0B}^f\\&+\left(\gamma_A\gamma_{1A}\left(\frac{1+T_{1A}}{1+T_A}\right)^{1-\eta}-\frac{(\phi+\sigma)}{\Theta}\alpha_{1A}\right)\hat{p}_{1A}^f+\left(\gamma_B\gamma_{1B}\left(\frac{1+T_{1B}}{1+T_B}\right)^{1-\eta}-\frac{(\phi+\sigma)}{\Theta}\alpha_{1B}\right)\hat{p}_{1B}^f\end{aligned}$$

Substituting the equilibrium expressions found for $\hat{p}_{0i}^f$ when wages are flexible, the exchange rate policy rule above takes the form

$$\hat{s}=\mathrm{H}\hat{p}_X^f,$$

where H depends on the model's parameters, and the behavior of which can be examined numerically.[16]

[16] The numerical estimations are available from the author upon request.

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