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Exports, Exchange Regimes, and Fragility

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I. Introduction

Two billion people live in countries affected by fragility, conflict, and violence. Nearly 50 percent of the global poor are predicted to be living in fragile and conflict-affected situations by 2030 (World Bank, 2018). Though there is no undisputed definition of fragility, it generally refers to countries where the state is ineffective in providing services to citizens, lacks authority and legitimacy, and is unable to manage its population's expectations through the political process.

The OECD (2016) identifies five dimensions of fragility: (a) *Economic fragility*, that is, the vulnerability to risks stemming from weaknesses in economic foundations and human capital including macroeconomic shocks, unequal growth and high youth unemployment, (b) *Political fragility*, which considers the vulnerability to risks inherent in political processes, events or decisions; political inclusiveness (including of elites); and transparency, corruption and society's ability to accommodate change and avoid repression, (c) *Environmental fragility*, comprising the vulnerability to environmental, climatic and health risks that affect citizens' lives and livelihoods, (d) *Security fragility*, that is, the vulnerability of overall security to violence and crime, including both political and social violence, and (e) *Societal fragility*, which corresponds to the vulnerability to risks affecting societal cohesion that stem from both vertical and horizontal inequalities, including inequality among culturally defined or constructed groups and social cleavages. In this paper we focus on the interplay between the first two dimensions.

In fragile environments, economic growth is significantly slower than and twice as volatile as in other emerging economies. Backwardness also shows in foreign trade. The share of exports in GDP of fragile economies has remained stagnant since the 1980s, while in other emerging economies it has risen significantly—by about 10 percentage points—reflecting their increased integration into global markets and higher value chains. The lack of economic integration into the world economy is certainly related to low levels of labor productivity: evidence indicates that foreign trade induces higher productivity by allowing specialization and the exploitation of comparative advantages, allowing market expansion and use of economies of scale, helping to diffuse technological innovations and improved managerial practices, lessening anticompetitive practices of domestic firms, and reducing incentives for firms to conduct rent-seeking activities that are mostly unproductive.

One key determinant of exports is the real exchange rate, that is, the relative price between traded and nontraded goods. Because it largely determines the relative profitability of investment in traded and nontraded sectors, this economy-wide relative price signals intersectorial resource transfers and factor movements in the economy, particularly capital accumulation. Exchange rate misalignment and instability have been frequently associated with the choice of exchange regimes: misalignment is more often observed in economies that peg their currency to the euro or the US dollar, while instability is usually linked to floating exchange regimes. Though the choice of an inflexible exchange regime does not automatically imply a tendency of the currency to misalign, there is significant evidence of real exchange rate appreciation in fragile economies.

In this paper we revisit the role of exchange regimes in fostering exports and economic growth in fragile economies and, thereby, in reducing political fragility. For this purpose, we use a dynamic, stochastic, general equilibrium model (DSGE). Two reasons justify the use of this methodology. First, our DSGE model is tailored to replicate the structural features of fragile economies, in particular the presence of frictions in market adjustment, the influence of external shocks (for example, foreign aid), and the roles of the government in providing public goods (public investment) and delivering social transfers to the population. The former are instrumental in supporting sustained growth while the latter may determine the support of the government and, thereby, its political fragility. In a context of limited government resources, fulfilling these roles poses a key political dilemma to the government. Second, and most important, our DSGE model allows us to track the response of variables associated with fragility to shocks that are likely to be important in fragile economies. The simulations we perform below illustrate the types of general-equilibrium interactions that may complicate the analysis of the effects of shocks that typically affect fragile economies on endogenous variables that may influence fragility.

In competitive economies, first-best approaches would call for credibly implementing either a floating regime or maintaining a hard peg to the currency of a large economy. Friedman's famous argument for floating exchange rates stipulates that in the long run the exchange rate system does not have significant real consequences (Friedman, 1968). His reasoning is that the exchange rate system is ultimately a choice of monetary regimes. In the end, monetary policy does not matter for real quantities, he argues, but in the short run the wrong monetary regime can have quite negative destabilizing effects in the economy.

Focusing only on the stabilization properties of fixed-vs-floating exchange regimes seems to be a very narrow perspective on the role of exchange regimes in fragile economies, largely because of the presence of distortions. Fragile economies are usually plagued by distortions, frictions and externalities rendering the standard first-best prescriptions inapplicable. In addition to economic distortions, political issues and institutional weaknesses are key elements to consider in the evaluation of exchange regimes. When externalities and frictions are present, second-best policies are preferred and there may be space for the choice of exchange regime to have a lasting impact on real quantities such as exports, investment, and technology adoption.

In an influential paper, Rodrik (2008) calls for an undervalued exchange rate as a mechanism for export promotion and sustained economic growth. His observation is that producers of traded goods suffer disproportionately from the government or market failures that keep poor countries from converging toward those with higher income. Collier and Gunning (1999) makes a similar point asserting that high transaction costs resulting from a poor policy environment become a source of comparative disadvantage for fragile economies in exporting manufacturing, which is one of the most transaction-intensive sectors.

The presence of frictions and externalities is the main theoretical justification for deviating from policy neutrality. Learning externalities from exports could justify export subsidies; knowledge spillovers from foreign companies could justify tax breaks for foreign direct

investment (FDI); production externalities in "advanced" sectors could justify infant-industry protection or other measures to expand those industries. However, as noted by Harrison and Rodriguez-Clare (2010), the theoretical justification for protection requires at a minimum either that the country have a latent comparative advantage in the protected industry or that the international price for this industry is higher than warranted by the true opportunity cost of this good in the rest of the world.

In Section II of this paper we discuss the main economic characteristics of 51 fragile countries in terms of exports, public and private investment, foreign resources (such as external aid) and economic growth. These characteristics are later considered in the structure and simulations of our DSGE model. There is no common, undisputed definition of fragility (see, among others, UNDP, 2009; USAID, 2005; and OECD, 2008). Our working definition of a fragile economy is based on the Country Policy and Institutional Assessment (CPIA) indices of the World Development Indicators (World Bank, 2019). Our demarcation criterion is to consider an economy to be fragile if it falters on macroeconomic management, quality of public administration, property rights and rule-based governance, and transparency, accountability, and corruption in the public sector (see Appendix A). The evidence suggests that backwardation in fragile economies relate to (a) low investment levels, in particular public investment in infrastructure and other public goods; (b) low exports levels and relative inability to become competitive in international markets; and (c) a growing proclivity of governments towards conducting monetary policy under fixed exchange regimes. Consequently, a key issue for fragile economies would be to determine which exchange regime is more conducive to a virtuous circle of higher levels of investment and exports, given the structural and political restrictions that characterize fragility. In this section we also briefly review the debate on trade-promoting and industrial policies as tools to achieve higher GDP growth by enhancing exports. We focus on one particular explanation based on learning-by-exporting, that is, the variety of mechanisms that induce productivity gains when firms start exporting, such as investing in marketing, upgrading product quality, innovating, or dealing with foreign buyers.

In Section III of this paper we discuss the main political characteristics of the 51 fragile countries. Political fragility plays an important role in determining the fate of fragile countries, interacting frequently with economic aspects. Governments in fragile economies frequently lack authority and legitimacy, and are unable to manage its population's expectations through the political process. The evidence suggests that the incidence of violent civil conflicts is significantly higher in fragile economies, both pre and post 1990. Political regimes in fragile economies are not only less democratic than in other emerging economies but also significantly less accountable. The executive in fragile economies is significantly less constrained in his/her abilities to engage in arbitrary practices.

The interaction between political and economic factors in fragile economies is a relatively new topic of analysis. Most of the literature has focused on violent political and social conflicts, particularly civil wars. But there are a number of fragile economies where large-scale armed conflict is not present and where the insights of the economics of civil war do not necessarily apply. In these economies, authoritarian governments do not rely on repression but on enticing the different groups to support the government, that is, an

implicit arrangement between ruling elites and citizens whereby citizens relinquish political influence in exchange for public spending. In section III we summarize the nature and main insights of the political economy model by Soto (2019) which links political fragility with the transfers and non-pecuniary goods given by the ruling coalition to its own constituency and to opposition groups. We subsequently use this model to justify the type of analyses using the DSGE model we develop below. Although the political economy model is not embedded into the DSGE model, it provides a general framework to understand how economic variables –in particular, the different government policies—may affect fragility.

Section IV provides a summary presentation of our DSGE model which is designed to understand the role of different policies in inducing exports and economic growth, on one hand, and affecting political fragility, on the other hand. The type of government policies that we would like to study relate to government transfers to the population (which have direct effect on political fragility as discussed above), the level of government expenditures (which links to Dutch disease problems) and the allocation of public investment (which can be instrumental in reconstruction of conflict-affected economies as well as in fostering exports). We also consider the role of external debt levels and foreign aid surges, the latter being an important external force that, on one hand, might help support government finances but, on the other hand, can be seriously damaging to the external competitiveness of a small economy if not properly managed.

Among the most interesting and novel features of the model is its ability to track transfers given by the ruling coalition to the population to entice political support, the fact that these transfers cannot be arbitrarily set but are limited by the available financing and the intertemporal restrictions that governments must obey to implement sustainable policies. A second feature is the presence of quadratic costs to the relocation of physical capital from one sector to another, a realistic friction that shapes the speed at which an economy returns to sustained growth after a policy shock. The third and most unique feature is the explicit modeling of learning by exporting, which occurs in most industries even when exports are largely concentrated on commodities. Learning, as opposed to total factor productivity (TFP) gains, is the result of accumulating knowledge of previous export activities and, therefore, is an endogenous externality.

Finally, because our aim is to understand the impact on export and growth of the choice of exchange regimes, the proposed model allows for markets to clear continuously under two alternative closures. One closure allows the nominal exchange rate to freely float in response to the supply and demand of foreign liquidity. In this case, the nominal exchange rate is endogenous and foreign reserves of the Central Bank are kept constant. The other closure imposes rigidities on the adjustment of the nominal exchange rate which, in the limit, can mimic a fixed exchange rate regime. In the latter case, reserves are used to manage the exchange rate.

Section V collects the main results and the policy implications from our analyses. Our conclusions complement and support those from Chami, Cosimano, Espinoza and Montiel (2019) which also use a DSGE model to study issues related to shorter-term macroeconomic stabilization in fragile states.

II. Economic Fragility

In this section we identify the main characteristics of fragile economies in terms of exports, investment, and economic growth. These characteristics are later considered in the structure and simulations of our DSGE model. Subscribing to the received literature, we identify the following elements that our model ought to take into account.

Economic Growth and Investment

Not surprisingly, fragile economies tend to grow significantly slower than other emerging economies (around one percentage point less in the period 1960-2017 as shown in Table 1). Not only is economic growth slower in fragile economies, but it has also been between two and three times more volatile, particularly in the period 1960-1989.

As expected, low and volatile growth rates in fragile economies are directly linked to lower levels of gross fixed capital formation, particularly by the private sector. Total investment has been on average around three percentage points of GDP lower in fragile economies than in other emerging countries. Private investment in fragile countries, furthermore, has been much lower than in non-fragile emerging economies, by around five percentage points before 1990 and slightly less afterwards. This trend, in turn, reflects a relative weakening in the role of public investment in capital formation and, to the extent that the government provides public capital goods that cannot be replicated by the private sector, a potential limitation to sustained development.

The weaknesses in private and public investment show in significant lower levels of infrastructure, indicating that fragile producers and, particularly, exporters suffer from much higher costs than their counterparts in other emerging economies. As shown in Table 1, fragile economies have significant limitations in access to electricity, use of electric power, access to mobile telephony, and port facilities.

Lower investment rates in fragile economies also reflects in significantly worse levels of labor productivity when compared to non-fragile emerging countries. We proxy average labor productivity using real GDP per person employed. As shown in Table 1, fragile economies exhibit a significant backwardation in productivity vis-à-vis the rest of emerging countries. These lower levels of productivity could be the result of a number of elements and conditioning factors, among which we identify the dominance of low-productivity primary activities, poor institutions, and higher population growth.

One potential explanation for the lower levels of investment and productivity of fragile economies lies in their inability to exploit profitable businesses as a result of shortage of resources: investment opportunities cannot materialize because of the lack of cash. Data on foreign aid to fragile economies suggest otherwise. As shown in Table 1, aid levels were significantly higher in fragile economies vis-à-vis other emerging countries in any period of time. Although aid flows seems to have been incapable of supporting sustained economic growth and higher productivity levels in fragile economies, empirical evidence collected by

Elbadawi, Kaltani and Schmidt-Hebbel (2008) and Adam, Collier, and Davies (2008) suggests that they were instrumental in promoting monetary reconstruction in post-conflict countries where they have helped to reduce inflation without leading to significant real exchange rate overvaluation.

Table 1: Main Economic Indicators of Fragile States and Non-fragile Emerging Economies

	Fragile Economies		Non-fragile Emerging Economies	
	1960-1989	1990-2017	1960-1979	1980-2017
Annual Growth of Real GDP per capita (%)	0.7	1.4	2.3	2.3
Coefficient of Variation of GDP growth	2.2	1.2	0.6	0.7
Total Investment (% of GDP)	18.0	20.2	20.9	22.9
Private Investment (% of GDP)	7.9	13.2	14.4	16.0
Public Investment (% of GDP)	10.1	7.0	6.5	6.9
Access to electricity (% of population)	n.a.	34.6	n.a.	85.3
Electric power consumption (kWh per capita)	187	390	1,159	2,791
Mobile cellular subscriptions (per 100 people)	n.a.	22.8	n.a.	48.8
Container port traffic (TEU)	n.a.	591,108	n.a.	4,089,633
Labor Productivity (GDP per person employed, US$ of 2011 PPP)	n.a.	7,124	n.a.	37,443
Foreign Aid (% of GDP)	6.3	8.7	3.5	4.1
Foreign Direct Investment (% of GDP)	0.9	3.9	1.2	4.4
Total natural resources rents (% of GDP)	8.7	12.3	7.5	6.5
Exports of Goods and Services (% of GDP)	24.2	30.8	27.5	39.9
Exports of Manufactures (% of Total Exports)	14.9	25.1	17.0	42.3
High-technology Exports (% of Total Exports)	n.a.	4.3	n.a.	7.8

Source: own elaboration based on World Development Indicators, World Bank.
Note: OECD countries are excluded. n.a.= not available.

Nevertheless, foreign aid is not the only source of cash for fragile economies. Foreign direct investment and natural resource rents could also provide much needed resources for development. Evidence on foreign direct investment—another significant source of resources and technology diffusion—indicates that there are no substantial difference between fragile and non-fragile economies. On the contrary, indicates that fragile economies have historically benefitted from high resource rents (defined as the sum of oil rents, natural gas rents, coal rents, mineral rents, and forest rents). Furthermore, such rents have become more important in the recent decades when compared to other emerging economies.

Exports Patterns and Foreign Trade

Fragile economies differ vis-à-vis other emerging economies not only in growth and investment but also in trade patterns. During the period 1960-1989, exports played a similar role in economic activity in fragile economies and in other emerging countries. A striking fact is that the share of exports in GDP of fragile economies has remained almost stagnant since the 1980s whilst that of other emerging economies have risen significantly – by about ten percentage points of GDP—reflecting their increased integration to global markets and higher value chains. The lack of economic integration to the world economy certainly relates to the lower levels of labor productivity discussed above: evidence for a large number of economies indicates that foreign trade induces higher total factor productivity as a result of several mechanisms. These include allowing specialization and the exploitation of comparative advantages, allowing market expansion and use of scale economies, helping diffusing technological innovations and improved managerial practices, lessening anticompetitive practices of domestic firms, and reducing incentives for firms to conduct rent-seeking activities that are mostly unproductive.

In addition to having substantially lower levels of integration to the world economy, fragile states also export significantly less manufactures. As shown in Table 1, from 1960 to 1989 fragile economies had a very similar export pattern to that of other emerging economies. This, however, changed quite dramatically afterwards: whilst exporting manufactures stagnated in fragile economies, they boomed in non-fragile emerging countries. Furthermore, and concomitantly to their inability to export manufactures, fragile economies also tend to export goods and services of lower levels of sophistication and, thereby, lower value added. After 1990, the content of high-tech goods in exports has hovered around 4% in fragile economies while in non-fragile emerging economies it has been twice as high on average (as a point of reference, the average value for developed economies is 14%).

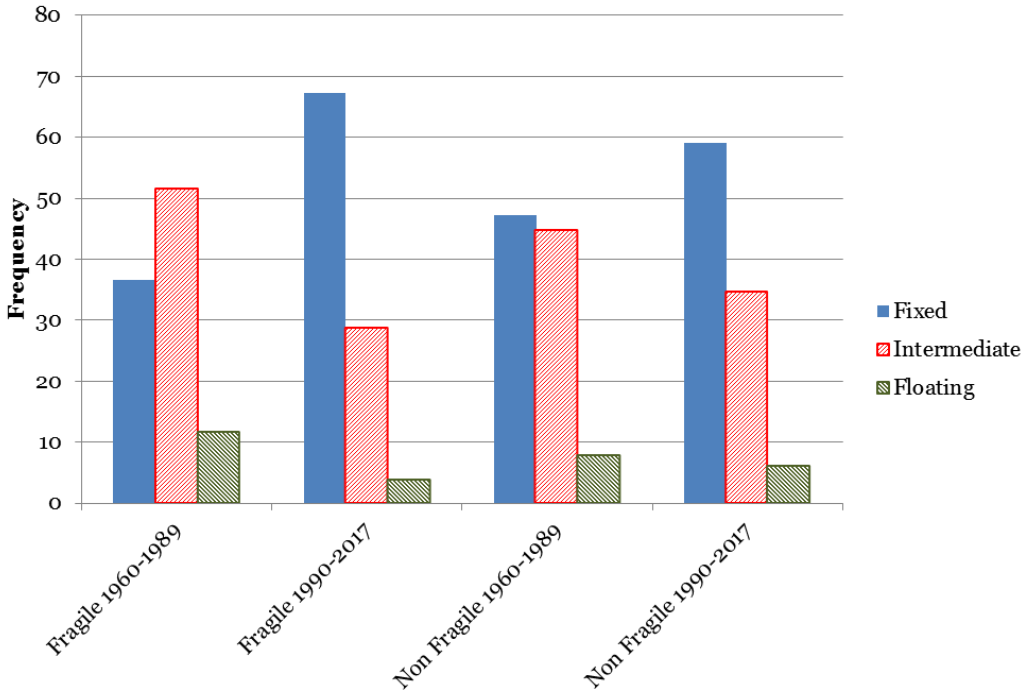
Exchange Regimes

When analyzing export patterns one cannot abstract from the set of incentives entrepreneurs face when deciding to export or sell domestically. One key determinant of said incentives is the real exchange rate, i.e., the relative price between traded and non-traded goods. This economy-wide relative price has strong influence on economic activity as it largely determines the relative profitability of investment in traded and non-traded sectors thus affecting capital accumulation. Sustained overvaluation has been linked to lower long-run economic growth (Aguirre and Calderón, 2006), lower financial deepening (Dehesa et al., 2007), and higher tendency to currency crises (Burkart and Coudert, 2002). Misalignment have been frequently associated with the choice of exchange regimes as it tend to occur more often in economies that peg their currency to that of developed countries.

As shown in Figure 1, there has been a tendency to adopt fixed exchange regimes in all emerging economies in the period 1990-2017 and dismiss managed floats and other intermediate regimes. Such trend, nevertheless, has been much more marked in fragile

economies: two thirds of fragile economies had implemented fixed exchange regimes during the period 1990-2017 as opposed to only one third in the period 1960-1989. Non-fragile economies with inflexible exchange regimes increased from 45% to less than 60% in the same time span. While the choice of an inflexible exchange regime does not automatically imply a tendency of the currency to misalign –as amply demonstrate by the experience of the European Union since the adoption of the euro—there is significant evidence of currency appreciation in fragile economies. Estimates by Couharde et al. (2017) show that fragile states are more likely to have an overvalued currency (55%) than non-fragile economies (45%).

Figure 1: Exchange Regimes in Fragile and Non-Fragile Economies



Source: own elaboration based on data from Ilzetsky et al. (2016)

Productivity Gains and Learning by Exporting

The evidence suggests that key determinants of development in fragile economies relate to (a) investment levels, in particular public investment as the main provider of infrastructure and other public goods; (b) exports and the inability of fragile economies to become competitive in international markets; and (c) the growing proclivity of governments towards conducting monetary policy under fixed exchange regimes.

Consequently, a key issue for fragile economies would be to determine which exchange regime is more conducive to a virtuous circle of higher levels of investment and exports,

given the structural and political restrictions that characterize fragility. The received knowledge is scarce and the issue of the causality between exports and productivity gains resulting from investment is not yet settled.

The notion that exporting may increase the productivity of firms and, thereby, support sustained economic growth has been at the roots of economic development for long time. Successful cases of export-led growth are Germany and Japan in the 1950s and 1960s and the four East Asian Tigers (South Korea, Hong Kong, Singapore, and Taiwan) in the 1970s and 1980s. However, what exactly constitutes export-led growth is ambiguous. As noted by Weiss (2005), the precise mechanism through which countries can benefit from openness to trade and rising exports has been the subject of much discussion. Possible mechanisms include:

- If economies can break into export markets they will be able to overcome the constraints on sales imposed by the absolute size and dynamism of the domestic market. Insofar as increasing returns to scale in production are important this will reinforce the advantage of operating at higher output levels due to exporting (see Bartelme et al., 2018).
- Exporting can lead to productivity gains –arising from exposing firms to foreign competition, technology and marketing—that would otherwise not be obtainable from selling only to domestic markets. Participating in export markets brings firms into contact with international best practice and fosters learning and productivity growth (World Bank, 1997).
- Exports allow access to imports that can be purchased with the foreign exchange they generate. For individual producers gains from imports can be both static, if they cost less than competing domestic production, and dynamic where capital and intermediate imports embody superior technology that allows productivity gains (Halpern et al., 2015).
- An export-oriented strategy attracts foreign direct investment (FDI) that would not have come to the economy under an import substitution regime, and insofar as this FDI generates positive externalities for the domestic economy, there will be further benefits that go beyond the monetary value of increases in exports (Kimura and Kiyota, 2006).

Empirical studies tend to agree that exporters have, on average, higher productivity levels than non-exporting firms. Naturally, correlation is not causality. Therefore, a still ongoing debate ensued as to whether exporting has a *causal impact* on measures of firm performance. Two causal mechanisms are often used to explain the higher productivity of exporters as compared to non-exporters. The first hypothesis is self-selection, where only the more productive firms will self-select into the export market (for example, Bernard and Jensen, 1999). An alternative but not mutually exclusive explanation is learning by exporting, which argues that export participation can be a source of productivity growth enabling exporting firms to become more productive relative to non-exporters (e.g. Van Biesebroeck, 2005). In our empirical work, we focus on the latter as the key causal mechanism linking exports and sustained growth. The DSGE model we develop below lends itself to studying learning by exporting using a representative exporting firm; in

order to study the self-selection mechanism the DSGE model would have to extended to consider the distribution of productivity of potentially exporting firms, an information that is unlikely to be available for fragile countries.

Learning by exporting has been identified as an important mechanism whereby firms can increase productivity if they access information to which they would otherwise not be privy (Salomon and Shaver, 2005). Indeed, it refers to a variety of mechanisms that might induce productivity gains when firms start exporting, such as investing in marketing, upgrading product quality, innovating, or dealing with foreign buyers (Eaton et al., 2016). Evidence regarding the learning-by-exporting hypothesis is controversial, because proper measurement would require controlling for other firm-level actions such as R&D, technology adoption, and quality upgrading (de Loecker, 2013). According to a recent survey by Martins and Yang (2009), the evidence is conclusive in that exporting does increase productivity and that the impact is higher for developing than developed economies. They also find that the export effect tends to be higher at the initial stages of exporting (compared to later years).

The evidence suggests that there is a strong correlation between exporting and productivity gains, and empirical studies linking exports and economic growth abound. The successful experience of some countries with export-led growth and the abundant microeconomic evidence of a positive correlation between exports and both higher productivity and sustained growth has revamped the importance of trade and trade-promoting policies (see, for example, Frankel and Romer, 1999) and has whetted the appetite of the supporters of active industrial policies (for example, Hausman et al, 2008). Trade and industrial policies have diverse instruments available for these purposes. At the micro level, tax incentives, subsidies, government purchasing, contracting of services, soft loans, guarantees, tariffs, and regulations are considered to play an export-fostering role. At the macroeconomic level, exchange regimes are considered a key component of the export-promoting strategy and real exchange undervaluation—be it transitory or long-lasting—features prominently in most empirical and policy-oriented studies.

Aizenman and Lee (2010) focus on how different forms of learning-by-doing externalities call for different first-best policy interventions (in the absence of policy intervention, externalities are sub-optimally produced). Depending on the nature of the learning-by-exporting externality, it may call for subsidizing the cost of capital, subsidizing the cost of labor, or both. Real exchange rate undervaluation –as proposed, for example, by Rodrik (2008)—would be the suggested policy only if the learning-by-exporting externality calls for subsidizing employment in the traded sector, and if this end cannot be accomplished through more effective means. They claim that activist exchange rate policies may generate competitive gains through keeping the real exchange undervalued, and the resultant increase in exports will promote economic growth. Korinek and Serven (2016) propose that a long-lasting undervaluation of the currency can be achieved by accumulating foreign reserves, as opposed to expansionary monetary policies that can only depreciate the exchange rate in the short term. In the DSGE model we allow for temporary undervaluation of the currency but impose the restriction that the real exchange rate must return to equilibrium in steady state.

III. Political Fragility

As mentioned, economic fragility is but one of the two crucial aspects of fragility we consider: political fragility plays an equally important role in determining the fate of fragile countries, interacting frequently with economic aspects. As indicated, governments in fragile economies frequently lack authority and legitimacy, and are unable to manage its population's expectations through the political process.

Table 2 provides a summary of the main political indicators in fragile economies vis-à-vis non-fragile emerging states. The evidence suggests that the incidence of violent civil conflicts is significantly higher in fragile economies, both pre and post 1990. The numbers are quite large: on average, one out of four fragile economy was involved in a civil conflict within, and frequently beyond, its frontiers in the period 1990-2018. These conflicts exact a significant toll on the economy, diverting government resources away from socially beneficial ends and penalizing long-term investments in both physical and human capital.

Not surprisingly, political participation in fragile economies is low, when measured by the democracy index of the Polity IV project, though it has improved in the period 1990-2018. Non-fragile economies have also improved on political participation and now locate around one half of the scale. Political regimes in fragile economies are not only less democratic but also significantly less accountable, according to both the DPI checks and balances and Henitz's Political Constraints index. The checks and Balances indicators evaluates the number of decision makers whose agreement is necessary before policies can be changed. Countries with multiple decision makers may offer greater protection from arbitrary government action to individuals and minorities. Henitz's indicator measures the extent to which any one political actor or the replacement for any one actor—for example, the executive or a chamber of the legislature—is constrained in his or her choice of future policies. It can be seen that the executive in fragile economies is significantly less constrained in his/her abilities to engage in arbitrary practices; improvements over the years in both indices have been rather modest.

Finally, fragile economies are not only characterized by higher conflict and lower levels of representation but also by a significantly less effective government. The ICRG indices in Table 2 indicate that fragile economies lag behind in institutions that inhibit the government to benefit its constituency to the detriment of the rest of the population, such as control of corruption and rule of law. Likewise, lower government effectiveness and regulatory quality also point to the fact that in fragile economies there are significant areas of arbitrariness and inefficiency in the working of the government that, more often than not, tend to benefit government supporters and allies.

The interaction between political and economic factors in fragile economies is a relatively new topic of analysis. The literature has focused with more enthusiasm on violent political and social conflicts, particularly civil wars. Blattman and Miguel (2010) indicate that researchers have focused on why do civil wars occur at all when, given the high costs of war, groups have every incentive to reach an agreement that avoids fighting. Explanations have focused on information asymmetries and the inability to sign binding contracts in the

absence of the rule of law. Less progress, however, has been made on the equally important problem of why armed groups form and cohere, and why individuals decide to fight.

Table 2: Main Political Indicators of Fragile States and Non-fragile Emerging Economies

	Fragile Economies		Non-fragile Emerging Economies	
	1960-1989	1990-2018	1960-1989	1990-2018
Incidence of Armed Conflicts (countries with active conflicts, %)	15.7%	23.1%	9.9%	12.2%
Polity IV Democracy index (0=low, 10=high)	1.01	3.48	2.25	4.79
DPI Checks and balances index (0=low, 10=high)	1.31	2.46	1.73	2.63
Henitz's Political Constraints index (0=low, 1=high)	0.08	0.23	0.18	0.35
ICRG Control of Corruption (6=high, 0=low)	n.a.	0.32	n.a.	0.42
ICRG Rule of Law (4=high, 0=low)	n.a.	0.45	n.a.	0.62
ICRG Regulatory Quality (4=high, 0=low)	n.a.	0.50	n.a.	0.67
ICRG Government Effectiveness (4=high, 0=low)	n.a.	0.30	n.a.	0.54

Source: authors' own elaboration based on data from DPI (2017), Henitz and Zelner (2017) and ICRG (2018).

But there are a number of fragile economies where large-scale armed conflict is not present and where the insights of the economics of civil war do not necessarily apply. In fact, in a number of fragile economies governments do not rely on violence and repression but on enticing the different groups to support the government, that is, an implicit arrangement between ruling elites and citizens whereby citizens relinquish political influence in exchange for public spending.

In this section we summarize a model by Soto (2019), who develops a theoretical model that links political fragility with the transfers and non-pecuniary goods given by the ruling coalition to its own constituency and to opposition groups. We subsequently use its insights to justify the type of analysis we undertake using the DSGE model we develop below. Although the political economy model is not embedded into the DSGE model, it provides a general framework to understand how economic variables –in particular, the different government policies—may affect fragility. Political fragility, in this context, would correspond to an unstable political environment (characterized by the risk of a coup d'état or a civil conflict) and weak state capacity, made only worse by a high propensity to destabilization by external shocks.

The model posits a simple game between the governing coalition and opposition groups. Political power entails control of government rents (taxation, natural resources, etc.), as well as the authority to choose a preferred set of non-pecuniary policies (for example, the degree of political participation and civil liberties). Government rents are stochastic; in every period, its level is known to the government but unknown to the population, which

has to form expectations based on private and publicly available signals. The informational asymmetry is used by the government in its advantage to maximize the probability to stay in power.

The key insight is that although the ruling coalition would prefer to keep all available rents for its constituency and set non-pecuniary policies according to their own preferences, it will find it desirable to share rents and accommodate to some degree its policies to consider the preferences of the opposition so as to limit popular discontent or to contain the threat of an uprising. Rent-sharing is modelled in the form of direct transfers to the population but it could include guaranteed public jobs at a wage premium, labor market protection in the private sector, or subsidies for schooling, housing, and utilities.

The government offers each group in the opposition a bundle comprising a share of total rents (the rest goes to its constituency) and an attractive non-pecuniary policy (that may or may not be the preferred policy of its constituency). When evaluating the bundle, the opposition has two alternatives: (a) accept the bundle or (b) reject the bundle and attempt to overthrow the ruling coalition. The outcome is uncertain. If the overthrown is successful, the opposition captures all rents and impose its preferred policy. If it is unsuccessful, then the ruling coalition does not give any transfer to the opposition and enacts its ideal policy. The ruling coalition will successfully appease the opposition when the value of the bundle for the population exceeds the expected value of overthrowing the government. The equilibrium takes the form of an authoritarian bargain (Desai, Olofsgard and Yousef, 2009).

The uprising is successful with a probability that depends inversely on the political support given to the ruling coalition by the population. The model assumes that such political support depends on the relative size of the transfer offered to a group in the opposition vis-à-vis the rest of the individuals (that is, its *share of the pie*). Each group observes the transfer being offered but is uncertain about the total size of rents and must form a conjecture in order to determine if his or her relative position has improved or deteriorated. Their conjecture is based on available *public* information and the *private* signal received in the bundle offered. Public information includes all available information, except the total rent.

In this context of incomplete information, political support for the governing coalition increases with the *expected* share of the pie: whenever transfers are lower than expected, political support dwindles. Consider the situation when government rents dwindle (for example, as a result of dropping prices of natural resources) and the ruling coalition is forced to reduce the total transfer to society. Each group in the opposition observes the proposed cut in its transfers but not the total decline in government rents and, therefore, must guess whether the offered transfer maintains its share of the pie. If not, they withdraw their support to the government. Likewise, during a commodity price boom the individual would assess whether it is getting its fair share of the windfall.

Because both private and public information are noisy, when forecasting the total available transfer, each opposition group must decide how much to trust each signal. They use a Bayesian rule that weighs the relative uncertainty of each signal: the lower is the relative uncertainty of one type of information, the higher is its informational value. A group that

has received historically a very predictable share of the pie would put significantly more trust in the transfer offered by the government than in public signals. Governments in more unstable economies, that is, where the relative uncertainty of public information is higher, would face lower political support than more stable economies for the same level of transfers. In this case, even smaller shocks can be destabilizing.

This political economy theory provides a number of insights that guide the design of the structure of our empirical DSGE model and identifies the main policies one would like to study in the context of fragile economies. Among others:

- *For any level of rents and given the ideal policies of the governing coalition, an increase in transfers to the opposition lowers the consumption and utility of the ruling coalition but it raises his political support thereby reducing the probability of a successful overthrow of the regime*. Transfers reduce fragility. This is the capital trade-off for the ruling coalition. This would explain the generous transfers given to opposition groups during political turmoil (Manacorda and Vigorito, 2011).

- *For any level of rents and given the ideal policies of the governing coalition, it is costlier to collect political support in societies where individual transfers are more uncertain than total transfers*. Stable transfers reduce fragility. Ruling coalitions would like to have opposition groups to trust significantly the information value of individual transfers. For example, when transfers come in the form of public employment and subsidies, as is the case in most fragile economies, the ruling coalition would avoid changing current expenditures (public wages, social programs) during the business cycle and focus on adjusting capital spending. Evidence indicates that fiscal adjustment episodes tend to be accompanied by disproportionate public investment cuts, a characteristic behavior in developing countries related to the fact that capital expenditure cuts may prove to be more politically palatable than cuts in current expenditure (Ardanaz and Izquierdo, 2017).

- *An increase in government rents improves the welfare of the ruling coalition but it also increases the payoff of a successful overthrow, thereby calling for additional transfers to lower the probability of success*. Sharing fiscal bonanzas reduce fragility. This would explain, for example, the generous transfers given to citizens by oil exporters during price booms (Diamond and Mosbacher, 2013).

- *Aligning the ideal policy of the ruling coalition to that of the nationals would reduce the cost of securing political allegiance*. Transfers are used by the ruling coalition to counterbalance the political cost of imposing their ideal policies over those of the opposition. When the cost of such transfers is too high, government are force to yield to popular demands and re-align their preferred policies (Lacroix and Filiu, 2018). Likewise, during the Arab Spring, GCC monarchies expanded transfers massively to maintain political support but chose to crack down rapidly on any political demand (Kamrava, 2012).

IV. Modeling Fragility, Exports, and Exchange Regimes

In this section we present a stylized description of our dynamic, stochastic general equilibrium (DSGE) model, identifying its key characteristics and providing a snapshot on how to solve it and simulate its dynamic properties (a description of the full model is in Appendix B). The model extends the standard DSGE macroeconomic model to account for (a) costly relocation of resources between sectors, (b) learning by exporting, and (c) the presence of capital goods provided freely by the public sector (for example, infrastructure). The model is calibrated to mimic the case of fragile economies and used to study its response to different types of policy shocks.

An alternative methodology is employed by Chami et al. (2019) –hereafter CCEM— whereby they set up a nonstandard DSGE framework specifically intended to describe what they perceive as a typical macroeconomic setting in fragile states. These include (a) the tendency to monetize fiscal deficits (itself the result of small domestic debt markets and closed financial accounts) as well as (b) labor market frictions that create unfair wage distributions. When appropriate, we identify the differences and complementarities between both models.

We focus on a small open economy. Most fragile countries are small economies by international standards, in that their internal markets are not sizable and that they cannot affect international markets in a systematic manner. Most conflict countries are also de-facto open economies even if from a de-jure perspective they may appear as relatively closed, simply because frontiers liquefy as a result of the conflict and/or because of their very weak state capacity.

The model is designed to understand the role of different policies in inducing exports and economic growth, on one hand, and affecting political fragility, on the other hand. The type of government policies that we would like to study relate to government transfers to the population (which have direct effect on fragility as discussed above), the level of government expenditures (which links to Dutch disease and debt service problems) and the allocation of public investment (which can be instrumental in fostering exports and supporting sustained growth). We also consider the role of external debt levels and foreign aid surges, the latter being an important external force that, on one hand, might help government finances and the balance of payments but, on the other hand, can seriously damage the external competitiveness of a small economy if not properly managed.

Crucially, in our model the level of transfers given by the ruling coalition to the population in order to entice political support cannot be arbitrarily set and, in fact, it results from the choices of the authorities regarding the abovementioned policies and the fact that such choices are limited by the available financing and the intertemporal restrictions that the government must obey to implement sustainable policies. Contrary to CCEM, we do not link explicitly government transfers to the probability of the government remaining in power. Nevertheless, we compute a second-order approximation to the change in welfare induced by the different policies and, therefore, obtain an indirect measure of their effect on political fragility.

Our specification comprises the following elements, which we discuss in more depth in what follows. Given our interest in the role of exports and exchange regimes we consider three markets –nontraded, exported, and imported goods—so that we can identify separately terms-of-trade from the real exchange rate. Without loss of generality, we assume that exported goods are not consumed domestically and that imported goods are not produced in the country. Production of exportable and nontraded goods uses private capital, public capital, and employment with different intensities, according to standard production functions.

We assume that labor markets clear continuously (that is, we abstract from unemployment issues) but we impose that relocating physical capital from one sector to another is subject to a quadratic cost. CCEM, on the contrary, make public employment the key policy variable that influences fragility. In their case, public employment must be solved for explicitly, as in a Ramsey model, to maximize the utility of the policymaker (which is a composite of the utility of the representative agent, public consumption, and the probability and cost of state failure),

A salient feature of our model is the explicit modeling of learning by exporting, which occurs in most industries even if exports are largely concentrated on commodities. Learning, as opposed to TFP gains, is the result of accumulating knowledge of previous export activities and it is subject to depreciation. Consequently, exporting knowledge operates as an endogenous externality.

The households, which are the ultimately owners of all firms in the economy, receive both profits from firms as well as the returns on renting capital to produce goods and services. Households supply labor to the market and collect wages and are also the holders of government bonds and foreign assets. Finally, households hold money and, as mentioned, receive a transfer from the government.

The third component of our model is the government, which comprises the fiscal and monetary authorities. The fiscal authority is in charge of collecting taxes from the sales of exports and nontraded goods, spending on government consumption and public investment, and issuing and repaying government debt. The government is not entitled to issue external debt. The fiscal authority is also the recipient of foreign aid. The Central Bank issues money and collects seigniorage, which is passed on directly to the financing of the government, and maintains foreign reserves for which it earns the international risk-free rate of return.

The setup of our model allows for studying the effects of an important type of external shock: foreign aid. As discussed, aid flows to fragile economies, particularly those in post-conflict situations, is usually massive and occasionally untimely. In effect, financial flows usually come at times when the absorptive capacity of the fragile economy is unable to cope with the massive inflow of resources. It is not unusual to observe that in those cases the real exchange rate appreciates and most of the resources are devoted to financing consumption booms.

Finally, because our aim is to understand the impact on export and growth of the choice of exchange regimes, the proposed model allows for markets to clear continuously under two alternative closures. One closure allows the nominal exchange rate to freely float in response to the supply and demand of foreign liquidity. In this case, the nominal exchange rate is endogenous and foreign reserves of the Central Bank are kept constant. The other closure imposes rigidities on the adjustment of the nominal exchange rate which, in the limit, can mimic a fixed exchange rate regime. In the latter case, reserves are used to manage the exchange rate.

One key difference between our model and that of CCEM is in time horizon. CCEM adopt a shorter time perspective since their model does not allow for capital accumulation or intersectoral capital reallocation, while we allow for accumulation of public capital and (costly) intersectoral reallocation of private capital as well as learning by exporting. These features produce marked differences between short-term and long-term responses to policy shocks.

Production Frontier

We consider three markets: nontraded, exported, and imported goods. Without loss of generality, we assume that exported goods are not consumed domestically and imported goods are not produced in the country. Production of the two domestic industries (exportable goods, *X,* and nontraded goods, *N*) uses private capital (*Kn, Kx*), public capital (*Kg*), and employment (*Ln, Lx*) with different intensities (as reflected in parameters ϕ, φ, η and λ), according to standard production functions as described in equations (1) and (2).

$$(1) \qquad N_t = An_t Kg_{t-1}^{\phi}(Kn_{t-1})^{\varphi} Ln_t^{1-\varphi}$$

$$(2) \qquad X_t = Ax_t Kg_{t-1}^{\eta}(H_t Kx_{t-1})^{\lambda} Lx_t^{1-\lambda}$$

Public capital enters directly the production function of the firms and, by being provided freely by the government (such as infrastructure), it lowers costs and enhances TFP. This feature is not present in CCEM. Technology (denoted by *An* and *Ax*) evolves in an exogenous but stochastic and independent manner in each industry according to a standard AR(1) process. We also assume that the capital share in the tradable sector is greater than in the non-tradable sector, that is $\lambda > \phi$. Because the tradable sector employs relatively more capital, then it will also draw more investment and will generate greater learning-by-exporting externalities, as we discuss in more detail below.

The first salient feature of our model is the explicit modeling of learning by exporting, as indicated by variable H_t in equation (2). As discussed, exporting in most industries is subject to learning even if exports are largely concentrated on commodities. Learning, as opposed to TFP gains, is the result of accumulating knowledge of previous export activities

and it is subject to time depreciation (at a rate of ϑ).[1] Consequently, knowledge of exporting operates as an endogenous externality. We model the learning externality in exports as:

$$(3) \qquad ln(H_t) = (1-\vartheta)ln(H_{t-1}) + \vartheta ln(Kx_{t-1})$$

The second salient feature of the model is the presence of adjustment costs to capital accumulation. Following Chatterjee and Mursagulov (2016), firm owners in the nontraded sector pay a quadratic cost to capital adjustment of the form $\Gamma(Z_t) = Z_t + \frac{h}{2}Z_t^2$ where Z_t is total private investment. Whenever parameter h is positive, the total cost of investment exceeds the value of capital goods. This assumption allows us to have different short-term and long-term elasticities of capital supply, because the finite speed of adjustment to investment precludes the capital stock to reach equilibrium instantaneously. Adjustment costs to capital accumulation play an important role in contemporary DSGE models. Baxter and Crucini (1993), for example, show their importance in explaining the saving-investment correlations and the home bias puzzle in open-economy models. Other authors have introduced costly capital adjustments to explain the equity premium puzzle in production economies with capital (Boldrin, Christiano, and Fisher, 2001) or to rationalize the observed large welfare costs of business cycles (Barlevy 2004). More importantly for our goals, Beaudry and Portier (2007) document that these type of costs are key driving forces of the business cycle. The stock of capital in both industries evolves according to the perpetual inventory method. The accumulation of private capital in each sector is given by:

$$(4) \qquad Kn_t = Z_t + (1-\delta_T)Kn_{t-1}$$
$$(5) \qquad Kx_t = I_{x,t} + (1-\delta_T)Kx_{t-1} - \Gamma(Z_t)$$

Firms maximize the discounted present-value of profits over an infinite horizon. In both industries, sales are valued at domestic prices net of government taxes denoted by τ_X and τ_N. Costs include both the payment of labor at nominal wage W_t and renting capital at a cost of rx_t^K per unit. We abstract from capital and labor taxes. Note that we assume that factor markets clear at every instant and, therefore, capital is not idle and there is no unemployment.

$$(6) \qquad \underset{Kx_{t-1},Lx_t}{\Pi x_t} = (1-\tau_X)Px_tX_t - rx_t^K(Px_tKx_{t-1}) - W_tLx_t$$
$$(7) \qquad \underset{Kn_{t-1},Ln_t}{\Pi n_t} = (1-\tau_N)Pn_tN_t - rn_t^K(Pn_tKn_{t-1}) - W_tLn_t$$

The domestic price of exported goods (as well as that of imported goods) follows the law of one price $P_t^x = s_tP_t^{x*}$ where P_t^{x*} is the international price and s_t is the endogenous, nominal exchange rate. The price of nontraded goods is also endogenous, determined by

[1] Note the difference between our modelling of learning by exporting and that in Clerides et al. (1998). Their critical assumption is that learning by exporting depends only on a firm's previous participation in foreign markets and not, as we assume, on the cumulative volume of its exports. Their specification allows better for fixed costs to exporting whilst ours better reflect dynamic efficiency gains from participating in foreign markets.

the interaction of supply and demand. Consequently, the real exchange rate –the relative price of traded goods to nontraded goods—is endogenously determined.

Production decisions are made by forward looking individuals aimed at maximizing the discounted present value of real profits over an infinite horizon at discount rate $\tilde{Q}_{t+j} = \beta^j \frac{UMgC_{t+j}}{UMgC_t}$. Optimization by exporters indicate that in equilibrium the following important condition holds:

$$(8) \qquad \lambda(1-\tau_X)\left[(1+\vartheta)\frac{Y_{X,t}}{K_{X,t-1}} + (1-\vartheta)\vartheta E_t \tilde{Q}_{t+1}\left(\frac{Y_{X,t+1}}{K_{X,t}}\frac{\frac{K_{X,t}P_{X,t+1}}{P_{t+1}}}{\frac{K_{X,t-1}P_{X,t}}{P_t}}\right)\right] = r_{X,t}^K$$

When there is no learning-by-exporting, $\vartheta = 0$, and equation (8) yields the standard result for a Cobb-Douglas specification whereby firms equate the marginal value of the productivity of capital to its real rental cost: $(1-\tau_X)\left[\lambda\frac{Y_{X,t}}{K_{X,t-1}}\right] = r_{X,t}^K$. However, with learning by exporting, an important external effect occurs: by expanding capital and exports today, the firm learns how to be more productive *tomorrow* (because it increases knowledge of how to export), thereby generating a future extra benefit in expected terms, which is internalized by the firm and discounted at rate $\tilde{Q}_{t+1}$. This extra effect is not considered in CCEM but it will make important differences in the response of the economy to government policies, as discussed below. In this way, our model complements the analysis by CCEM.

Demand Possibilities

The representative household consumes nontraded and imported goods, while it supplies labor to the market. For simplicity, we assume that households supply inelastically one unit of labor to both sectors, so that $1 = Lx_t + Ln_t$. Wages, nevertheless, are endogenously determined by the combined labor demand of the nontraded and exported sectors. Given that labor is non-specific, wages equalize at all times. Unemployment is thus excluded from our analysis. In addition to consuming goods and supplying labor, households hold real money balances which, again for simplicity, we model using a "money-in-the-utility function" specification. CCEM, on the other hand, motivate money holding thorough a transactions technology.

The representative household is infinitely-lived and discounts the future using the discount factor β. Hence:

$$(9) \qquad U_t = \max_{C_t, M_t} E_t \sum_{j=0}^{\infty} \beta^j \left[\frac{C_{t+j}^{1-\theta}}{1-\theta} + \frac{1}{1-\chi}\left(\frac{M_{t+j}}{P_{t+j}}\right)^{1-\chi}\right]$$

Our specification reflects the notion that households value having a stable path of consumption over time and that they will attempt to smooth-out consumption in response

to policy shocks. We thus assume that agents are not liquidity constrained. Such possibility is not allowed in CCEM, again indicating the shorter term horizon of their specification.

Consumption comprises both imported and nontraded goods which we represent using a CES function:

$$(10) \qquad C_t = \left((1-\alpha)^{\frac{1}{\varepsilon}} Cm_t^{\frac{\varepsilon-1}{\varepsilon}} + \alpha^{\frac{1}{\varepsilon}} Cn_t^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

where ε is the elasticity of substitution and α is the share of nontraded goods in total consumption.

The representative household owns all firms in the economy and thus collects profits Π_t^x and Π_t^n as well as real wages. Being also the owner of all physical capital in the economy, it earns returns of the form $r_t^K(P_t K_{t-1})$ and decides investment in the exportable and nontraded sectors. Crucially for the political support of the government, it also receives a lump-sum transfer which we denote by TR_t.

As for assets, in addition to money, the representative household holds domestic bonds B_t earning a nominal return i_t, and external bonds denominated in foreign currency – denoted by F_t— earning a nominal return of i_t^*. The latter includes a risk premium, $\Psi\left(\frac{S_t F_t}{P_t}\right)$, which grows with the existing stock of foreign debt. External assets are expressed in local currency using the spot exchange rate. The household arbitrages the risks and returns of domestic and foreign assets. Note that because of imperfect capital mobility, weak uncovered interest parity holds as $(1+i_t) = E_t \frac{S_{t+1}}{S_t}(1+i_t^*)\Psi\left(\frac{S_t F_t}{P_t}\right)$ where $\Psi\left(\frac{S_t F_t}{P_t}\right)$ is the country risk premium.

The Government

The government is designed in a simple manner so as to analyze the role that different policies have on exports and the growth path of the economy and, thereby, on transfers, welfare and political fragility. It comprises of two authorities –fiscal and monetary—which we assume to operate in full in coordination and in a consistent manner: whenever any of these authorities enact a policy of their choice, they must obey their short and long run budget constraint, as well as the consolidated government constraints.

The government in this model is different from that in CCEM. In their specification, the government is a planner that set policies taking into account the risk of state failure. It encompasses a range of relevant situations, including governments that can be myopic and/or corrupt, as well as those that optimize social welfare. In our specification, we impose that the government must obey its intertemporal budget constraint and is, therefore, always solvent. This would rule out myopic and corrupt governments that base their political support on irresponsible policies. Our assumption is justified on the grounds that households in this model internalize the short-term and long-term financial needs of the government.

Regarding the fiscal authority, and without loss of generality, we assume that the government consumes only nontraded goods and that the level of its current expenditures is exogenous, thus becoming its first policy variable. Note that government spending does not enter the household utility function and, consequently, it is pure waste. This is a standard hypothesis in the real business cycle literature (e.g. Baxter and King 1993) and new Keynesian models (e.g. Smets and Wouters 2007): private and government consumption are separable in preferences or that government consumption is a pure waste of resources.[2]

In our case, two considerations motivate this assumption. First, because our focus is on exchange regimes, our interest is on the issue of the appreciation of the real exchange rate as a result of increased government expenditures and the subsequent penalizing effect of exports. This, as discussed, has occupied a prominent role in policy discussions in fragile economies. Second, as discussed in our political economy mode, one characteristic of fragile economies is that government expenditures is allocated usually towards the government constituency to the neglect of the population: government purchases of nontraded good benefit only the policymakers themselves and, from the perspective of society, this spending is simply waste.

A positive shock to government expenditures in our model, nevertheless, must be financed in the short and long run by foreign aid (A_t), raising taxes, and/or issuing domestic debt. In our simulations we keep tax rates –but not tax collection—fixed and consider foreign aid to be exogenous. Consequently, any fiscal imbalance must be financed by issuing domestic bonds which are purchased by the households. Arbitrage between domestic and foreign assets occurs, thereby making external debt the adjustment variable.

The government decides on the level of public investment, which we denote G_t^I. The stock of public capital (such as roads, ports, telecoms, etc.) evolves according to

$$K_{G,t+1} = G_{X,t}^I + G_{N,t}^I - (1 - \delta_G)K_{G,t} \quad (11)$$

The government must also decide on its third policy variable, namely the level of tax rates to be levied separately on the consumption of nontraded (τ_N) and traded goods (τ_X). Actual tax collection is endogenous and it depends on the levels of consumption and exports.

Regarding the monetary authority, its main policy variable is that of money issuing and the collection of seigniorage. The Central Bank determines the rate of monetary expansion – and in the long run, inflation—but seigniorage is actually endogenous because it will depend on the levels of money demand and economic activity resulting from the decisions of consumers and producers. In addition to seigniorage, the Central Bank transfers to the

[2] Our assumption also allows us to avoid the issue of whether public consumption is complement or substitute of private consumption. The empirical evidence is not conclusive. Aschauer (1985) finds a significant degree of substitutability between the two variables of interest in the case of the U.S. whereas Amano and Wirjanto (1998) find weak complementarity. Karras (1994), examining the relationship between private and public consumption across thirty countries, finds that the two types of goods are best described as complementary (but often unrelated).

government the full return on holding foreign reserves. The total transfers is denoted by Q_t.

As mentioned, at every instant in time the government must obey its nominal budget constraint, which also includes servicing its existing debt (B_{t-1}) and transferring resources (TR_t) to its constituency and the general population. Therefore:

$$(12) \qquad P_{X,t}G_t^I + P_{N,t}\left(G_{N,t}^C\right) + TR_t + B_{t-1}(1+i_{t-1}) = A_tS_t + B_t + \tau_N Y_{N,t}P_{N,t} + \tau_X Y_{X,t}P_{X,t} + Q_t$$

In order to have an intertemporally consistent budget balance we impose the restriction that in the steady state transfers (TR_{ss}) must be in line with the level of debt that is sustainable (B_{ss}). The latter is determined from the no-Ponzi conditions of our dynamic model. Equation (13) indicates that there exists a level of long-run transfer of resources to the public TR_{ss} which is consistent with the steady state level of the government's debt (B_{ss}): whenever the current level of public debt is in excess of its sustainable level, transfers must be adjusted downwards to its sustainable level with a dynamic pattern controlled by the decay parameter, ρ. Parameter γ_b controls how much the government relies on debt for short term financing.

$$(13) \qquad log\, TR_t = (1-\rho)\, log\, TR_{ss} + \rho\, log\, TR_{t-1} + \gamma_b(B_{ss} - B_t)$$

Exchange regimes

Key for our paper is the monetary authorities' choice of the exchange regime. We focus on the two polar cases of a freely floating exchange rate and a fixed parity of the local currency to the US dollar. In both cases, we assume that once chosen, the exchange regime cannot be changed. In other words, we assume that the exchange regime –particularly, the fixed parity rate—is fully credible. We, therefore, abstract from the fact that in real life such credibility may falter. CCEM, on the other hand, assume a floating exchange rate regime that allows for central bank intervention to influence the rate.

In the floating exchange regime, the nominal exchange rate is freely determined by market forces without any intervention from the monetary authorities. The fixed exchange regime is modelled by imposing rigidities to the adjustment of the nominal exchange rate which, in the limit, can mimic the case of a totally fixed exchange regime. In this case, the foreign reserves held by the Central Bank are used to manage the exchange rate. The adjustment friction δ_t determines the evolution of the nominal exchange rate, such that:

$$(14) \qquad S_t = \delta_t S_{t-1}$$

$$(15) \qquad \delta_t = \left(\frac{P_{t-1}}{P_t}\right)^{\sigma_2 - 1}\left(\frac{S_t}{S_{t-1}}\right)^{\sigma_2}$$

When parameter $\sigma_2 = 1$, the nominal exchange rate is flexible (that is, it is determined endogenously every period), while if $\sigma_2 = 0$, the nominal exchange rate adjusts to match exactly the evolution of the domestic price index.

Parameterization

To solve and simulate our DSGE model we need to parameterize its equations. We use a set of about 31 parameters chosen to describe adequately the case of fragile economies. We estimate a number of parameters using data from World Economic Indicators (World Bank, 2019). Some of the parameters are obtained from previous studies, which we identify in Table 2. Other parameters are obtained from the constraints imposed by the model and its solution, usually from the first-order conditions governing the decision–making processes of consumers, producers, and investors. The model also solves from some built-in parameters, such as the shares of factor payments on value added. Finally, some parameters were chosen to secure a parsimonious representation of the responses of the endogenous variables.

Table 2: Parameterization

Parameter		Source
β=0.96	Discount factor	Levin et al. (2005)
$\theta = 1$	Constant relative risk	Authors' estimates
$\psi_B = 0.01$	Parameters of sensibility risk premium	Authors' estimates
$\chi = 8$	Inverse of demand of money elasticity	Adam (2000)
$\delta_T = 0.1$	Depreciation of capital, tradable sector	Levin et al. (2005)
$\delta_N = 0.1$	Depreciation of capital, non-traded sector	Levin et al. (2005)
$\delta_G = 0.1$	Depreciation of capital, public sector	Levin et al. (2005)
$\tau_X = 0.12$	Tax, tradable sector	Authors' estimates
$\tau_N = 0.05$	Tax, non-traded sector	Authors' estimates
$\alpha = 0.6$	Share of consumption, non-traded sector	Castillo et al. (2009)
$\varepsilon = 0.75$	Elasticity of tradable sector/non-traded sector	Castillo et al. (2009)
$\lambda = 0.4$	Share of capital, tradable sector	Authors' estimates
$\varphi = 0.4$	Share of capital, non-traded sector	Authors' estimates
$\eta = 0.15$	Share of public capital, tradable sector	Chatterjee & Mursagulov (2016)
$\phi = 0.15$	Share of public capital, non-traded sector	Chatterjee & Mursagulov (2016)
$\gamma_b = 5$	Sensibility of transfer to government debt	Authors' estimates
$\vartheta = 0.001$	Elasticity of externality, private capital	Authors' estimates
$h = 0.001$	Capital adjustment cost, non-traded sector	Levin et al. (2005)
$i^* = 0.06$	Nominal International interest rate	Authors' estimates
$\mu = 0.05$	Persistency of monetary shock	Authors' estimates
$\rho = 0.5$	Persistency of transfer to consumer	Authors' estimates
$P_X^* = 1$	International price of exported goods (normalized)	Authors' estimates
$P_M^* = 1$	International price of imported goods (normalized)	Authors' estimates
$M_{ss} = 1$	Money holdings in steady-state (normalized)	Authors' estimates
$A_{X,ss} = 1$	TFP in exported sector (normalized)	Authors' estimates
$A_{M,ss} = 1$	TFP in nontraded sector (normalized)	Authors' estimates

Notes: the value of some parameters has been imposed to be coherent with the data in steady-state (SS): TFP ($A_{ss} = 0.05$), transfers ($TR_{ss} = 0.05$), government consumption of nontraded goods ($G_{N,ss}^C = 0.3$), government investment ($G_{ss}^I = 0.1$), and $\sigma_2 = [0,1]$.

In addition to the equations, we need to parameterize the structure of the stochastic shocks of policy variables that are later used in the simulations. Following the common practice in

the literature, for each stochastic variable we posit models of the form: $\ln x_t = \alpha + \rho \ln x_t + \varepsilon_t$, where ε_t is a pure i.i.d. innovation. Table 3 presents the estimated values for the uncertainty in shocks (as measured by their standard deviation of innovations) as well as their persistence (as measured by coefficient ρ).

Table 3: Estimated Stochastic Processes for Shocks, 1990-2018

Shocks	Standard Deviation	AR (1) coefficient
General government expenditure (percent of GDP)	0.766	0.531
Gross fixed capital formation (percent of GDP)	0.801	0.470
Net official foreign aid received (percent of GDP)	1.031	0.285

Source: Authors' estimation using data for the period 1990-2018 obtained from World Bank (2019).

Model Solution and Simulations

As described, the model is highly non-linear and does not lend itself to closed-form solutions. The solution, therefore, is undertaken using simulations of the toolbox DYNARE in Matlab. In total, the model has 45 equations, which we describe in Appendix B.

The dynamic properties of non-linear models are best described using impulse response functions. Nevertheless, before discussing the response of our model to policy shocks, it is useful to describe some of the key characteristics of our model that shape the findings of the paper.

Consider, first, that in our model there is imperfect capital mobility and that, therefore, weak uncovered interest parity holds. Domestic interest rates depend on the country risk premium, itself inversely determined by the stock of foreign assets or debts and the real exchange rate. An increase in net foreign assets naturally lowers the country risk while a depreciation of the real exchange rate makes repayment of foreign obligations more expensive vis-à-vis domestic prices and thus increases the country risk. The key issue is that the stock of foreign assets and the exchange rate—real and nominal—are endogenously determined in our model by the combined decisions of the government and the private sector, so that the long-term steady state and the trajectories toward equilibrium depend on the nature of the shock affecting the economy. Needless to say, different steady states and trajectories to equilibrium will induce dissimilar levels of transfers and real wages, affecting political support for the government.

Second, consider the existence of frictions in the reallocation of capital between sectors in the economy. Because reallocating is costly, the marginal value of capital does not equalize the alternative cost of resources—there will always be a wedge—and, consequently, future relocations of capital will have an effect on today's investment that goes beyond the expected changes in the cost of capital. This restriction, by itself, will make adjustments in production more difficult than in the case where there is no friction, and will induce differential trajectories toward adjustment, distorted output levels and taxes paid vis-à-vis the no-frictions case, and, ultimately, an altered pattern of transfers

Third, recall that learning by exporting changes the dynamics of the exporting firms because current investment and production decisions have significant effects on future production costs and profitability. Because exporters are forward looking, entrepreneurs anticipate that higher exports today will lower production costs for the entire future and increase profitability. The return on capital, therefore, will be more than just today's value of the marginal productivity of capital because it will include the discounted shadow value of tomorrow's cost reductions derived from today's production. All else being equal, this externality will induce, in equilibrium, higher levels of private capital accumulation in traded sectors than the no-externality case and, because of complementarity, higher levels of investment by the public sector.

Note, finally, that in the absence of adjustment costs to capital and learning externalities, our model collapses to the standard intertemporal model of production and consumption of an open economy. It is precisely this feature of our model—that it encompasses the distortion-free economy as a special case—which allows us to identify and isolate the role of frictions and externalities on exports, wages, transfers, and economic growth under different exchange regimes. We therefore start our analysis from the distortion-free case where markets clear and all prices are free to adjust within the boundaries of a floating exchange regime. We focus then on the dynamics of the three types of shocks that we think are the most common and important for fragile economies: aid shocks, government expenditure shocks, and public investment shocks. We compute the model solution and simulate the dynamic effects on key macroeconomic variables, such as the real exchange rate, exports, consumption, and investment, but we focus more closely on three variables closely linked to fragility. First, we consider real transfers from the government to the population which, according to our political economy model, directly affect political support for government. Second, real wages which, being an important determinant of welfare, also determine the political support of the government. Third, we also scrutinize sovereign country risk, which signals to a large extent the financial fragility of an economy.

Aid Shocks

One of the classical phenomena in fragile economies, particularly those coming out of violent civil conflicts, is the sudden inflow of unrequited external aid given to governments. International donors and multilateral organizations pour resources into the fragile economy in an attempt to promote development, foster exports, and combat poverty. Geopolitical considerations are often also present. Aid can involve a transfer of financial resources or commodities (such as food or military equipment) or technical advice and training and it may take the form of grants, concessional credits, or official development assistance.

In our model, foreign aid can be used basically for two purposes. First, to buy back government debt, saving on its service and reducing an eventual debt overhang. A debt overhang reduces the incentives for investment, both foreign and domestic, because of the threat of future taxes. In principle, efficiency gains resulting from a reduction in debt overhang could be quite significant. Bulow and Rogoff (1989) argue, nevertheless, that when market prices correctly reflect the probability of repayment, these schemes typically

result in a waste of valuable resources. The problem is that a buyback raises the market value of the debt left outstanding, and consequently it may not improve the net asset position of the sovereign. We call this case the *Aid-for-Debt Swap*. Second, resources can be used to finance an expansion in government expenditures. Though in principle aid should help support development, evidence indicates that a significant fraction of received aid is squandered in non-productive uses, such as military expenses (Collier and Hoeffler, 2007). Bueno de Mesquita and Smith (2009), on the other hand, found that aid is used for the provision of public goods despite leakages and waste. For a survey on the use and effectiveness of aid in fragile economies see Dreher, Lang, and Ziaja (2017). We call this case the *Aid-for-Government expenditures* case.

We simulate the effects of a once-and-for-all shock (one-period lump-sum transfer) of foreign aid to a fragile economy using our DSGE model and compute the trajectories of the variables of interest as deviations from their steady-state level. We focus first on the aid-for-debt swap and then on the aid-for-expenditures case.

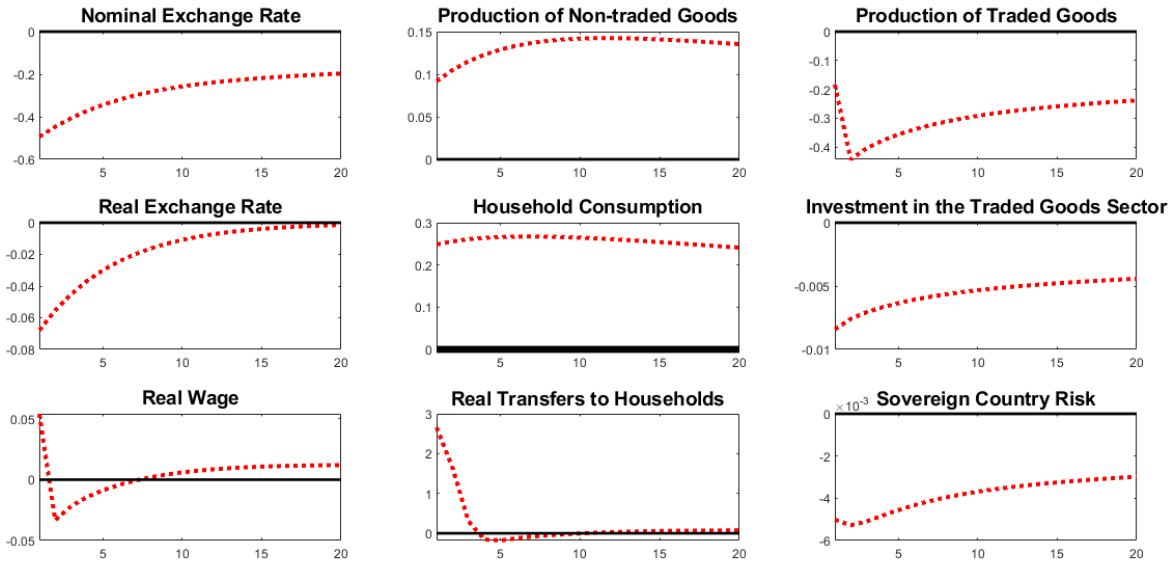
Aid-for-Debt Swap

The aid-for-debt swap corresponds to the case where all aid inflow is used to retire government debt. That is, it corresponds to a pure wealth shock. The results of our simulations are displayed in Figure 2. We start our analysis from the distortion-free case where there are no frictions, no learning by exporting and where all prices—including the nominal exchange rate—are free to adjust. The causal mechanism is as follows. Upon receiving the inflow of foreign aid, the government uses all resources to reduce its debt. The lowering of the internal debt and the readjustment of the portfolio of the private sector lead to a decline in country risk and an expansion in perceived permanent wealth by the households. In turn, this leads to an expansion in the demand for nontraded goods and also in the demand for imports: both effects amount to a consumption boom. To fulfil the demand for nontraded goods, production must expand, which requires relocating capital from the traded to the nontraded sector. Investment in the nontraded industries expands at the cost of lowering capital in the traded sector and exports, thus leading to a trade account deficit.

The most interesting results are those for the variables linked to political fragility. As a result of the expansion in the demand for nontraded goods and the relocation of capital from exports to nontraded industries, the demand for labor expands and initially real wages increase. Wages decline in the medium term because as a result of the frictionless relocation of capital from the traded to the non-traded sector, workers are employed in the transitorily less productive sector. The population perceives this as an increase in welfare which, coupled with the consumption boom, raises political support for the government, at least in the short term. More importantly, the aid shock improves the budget of the government and allows for a significant expansion in transfers to the population, thereby raising additional political support. However, the expansion in transfers is short-lived, because the aid shock is a once-and-for-all event, and it reverts to equilibrium in the long term because government finances worsen as a result of the reduced tax collection that follows the relocation of activities from the traded to the nontraded sectors. Political

support for the government is limited in time. Finally, because the aid shock was used to buy back government bonds (inducing by arbitrage a lowering of the external debt), there is a significant and permanent decline in country risk that reduces the external fragility of the economy.

Figure 2: Aid-for-debt Swap Shock
Floating Exchange Regime, No Frictions, and No Learning by Exporting



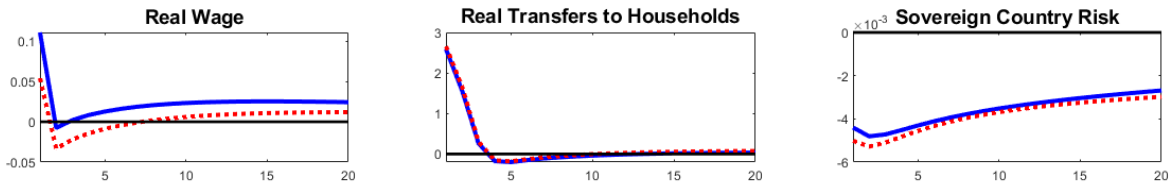
We now turn to the analysis of the aid shock in a context of frictions to capital adjustment and learning externalities but still in the floating exchange regime. We confine our discussion only to the evolution of the fragility-related variables, but full results are available upon request. As shown in Panel A of Figure 3, when introducing frictions to capital adjustment and learning-by-exporting externalities, the general message remains qualitatively intact but the magnitude and phase of the responses to the aid shock is somewhat changed. First, note that the general dynamics of our three variables of interest are relatively similar. This is not unexpected since the shock corresponds basically to a wealth shock that does not induce a significant adjustment in the margin to the decisions made by households and the government. Nevertheless, the frictions in the capital market make the relocation of resources towards the nontraded industries costlier than in the absence of such frictions. In addition, extracting workers from the traded sector to relocate to nontraded goods industries is now costlier because there is a sacrifice in future cost reductions that are foregone as a result lower learning in exporting activities. Since the pull of demand in the nontraded sector cannot be serviced as quickly as in the baseline case, real wages rise initially more –and decline subsequently much slower—in the frictions case. While this would imply additional political support for the government and lower fragility levels, the government fiscal position worsens more under frictions because tax collection suffers more from the decline in exports during the consumption boom than in the no-frictions case. Transfers are, thus, smaller. Finally, the presence of learning externalities in exporting indicate that the economy is more capable of servicing its foreign

debt in the long run thus allowing for a more appreciated real exchange than in the non-frictions scenario. The aid-for-debt swap shock, then, benefits more than proportionally the economy in the short and medium run.

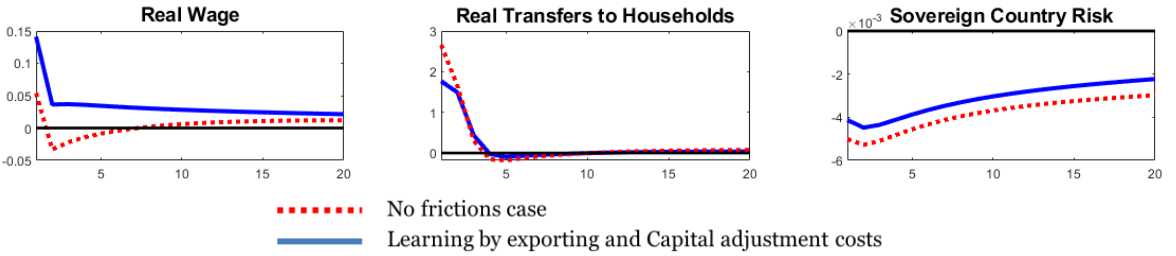
Panel B of Figure 3 also shows the results of the model simulations in the fixed exchange regime scenario. As shown, the trajectories of the variables in response to the wealth shock are qualitatively similar to the case of the floating exchange regime, except that in the steady state under the fixed exchange regime real wages are higher and decline slowly, transfers are lower and the decline in country risk is less significant. The underlying reason for the less dynamic response of the economy in this case is that the drop in the relative price of exported to nontraded goods is much smaller since the exchange rate is fixed and, therefore, the relocation of resources between the traded and nontraded sectors is also dampened.

Figure 3: Aid-for-Debt Swap Shock

Panel A: Floating Exchange Regime



Panel B: Fixed Exchange Regime



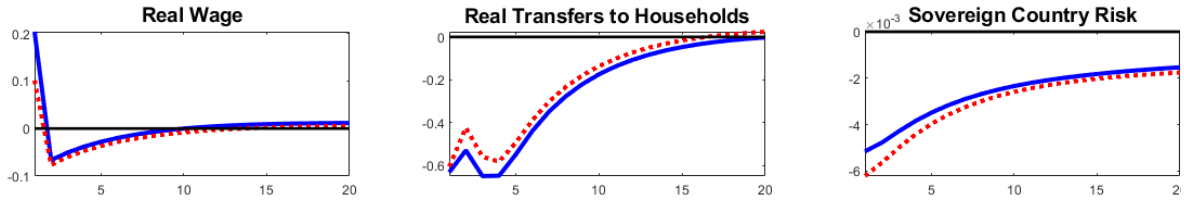
Aid-for-Government Expenditure

The aid-for-expenditures shock corresponds to the case where 50 percent of the aid inflow is used to retire government debt and the other 50 percent is used to finance government expenditures. The 50-50 shares were chosen for expositional purposes only. The results of our simulations are displayed in Figure 4 and, again, we focus only on the three fragility variables which are compared to the no-frictions case. Consider first the case of the floating exchange regime, as depicted in Panel A. Now, the wealth effect is much weaker, as shown in the less dramatic decline in the sovereign country risk. Because the government

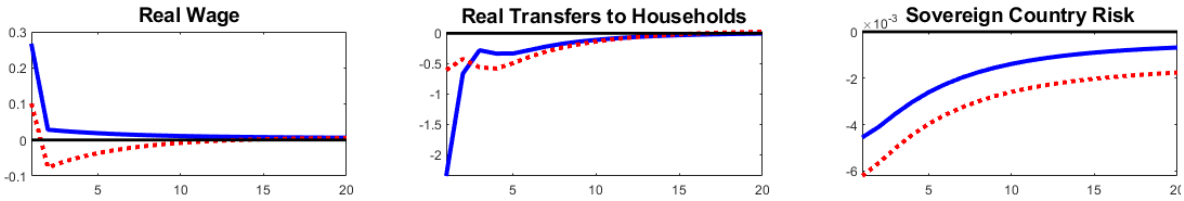
purchases only nontraded goods, there is a demand shock that translates into a concurrent higher demand for labor—with a significantly higher increase in real wages vis-à-vis the no-friction case—and a higher investment flow from the traded sector to the nontraded sector. Inevitably, the trade balance worsens. Foreign aid, in this case, does not allow the fiscal authority to pass on some of the resources to the population in transfers; as shown, contrary to the aid-for-debt case, the government uses external and internal resources to finance the purchases of nontraded goods. Note that the latter do not increase the welfare of society, so this policy is definitely worse than the previous case. Below we compute a quantitative measure of the welfare changes of these different policies using the expected households utility over the simulation horizon.

Figure 4: Aid-for-Government Expenditures Shock

Panel A: Floating Exchange Regime



Panel B: Fixed Exchange Regime



No frictions case
Learning by exporting and Capital adjustment costs

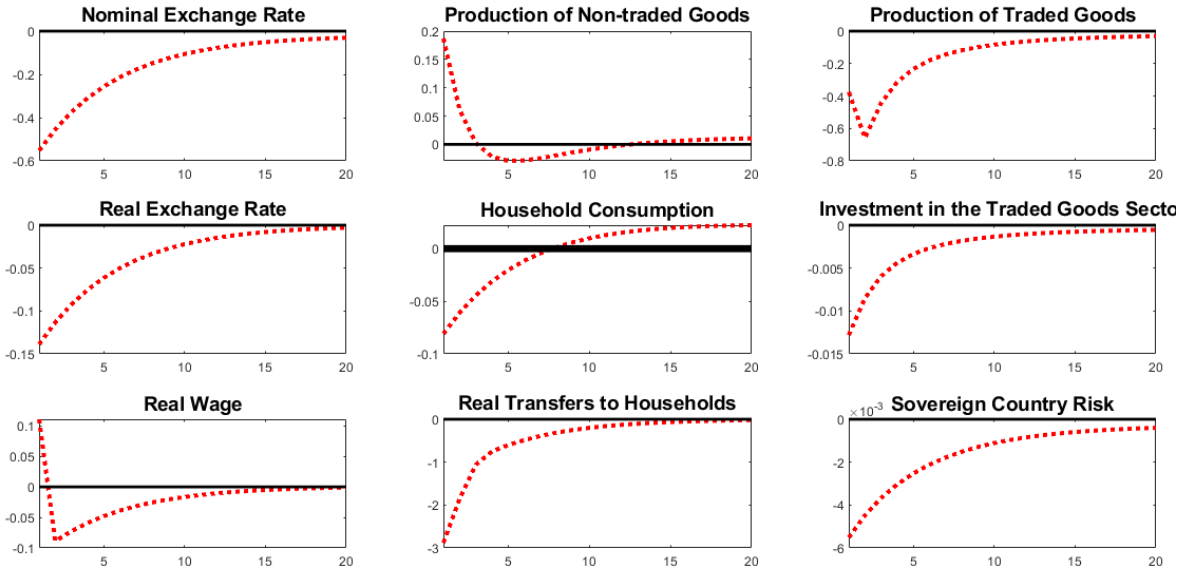
Panel B of Figure 4 shows the results of our simulations for the alternative fixed exchange regime. It can be seen that the impact on real wages is significantly stronger in this case not only because the government induces a demand shock for nontraded goods and thereby of labor, but also because the price level adjusts only very slowly upwards. The latter effect occurs because the price of traded goods in domestic currency increases very slowly as the nominal exchange rate adjusts sluggishly toward equilibrium. As expected, the sovereign country risk improves less than when all of the aid support is used to retire government debt. The more interesting results are in the transfers to the population. In the absence of frictions, transfers are slightly negative, because the wealth is weaker. In the frictions case, transfers are initially very negative (becoming a substantial tax on consumers) because the increased government demand for nontraded goods raises its

price and crowds out private demand, thus lowering tax collection. In order to finance the deficit, the government issues bonds thus raising the sovereign country risk and the domestic interest rate which incentivize households to postpone consumption, thus further reducing tax revenue. Transfers become the adjustment variable. Since aid is a once-and-for-all shocks, the crowd-out effect government demand is transitory and, as the fiscal stance improves, transfers return to equilibrium.

Government Expenditures Shock

In this exercise we give a once-and-for-all shock to the current expenditures of the government, that is, a demand shock to the nontraded sector because, as mentioned, the government does not consume imports. The main difference between this case and the previous exercise is that here the additional government expenses must be financed out of internal resources and not by recourse to foreign aid. Financing by the government can be achieved by raising taxes, lowering capital expenses, issuing debt and/or reducing transfers to the population. To keep comparability with previous cases we keep tax rates and capital expenses fixed. The results of our simulation for the case of an economy with no frictions and conducting monetary policy in a floating exchange regime are shown in Figure 5.

Figure 5: Shock to Government Expenditures
Floating Exchange Regime, No Frictions, and No Learning by Exporting



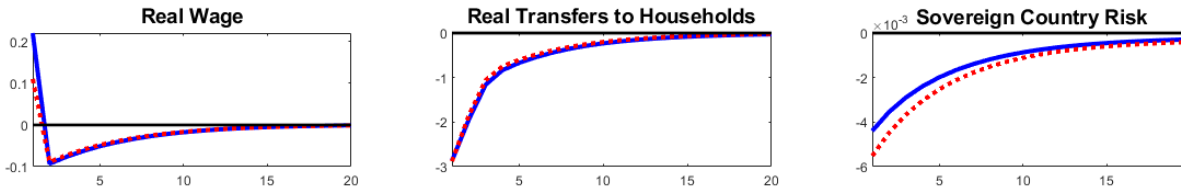
The shock to government expenditures bears some resemblances to the previous case but differs in a significant dimension. Note, first, that the shock has an appreciating effect on both the nominal and real exchange rate. This is expected, but the response is much smaller (about one-third) and it is noticeably short-lived. The reason is that the government has to obey its intertemporal budget constraint and must finance the expansion of expenses somehow. As expected, production of nontraded goods increases,

albeit only transitorily, and exports decline as a result of the relocation of capital and workers. Second, the differences with the previous case are nonetheless manifest: because the government is competing with the private sector for resources, consumption declines as a result of negative transfers needed to finance the budget in the absence of foreign resources. Fragility is most likely to increase, and in a significant manner. Note also that the sovereign country risk increases and then returns to its previous level. The reason is that by financing the expansion of expenditures while curtailing transfers, the government will not change its internal debt nor the country's external debt.

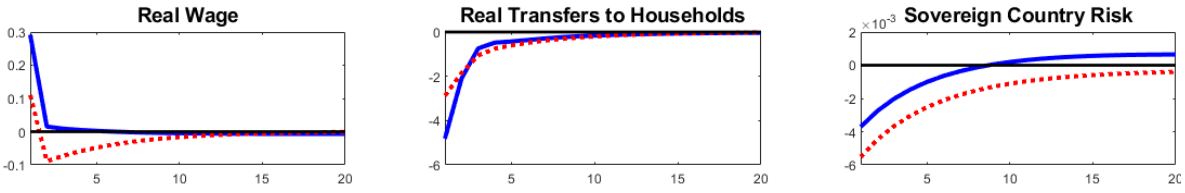
The results do not change significantly when allowing for adjustment costs to capital relocation as well as learning-by-exporting. As shown in Panel A of Figure 6, the trajectories of the real wage and government transfers show clearly that the drop is slightly less acute –because of frictions—and that the adjustment to equilibrium is now slower. Interestingly, the negative effects on the sovereign country risk are smaller in this case, because frictions retard the relocation of capital from the traded to the nontraded sector and the government is not required to issue as much debt as in the no-frictions case. As expected, since this government policy is transitory, all real variables return to equilibrium in the long term.

Figure 6: Positive Shock to Government Expenditures

Panel A: Floating Exchange Regime



Panel B: Fixed Exchange Regime



No frictions case
Learning by exporting and Capital adjustment costs

The case of the fixed exchange regime is displayed in Panel B of Figure 6. As it can be seen, there are important differences vis-à-vis an economy conducting monetary policy under a floating exchange regime. Consider first the no-frictions case. Because the government is financing domestically its higher demand for nontraded goods, there is no pressure on the

exchange market and consequently no unsustainable appreciation of the real exchange rate. Wages, as before, drop initially before slowly returning to equilibrium. Because the government must finance its expenditures domestically, transfers to the households ostensibly drop and issues debt that, ultimately, is to be paid by the consumers. Households internalize this fact, anticipate the future payment of such government debt and make arbitraging decisions accordingly.

In the presence of frictions, the effects on the wages and transfers remain very similar but the sovereign country risk increases in the long run, because the relocation of capital toward nontraded sector destroys export knowledge and the ability to repay the external debt of the economy.

What drives the results in our model, and it might be in dissonance with the observed negative experiences of fragile countries attempting to jump-start their economies with an expenditure shock, is that in our case the government is restricted to obey its intertemporal budget constraint, thereby making its policies to be sustainable. The often-encountered situation of a government that engages in an expansionary fiscal policy to gain popularity and political support at the (usually hidden) cost of expanding the public debt beyond sustainability is not taken into account in our model. Using a similar DSGE model, Evans, Kotlikoff, and Phillips (2013) study the point where an unsustainable fiscal policy can no longer be maintained and collapses (dubbed the *game over point*). Their very long-term, closed-economy model, calibrated to replicate the US economy, is ill-designed to study the cases of fragile economies.

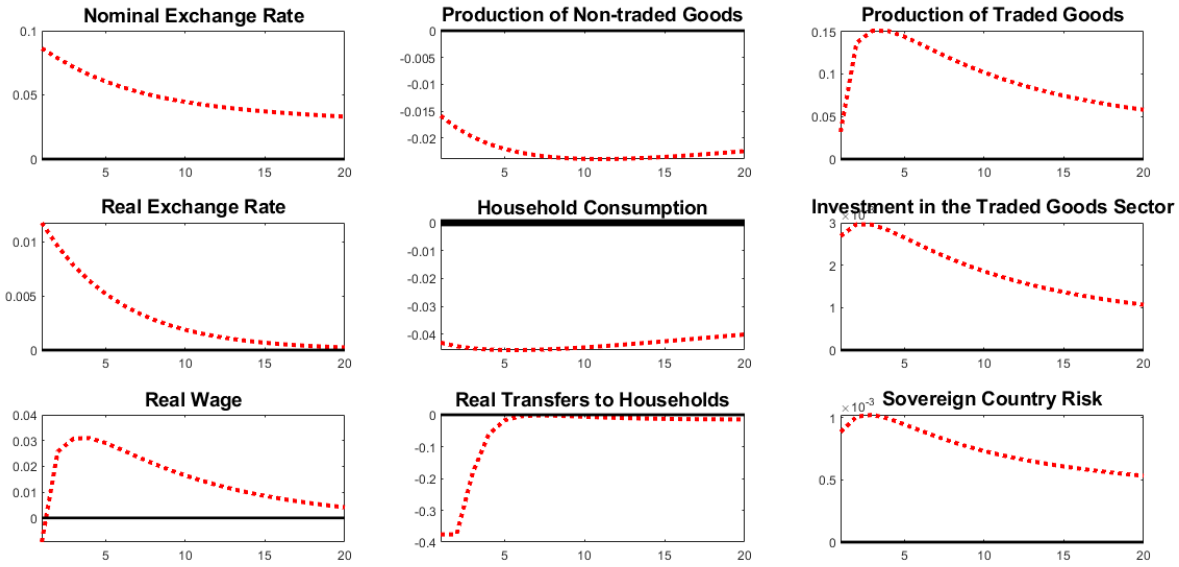
Public Investment Shocks

Our final exercise consists of studying the effects of a positive impulse to public investment financed with domestic sources. As discussed above, public investment freely provides public goods to producers that reduce costs and enhance productivity and production of traded and nontraded goods. Note, however, that the effects of this shock to public investment depreciate over time. The results of the simulations are presented in Figure 7. We assume that there is no time-to-build in public goods, so that the impulse immediately augments the production of traded goods. Because the share of public goods in the traded sector is larger than that in the nontraded sector, exports expand and the nontraded sector shrinks. Capital flows from the latter to the exporting sector, which also benefits from the relocation of workers, transitorily at lower real wages. Note that, because there is learning-by-exporting, the expansions in exports and investment in the traded sector are long-lasting and quite significant. This reflects a type of "virtuous circle" between public investment and exports: a higher stock of public capital lowers costs in the traded sector and expands exports which, in turn, further lower production costs because of learning. Higher exports provide for increased tax revenue which allows for financing subsequent expansions in public investment.

Note also that the decline in the demand for nontraded goods and consumption, brought on by the negative transfers needed to finance the expansion in public investment, induces significant nominal and real depreciation. The nominal depreciation increases the

sovereign country risk because the stock of debt is denominated in foreign currency and, thus, becomes more difficult to service; nonetheless, valuation returns to equilibrium as the expansion in exports causes the nominal value of the currency to appreciate. In other words, there is a transitory and relatively mild increase in external fragility as a result of the revaluation of the debt that eases in time until it returns to equilibrium. Note that though real wages and consumption take a relatively long term to return to equilibrium (indicating a deterioration in the confidence on the government), real transfers to the population are *greater in the medium term* as a result of the higher taxes collected from the traded sector. Here the traded sector provides for sustained growth derived from the higher export levels achieved by the lower production cost induced by public infrastructure.

Figure 7: Positive Shock to Public Investment

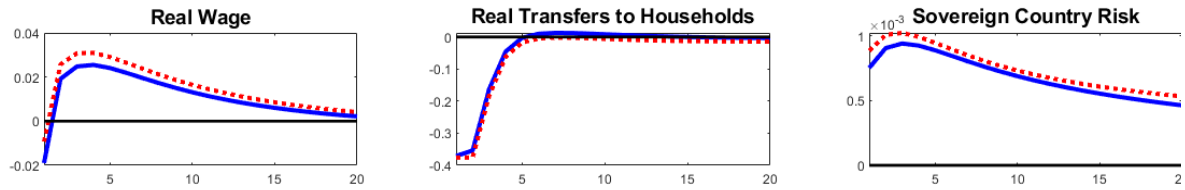


The latter effect is softened, as expected, when we allow for frictions. As shown in panel A of Figure 8, the combined effect of adjustment costs to capital relocation and learning externalities induces a less pronounced hike in real wages as a response to the public investment shock. It also allows for a less significant initial drop in transfers but sustain higher transfers in the medium term, thus reducing long-term fragility even if in the short run there is a transitory adverse effect.

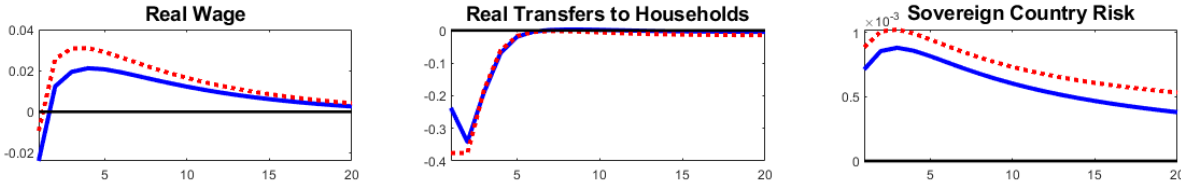
Panel B suggests that the choice of exchange regime is relatively innocuous, a feature that derives from the sustainability of the fixed exchange regime in our model: the country never gets into the position of having to devalue the currency to achieve balance in its foreign accounts.

Figure 8: Positive Shock to Public Investment

Panel A: Floating Exchange Regime, Frictions and Learning by Exporting



Panel B:Fixed Exchange Regime, Frictions and Learning by Exporting



No frictions case

Learning by exporting and Capital adjustment costs

Welfare Implications

The ultimate purpose of our analysis would be to indicate which exchange regime is preferred for the three types of government policies discussed above. Such measure ought to rely on changes in welfare. Since our DSGE model is micro-founded, maximizing a measure of welfare of the representative household may be an appropriate instrumental objective to guide the choice of policies. Welfare is, thus, measured using the utility function of the households, as described in equation (9).

Computing welfare levels under optimal and non-optimal policy shocks is not straightforward given the highly non-linear nature of the DSGE model. As discussed in Benigno and Woodford (2012), it is relatively easy to approximate the welfare implications of policies of a simple, linear quadratic model if one specifies an ad hoc quadratic loss function on the basis of informal consideration of the kinds of instability in the economy that one would like to reduce, and posits linear structural relations that capture certain features of economic time series without requiring these relations to have explicit choice theoretic foundations. But it is highly unlikely that the analysis of optimal policy in a DSGE model will involve either an exactly quadratic utility function or exactly linear constraints. This is not the case of our model. However, linear quadratic problems can usefully be employed as approximations to exact optimal policy problems in a fairly broad range of cases, when the solution to the problem represents a *local linear approximation* to the actual optimal policy and as long as the policy shocks are small enough.

We rely on a second-order approximation of the equilibrium conditions around the non-stochastic steady-state in order to obtain reliable welfare level measures. Households'

welfare in the economy is measured, to a second-order approximation, as the discounted expected sum of each period's utility value. Consider the value function of the utility of the household:

$$(16) \qquad V_t = max\left\{\frac{C_t^{1-\theta}}{1-\theta} + \frac{m_t^{1-\chi}}{1-\chi} + \beta E(V_{t+1})\right\}$$

Let the value function in steady-state: $V_{ss} = \frac{1}{1-\beta}\left[\frac{C_{ss}^{1-\theta}}{1-\theta} + \frac{m_{ss}^{1-\chi}}{1-\chi}\right]$

We, thus, define an index of welfare as the deviation of the Expected Value of $E(V_t)$ with respect to its steady-state value, V_{ss}. When the deviation $E(V_t) - V_{ss}$ is highest, we say that this framework generates the least loss of welfare. Note that the second-order approximation is necessary because, in the first-order approximation, the expected value is equal to the value function in the steady-state. The discount factor β inn Table 2 is used when computing the discounted sum of each period's expected utility value.

The results are presented in Table 4. Consider, first, the welfare effects of the external aid shocks. As discussed, this shock amounts to a pure wealth shock, used by the government to reduce the public debt. The highest welfare gain of such debt reduction obtains in the absence of frictions to capital relocation in the economy and endogenous learning externalities in exporting. In such case, a credible fixed exchange rate regime provides a higher welfare gain vis-à-vis the floating exchange regime. Welfare gains in the case of frictions and externalities are noticeable lower, as expected, and suggest again that the best regime would be the credible fixed exchange regime. It is important to bear in mind that, contrary to many real life situations in fragile economies, in our DSGE model the fixed exchange regime is credible because the government is forced to fully internalize all of its policies in an infinite horizon set up.

Table 4: Estimates of Welfare Levels and Changes

One Standard Deviation Shock to:		Floating Exchange Regime		Fixed Exchange Regime	
		No Frictions No Learning by Exporting	Frictions and Learning by Exporting	No Frictions No Learning by Exporting	Frictions and Learning by Exporting
External Aid	$E(V_t)$	-10.2	-29.2	-5.2	-20.8
	V_{ss}	-23.9	-25.6	-23.9	-25.6
	$E(V_t) - V_{ss}$	13.7	-3.6	**18.7**	4.8
Government Expenditure	$E(V_t)$	-20.5	-29.9	-24.7	-29.9
	V_{ss}	-23.9	-25.6	-23.9	-25.6
	$E(V_t) - V_{ss}$	**3.4**	-4.3	-0.8	-4.4
Public Investment	$E(V_t)$	-24.9	-26.6	-24.7	-26.3
	V_{ss}	-23.9	-25.6	-23.9	-25.6
	$E(V_t) - V_{ss}$	-0.9	-1.1	**-0.8**	**-0.8**

Source: authors' own estimates.
Note: welfare levels are expressed in net present value terms.

Consider now the case of a shock to government spending in nontraded goods financed domestically by a combination of public debt issuing and lowering transfers to the population. In a number of cases this policy has been linked to the Dutch disease phenomenon, particularly when the economy operates in a fixed exchange regime. It can be seen that the preferred policy in this case is the floating exchange regime, precisely because the flexible exchange regime allows the households quick and efficient adjustment of expenditures in the face of a drop in wealth. Recall that government expenditures in our model are a complete waste and, therefore, consumers anticipate the future increase in taxes needed to repay public debt and/or face immediately the drop in government transfers that is concomitant with higher government spending. Next, notice that under frictions and externalities, both regimes imply an equally negative utility in net present terms. This, naturally, arises from the adjustment costs that an economy has to pay for a policy that is essentially wasteful and transitory.

Finally, consider the policy of expanding public investment financed by issuing domestic debt. It can be seen that there are virtually no differences between exchange regimes in the no frictions case and when there is learning by exporting and capital adjustment costs. The underlying reason for this result is that in both exchange regimes the government and the private sector fully internalize the positive –yet transitory—effects of public investment in exports as well as the cost of financing such investment.

V. Conclusions

State fragility has emerged as a rallying point in recent development policy debates. This in part reflects the widely held view that the state has a central role in the development process, which has been further reinforced following the 2008 global economic recession. The definition of fragility and the symbiotic cause-and-effect relationship between state fragility and underdevelopment has been the focus of these debates.

In this paper we revisit the role of exchange regimes in fostering exports and economic growth in fragile economies and, thereby, in reducing political fragility. A comparison between fragile and emerging countries reveals that slower growth in fragile countries is linked to lower levels of private and public gross fixed capital formation, inability to compete successfully in exporting markets, and reliance on much higher levels of external aid. Likewise, fragile economies show significant political differences vis-à-vis other emerging economies. Political regimes in fragile economies are not only less democratic than in other emerging economies but also significantly less accountable. The executive in fragile economies is significantly less constrained in his/her abilities to engage in arbitrary practices. Nevertheless, authoritarian governments in fragile economies do not rely exclusively on repression but also on enticing the different groups to support the government. This is an implicit arrangement between ruling elites and citizens whereby citizens relinquish political influence in exchange for public spending. Political fragility thus depend on the amount of transfers and non-pecuniary goods given by the ruling coalition to its own constituency and to opposition groups.

Our analysis is based on a DSGE model, tailored to replicate some of the structural features of fragile economies, in particular the presence of frictions in market adjustment, the influence of external shocks (for example, foreign aid), and the roles of the government in providing public goods (public investment) and delivering social transfers to the population. The former are instrumental in supporting sustained growth while the latter may determine the support of the government and, thereby, its political fragility. Fragile economies are usually plagued by distortions, frictions and externalities rendering the standard first-best prescriptions inapplicable. In addition to economic distortions, political issues and institutional weaknesses are key elements to consider in the evaluation of exchange regimes.

A key issue for fragile economies, therefore, would be to determine which exchange regime is more conducive to a virtuous circle of higher levels of investment and exports, given the structural and political restrictions that characterize fragility. The DSGE model allows us to track the response of variables associated with fragility to shocks that are likely to be important in fragile economies. We treat fiscal variables –government spending and fixed capital formation—as exogenous and study the response of the economy to shocks in such policies. Our simulations illustrate the types of general-equilibrium interactions that may complicate the analysis of the effects of shocks that typically affect fragile economies on endogenous variables that may influence fragility.

Our analyses complement those by CCEM. In their model the link between fiscal policy and political fragility is explicitly modelled via public employment, while in ours the link operates implicitly via transfers to households. CCEM model adopt a shorter time perspective since they do not give a role to capital accumulation, intersectoral capital reallocation or the potential role of increased export competitiveness derived from learning by exporting.

Before briefly summarizing the model simulation results, we note that, in the absence of adjustment costs to capital and learning externalities, our model collapses to the standard intertemporal model of production and consumption of an open economy. It is precisely this feature of our model—that it encompasses the distortion-free economy as a special case—which allows us to identify and isolate the role of frictions and externalities on exports, wages, transfers, and economic growth under different exchange regimes. We have, therefore, started our analysis from the distortion-free case where markets clear and all prices are free to adjust within the boundaries of a floating exchange regime. We focused then on the dynamics of the three types of shocks that we think are the most common and important for fragile economies: aid shocks, government expenditure shocks, and public investment shocks.

Aid shocks. Fragility decreases with foreign aid when the government decides to improve its asset stance by retiring public debt, because this reduces the sovereign country risk, real interest rates, and servicing the public debt. In turn, this liberates resources to transfer to the population, thus raising political support for the government. The latter effect is reinforced by the consumption boom—and the concurrent raise in wages—brought about by the higher permanent income of consumers. These effects, obtained in the context of a floating exchange rate, remain qualitatively comparable in the fixed exchange regime.

However, when the government chooses to spend part of the foreign aid in the domestic markets the effects can change dramatically, depending on the exchange regime. In a floating exchange regime, the fraction of the aid from the donors used to reduce the public debt will improve the sovereign country risk but significantly less than in the other case (country risk is a non-linear function of the stock of debt). Internal fragility will improve in response to higher wages, which in this case do not increase as much as before because the improvement in permanent income is only partial. Furthermore, transfers to the population will be much reduced as a result of the government's decision to spend a fraction of tax revenues for purchasing nontraded goods.

Government expenditure. A pure shock to government expenditures where responsible authorities engage in sustainable fiscal policies, has very little effect on the medium- to long-term working of the economy or the welfare of the households. This is the result of having to finance such shock with domestic resources coming in the form of a reduction in transfers to the population or by issuing debt that, ultimately, had to be paid by the households in the form of taxes. Consequently, this type of policy cannot be used to gain political support for the government and lower fragility in the medium to long term. In the short term, some transitory gains can be achieved when rigidities and frictions delay the response of the private sector. However, such gains are neither significant nor persistent. Strikingly, there are no differences in the response of the economy to shocks between having a floating exchange regime or a hard peg to another currency. The sustainability of fiscal policy and the fact that households are forward-looking guarantee that the fixed exchange regime is sustainable and, therefore, choosing to have a fixed exchange regime becomes irrelevant.

As a corollary, one should conclude that only in the short-term can governments engage in significant expansions of government expenditures to placate political discontent in a manner that is inconsistent with their long-term budget constraint. In the long term, such populist policy is to be undone by the need to finance the budget and by the realization on the part of households, creditors, and financial markets that the policy stance is unsustainable. Hence, short-term policies might increase popularity and fragility at the same time.

Public investment. An increase in public investment in the form of making public goods available to firms induces a far more favorable fiscal stance in the long term, allowing for expanded transfers to households even if in the short term there is a mild deterioration required to finance such capital expenditures. Note that, because there is learning-by-exporting, the expansions in exports and investment in the traded sector are long-lasting and quite significant. This reflects a type of "virtuous circle" between public investment and exports: a higher stock of public capital lowers costs in the traded sector and expands exports which, in turn, further lower production costs because of learning. Higher exports provide for increased tax revenue which allows for financing subsequent expansions in public investment. Long-term fragility is thus reduced, regardless of the choice of exchange regimes. In the short term, the government will have to shore up the decline in political support that results from the responsible financing of higher public investment.

The ultimate purpose of our analysis would be to indicate which exchange regime is preferred in terms of welfare for the three types of government policies discussed above. Since our DSGE model is micro-founded, maximizing a measure of welfare of the representative household may be an appropriate instrumental objective to guide the choice of policies. We rely on a second-order approximation of the equilibrium conditions around the non-stochastic steady-state in order to obtain reliable welfare level measures. We define an index of welfare as the deviation of the expected value of utility after a shock with respect to its steady-state value.

Consider, first, the welfare effects of an external aid shock used to retire public debt. As expected, the highest welfare gain obtains in the absence of frictions to capital relocation in the economy and endogenous learning externalities in exporting. In such case, a credible fixed exchange rate regime provides a higher welfare gain vis-à-vis the floating exchange regime. It is important to bear in mind that, contrary to many real life situations in fragile economies, in our DSGE model the fixed exchange regime is credible because the government is forced to fully internalize all of its policies in an infinite horizon set up.

Consider, next, the case of a shock to government spending financed domestically. In a number of cases this policy has been linked to the Dutch disease phenomenon, particularly when the economy operates in a fixed exchange regime. We find that the preferred policy is the floating exchange regime, precisely because the flexible exchange regime allows the households for quick and efficient adjustment of expenditures in the face of a drop in wealth. Recall that government expenditures in our model are a complete waste and, therefore, consumers anticipate the future increase in taxes needed to repay public debt and/or face immediately the drop in government transfers that is concomitant with higher government spending.

Finally, consider the policy of expanding public investment financed by issuing domestic debt. We found that there are virtually no differences between exchange regimes, even when there is learning by exporting and capital adjustment costs. The underlying reason for this result is that in both exchange regimes the government and the private sector fully internalize the positive –yet transitory—effects of public investment in exports as well as the cost of financing such investment.

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Appendix A: List of Fragile States

Afghanistan	Haiti	Pakistan
Angola	Honduras	Papua New Guinea
Bangladesh	Lao P.D.R.	Republic of Congo
Benin	Lesotho	Sao Tome and Principe
Burundi	Liberia	Sierra Leone
Cambodia	Madagascar	Solomon Islands
Central African Republic	Malawi	South Sudan
Chad	Maldives	Sudan
Comoros	Mali	Tajikistan
Cote d'Ivoire	Mauritania	The Gambia
Democratic Republic of Congo	Micronesia	Timor-Leste
Djibouti	Mongolia	Togo
Eritrea	Mozambique	Uzbekistan
Ethiopia	Myanmar	Vanuatu
Guinea	Nepal	Yemen
Guyana	Niger	Zambia
Kiribati	Nigeria	Zimbabwe

Appendix B. The Model

The model comprises the following components.

(1) The households, which are the ultimate owners of all firms in the economy, receiving both profits from firms as well as the returns on renting capital to produce goods and services. Households supply labor to the market and collect wages, and are also the holders of government bonds as well as foreign assets. Finally, households consume nontraded goods and imports and maintain money as a way to reduce transaction costs, which we model following the "money in the utility function" tradition.

(2) There are three goods in the economy: without loss of generality, we assume that exported goods are not consumed domestically and imported goods are not produced in the country. Production of exportable and nontraded goods uses private capital, public capital, and employment with different intensities, according to standard production functions. Production of exports is subject to a positive externality in the form of learning by exporting. Relocation of capital between export and nontraded sectors is possible, but it entails paying a quadratic adjustment cost.

(3) The government comprises both fiscal and monetary authorities. The fiscal authority is in charge of collecting taxes from the sales of exports and nontraded goods, spending in government consumption and public investment, and issuing and repaying government debt. The government, however, is not entitled to issue external debt. The fiscal authority is also the recipient of foreign aid. The monetary authority (Central Bank) issues money and collects seigniorage, which is passed on directly to the financing of the government, and maintains foreign reserves for which it earns the international risk-free rate of return.

(4) The model has two closures. One allows the nominal exchange rate to freely float in response to the supply and demand of foreign liquidity. In this case, foreign reserves of the Central Bank are kept constant. The other closure imposes rigidities to the adjustment of the nominal exchange rate which, in the limit, can mimic a fixed exchange rate regime. In the latter case, reserves are used to manage the exchange rate.

Households

The economy is populated by infinitely living households. The stand-in household maximizes the expected discounted value of the intertemporal utility function:

$$\text{(A1)} \quad \Omega_t = \max_{C_t, B_t, F_t, M_t, K_{X,t}, K_{N,t}} E_t \sum_{j=0}^{\infty} \beta^j \left[\frac{C_{t+j}^{1-\theta}}{1-\theta} + \frac{m_{t+j}^{1-\chi}}{1-\chi} \right]$$

where E_t is the expectations operator, β^j corresponding to the subjective discount factor, C_t is private consumption and m_t represents real monetary balances $\left(m_t = \frac{M_t}{P_t}\right)$. Parameters θ and χ are given (later to be parameterized according to evidence for fragile economies).

Optimization is subject to the following set of restrictions.

(A2) $C_{N,t}P_{N,t} + C_{M,t}P_{M,t} + P_{X,t}I_{X,t} + B_t + S_tF_t + M_t =$

$$W_t\left(L_{X,t} + L_{N,t}\right) + M_{t-1} + S_tF_{t-1}(1 + i^*_{t-1})\Psi\left(\frac{S_{t-1}F_{t-1}}{P_{t-1}}\right) + B_{t-1}(1 + i_{t-1}) + r^K_{X,t}\left(P_{X,t}K_{X,t-1}\right) + r^K_{N,t}\left(P_{N,t}K_{N,t-1}\right) + \Pi_{X,t} + \Pi_{N,t} + TR_t$$

(A3) $L_{X,t} + L_{N,t} = 1$

(A4) $K_{X,t} = I_{X,t} + (1 - \delta_T)K_{X,t-1} - \Gamma(Z_t)$

(A5) $K_{N,t} = Z_t + (1 - \delta_T)K_{N,t-1}$

(A6) $\Gamma(Z_t) = Z_t + \frac{h}{2}Z_t^2$

Equation A2 is the nominal budget constraint of the stand-in household, where $C_{M,t}$ and $C_{N,t}$ represent the consumption of imported and nontradable goods, and $I_{X,t}$ denote private investment in the export sector. The domestic prices of the nontraded, imported and exported goods are $P_{N,t}$, $P_{M,t}$, and $P_{X,t}$, respectively. Employment in the nontradable sector and exporter are denoted by $L_{N,t}$ y $L_{X,t}$ respectively, while W_t is the nominal wage. We assume perfect mobility of workers between sectors and normalize the supply of labor to 1 (as shown in equation A3).

The household owns physical and financial assets. Physical assets are in the form of capital accumulated in the export and nontraded sector, $K_{X,t-1}$and $K_{N,t-1}$, equations A4 and A5 respectively, with corresponding real returns $r^K_{X,t}$ and $r^K_{N,t}$. The term Z_t represents the investment transferred from the export to the nontraded sector; this transfer has a nonlinear cost $\Gamma(Z_t)$ as shown in equation A6. Financial assets comprise of local bonds B_t with nominal yield i_t and external bonds F_t denominated in foreign currency with yield i^*_t. The nominal exchange rate is denoted by s_t and Ψ identifies the country-risk premium, which increases with the real stock of foreign debt. The stand-in household also owns the firms and, therefore, collects nominal profits $\Pi_{X,t}$, and $\Pi_{N,t}$. Finally, TR_t are the nominal transfers from the government to the families.

Let total consumption be $P_tC_t = C_{N,t}P_{N,t} + C_{M,t}P_{M,t}$, where P_t is the consumer price index (to be derived below). Define the relative prices $p_{X,t} = \frac{P_{X,t}}{P_t}$ and $p_{N,t} = \frac{P_{N,t}}{P_t}$. Denote real profits by $\frac{\Pi_{X,t}}{P_t} = \Pi^R_{X,t}$ and $\frac{\Pi_{N,t}}{P_t} = \Pi^R_{N,t}$ and the real wage by $\frac{W_t}{P_t} = \omega_t$. The first-order conditions can be written as follows, where κ_t is a standard Lagrange multiplier:

(A7) $C_t^{-\theta} = \kappa_t$

(A8) $\left(\frac{M_t}{P_t}\right)^{-\chi} = \kappa_t - \beta E_t \kappa_{t+1}\left(\frac{P_t}{P_{t+1}}\right)$

(A9) $E_t\left[\kappa_{t+1}(1+i_t)\left(\frac{P_t}{P_{t+1}}\right)\right] = \frac{\kappa_t}{\beta}$

(A10) $E_t\kappa_{t+1}\left[\frac{s_{t+1}}{P_{t+1}}(1+i_t^*)\Psi\left(\frac{s_tF_t}{P_t}\right) + \frac{s_{t+1}F_t}{P_{t+1}}(1+i_t^*)\Psi'\left(\frac{s_tF_t}{P_t}\right)\frac{s_t}{P_t}\right] = \frac{1}{\beta}\kappa_t\frac{s_t}{P_t}$

(A11) $\kappa_t = \beta E_t\kappa_{t+1}\left[\frac{p_{X,t+1}}{p_{X,t}}\left(r_{X,t+1}^K + 1 - \delta_T\right)\right]$

(A12) $\kappa_t(1+hZ_t) = \beta E_t\kappa_{t+1}\left[\frac{p_{N,t+1}}{p_{N,t}}\left(r_{N,t+1}^K + (1+hZ_{t+1})(1-\delta_N)\right)\right]$

Using equations A9 and A10 and noting that there is imperfect capital mobility, we find that weak uncovered interest parity holds as $(1+i_t) = E_t\frac{s_{t+1}}{s_t}(1+i_t^*)\Psi\left(\frac{s_tF_t}{P_t}\right)$ where $\Psi\left(\frac{s_tF_t}{P_t}\right)$ is the country risk premium. Note also that when $h = 0$, that is, there are no adjustment costs to capital, we recover the standard intertemporal arbitrage condition in physical assets:

(A13) $\kappa_t = \beta E_t\kappa_{t+1}\left[\frac{p_{N,t+1}}{p_{N,t}}\left(r_{N,t+1}^K + (1-\delta_N)\right)\right]$

Price level

Once the aggregate consumption level is determined, the representative consumer must choose a consumption basket that minimizes spending on nontraded goods ($C_{N,t}$) and imported goods ($C_{M,t}$):

(A14) $\min_{C_{N,t},C_{M,t}} P_tC_t = C_{N,t}P_{N,t} + C_{M,t}P_{M,t}$

subject to the CES consumption aggregator, that is, a Dixit-Stiglitz consumption index comprising nontraded goods and imported goods:

(A15) $C_t = \left((1-\alpha)^{\frac{1}{\varepsilon}}C_{M,t}^{\frac{\varepsilon-1}{\varepsilon}} + \alpha^{\frac{1}{\varepsilon}}C_{N,t}^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}}$

where ε is the elasticity of substitution. The optimization problem is:

(A16) $\min_{C_{N,t},C_{M,t}} C_{N,t}P_{N,t} + C_{M,t}P_{M,t} - \lambda\left[\left((1-\alpha)^{\frac{1}{\varepsilon}}C_{M,t}^{\frac{\varepsilon-1}{\varepsilon}} + \alpha^{\frac{1}{\varepsilon}}C_{N,t}^{\frac{\varepsilon-1}{\varepsilon}}\right)^{\frac{\varepsilon}{\varepsilon-1}} - C_t\right]$

The first-order conditions are:

(A17) $C_{N,t} = \alpha\left(\frac{P_{N,t}}{P_t}\right)^{-\varepsilon} C_t$

(A18) $C_{M,t} = (1-\alpha)\left(\frac{P_{M,t}}{P_t}\right)^{-\varepsilon} C_t$

Replacing these results in total expenditures, we obtain the aggregate price index:

(A19) $P_t = \left[(1-\alpha)\left(P_{M,t}\right)^{1-\varepsilon} + \alpha\left(P_{N,t}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$

Production Frontiers

The economy is populated of infinitely many identical firms operating in perfect competition in the export sector and in the nontraded sector. That ensures the absence of market power.

Exported Goods

The stand-in exporter firm chooses employment and physical capital to maximize the expected net present value of its stream of real profits. The optimization problem of the firm is, therefore:

(A20) $\max_{K_{X,t-1},L_{X,t}} \Pi^R_{X,t} = E_t \sum_{j=0}^{\infty} Q_{t+j}\left[(1-\tau_X)p_{X,t+j}X_{t+j} - r^K_{X,t+j}\left(p_{X,t+j}K_{X,t+j-1}\right) - \omega_{t+j}L_{X,t+j}\right]$

Optimization of equation A20 is subject to the following constraints:

(A21) $X_t = A_{X,t}K^{\eta}_{G,t-1}\left(H_tK_{X,t-1}\right)^{\lambda}L^{1-\lambda}_{X,t}$

(A22) $\ln(H_t) = (1-\vartheta)\ln(H_{t-1}) + \vartheta\ln\left(K_{X,t-1}\right)$ with $0 < \vartheta < 1$

Equation A21 is the production function of exported goods, where $A_{X,t}$ denotes the firms productivity, $K_{G,t-1}$ is public capital, and H_t denotes the firm's level of knowledge. The latter evolves as a result of learning by exporting but is subject to depreciation, as shown in equation A22. Q_{t+j} is the stochastic discount factor.

First order conditions are:

(A23) $(1-\tau_X)(1-\lambda)\frac{Y_{X,t}}{L_{X,t}}\frac{P_{X,t}}{P_t} = \omega_t$

(A24) $(1-\tau_X)\left[(1+\vartheta)\frac{\lambda Y_{X,t}}{K_{X,t-1}} + \frac{(1-\vartheta)\vartheta}{K_{X,t-1}}E_tQ_{t+1}\left(\lambda\frac{Y_{X,t+1}}{K_{X,t}}\frac{\frac{P_{X,t+1}}{P_{t+1}}}{\frac{P_{X,t}}{P_t}}\right)\right] = r^K_{X,t}$

Equation A23 is the standard first-order condition whereby firms equate the marginal productivity of labor to the real wage. Note that in the absence of learning-by-doing, $\vartheta = 0$, equation A24 becomes $(1-\tau_X)\left[\lambda\frac{Y_{X,t}}{K_{X,t-1}}\right] = r^K_{X,t}$, the standard first-order condition whereby firms equate the marginal productivity of capital to the real rental price of capital. When $\vartheta > 0$, on the other hand, there is an intertemporal externality: by expanding capital and exports today, the firm learns how to be more productive tomorrow (because it increases knowledge on how to export), thereby generating a future extra benefit in expected terms, which is internalized by the firm and discounted at stochastic rate $E_t Q_{t+1}$.

Nontraded Goods

For simplicity, we assume that firms in the nontraded sector engage in perfect competition. The stand-in firm has production function $N_t = An_t Kg^{\phi}_{t-1} Kn^{\varphi}_{t-1} Ln^{1-\varphi}_t$ and maximizes real profits:

$$\text{(A25)} \quad \underset{K_{N,t-1},L_{N,t}}{\Pi^R_{N,t}} = (1-\tau_N)p_{N,t}N_t - r^K_{N,t}\left(p_{N,t}K_{N,t-1}\right) - \omega_t L_{N,t}$$

First-order conditions are:

$$\text{(A26)} \quad (1-\tau_N)\varphi\frac{Y_{N,t}}{K_{N,t-1}} = r^K_{N,t}$$

$$\text{(A27)} \quad (1-\tau_N)(1-\varphi)\frac{Y_{N,t}}{L_{N,t}}p_{N,t} = \omega_t$$

The Government

We assume that the government's current and capital expenditures are control variables and, therefore, exogenous. Government expenditures comprise government consumption in nontraded goods—denoted by $G^C_{N,t}$—and public investment, which can be allocated to either sector, $G^I_{X,t}$ or $G^I_{N,t}$. The government chooses how much of public investment goes to each sector which, for simplicity, we express as a fraction of production in each sector.

$$\text{(A28)} \quad G^I_{X,t} = g^I_X Y_{X,t}$$

$$\text{(A29)} \quad G^I_{N,t} = g^I_N Y_{N,t}$$

Total public capital evolves according to:

$$\text{(A30)} \quad K_{G,t+1} = G^I_{X,t} + G^I_{N,t} - (1-\delta_G)K_{G,t}$$

In addition to spending in goods and services and financing public capital, the government also must repay the public debt (B_t) and transfer money to the households TR_t. The financing of the expenditures is based on taxes collected on the sales of exports and nontraded goods $\tau_X Y_{X,t} P_{X,t}$ and $\tau_N Y_{N,t} P_{N,t}$, respectively, issuing public debt B_t, and using resources received in the form of foreign aid A_t. The government receives a transfer from the Central Bank, identified below, and must obey its nominal budget constraint:

$$\text{(A31) } P_{X,t}G^I_{X,t} + P_{N,t}\left(G^I_{N,t} + G^C_{N,t}\right) + TR_t + B_{t-1}(1+i_{t-1}) = A_t S_t + B_t + \tau_N Y_{N,t} P_{N,t} + \tau_X Y_{X,t} P_{X,t} + Q_t$$

In order to have an intertemporally consistent budget balance we impose the following condition on the transfers so that the government's debt is sustainable:

$$\text{(A32) } \log TR_t = (1-\rho)\log TR_{ss} + \rho \log TR_{t-1} + \gamma_b(B_{ss} - B_t)$$

That is, there exists a level of long-term transfer of resources to the public TR_{ss} which is consistent with the steady-state level of the government's debt (B_{ss}): whenever the current level of public debt is in excess of its sustainable level, transfers must be adjusted downwards to their sustainable level with dynamic pattern control by the decay parameter, ρ.

The transfer of the Central Bank is:

$$\text{(A33) } Q_t = M_t - M_{t-1} - s_t R_t + (1+i^*_t)s_t R_{t-1}$$

where R_t are the foreign reserves of the Central Bank. Money issuing is also a control variable that allows the government to collect seigniorage. Money expands at rate $\frac{M_t - M_{t-1}}{M_{t-1}} = \mu$

Model Closures and Exchange Rate Regimes

Solving and simulating the model demands that all markets clear. The non-trade market clears when $Y_{N,t} = C_{N,t} + G_{N,t}$ while the imported goods market clears by definition $Y_{N,t} = C_{M,t}$. Total consumption satisfies $C_t = C_{N,t}p_{N,t} + C_{M,t}p_{M,t}$ in equilibrium. The labor market also clears by definition $L_{X,t} + L_{N,t} = 1$ while total capital satisfies:

$$\text{(A34) } K_{X,t} + K_{N,t} = I_{X,t} + \frac{h}{2}Z_t^2 + (1-\delta_T)K_{X,t-1} + (1-\delta_N)K_{N,t-1}$$

Before indicating the alternative closures of our model, let us identify important equilibrium restrictions. First, we define the real exchange rate (RER) so that an increase in the price of nontraded goods causes the RER to appreciate (and it lowers the RER index).

(A35) $\text{RER}_t = \frac{P_{M,t}}{P_t} = \frac{S_t P^*_{M,t}}{P_t} = \frac{S_t P^*_{M,t}}{\left[(1-\alpha)\left(S_t P^*_{M,t}\right)^{1-\varepsilon} + \alpha\left(P_{N,t}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}}$

The balance of payments is found to be:

(A36) $\frac{S_t F_t}{P_t} - \frac{S_{t-1} F_{t-1}}{P_{t-1}} = BT_t + RF_t + Aid_t$

where $\frac{S_t F_t}{P_t} - \frac{S_{t-1} F_{t-1}}{P_{t-1}}$ indicates the change in total foreign assets. The term BT_t is the trade balance and corresponds to $BT_t = p_{X,t}[(1 - g^I_X)Y_{X,t} - I_{X,t}] - Y_{M,t} p_{M,t}$. RF_t represents debt service, comprising interest payments, revaluation of the stock of debt due to changes in the nominal exchange rate, and the risk premium, that is $RF_t = \frac{S_{t-1} F_{t-1}}{P_{t-1}}\left(\frac{S_t}{S_{t-1}}\frac{P_{t-1}}{P_t}(1 + i^*_{t-1})\Psi\left(\frac{S_{t-1} F_{t-1}}{P_{t-1}}\right) - 1\right)$. Finally, Aid_t represents the flows of foreign aid expressed in local currency $Aid_t = \frac{A_t S_t}{P_t}$.

The model has two closures. One allows the nominal exchange rate to freely float in response to the supply and demand of foreign liquidity. In this case, foreign reserves of the Central Bank are kept constant. The other closure imposes rigidities to the adjustment of the nominal exchange rate which, in the limit, can mimic a fixed exchange rate regime. In the latter case, reserves are used to manage the exchange rate. The managed exchange rate regime allows for a friction δ_t to determine the evolution of the nominal exchange rate, such that:

(A37) $s_t = \delta_t s_{t-1}$

(A38) $\delta_t = \left(\frac{P_{t-1}}{P_t}\right)^{\sigma_2 - 1}\left(\frac{s_{t-1}}{s_t}\right)^{\sigma_2}$

When parameter $\sigma_2 = 1$, the nominal exchange rate is flexible, while if $\sigma_2 = 0$, the nominal exchange rate adjusts to match exactly the evolution of the domestic price index.