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**Importing High Food Prices by Exporting:  
Rice Prices in Lao PDR**

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# Importing High Food Prices by Exporting:

## Rice Prices in Lao PDR<sup>1</sup>

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### Abstract

This paper shows how a developing country, Lao PDR, imports high glutinous rice prices by exporting its staple food to neighboring countries, Vietnam and Thailand. Lao PDR has extensive export controls on rice, generating a sizable difference between domestic and international prices. Controls are relaxed after good harvests, leading to a surge in exports early in the season and rapidly rising prices later in the year. There is thus a strong case for removal of trade restrictions since they give rise to price spikes, keep the long-term price of glutinous rice low, and thereby hinder increases in income from agriculture. Although this is a case study of Lao PDR, the findings may equally apply to other developing countries that export their staple food.

Keywords: exports, food prices, free trade, rice prices, rice markets, sticky rice, welfare

JEL Classification: Q11, Q17, Q18, F15

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## 1. Introduction

In the face of rapidly increasing rice prices, the Lao government imposed a rice export ban in November 2010. Even though the price of the staple food in one of the world's poorest countries had risen by over 50 percent, and the ban only lasted until February 2011, it was criticized by economists and multilateral organizations. The IMF (2011 p. 18), for instance, asserted that “discretionary measures that seek to isolate domestic markets from international price developments may not be effective and are not advisable.” Representatives of the Lao government disagreed,<sup>4</sup> responding that “the measure was made necessary to address a speculatively fuelled price increase and excessive foreign demand pressures in September 2010, which endangered the domestic rice stock.”

Rapidly rising or very high staple food prices constitute a great challenge in many less-developed countries: they directly affect the poor, who often spend more than half of their income on food, and they raise the risk for food riots and political unrest (Barrett and Bellemare, 2011; Bellemare, 2011; Bellemare, et al., 2013). Rice trade policy is generally not guided by economic principles alone, as any decisions tend to be highly politicized (see e.g. Timmer, 1975; David and Huang, 1996). In Lao PDR, glutinous rice<sup>5</sup> consumption constitutes almost 70 percent of the calorie and protein intake, which makes access to affordable glutinous rice of crucial importance to the welfare status of the poor (FAO,

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<sup>4</sup> Statement by Aida Budiman, Alternate Executive Director for Lao P.D.R. and Thamnuvong Soulysak, Advisor to Executive Director July 5, 2011 (IMF, 2011; p. 4).

<sup>5</sup> In other parts of Southern and Eastern Asia non-glutinous (ordinary) rice is the main staple food, and glutinous rice is mainly used for breakfast dishes, sweet, rice wine, etc. and consumed in small per-capita quantities. The exception is northeastern Thailand, which borders Laos, where glutinous rice also is the staple food.

2001; EMC, 2011; Bouahom and Douangsavanh, 2013). While many rice farmers in Lao PDR would potentially benefit from higher prices, the fact is that only a quarter of the households sell rice and over a third buys it (Hill and Christiansen, 2006; Lao Census, 2012; World Bank, 2015).<sup>6</sup> It is thus understandable that many less-developed countries, including Lao PDR, resort to extensive trade restrictions with the aim of ensuring stable staple food prices (Galtier, 2013). And, in fact, appropriate trade restrictions may also agree with optimal trade and storage models, see e.g. Gouel and Jean (2014) and Gouel et al. (2014).

Nonetheless, it is commonly believed that government policy interventions encountered in practice are more likely to generate price spikes than to curb them. Interventions are frequently of a discretionary nature, creating an environment of uncertainty that hampers private market development and ultimately increases prices; see for example the recent studies of maize markets in Sub-Saharan Africa by Chapoto and Jayne (2009), Jayne and Tschirley (2010) and Tschirley and Jayne (2010). But even transparent and rule-based trade restrictions may lead to price spikes as rational agents anticipate the lifting of these restrictions (Porteous, 2012). The same trade restrictions, if collectively enforced by a sufficiently large share of the market, have also been linked to price spikes on the world market (see e.g. Anderson and Nelgen, 2012; Barrett and Bellemare, 2011; Martin and Anderson, 2012; Ivanic and Martin, 2014a).<sup>7</sup> Yet, not all government interventions are bad. There are examples where government interventions

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<sup>6</sup> It should be noted that in 2012 about a third of the households that are net-buyers of rice spend less than 10% of their food expenditures on purchasing rice (World Bank, 2015).

<sup>7</sup> The 2008-2009 global food price crisis is arguably an example of this.

have successfully stabilized prices in Asian rice markets, as described by Dawe (2001), Timmer (2011), and Cummings (2012). When evaluating current policy versus possible alternatives, it is thus important to have a complete picture of how prices are determined.

We use data on prices, exports and harvests to evaluate the drivers of glutinous rice prices in Lao PDR, focusing on the role of exports to Thai and Vietnamese markets. Both Thailand and Vietnam produce and consume large quantities of glutinous rice, and share long and porous borders with Lao PDR. The price data for glutinous rice (also called rice in the rest of the paper) are monthly averages of consumer prices for the period January 2001-December 2012. We went to great lengths to compile this database, which to our knowledge has not been used in any previous studies. There is a lack of detailed historical data on international trade, but information is available on official exports for the period after 2005. We combine these with harvest data to analyze how they jointly determine changes in Lao rice prices.

Our main findings are three-fold: First, cointegration analysis and innovation accounting (impulse responses and variance decomposition) provide compelling evidence that Lao PDR is importing its rice price changes in the long run by exporting its produce to Vietnam and Thailand. While there are feedback effects from Lao to Vietnamese prices, shocks to Vietnamese prices explain a much larger part of changes in Lao prices than vice versa. This finding is corroborated by regressions of (official) exports to Vietnam on Lao price changes, which confirm a positive association.

Second, adding Lao harvests to error correction models reveals a pattern where good harvests initially lead to lower prices, as expected, but then tend to raise prices as stocks are depleted over the year. While we have few data points, it appears that good

harvests are followed by a surge in official exports. The 50% price spike in late 2010 was thus most likely the result of large exports from the 2009 harvest, not of a regional production decline in 2010 as FAO (2011) and others have claimed. This phenomenon where good harvests are followed by a sharp increase in prices does not appear to be well documented, even though it is probably not as rare as one might think. Jayne and Tschirley (2010) observe a similar phenomenon in Malawi in 2008-2009 (on the maize market), although in this case it was the government who commissioned the exports on the basis of their overly optimistic estimates of the harvest. In Lao PDR, large exports appear to accumulate during episodes of free trade that are granted by the government. It is not clear whether the Lao government's estimates of the harvest are optimistic, or whether they are simply not able to keep track of the volume of exports.

Third, rice prices in Lao PDR are found to be considerably lower than in Thailand and Vietnam, despite the linkages between the countries. This may be attributed to a variety of factors, including quality differences (Anh and Nghiep, 2012). Our findings suggest that prices may rise considerably if trade were to be liberalized.

Many of the documented price spikes in the literature have been attributed to the discretionary introduction of export bans (Jayne and Tschirley, 2010; Tschirley and Jayne, 2010; Ivanic and Martin, 2014a).<sup>8</sup> In Lao PDR, restrictions on exports are the norm, as current policy aims at keeping domestic rice prices low. In this environment, price spikes seem to emerge during episodes where export bans are relaxed.

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<sup>8</sup> The recent price spike on the world market for non-glutinous (ordinary) rice serves as an example (see e.g. Ivanic and Martin, 2014a).

Liberalizing trade all together has a good chance of curbing the policy-induced price spikes. It would arguably also shift the long-term price of rice to a higher level by sharply reducing the price gap with Vietnam and Thailand, which would raise the revenues from agriculture. The hope is that this would allow for an expansion and possibly a modernization of the agricultural economy in Lao PDR (World Bank Lao Development Report, forthcoming). In the long-term both the non-poor and the poor (who tend to be net-consumers of rice) are expected to benefit from trade liberalization and higher rice prices: Ivanic and Martin (2014b) simulate the impact of food price increases in a number of countries (but not Lao PDR) and find that poverty ultimately decreases in rice-producing countries such as Cambodia and Vietnam; Jacoby (2013) shows that food price increases in India led to even faster increases in rural employment and wages, thereby reducing poverty; and a recent World Bank study attributes an important part of the poverty reduction in Cambodia to improvements in rural wages and agricultural employment following an increase in the price of rice (World Bank, 2013).

Though not addressed in this paper, it is advisable to take into account the likely distribution of benefits and costs when designing the policy, and consider options for appropriately targeted measures to cushion negative impacts on the poor and vulnerable. Ideally, the measures would also take into account the special needs of upland areas where food insecurity is problematic even in the absence of price increases.

Section 2 describes the data and outlines the key issues in the discussion about food policy and international trade. Section 3 carries out the cointegration analysis, estimates error correction models and implements innovation accounting, while Section 4 analyzes

the role of exports and harvests. Section 5 briefly discusses policy implications. Section 6 concludes the paper.

## **2. The price data**

This section describes the price data and highlights price differences and long-run relationships between the price series. We have compiled a database of monthly prices for all three countries (Lao PDR, Thailand and Vietnam) for the period January 2001 to December 2012. All prices have been converted to US dollar per kilogram.

The Lao price denotes the average consumer price for first quality glutinous rice. Since the Lao rice market is not perfectly integrated, it should be noted that our price series is more representative for Central and Southern regions than the Northern region where prices are usually lower. Less than 20% of the rice is cultivated in the Northern provinces and most of it is for self-consumption. The Thai and Vietnamese prices are also consumer prices. The Thai series is from the Northeast of Thailand, where glutinous rice is the staple food. For Vietnam our price data are at the province level. We use these data to compute an index based on the average of the consumer prices for the provinces from the Northern region of Vietnam, the region with the closest ties to Lao PDR, by appealing to principal component analysis. Prices in 2010 correspond to those in Hanoi, the by far largest city. Other measures were also explored but provided similar results. The data appendix provides detailed information about the price series used.

Fig. 1 shows the glutinous rice prices for Lao PDR, Thailand and Vietnam for January 2001 - December 2012. Overall, the price series show a similar pattern; they are stable until 2005 when they uniformly start increasing, arguably in line with world market



food prices in general. After 2005, the behavior of the three series differs greatly; the Thai series is highly volatile, first increasing rapidly, following the world market price of non-glutinous rice (not reported), and then falling below Lao prices during the financial crisis and the general decline in world food prices. Lao and Vietnamese prices follow each other closely, increasing sharply during 2010 and then stabilizing, though at the end of the period the spread between them increases somewhat.

The price in Lao PDR is clearly lower than in the other countries, except for a short period after the collapse of the Thai price in 2008. Part of this gap may be attributed to differences in quality; Vietnamese consumers consider Lao rice to be inferior to Thai and high-quality Vietnamese rice (Anh and Nghiep, 2012). Another part of the gap reflects the transaction costs involved when trading the rice between the countries (due to trade restrictions and transportation).

Lao PDR's price advantage might be even larger than reflected in consumer prices, since these include various mark-ups over farm-gate paddy (un-milled) rice prices. For instance, milling is known to be less efficient in Lao PDR than in Thailand and Vietnam, resulting in lower recovery rates and lower quality. In 2011-2012, the Lao-Vietnamese ratio of the average price of paddy rice was 0.45 (Eliste and Santos, 2012), while the average consumer price ratio was 0.60. As a point of reference, the consumer price of Lao rice in Vietnam (in Quang Tri Province) was about the same as common, low cost, Vietnamese glutinous rice (glutinous rice 352) in 2012 (Anh and Nghiep, 2012).

Fig. 2 shows the log of the three series, re-scaled to highlight the long-run relationships; this shows clearly how Lao and Vietnamese prices track each other well, while Thai prices deviate substantially between 2006 and 2011. As of 2011 all three series

are back on track. In sum, even if the study period is relatively short, the long-run interdependence between the three variables is clearly visible. This is supported by cointegration tests below.

Figure 1. Glutinous rice prices in Lao PDR, Thailand and Vietnam (Jan. 2001-Dec. 2012)

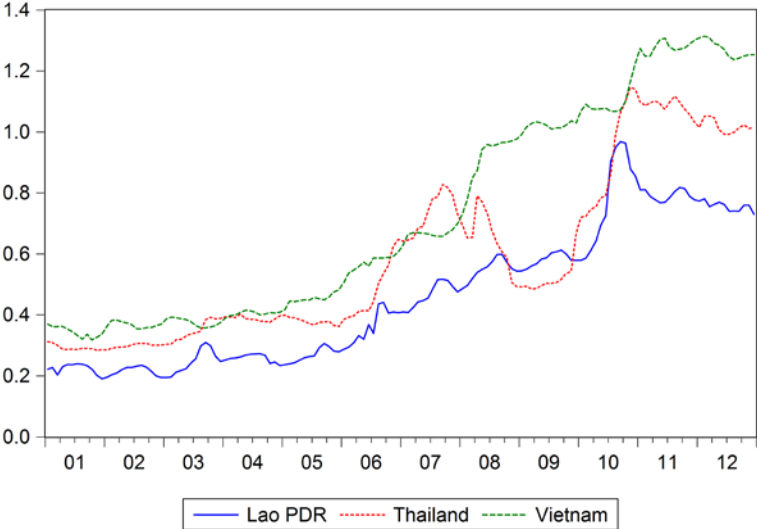
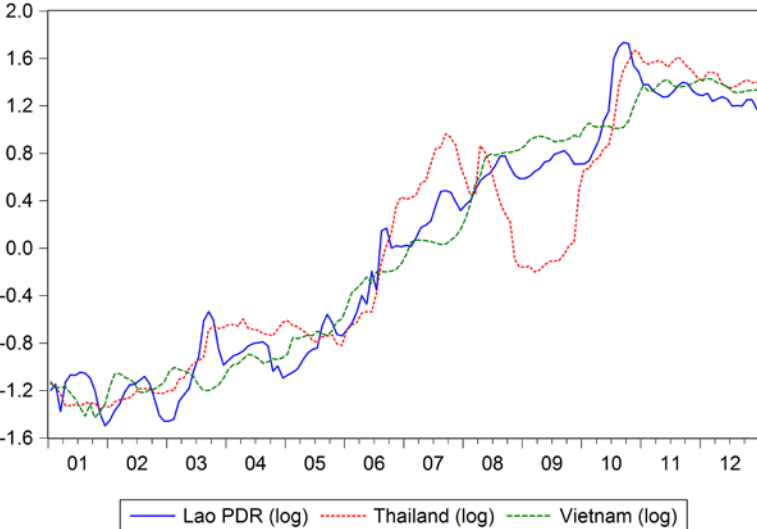


Figure 2. Log glutinous rice prices in Lao PDR, Thailand and Vietnam (Jan. 2001-Dec. 2012)



Note: The series have been re-scaled to highlight the long-run relationship.

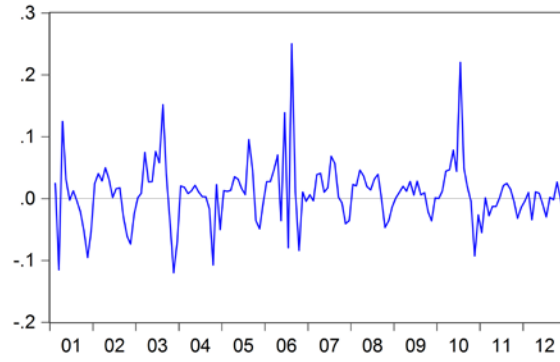
Fig. 3 depicts the first difference of the log of monthly prices. Lao prices are on average the most volatile, with the episodes in 2006 and 2010 standing out. The price spike in 2010, which led to an export ban criticized by the IMF, implied a price rise of over 50% between September 2009 and September 2010. Thai prices are stable until 2006, but then become highly volatile for a couple of years. This is arguably because of a close link to world market prices for non-glutinous rice, as Thailand is a large exporter of both glutinous and non-glutinous rice. Vietnamese prices show some within-seasonal fluctuations, as expected for an agricultural product, but there are no clear episodes of high volatility. Table 1 provides some additional information on volatility by reporting standard deviations for first and twelfth log differences and measures of deviation from the normal distribution (skewness and kurtosis). This confirms that Vietnamese prices are the most stable.

Table 1. Data description, first and twelfth differences

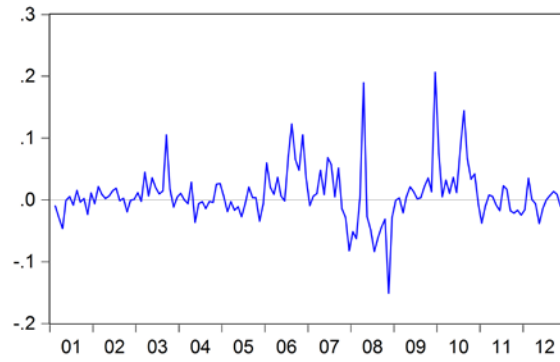
	Lao PDR	Thailand	Vietnam
Mean (1 <sup>st</sup> difference)	0.008	0.008	0.009
Std. Dev. 1st difference	0.051	0.043	0.024
Std. Dev. 12th difference	0.161	0.263	0.099
Skewness (1 <sup>st</sup> difference)	1.098	1.231	0.717
Kurtosis (1 <sup>st</sup> difference)	8.217	8.910	4.078
Observations (1 <sup>st</sup> difference)	143	143	143

Figure 3. Prices in growth rates (log first differences)

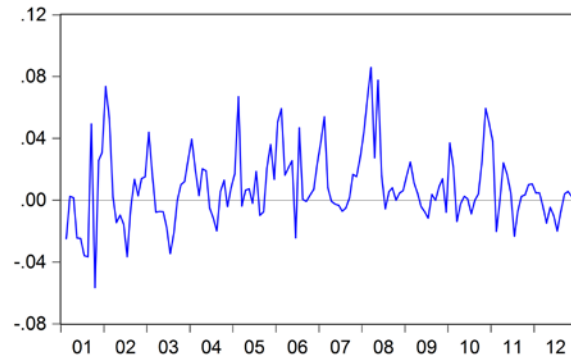
Lao PDR (log difference)



Thailand (log difference)



Vietnam (log difference)



### 3. Co-integration analysis and innovation accounting

In this section we first use cointegration analysis to test for potential long-run (equilibrium) relationships between the price series, and then apply impulse response analysis and variance decomposition to shed light on the relative importance of Lao, Thai and Vietnamese price shocks for the evolution of rice prices in Lao PDR.

The Johansen procedure<sup>9</sup> is used to test for cointegrating vectors, since it allows for multiple cointegrating vectors and short run dynamics. The trace test statistics, reported in Table 2, indicate that there is one cointegrating vector: the test for no stationary vector is clearly rejected,  $p$ -value=0.008, while the test for at most one vector is insignificant. The sizes of the eigenvalues also indicate that there is one cointegrating vector: the largest one is 0.18, i.e., well over zero, while the other two are close to zero. Fig. 4 (upper panel) shows recursive estimates of the largest eigenvalue and 95% confidence bands for the period 2004:1-2012:12. The eigenvalue is close to 0.20 over the whole sample.

Table 2: Trace test statistics of the number of cointegrating vectors

	None	At most 1	At most 2
Statistic	36.089	8.154	0.266
Critical value, 0.05	29.797	15.490	3.841
$p$ -value	0.008	0.449	0.606
Eigenvalue	0.183	0.056	0.002

Note: The data is for January 2001-December 2012. The VAR has six lags and seasonal dummies. The test is based on unrestricted constant.

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<sup>9</sup> See Juselius (2006) for a detailed description of the Johansen procedure for cointegration analysis.

Table 3 reports long-run and adjustment coefficients, along with their significance, and test statistics for the exclusion of individual variables from the cointegrating vector. The coefficients of the cointegrating vector, i.e., the long-run coefficients, are 0.84 for Vietnamese rice prices and 0.20 for Thai prices, indicating a dominant role for Vietnamese prices. Fig. 4 (middle and lower panel) reports the recursive estimates of long-run coefficients along with 95% confidence intervals. They are a bit volatile in the beginning of the sample, arguably due to the small number of observations, but are overall quite stable. The cointegrating vector,  $P_{\text{Lao PDR}} - 0.84 P_{\text{Vietnam}} - 0.20 P_{\text{Thailand}}$ , is depicted in Fig. 5, and it is clearly stationary.

The exclusion tests show that all three series are needed to establish cointegration (Table 3). This implies that all three variables have a unit root, since we otherwise would have found a stationary vector made up of two variables only. Augmented Dickey Fuller tests, reported in the appendix, and visual inspection of the variables (Fig. 2 and 3), provide additional support for this conclusion. Table 3 also shows that Lao prices are endogenous, since the adjustment coefficient is significant and negative, with a value of  $-0.25$ . The adjustment coefficient for Vietnamese prices is small, but significant, so there is evidence of some feedback effects from Lao prices. Thai prices are weakly exogenous since the adjustment coefficient is insignificant.

Since we find one cointegrating vector only, re-estimating it with a static model (OLS) or augmented distributed lag regression (ADLR), ignoring that Vietnamese prices are not weakly exogenous, gives an indication of the robustness of the results for the long-run coefficients. The long-run coefficients are 1.00,  $-0.33$ ,  $-0.74$  for the static model and

1.00, -0.23, - 0.79 for the ADLR. Thus, even though we have a short sample, the choice of model has little impact on the key coefficients.

Table 3: Cointegrating vector

	Lao PDR	Thailand	Vietnam
Long-run coefficients, $\beta$ s	1.000	-0.195 [-3.016]	-0.836 [-14.140]
Exclusion restrictions			
LR statistic	17.831	3.906	20.048
$p$ -value	0.000	0.048	0.000
Adjustment coefficients, $\alpha$ s	-0.249 [-4.316]	0.012 [0.197]	0.072 [2.501]
Test of significance			
LR statistic	19.777	0.038	6.692
$p$ -value	0.000	0.846	0.010

Note: t-values in brackets. See Table 2 for model specification.

Figure 4. Recursive plots with 95% confidence bands. Eigenvalues (upper panel), long-run coefficient for Thailand (middle panel) Vietnam (bottom panel)

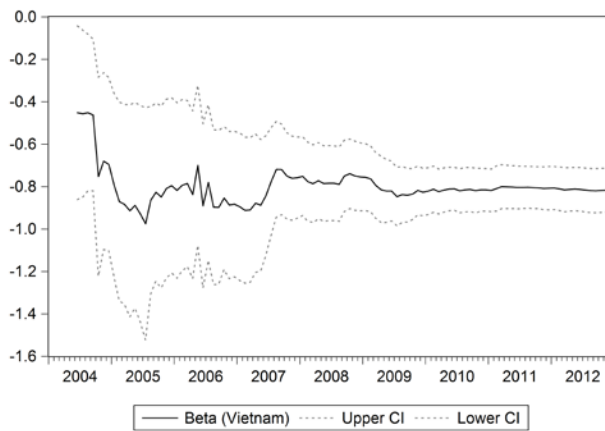
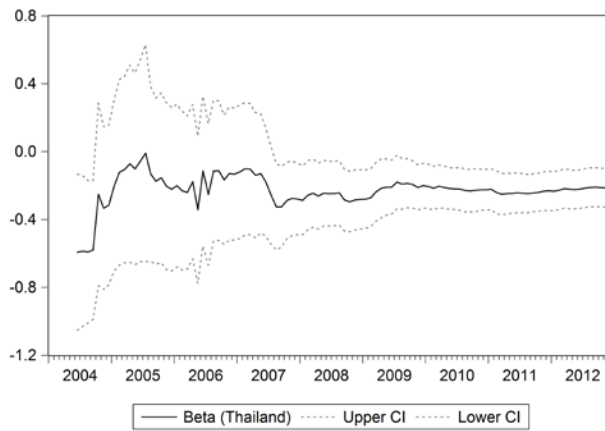
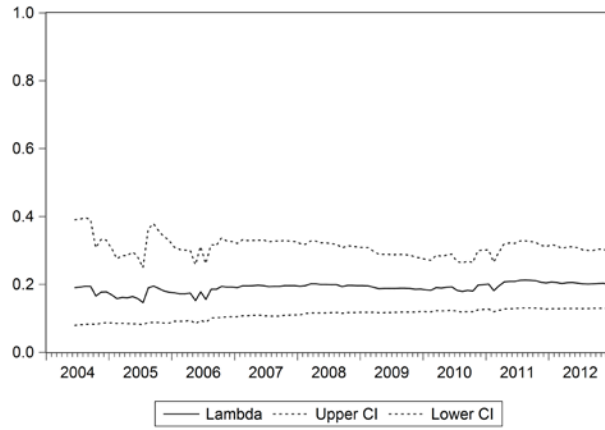
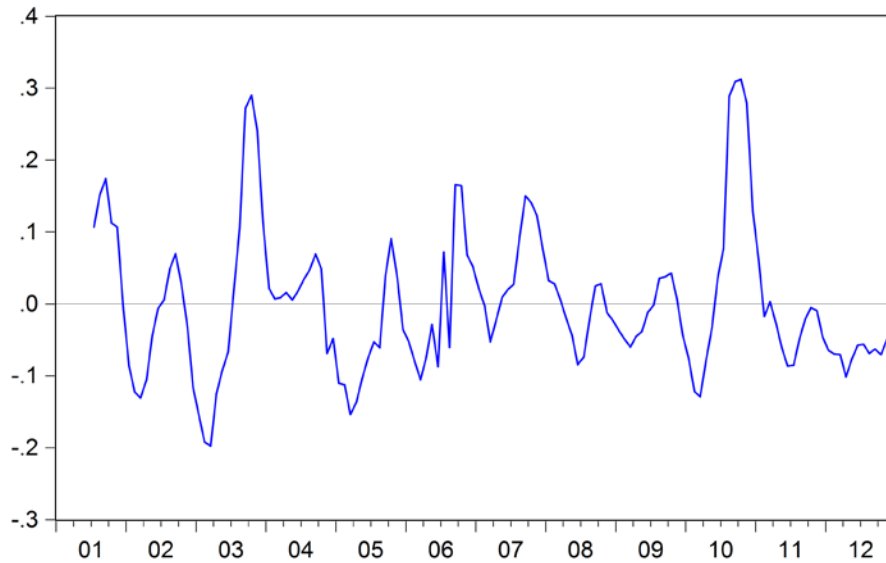




Figure 5. Cointegrating vector



As both Lao and Vietnamese prices are endogenous, and the long-run coefficient for Thai prices is relatively small, it is not obvious which of the price series are the key drivers. Impulse responses and variance decomposition help to identify the relative importance of the variables by estimating the impact of individual shocks on the dynamics of the prices. The results are based on a VAR in error correction form, imposing the restrictions implied by the cointegration analyses. However, estimating an unrestricted VAR gives similar results. The Cholesky decomposition, which removes the contemporaneous correlations between the residuals, is used to identify the shocks. The ordering of the variables are Vietnam, Thailand and Lao PDR. Since the correlations are low, the choice of ordering only has marginal effects on the results.<sup>10</sup>

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<sup>10</sup> The contemporaneous correlation between the residuals of Vietnam and Thailand, and Lao PDR and Vietnam, are only -0.09 and -0.12, so the ordering does not affect the results. The correlation is somewhat

Fig. 6 depicts impulse responses of one standard deviation shocks for 60 months. Shocks to Vietnamese prices have a large and long-lasting impact on Lao prices, even larger than domestic shocks, while Thai prices have a more modest impact. Shocks to Lao prices also impact on Vietnamese prices, but domestic shocks have a larger effect. Shocks to Thai prices do not affect Vietnamese prices, nor do shocks to Vietnamese prices affect Thai prices.

Further insights about the relative importance of domestic versus non-domestic shocks are obtained by means of forecast error variance decompositions. Fig. 7 shows that Thai and Vietnamese prices are best explained by their own domestic shocks in the long run, while variations in Lao prices primarily are determined by shocks to Vietnamese prices, and to some extent by their own domestic shocks. The latter result is somewhat sensitive to the choice of price variable for Vietnam; using any of the other two price variables, described in the appendix, makes the role of Lao price shocks more important than Vietnamese shocks. Nonetheless, both the cointegration analysis and the VAR analysis show that Vietnamese prices play a key role in the determination of Lao prices.

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higher for Lao PDR and Thailand, 0.24. However, since Thai prices are weakly exogenous, we allow shocks to Thai prices to affect Lao prices contemporaneously but not vice versa.

Figure 6. Impulse responses

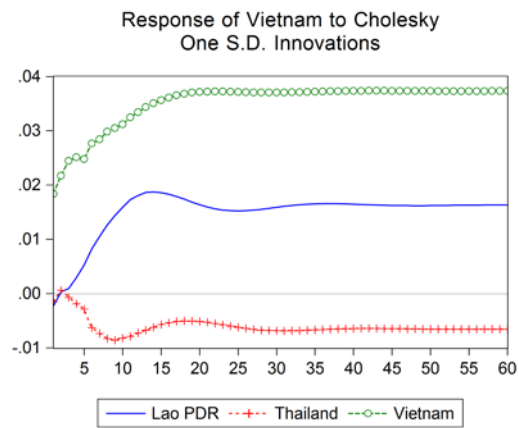
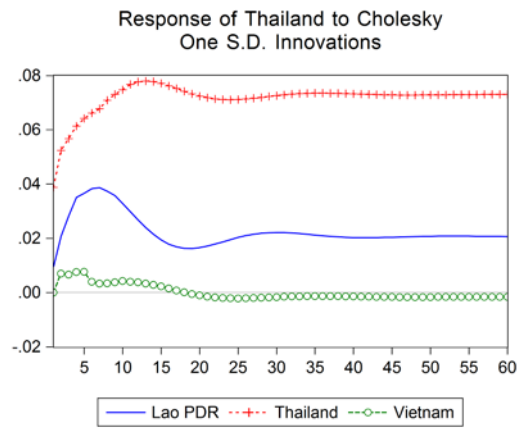
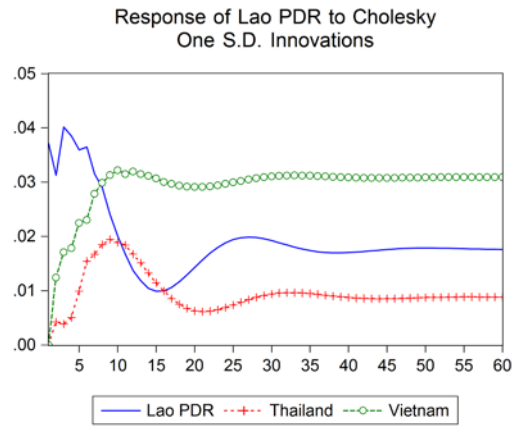
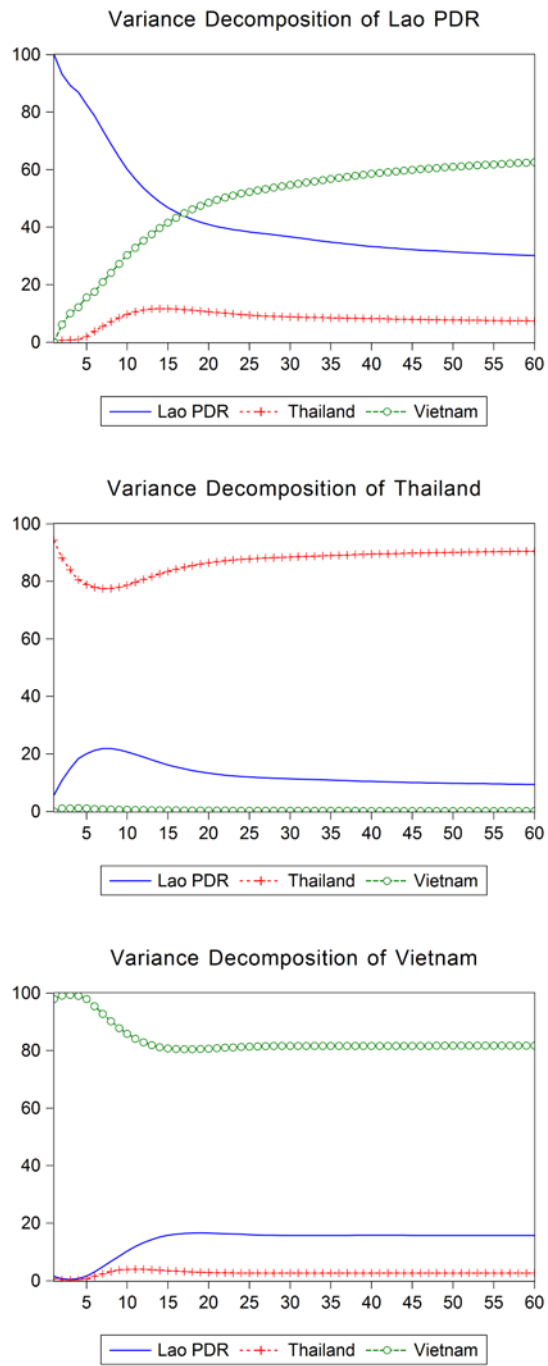


Figure 7. Forecast error variance decomposition



#### 4. Lao – Vietnam trade and harvest price dynamics

In this section we use data on official exports and harvests to analyze how they affect Lao rice prices. Increases in exports should raise prices, while good harvests should reduce them. The focus is on Vietnam because it is the destination for practically all official exports and because of the close links with the Lao market revealed by the cointegration analysis. There are informal exports of paddy to Thailand across the Mekong River, but mostly for milling. The rice is then presumably re-imported to Lao PDR, possibly as Thai rice (FAO, 2011).

We have data on monthly official exports of rice for October 2005 - November 2012, and annual harvest data for the entire 2001 – 2012 period (see appendix.). The harvest data were first de-trended (by subtracting a linear trend) to obtain a measure of unusually good or bad harvests. We then converted the data to monthly observations by applying prior knowledge about the distribution of the harvest between the two harvest periods, the wet and the dry seasons (GIEWS, 2014a).<sup>11</sup>

Fig. 8, upper panel, shows the monthly rate of change of Lao prices and exports to Vietnam. The increase in exports at the end of 2009 and the rapid price increase about six months later in 2010 are highly visible. A similar pattern exists for 2005 and the price increase in 2006. Fig. 9 depicts the rate of change of prices and de-trended harvests. Prices tend to decline soon after the large harvest in the wet season (October to December). However, about six months after the bumper harvest in 2009, well before the 2010 harvest,

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<sup>11</sup> In the case of Lao PDR, we assign the following weights to each of the 12 months: Jan-Mar (0), Apr-May (0.085 each), Jun-Aug (0), Sept (0.083), Oct (0.249), Nov (0.332), and Dec (0.166). For Vietnam, the weights were set to: Jan-Feb (0.05 each), Mar-May (0), June (0.05), Jul-Sept (0), Oct (0.15), Nov (0.40), and Dec (0.30).

prices rose sharply. Since the harvest in 2010 is close to trend, expectations of a bad harvest in 2010 are unlikely to have caused the price spike, unless these expectations were completely off.

One possibility is that the 2010 price increase was due to a bad Vietnamese, or regional, harvest in 2010, as is claimed by FAO (2011). This conclusion does not seem to be supported by the data on the (de-trended) harvests in Lao PDR and Vietnam, which suggest that both harvests stayed close to the trend (Fig. 10). While we have few data points, it appears that the size of the harvests in Lao PDR impacts on the exports to Vietnam; large harvests have been found to increase subsequent exports (Fig. 11).

The conclusions drawn from the visual inspection of the graphs are corroborated by re-estimating the error correction model for Lao PDR (from Section 3), with exports (lagged six months) and harvest size (lagged two and eight months) added as independent variables. The choice of lags was based on the graphs. Good harvests are expected to reduce prices as supply increases in the short-run, but may then also increase prices later in the year as rice stocks start running out prior to the next harvest.

Column 1 in Table 4, confirms that exports have a highly significant effect on prices ( $t$ -value = 3.9). A one standard deviation (1.409 million kg) increase in exports is associated with roughly a 25 percent annualized inflation rate ( $0.015 * 1.409 * 12 = 0.254$ ). This should be considered as a rough indication, however, given that the export variable is heavily skewed with many observations close to zero. Column 2 reports the same regression with only harvests added, using data for 2001:9-2012:12. The second lag is negative as expected, though the  $p$ -value is 0.15, while the eighth lag is positive and significant. Thus, the larger the harvest, the larger the price increase at the end of the year,

before the next harvest. The third column includes both harvests and exports, though exports are a mediator for harvests. While controlling for exports slightly reduces the coefficients for the harvest variables (and vice versa), the positive effect of harvest size at the longer lag continues to be significant. One interpretation is that the lagged harvest size acts as a proxy for informal exports which are expected to have a positive effect on prices.

Figure 8. Lao rice prices (monthly rate of change) and rice export to Vietnam

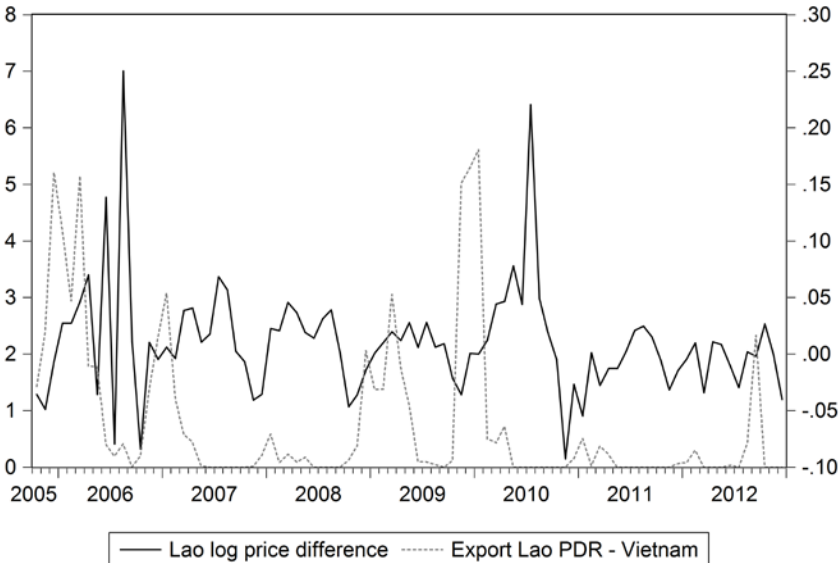


Figure 9. Lao rice prices (monthly rate of change) and harvests (log deviation from trend)

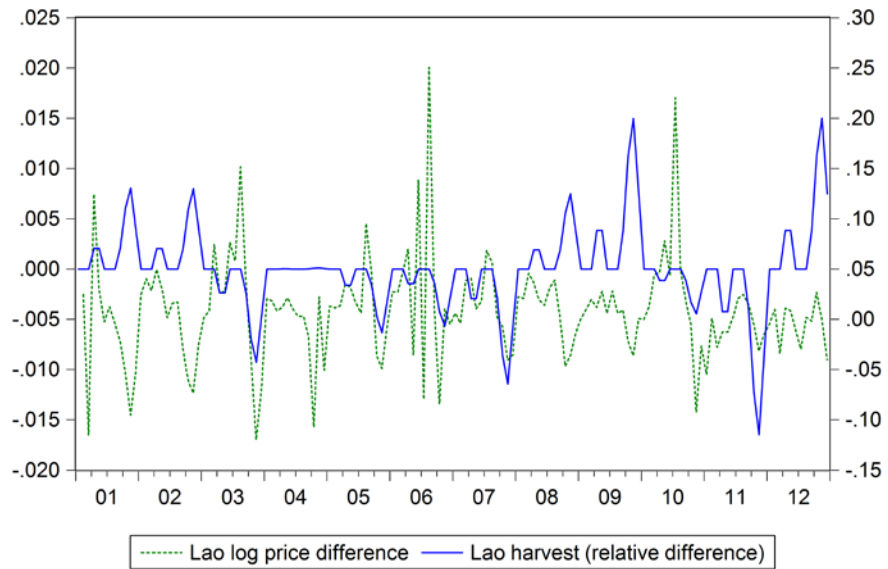


Figure 10. Harvests in Lao PDR and Vietnam (log deviations from trend)

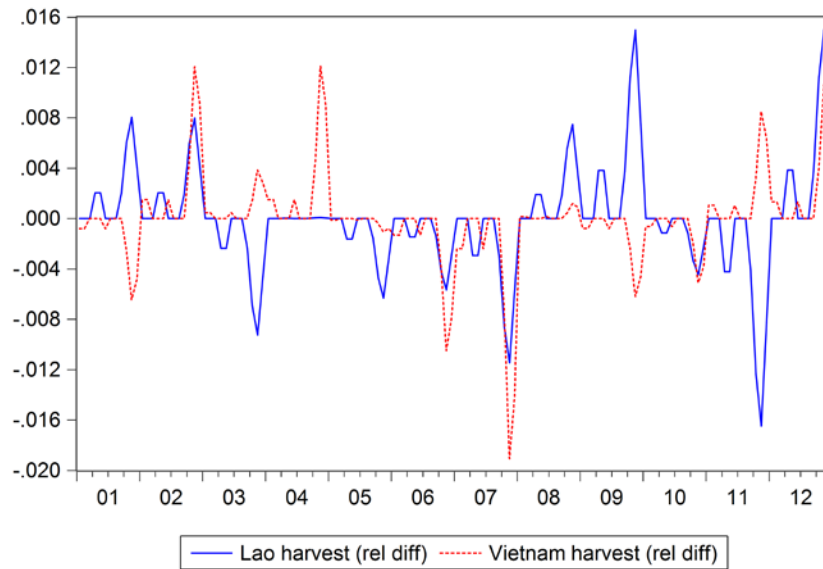




Figure 11. Lao rice harvests and exports to Vietnam

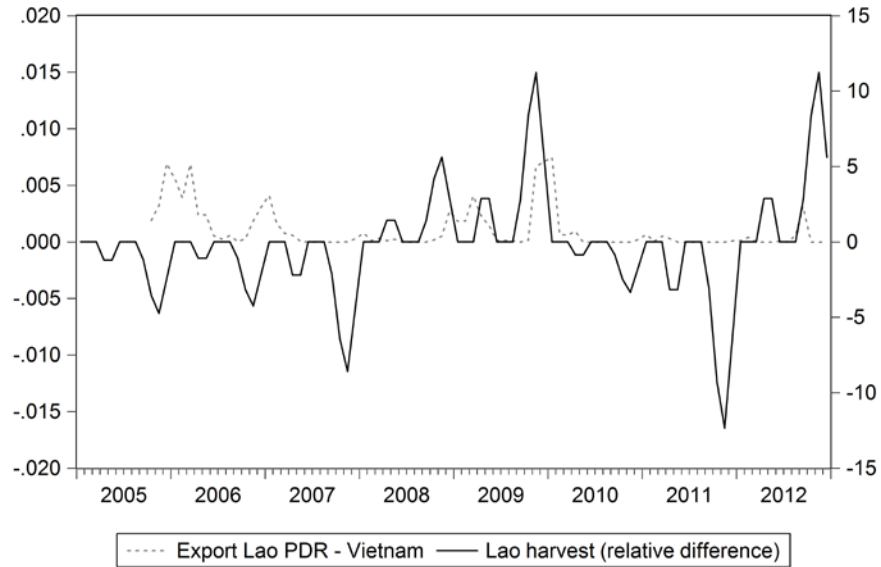


Table 4. Regressions with exports and harvest added to the ECM for Lao PDR

Variable	(1)	(2)	(3)
Error Correction Term	-0.222** [-2.384]	-0.241*** [-4.243]	-0.278*** [-3.063]
Export to Vietnam (t-6)	0.015*** [3.515]		0.010** [2.268]
Lao harvest (t-2)		-1.320 [-1.433]	-0.964 [-0.886]
Lao harvest (t-8)		3.496*** [3.771]	3.371*** [2.748]
Observations	81	136	81
Time period	2005:10-2012:12	2001:1-2012:12	2005-10-2012:12
Adjusted R-squared	0.453	0.498	0.485

Note: The error correction term is  $P_{\text{Lao PDR}} - 0.84 P_{\text{Vietnam}} - 0.20 P_{\text{Thailand}}$ .

## 5. Policy Implications

Our data analysis highlights three key issues: (1) a long-run dependence of Lao PDR rice prices on regional prices, (2) Lao PDR's low relative price level, and (3) the emergence of price spikes following periods of large exports. In this section we will briefly discuss the policy implications of these findings for Lao PDR.

Although there is a lack of detailed information about policies and market regulation, and how they have changed over time, the overall picture is reasonably clear. Since the launch of the market reform program in 1986, the New Economic Mechanism, the Lao government has implemented a range of policies to boost rice production and manage supply and prices (Bourdet, 2000). One aim was self-sufficiency at the national level, which was achieved in 1999/2000 according to the government.

Policies used to control the rice market include an import duty of 5% on paddy rice and an elaborate system of export and import permits (WFP, 2014; LAO Trade Portal, 2014). In addition, traders need authorization from provincial authorities, who collect customs levies at international border crossings that partly accrue to the provinces. On top of this, informal payments are reportedly required to move food across provincial and national borders (WFP, 2014). Moreover, the government owns a company, State Food Enterprise, which is a major actor in the rice market. It buys rice during harvests for government staff and sells rice stocks during periods of shortage to the general population, and is assumed to influence market prices (Tobias et al., 2012).

Another important factor is that domestic transport costs are high due to mountainous terrain and underdeveloped infrastructure, which sometimes make it

unprofitable to move rice from surplus to deficit provinces. As a result, surpluses in the lowland along the Mekong River might instead be exported to Thailand and Vietnam, even though there are deficits in the north. Also, in some provinces it is cheaper to import rice from abroad than from other provinces in Lao PDR (WFP, 2014).

In spite of these controls and structural obstacles, prices in Lao PDR follow those in Thailand and Vietnam well, as the cointegration analysis shows.<sup>12</sup> There are periods of a couple of years where Lao prices deviate substantially, but they eventually return to the long-run (equilibrium) path. We do not know if there is a long-run interdependence because the authorities occasionally allow for exports, or because of informal trade, or both.

The current policy of export restrictions is at least in part responsible for keeping prices relatively low in Lao PDR. We have also traced the price spikes back to the discretionary policy interventions of the government, as domestic prices are found to increase in periods where restrictions are relaxed. The 2010 price spike illustrates the dynamics well: In 2009 the harvest was unusually bountiful, so constraints on official exports were relaxed, which subsequently led to large exports. Rice prices rose slowly during the first quarter of 2010, and then rapidly until the 2010 harvest started in October. This story contrasts with FAO (2011), according to which prices rose to unusually high levels due to fears of low production in 2010, both nationally and regionally. The government may not have been able to adequately track the volume of trade over time relative to the size of the harvest, which ultimately led to overly optimistic exports and

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<sup>12</sup> Since the price level continues to be substantially lower in Lao PDR than in the neighboring countries, it appears that there are no arbitrage opportunities that would even out prices; the finding of cointegration only implies that the price difference does not change in the long run.

domestic shortages.<sup>13</sup> There is a paucity of information on unofficial exports to Vietnam, but they probably also increased; Anh and Nghiep (2012) estimate informal exports to Vietnam to be about 10% of official exports.

Against this background the lifting of trade restrictions, as is for example suggested by Eliste and Santos (2012), is arguably the first-best policy recommendation. The expectation is that this would permanently raise the domestic price of rice by substantially reducing the price gap with Vietnam and Thailand. This has the potential to significantly increase incomes from agriculture in Lao PDR. There is also a good chance that it will stimulate modernization of the agricultural sector, i.e. improve the quality of rice mills and marketing system (Lao Development Report; World Bank, forthcoming). In addition, liberalization of trade will eliminate policy-induced price spikes; as overall exports will be elevated to a new higher equilibrium level, it will plausibly limit the price impact of potential over-exporting in response to good harvests. What shape or form price spikes will assume in a free-trade world remains to be seen, but Vietnamese rice prices were relatively stable during the last decade.

While a policy of liberalization would appear to offer many benefits, it is important to remain alert to the distributional implications of such a free-trade policy.<sup>14</sup> It is conceivable that there will be both winners and losers from trade liberalization, at least in

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<sup>13</sup> Jayne and Tschirley (2010) make a similar observation on the maize market in Malawi, where in 2008-2009 a good harvest gave rise to a sharp increase in the price of maize not long thereafter. It appears that in Malawi it was government control that dictated the exports (based on its own estimates of the harvest), where in Lao PDR the exports accumulated as the government relaxed control of the cross-border trade.

<sup>14</sup> Until recently, the staple food price discussion was about whether governments should attempt to reduce food price volatility or abstain from market interventions (Dawe 2001; HLPE, 2011; Dawe and Timmer, 2012). However, the key challenge is arguably how poor countries should prevent large price spikes, since these are of a direct concern to the welfare of the poor, and have the potential to trigger political unrest (Barret and Bellemare, 2011; Jayne, 2011; Bellemare et al., 2013).

the short-term (Ravallion, 1990; Barrett and Dorosh, 1996; Ravallion, 2006, Mghenyi et al., 2011; Headey, 2013). The winners will include large land owners who are net producers while the losers will arguably include small land owners who are net consumers. However, in Lao PDR as many as 27% of households sold some rice produce in 2010/11 according to the 2012 Lao Agricultural Census.<sup>15</sup> In fact, only about 34% of the Lao households are net rice buyers, and close to a third of them spend less than 10% of their food budget on market rice purchases. It is estimated that only 26% of the poor are net-buyers compared to about 36% of the non-poor (World Bank, 2015).

In the medium to long term, many of the poor will ultimately also be better off as the benefits from the expansion of the agricultural sector will eventually trickle down. These benefits will likely be in the form of higher rural wages and an increase in demand for farm workers, see for example the study by Jacoby (2013) that establishes a significant rural wage response in India. A recent World Bank (2013) report on Cambodia also finds empirical evidence in support of this indirect effect, pointing to a significant reduction in poverty following an increase in the price of rice (which is argued to have led to an increase in rural wages and rural employment opportunities). Ivanic and Martin (2014b) obtain a similar result when simulating the impact of a rice price increase in Cambodia and Vietnam.

The benefits of the indirect effect, which constitutes a primary channel through which the poor net-consumers of rice will be compensated for the higher cost of living, may

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<sup>15</sup> As a percentage of farm households it is estimated that 71% sold some rice produce in 2010/11, up from 35% in 1998/99, which suggests that we are seeing a shift toward market-oriented agriculture (Lao Census, 2012).

not accrue instantaneously. Hence some intermediate solution that will protect the poor may be advisable; this is a topic that will require further study. There is a growing sense that cash and food transfers constitute a first-best policy to protect poor and vulnerable households against rising food prices (World Bank, 2014).<sup>16</sup> World Bank (2014) provides a comprehensive review of social protection programs around the world, focusing in particular on recent experiences in less-developed countries (see also Mokomane, 2012; and Alderman and Haque, 2006). The report recommends that social protection programs be combined with efforts to strengthen the rice sector and with investments in infrastructure.<sup>17</sup>

These and other good practice lessons can inform the government's investments into its social protection programs that could help mitigate some of the negative impacts of higher rice prices. The advantage that the government has in this case is that it can decide when to open the borders to free trade, and can hence announce its plan well ahead of time, so that both the public and the private sector can prepare for the transition.

## **6. Conclusion**

Glutinous rice is the staple food in Lao PDR and as such it is important for the welfare of many Laotians. As in numerous other less-developed countries, the Lao government monitors the staple food market closely and regularly intervenes to ensure

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<sup>16</sup> Access to highly disaggregated estimates of poverty (and other socio-economic indicators) such as poverty maps may help to improve the cost-efficiency of targeting the poor (see e.g. Elbers et al., 2007).

<sup>17</sup> Such investments would also help lower the transactions costs involved in moving rice from surplus to deficit areas.

availability of rice and stable prices. Nonetheless, real glutinous rice prices rose by close to 50% over a couple of months in 2010. The government responded by implementing an export ban, blaming farmers and millers for causing the price spike through speculation (Lao PDR, 2010). Since rapidly rising staple food prices directly affects the poor, who often spend more than half of their income on food, and may lead to political unrest, the government's reaction is not surprising.

The general view in academic and political circles is that government interventions are more often than not a contributing factor rather than a solution to price spikes, and hence a standard recommendation is to remove trade barriers all together (Anderson and Nelgen, 2012; Barrett and Bellemare, 2011; Eliste and Santos, 2012). The effectiveness of government interventions however is largely context-specific. Recent studies on several countries in Sub-Saharan Africa provide evidence that interventions in the maize markets have led to large price increases (see e.g. Chapoto and Jayne, 2009; Jayne and Tschirley, 2010; Porteous, 2012). And export and import restrictions that are associated with so-called beggar thy neighbor policies have been held responsible, at least in part, for the sharp food price increases during recent crises (Martin and Anderson, 2012; Jensen and Anderson, 2014). But there are also success stories. For example, it is commonly agreed that some Asian governments have successfully managed their rice prices (see e.g. Cummings, 2012; and Dawe and Timmer, 2012). To be able to evaluate current policy against alternatives one first needs to obtain a clear understanding of how food prices are determined in the country of interest.

We use cointegration analysis for the period January 2001 – December 2012 to test for long-run relationships between Lao, Thai and Vietnamese glutinous rice prices.

Thailand and Vietnam both have long borders with Lao PDR and are major rice producers and consumers. In a second step we use innovation accounting (impulse responses and variance decomposition) to evaluate the importance of domestic versus Thai and Vietnamese price shocks to Lao rice prices. Finally, the impact of exports and harvests on Lao prices are analyzed.

Our main findings are three-fold: First, cointegration analysis and innovation accounting show that Lao PDR is importing rice price changes in the long run by exporting its produce to Vietnam and Thailand, in spite of an elaborate set of controls on international trade. Second, the error correction models with exports and harvests added as independent variables reveal a pattern where good harvests are followed by large (official) exports, which later during the year lead to significant price increases, most likely since stocks are depleted ahead of the next harvest. Third, rice prices in Lao PDR are considerably lower than in Thailand and Vietnam, despite the evidence of market integration.

The Lao government wishes to prevent temporary price spurts while maintaining affordable rice prices by controlling exports, which has been identified as a key channel for transmitting price increases. This probably applies equally to other developing countries that export their staple food, and where a large part of the population is dependent on a staple food. This policy dilemma is not always fully appreciated by free-trade proponents.

The dilemma does not bar removal of trade barriers from being part of a recommended policy package. Trade liberalization would plausibly curb policy-induced price spikes and almost certainly raise the long-term price of rice, and thereby hopefully create the conditions for an expansion and modernization of the agricultural sector. If indeed, these developments will ultimately help to reduce poverty, as we have seen in



Cambodia (World Bank, 2013). It does mean, however, that such a reform is ideally combined with a careful assessment of the distributional implications, specifically how it would impact on poor net buyers of rice (Ravallion, 1990; Hertel et al., 2004; Ivanic and Martin, 2008; Ivanic et al., 2012).

Whatever the Lao government decides, the transition to free-trade will undoubtedly be helped if the reform package is transparent and announced well ahead of time so that both the public and private sector can prepare for it.

## References

- Ahn, D.T. and P.C. Nghiep (2012), "Rapid Assessment of Glutinous Rice Trade and Consumption in Viet Nam", Report, The World Bank, Hanoi.
- Alderman, H. and T. Haque (2006), "Countercyclical safety nets for the poor and vulnerable", *Food Policy*, 31(4): 372-383.
- Anderson K. and S. Nelgen (2012), "Trade Barrier Volatility and Agricultural Price Stabilization", *World Development*, 40(1): 36-48.
- Anderson, K., M. Ivanic, and W. Martin (2014), "Food Price Spikes, Price Insulation, and Poverty", Ch. 8 in *The Economics of Food Price Volatility*, edited by J.-P. Chavas, D. Hummels and B. Wright, Chicago and London: University of Chicago Press for NBER (forthcoming).
- Baird, S., F. Ferreira, B. Özler and M. Woolcock (2013), "Relative effectiveness of conditional and unconditional cash transfers for schooling outcomes in developing countries: a systematic review" *Campbell Systematic Reviews* 9(8).
- Barrett, C.B. and M.F. Bellemare (2011), "Why Food Price Volatility Doesn't Matter", *Foreign Affairs*, 12 July, available at <http://www.foreignaffairs.com/articles/67981/christopher-b-barrett-and-marc-f-bellemare/why-food-price-volatility-doesnt-matter>.
- Barrett, C. and P. Dorosh (1996), "Farmers' welfare and changing food prices: Nonparametric evidence from rice in Madagascar", *American Journal of Agricultural Economics*, 78(3): 656-669.
- Bellemare, M.F. (2011), "Rising food prices, food price volatility, and political unrest", MPRA Paper 31888, University Library of Munich, Germany.
- Bellemare, M.F., C.B. Barrett and D.R. Just (2013), "The Welfare Impacts of Commodity Price Volatility: Evidence from Rural Ethiopia" *American Journal of Agricultural Economics* 95(4): 877-899.
- Bouahom, B. and L. Douangsavanh (2013), "Rice Supply Chain in Lao PDR", Agriculture and Forestry Policy Research Center, National Agriculture and Forestry Research Institute (NAFRI) Ministry of Agriculture and Forestry, Lao PDR. Presentation at Developing Agriculture Supply Chain in CLMV, Khonekean, 18-22 Feb 2013.
- Bourdet, Y. (2000), "Emerging Rice Market in Laos?", Country Economic Report, Swedish International Development Agency, Stockholm.
- Byerlee, D., T. Jayne and R. Myers (2006), "Managing food price risks and instability in a liberalizing market environment: Overview and policy options", *Food Policy*, 31(4): 275-287.
- Chapoto, A. and T.S. Jayne (2009), "The Impacts of Trade Barriers and Market Interventions on Maize Price Predictability: Evidence from Eastern and Southern Africa," Food Security International Development Working Papers, Michigan State University 104, Department of Agricultural, Food, and Resource Economics.
- Cummings Jr, R.W. (2012), "Experience with managing food grains price volatility in Asia", *Global Food Security* 1(2): 150-156.
- David, C. and J. Huang (1996), "Political economy of rice price protection in Asia", *Economic Development and Cultural Change*, 44(3): 463-483.
- Dawe, D. (2001), "How far down the path to free trade? The importance of rice price

- stabilization in developing Asia”, *Food Policy* 26(2): 163-175.
- Dawe, D. and P. Timmer (2012), “Why stable food prices are a good thing: Lessons from stabilizing rice prices in Asia”, *Global Food Security*, 1(2): 127-133.
- Do, Q-T., A. Levchenko and M. Ravallion (2013), “Copying with Food Price Volatility: Trade Insulation as Social Protection”, in J-P. Chavas, D. Hummels and B. Wright (eds.) *The Economics of Food Price Volatility*, University of Chicago Press, forthcoming.
- Elbers, C., T. Fujii, P. Lanjouw, B. Ozler and W. Yin (2007), “Poverty alleviation through geographic targeting: How much does disaggregation help?”, *Journal of Development Economics*, 83(1): 198-213.
- EMC (2011), “Lao PDR Rice Sector Scoping and Design Study of Lao PDR SME Development in Selected Agriculture Sub-sectors and Value Chains”, Presentation January 2011, Vientiane: Emerging Market Consultants.
- Eliste, P. and S. Nuno (2012), “*Lao People's Democratic Republic Rice Policy Study 2012*”, Working Paper Report 78130, The World Bank.
- FAO (2001), “Special Report: FAO/WFP Crop and Food Supply Assessment Mission to Lao People's Democratic Republic”, FAO Global Information And Early Warning System on Food and Agriculture, Rome.
- FAO/WFP (2011), “Special Report: Crop and Food Security Assessment Mission to Lao People's Democratic Republic”, Rome: Food and Agricultural Organization of the United Nations and World Food Program.
- FAO, IFAD, IMF, OECD, UNCTAD, WFP, The World Bank, the WTO, IFPRI, and UNHLTF (2011), “Price Volatility in Food and Agricultural Markets: Policy Responses”, Policy Report for the G20, June.
- Galtier, F. (2013), “Managing food price instability: Critical assessment of the dominant doctrine”, *Global Food Security*, 2(2): 72-81.
- GIEWS (2014a), “FAO GIEWS Country Brief on Laos”, available at <http://www.fao.org/giews/countrybrief/country.jsp?code=LAO>.
- GIEWS (2014b), *Food Price Data and Analysis Tool*, Accessed 04-16-2014 <http://www.fao.org/giews/pricetool/>.
- GSD (2005), “Integrated Value Chain Analysis of Selected Strategic Sectors in Lao People's Democratic Republic”, Consultant report prepared for the World Bank, Vientiane: Global Development Solutions.
- Gouel, C. and S. Jean (2014), “Optimal food price stabilization in a small open developing country”, *World Bank Economic Review*, forthcoming.
- Gouel, C., M. Gautam and W. Martin (2014), “Managing food price volatility in a large open country: The case of wheat in India”, mimeo, The World Bank
- Headey, D. (2013), “The impact of the global food crisis on self-assessed food security”, *World Bank Economic Review*, 27(1): 1-27.
- Hertel, T., M. Ivanic, P. Preckel and J. Cranfield (2004), “The earnings effects of multilateral trade liberalization: Implications for poverty”, *World Bank Economic Review*, 18(2): 205-236.
- Hill, R.V. and L. Christiansen (2006), “Linking Laotian Farmers to Markets”, World Bank report, Washington D.C.
- HLPE (2011), “Price Volatility and Food Security”, A Report by the High Level Panel of

- Experts on Food Security and Nutrition of the Committee on World Food Security, Rome.
- Ivanic, M. and W. Martin (2008), “Implications of higher global food prices for poverty in low-income countries”, *Agricultural Economics*, 39(1): 405-416.
- Ivanic, M., W. Martin and H. Zaman (2012), “Estimating the short-run poverty impacts of the 2010-11 surge in food prices”, *World Development*, 40(11), pp. 2302-2317.
- Ivanic, M. and W. Martin (2014a), “Implications of domestic price insulation for global food price behavior”, *Journal of International Money and Finance*, 42: 272-288.
- Ivanic M. and W. Martin (2014b) “Short- and Long-Run Impacts of Food Price Changes on Poverty” World Bank Policy Research Working Paper 7011, Washington, D.C.
- Jacoby, H. (2013), “Food prices, wages, and welfare in rural India”, World Bank Policy Research Working Paper, No. 6412, Washington D.C.
- Jayne, T.S. (2011), Discussant’s comments on P. Timmer “Managing Price Volatility: Approaches at the global, national, and household levels”, Series on Global Food Policy and Food Security in the 21st Century, Center on Food Security and the Environment, Stanford University.
- Jayne, T.S. (2012), “Managing food price instability in East and Southern Africa”, *Global Food Security*, 1(2): 143-149.
- Jayne, T.S., N.M. Mason, R.J. Myers, R.J. Ferris, N. John, D. Mather, M. Beaver, N. Lenski, A. Chapoto, and D. Boughton (2010), “Patterns and Trends in Food Staples Markets in Eastern and Southern Africa”, International Development Working Paper 104, Michigan State University, Ann Arbor.
- Jayne T.S. and D. Tschirley (2010) “Food Price Spikes and Strategic Interactions between the Public and Private Sectors: Market Failures or Governance Failures?” *Commodity Market Review 2009–2010*, pp.121-138, Food and Agriculture Organization of the United Nations.
- Juselius, K. (2006), “*The Cointegrated VAR Model: Econometric Methodology and Empirical Applications*”, Oxford University Press: Oxford.
- Lao Census (2012), “Lao Census of Agriculture 2010/11: Highlights”, Steering Committee for the Agricultural Census, Agricultural Census Office
- Lao Trade Portal (2014), Lao Government, Vientiane, available at [http://www.laotradeportal.gov.la/index.php?r=site/display&id=456#.U1P\\_pk2KDCs](http://www.laotradeportal.gov.la/index.php?r=site/display&id=456#.U1P_pk2KDCs)
- Martin, A. and K. Anderson (2012), “Export restrictions and price insulation during commodity price booms”, *American Journal of Agricultural Economics*, 94(2): 422-27.
- Mghenyi, E., R. Myers and T. Jayne (2011), “The effects of a large discrete maize price increase on the distribution of household welfare and poverty in rural Kenya”, *Agricultural Economics*, 42, pp. 343-356
- Mokomane, Z. (2012), “Anti-Poverty Family-Focused Policies in Developing Countries”, mimeo, *Human Sciences Research Council*, Pretoria, South Africa.
- Niño-Zarazúa, M., Barrientos, A., Hickey, S., and D. Hulme (2012), “Social Protection in sub-Saharan Africa: Getting the Politics Right”, *World Development*, 40(1):163-176.
- Porteous, O. (2012), “Empirical effects of short-term export bans: The case of African maize”, Draft Working Paper, University of California-Berkeley.

- Ravallion, M. (1990), "Rural welfare effects of food price changes under induced wage responses: Theory and evidence for Bangladesh", *Oxford Economic Papers*, New Series, 42(3): 574-585.
- Ravallion, M. (2006), "Looking beyond averages in the trade and poverty debate", *World Development*, 34(8): 1374-1392.
- Svedberg P. (2012) "Reforming or replacing the public distribution system with cash transfers", *Economic and Political Weekly*, February 18.
- Timmer, P. (1975), "The political economy of rice in Asia: Indonesia", *Food Research Institute Studies*, 14(3), pp. 197-231.
- Timmer, P. (2011), "Managing Price Volatility: Approaches at the global, national, and household levels", Center on Food Security and the Environment, Stanford symposium Series on Global Food Policy and Food Security in the 21st Century, Center on Food Security and the Environment, Stanford University.
- Tobias A., I. Molina, H.G. Valera, K.A. Mottaleb and S.Mohanty (2012), *Handbook on Rice Policy for Asia*, International Rice Research Institute, Los Baños (Philippines).
- Tschirley, D. and T. Jayne (2010), "Exploring the logic behind Southern Africa's food crisis", *World Development*, 38(1), pp. 76-87.
- WFP (2014), *Food Security Atlas*, World Food Program, accessed from <http://www.foodsecurityatlas.org/lao/country/availability/food-markets>
- World Bank (2009), "Vulnerability and Safety Nets in Lao PDR", World Bank, Vientiane:, Processed.
- World Bank (2013), "Where Have All The Poor Gone? Cambodia Poverty Assessment 2013", A World Bank Country Study, Washington, D.C.
- World Bank (2014), "The State of Social Safety Nets 2014", Washington D.C.
- World Bank (2015), "Lao Poverty Policy Briefs", A World Bank Country Study, Washington, D.C.
- World Bank (forthcoming), "Lao Development Report 2014: Expanding Opportunities and Building a Skilled Workforce for broad-based growth", A World Bank Country Study, Washington, D.C.

## **Appendix**

### ***Data sources and construction***

*Lao PDR:* National average consumer prices for first grade glutinous rice. The prices are collected by the National Statistical Bureau, and can be accessed at GIEWS (2014b) data base. There are several missing observations after August 2010. These were interpolated using the CPI for glutinous rice during 2010. CPI data for glutinous rice was only publically available up to 2010, so the average of provincial prices collected by The Ministry of Industry and Commerce were used to calculate missing values for the rest of the period.

*Thailand:* Consumer prices from Ministry of Commerce in Bangkok (MOC). The original price is for 15 kg. It was converted to price per kg. The consumer prices are from the northeastern region.

*Vietnam:* Consumer prices for glutinous rice are available at province level for urban and rural areas, obtained from General Statistics Office in Hanoi. Northern Vietnam is the main destination for Lao exports for geographical reasons, so data from Northern provinces were aggregated using three different approaches: the average of the urban areas provinces in Northern Vietnam; the average of the eight provinces situated close to Laos in Northern Vietnam; principal component analysis for the eighteen Red River delta provinces in Northern Vietnam. The principal component analysis is used since there is no information about the quantities consumed. Overall there is little difference between the series so only results obtained with the latter series are reported in the main text.

*Exchange rates:* The monthly mean US dollar exchange rates from International Financial Statistics

*Lao export data:* Official exports collected by the Ministry of Industry and Commerce, measured in kilo per month.

*Paddy production:* Annual paddy rice harvests from the FAO database.

### *Additional table*

Table A1. Unit root tests

	Variable	t-ADF	Estimated root
Lao PDR	Log-level	-2.79	0.924
	1 <sup>st</sup> diff	-4.86**	
Thailand	Log-level	-2.55	0.958
	1 <sup>st</sup> diff	-4.82**	
Vietnam	Log-level	-1.97	0.967
	1 <sup>st</sup> diff	-4.65**	

Note. Three lags, trend and seasonal dummies: significance level 5%=-3.44 1%=-4.03; 5%=-2.88 1%=-3.48)