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Abstract:

Because of the relative importance of export to Thai economy, this paper searches for the best indicators to predict Thai export. We measure Out-of-Sample predictive performances of Export Business Indices in comparison with other popular macroeconomic indicators. We employ both the probit model to predict Thai-export contraction phrases, and a dynamic model to predict the value of Thai export. Our core finding is that common leading indicators outperform export business indices in many settings. Nonetheless, the latter provides supplementary information to gain insight of export dynamics.

Keywords: Leading Indicators, Thai Export, Business Cycles, Probit Model

JEL Classification: C25, E32, E37

1 Introduction

At the present time, people in various parts agree that export is one of the most important machines that bring about growth to Thai economy. The share of export to Thai GDP has grown from 42 percent in 1995 to almost 77 percent in 2008. The average growth rate of Thai

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GDP during 1998 – 2008 of 3.4 percent per year is mainly caused by the growth of export, which accounts on average for 2.7 percent per year[1].

It is in the interest of various stakeholders to predict the changes in export values of countries. In December 2001, the Bureau of Trade and Economic Indices at the Ministry of Commerce has started a program to develop the Export Business Indices (or Export Business Expectation/Situation Indices) in order to be additional tools for predicting Thai export values. The indices are also used as a part of policy plan for the government and business sectors.

Roughly speaking, the Export Business Indices are constructed using data from monthly surveys with exporters in various industries. However, similar to the international practices, the indices are constructed from just 6 simple questions, for example, "what do you think about the value of your exports in the present time compared to last month?", or "what do you think about the value of your new order in the present time compared to last month?". Each of these questions can be responded in 3 different ways, which are "better than", "the same as", or "worse than". These responses are then used to construct the indices.

It is easy to see that the construction of the indices is highly dependent on the perception of the exporters at each point in time. For the indices to be used practically, they should pass some statistical tests to guarantee that at least in the past, the indices performed well in comparison to other popular indicators. It is a main task of this paper to perform some of these tests. We compare predictive performances of these indices to other popular indicators in predicting two different export indicators of Thailand, which are, first, the contraction phases of the cyclical movement of Thai export, and, second, the value of Thai export.

The popular indicators that are used to compare with the Export Business Indices are those usually appear in leading indicator literature. Since we need to measure predictive performances of these popular indicators to compare with ones of the Export Business Indices, we expect that at the end, we can also indicate the best performer in predicting prospects of Thai export.

[1] Chaipat Poonpatpibul et.al. (2009). Is there an Alternative for Export-led Growth for Thailand?. Seminar paper in the Annual Seminar of The Bank of Thailand 2009.

2 Research Methodology

In this section, we explain the models and the process of deriving the measures of predictive performance of each indicator. We first discuss how we figure out the contraction phases of the cyclical movement of Thai export, followed by the probit model used to predict these phases, and lastly, we discuss the model we use to predict the value of Thai export.

2.1 Contraction Phases of Thai Export

Let R_t be the binary contraction indicator. It assumes two possible values as follow:

$$R_t = \begin{cases} 1 & \text{if Thai export is in a contraction phase} \\ 0 & \text{otherwise} \end{cases}$$

We define the contraction phase as the period from the date next to a peak of cyclical movement of Thai export value to the date of consecutive trough. In this way, the variable R_t assumes the value 1 throughout this contraction phase, and 0 otherwise.

We apply the process of the National Bureau of Economic Research (NBER) to figure out peaks and troughs of cyclical movement of the value of Thai export. The process, commonly mentioned as the Bry-Boschan algorithm, is widely applied in the literature, for example, Estrella and Mishkin (1998), Diebold and Rudebusch (1991), Karunaratne (2002), and Birchenhall, Osborn, and Sensier (2001).

Before applying the Bry-Boschan algorithm, we apply X-12 program to remove seasonal components from the data. The Bry-Boschan algorithm is then immediately applied. We follow the idea of Harding and Pagan (1999) and Harding and Pagan (2002) that it may not be useful to remove the trend component from the data, before figuring out the cyclical movement. According to this idea, the trend component of a time-series, which is usually a stochastic trend, plays an important part in generating cyclical movement to the data. Therefore it is quite hard to accurately separate the trend from the cyclical component. Moreover, it should be of the interests of policy makers and business planners to see the cyclical movement of data at its level, not at its growth. Hence, we apply the Bry-Boschan algorithm to the export data at its level.

2.2 The Probit Model

The first evaluation method we employ here is the measurement of predictive performances of various indicators in predicting the contraction phases of Thai export value. We follow Estrella and Mishkin (1998) in applying the probit model to form predictions.

Let $P(R_{t+h}=1)$ be the probability that the value of Thai export would fall into a contraction phase at the date $t+h$ (which means R_{t+h} assumes the value of 1), where h indicates a forecast horizon. In this study, we focus on five forecast horizons, which are $h=1,3,6,9$ and 12. The data used are on monthly basis, which means we apply the probit model to form 1-month, 3-month, 6-month, 9-month, and 12-month ahead forecasts. The probit model can be written as:

$$P(R_{t+h}=1)=F(\beta_0+\beta_1 x_t), \qquad (1)$$

where $F(.)$ represents the Standard Normal Cumulative Distribution Function, and x_t be an indicator used to form the forecast in period t. We estimate the probit model using the method of Maximum Likelihood.

Our evaluation process is of the Out-of-Sample category. The process mimics the real practice of forecasting, in the sense that it only includes data available up to the time when each forecast is made. For example, in forming a 3-month ahead forecast of the probability of Thai export being in a contraction phase in December 2000, we will use the data of independent variable x_t from the first observation up to the one in September 2000 only. Similarly, in forming a 3-month ahead forecast of the probability of Thai export falling into a contraction phase in January 2001, we will use the data of independent variable x_t up to the one in October 2000.

Let t_0 represent the month of April 2006 and t_1 represent the month of May 2010. Our evaluation process produces forecasts from date t_0+h to date t_1. This means the process repeatedly produces regression equations and forecasts for $50-h$ times, for each independent variable x_t and each forecast horizon h. A MATLAB program is constructed to perform this test.

Following Estrella and Mishkin (1998), we use *pseudo* R^2 to measure the accuracy of forecasts. For each independent variable x_t and each forecast horizon h, the *pseudo* R^2 is given by:

$$pseudo\ R^2 = 1 - \left(\frac{L_m}{L_c} \right)^{-(2/n)L_c}, \qquad (2)$$

where n represents the number of forecasts constructed ($50-h$ in this study), L_m is the maximum Log Likelihood value using forecasts constructed from the probit model (1), and L_c is the maximum Log Likelihood value using forecasts constructed from a probit model without any independent variable x_t.

Specifically, the Log Likelihood value L_m can be written as:

$$L_m = \sum_{t=t_0-h}^{t_1} \left[(1-R_{t+h}) \ln(1-\hat{P}_{t+h}) + R_{t+h} \ln(\hat{P}_{t+h}) \right], \qquad (3)$$

where $\hat{P}_{t+h}$ is the forecast constructed from the model (1) for the date $t+h$. The probit model without any independent variable x_t is given by:

$$P(R_{t+h}=1) = F(\gamma_0). \qquad (4)$$

The Log Likelihood value L_c can be written as:

$$L_c = \sum_{t=t_0-h}^{t_1} \left[(1-R_{t+h}) \ln(1-\hat{P}^c_{t+h}) + R_{t+h} \ln(\hat{P}^c_{t+h}) \right], \qquad (5)$$

where $\hat{P}^c_{t+h}$ is the forecast constructed from the model (4) for the date $t+h$.

The value of *pseudo* R^2 should be between 0 and 1. The value close to 1 implies that the independent variable x_t increases the accuracy of forecasting the probability of Thai export falling into a contraction phase, while the value close to 0 implies that the independent variable x_t possesses little valuable information in forecasting the probability. However, since our evaluation process is of Out-of-Sample category, the actual value of *pseudo* R^2

may turn out into a negative value. This just indicates a bad forecasting performance of the independent variable x_t, without providing any additional implication.

2.3 Model to Forecast Value of Export

Apart from applying probit model to predict the probability of Thai export falling into a contraction phase, we also employ a model to predict the value of Thai export directly. This model is a small variant of the one employed by Stock and Watson (2003). The model seeks the incremental predictive performances beyond the basic autoregressive model that each indicator contributes.

In the forecasting literature, the autoregressive model has frequently shown its superior position, in the sense that it can perform well in Out-of-Sample predictions than structural models constructed from Keynesian frameworks (Diebold, 1998). The idea is that an observation of a variable in the past contains valuable information in predicting itself in the future. If an independent variable x_t can increase the Out-of-Sample predictive performances of the autoregressive model, this implies that x_t also contains some valuable information in predicting the variable in the future and this information cannot be found from the variable in the past.

We implement the model shown in equation (6) below:

$$y_{t+h} = \alpha_0 + \alpha_1 x_t + \beta_0 y_t + \beta_1 y_{t-1} + \ldots + \beta_{12} y_{t-12} + \varepsilon_t^h, \qquad (6)$$

where y_t represents the value of Thai export in date t, and ε_t^h represents the error term in date t with forecast horizon h.

The predictive performances of model in (6) will be compared with ones of the autoregressive model as specified below:

$$y_{t+h} = \alpha^{(AR)} + \beta_0^{(AR)} y_t + \beta_1^{(AR)} y_{t-1} + \ldots + \beta_{12}^{(AR)} y_{t-12} + \varepsilon_t^{h(AR)}. \qquad (7)$$

The only difference of (7) from (6) is the presence of independent variable x_t. As discussed above, if the model in (6) has better predictive performances than one in (7), the independent variable x_t contains useful information in predicting y_{t+h}.

We use the Mean Squared Forecast Error (MSFE) to measure the forecast accuracy of this model. The MSFE from model in (6) will be compared with the MSFE from model in (7). We will report just the relative value between the two. This Relative MSFE can be written as:

$$\text{Relative MSFE} = \frac{\sum_{t=t_0+h}^{t_1}(y_{t+h} - \hat{y}_{t+h})^2}{\sum_{t=t_0+h}^{t_1}(y_{t+h} - \hat{y}_{t+h}^{(AR)})^2}, \qquad (8)$$

where $\hat{y}_{t+h}$ is the forecast value for date $t+h$ from model in (6) and $\hat{y}_{t+h}^{(AR)}$ is the forecast for date $t+h$ from model in (7).

Our evaluation process for this model will be of the Out-of-Sample category as well. Similar to the previous section, let t_0 represents the month April 2006 and t_1 represents the month May 2010. The evaluation process starts from constructing forecasts for date t_0+h up to date t_1. This needs the construction of forecasts $50-h$ times for each independent variable x and each forecast horizon h. We write a MATLAB program to perform this task.

3 Data

All data used in this study are monthly, starting from December 2001 to May 2010. The dependent variables or target variables that we want to forecast are 1) the probability of Thai Export falling into a contraction phase and 2) the value of Thai export. The data of the value of Thai export are from the Bureau of Trade and Economic Indices, Ministry of Commerce. The data are in real term and seasonally adjusted.

The Export Business Indices are composed of four indices, which are Export Value Index (CSE1), New Orders Index (CSE2), Inventory Index (CSE3), and Employment Index (CSE4). As mentioned before, these indices are constructed from a monthly survey by the Bureau of Trade and Economic Indices, Ministry of Commerce. These indices are seasonally adjusted through the X-12 program.

Other indicators evaluated in this study are some leading indicators and many macroeconomic indicators popularly used in constructing leading indicators. We collect these data from various sources, including the Bureau of Trade and Economic Indices, Ministry of Commerce, the Bank of Thailand, the Ministry of Finance (MOF), and the U.S. Foundation for

International Business and Economic Research (FIBER). The details of these indicators are in Table 3.1 below. All are seasonally adjusted.

Table 3.1: Indicators used to compare with Export Business Indices

Symbol	Indicator Name	Growth Rate	Source
THLLD	Medium-term Leading Economic Index		Bureau of Trade and Economic Indices
THLD	Short-term Leading Economic Index		Bureau of Trade and Economic Indices
CO	Coincident Economic Index		Bureau of Trade and Economic Indices
CAPB	Construction Areas Permitted in Bangkok Metropolis		Bank of Thailand
VACN	Value of Authorized Capital for Newly Registered Businesses		Department of Business Development, MOC
SETI	SET (Stock Exchange of Thailand) Index		Bank of Thailand
NFTO	Number of Foreign Tourists		Bank of Thailand
VMNM	Narrow Money		Bank of Thailand
VMBM	Broad Money		Bank of Thailand
MPI_SA	Manufacturing Production Index (MPI)		Bank of Thailand
AILR	Average Interbank Overnight Lending Rate		Bank of Thailand
CO06	Business Tax, VAT, and Specific Business Tax		Revenue Department, MOF
CO07	Import Duties		Customs Department, MOF
DSMV	Quantity of Automobile Sales		Bank of Thailand
IPRI	Growth of Import Price Index	✓	Bank of Thailand
PCEM	Production of Cement		Bank of Thailand
PETI	Growth of World Oil Price Index	✓	FIBER
VDCL	Growth of Domestic Loans	✓	Bank of Thailand
VIMP	Real Import Value (In Baht)		Bank of Thailand
CUTR	Growth of Capacity Utilization	✓	Bank of Thailand
IMPI	Growth of Industrial Material Price Index	✓	FIBER
JALD	Japan Leading Economic Index		FIBER
PBEE	Production of Beer		Bank of Thailand
PCVE	Production of Commercial Vehicles		Bank of Thailand
PMCY	Production of Motorcycles		Bank of Thailand
TOTI	Terms of Trade Index		Bank of Thailand
VEXP	Real Export Value (In Baht)		Bank of Thailand

In summary, we have two dependent variables, which are 1) the probability of Thai Export to fall into a contraction phase and 2) the value of Thai export, and 31 independent variables. Four of our independent variables are Export Business Indices, and other 27 are as shown in Table 3.1.

4 Empirical Results

In this section, we present our results in the same order as explained in the Research Methodology. That is, the result on identifying Thai-export contraction phases is firstly presented in section 4.1, the accuracy of each indicator in forecasting these contraction phrases using probit model is then discussed in section 4.2. And last but not least, section 4.3 describes the predictive performance of each indicator in forecasting the value of Thai export.

4.1 Contraction Phases of Thai Export

Figure 4.1 illustrates the peaks and troughs of the cyclical movement of Thai-export value identified using Bry-Boschan algorithm.

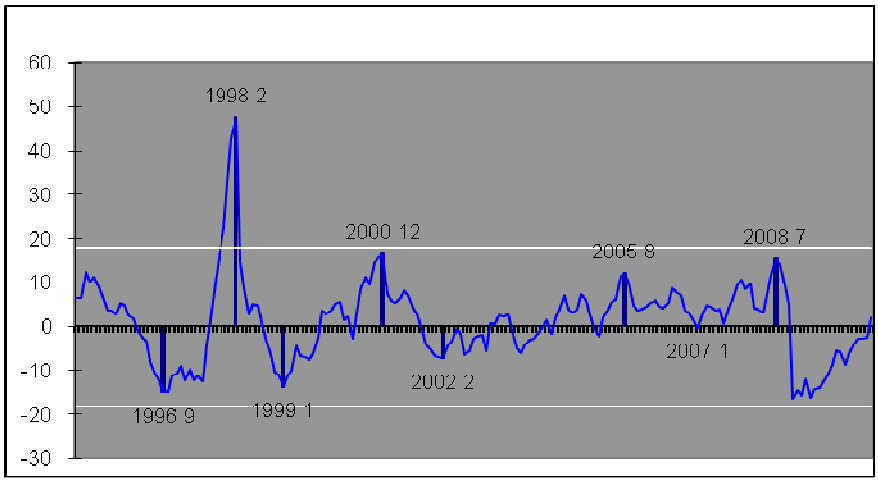

Figure 4.1: Cyclical Movement of Thai-Export Value

Table 4.1: The Chronological List of Peak and Trough Dates of Thai-Export Value

Peaks	Troughs
Feb 1998	Sep 1996
Dec 2000	Jan 1991
Aug 2005	Feb 2002
Jul 2007	Jan 2007

4.2 Predictive Performances in Predicting Thai-Export Contraction Phrases Using Probit Model

In this section, we present the results of using Probit Model in measuring the predictive power of our indicators of interest, including both Export Business Indices and other common leading indicators. Pseudo R^2 signifying the forecast accuracy of each indicator are shown below for each forecast horizon (1, 3, 6, 9 and 12 months). Only computable, nonnegative pseudo R^2 are reported. The higher pseudo R^2, the better the performance of the variable as a predictor of Thai-export contraction phrases.

Table 4.2 Performance on Predicting the Contraction Phrases of Thai Export

	1-m	3-m	6-m	9-m	12-m
CSE1	0.021	0.051	0.091	0.136	0.132
CSE2	0.031	0.079	0.145	0.213	0.194
CSE3			0.091	0.294	**0.373**
CSE4	0.052	0.151	0.185	0.198	0.285
THLLD			0.106	0.244	0.179
THLD	0.227		0.031		
CO	0.083				
CAPB					
VACN					
SETI					
NFTO	0.143		0.081	0.151	0.095
VMNM	0.512				
VMBM	0.512				
MPI_SA	0.290				
AILR					
CO06	0.292				
CO07	0.293	0.356	0.190	0.093	
DSMV	0.016				
IPRI	**0.706**		**0.853**	**0.755**	0.176
PCEM					
PETI	0.082				
VDCL	0.536	**0.615**	0.532	0.410	0.243
VIMP	0.303				
CUTR	0.101				
IMPI	0.049				
JALD					
PBEE	0.082	0.090			0.039
PCVE	0.045				
PMCY	0.008				
TOTI	0.142	0.123			
VEXP	0.298				

Table 4.2 demonstrates that, in general, common leading indicators perform better than Export Business Indices in predicting the contraction phrases of Thai export.

Common leading indicators with high predictive power are Growth of Import Price Index (IPRI), Growth of Domestic Loans (VDCL), Narrow Money (VMNM) and Broad Money (VMBM). Other leading indicators with slightly lower predictive power include Manufacturing Productive Index (MPI_SA), Business Tax, VAT and Specific Business Tax (CO06), Import Duties (CO07), Real Import Value (VIMP) and Real Export Value (VEXP).

Among Export Business Indices, Export Inventory Index (CSE3) performs best for 9-month and 12-month forecast horizons, and Export Employment Index (CSE4) for the cases of 1-month, 3-month and 6-month forecasts.

Table 4.3 List of the Best Predictors for Each Forecast Horizon

Forecast Horizon	1-month	3-month	6-month	9-month	12-month
Best Performing Indicator	IPRI	VDCL	IPRI	IPRI	CSE3

Independent variables with highest predictive power mostly are common leading indicators. While Growth of Import Price Index (IPRI) performs best in most models, Growth of Domestic Loans (VDCL) has the highest predictive accuracy when forecasting 3 months ahead. Export Inventory Index (CSE3) is the only Export Business Index that predicts Thai-export contraction phrases best for the case of 12-month forecast horizon.

4.3 Predictive Performances in Forecasting Thai-Export Value

In this section, we discuss the results of using independent variables – both Export Business Indices and other common leading indicators – to forecast Thai-export value. The forecast accuracy of each variable represented by Relative RMSE is shown below for each forecast horizon (1, 3, 6, 9 and 12 months). Only computable, not-exceeding-one Relative MSFE are reported. The lower Relative MSFE, the better the performance of the variable as a predictor of Thai-Export Value.

Table 4.4 Performances on Predicting the Value of Thai Export

	1-m	3-m	6-m	9-m	12-m
CSE1					0.913
CSE2					0.899
CSE3	0.999		0.981	0.804	**0.483**
CSE4				0.900	0.634
THLLD				0.920	0.821
THLD	0.928	0.833	0.933	0.990	
CO	0.961	0.948			
CAPB				0.954	0.951
VACN					
SETI	0.986	0.973			
NFTO	0.952	0.841	0.705	0.767	0.714
VMNM	0.908	0.782	0.889	0.983	
VMBM	0.969	0.874	0.986		
MPI_SA	0.963	0.925			
AILR					
CO06	0.953	0.886			
CO07			0.957	0.727	0.684
DSMV	0.957				
IPRI	**0.851**	**0.560**	**0.517**	**0.608**	0.716
PCEM					
PETI	0.951	0.818			
VDCL	0.939	0.859			
VIMP	0.884	0.876			
CUTR					
IMPI	0.966	0.864	0.987		
JALD					
PBEE		0.984	0.976	0.998	0.819
PCVE	0.976	0.960			
PMCY	0.983	0.988			
TOTI		0.986			
VEXP	0.996	0.914			

In most cases, common leading indicators perform better than Export Business Indices in forecasting the value of Thai Export. The only exception is in the case of 12-month ahead forecast where Export Inventory Index (CSE3) yields higher predictive accuracy than the rest of indicators.

Common leading indicators that perform well, signified by comparatively low Relative MSFE, include Growth of Import Price Index (IPRI), Number of Foreign Tourists (NFTO), Import Duties (CO07), and Narrow Money (VMNM).

Among Export Business Indices, Export Inventory Index (CSE3) stands out as the best performing indicator.

Table 4.5 List of Best Predictors of Thai-Export Value for Each Forecast Horizon

Forecast Horizon	1-month	3-month	6-month	9-month	12-month
Best Performing Indicators	IPRI	IPRI	IPRI	IPRI	CSE3

In most models, common leading indicator - particularly Growth of Import Price index (IPRI) – is the best predictor of Thai-Export Value. An Export Business Index – particularly Export Inventory Index (CSE3) - has the highest forecast accuracy only when the forecast horizon is 12 months.

5 Conclusion

This study intends to construct the early warning model for Thai international trade - particularly the contraction of Thai Export - as export plays such a vital role to the growth of Thai Gross Domestic Product.

Past literature applied the Bry-Boschan algorithm to identify peaks and troughs of both dependent and independent variables, and compared their turning points to figure out the independent variables that lead the movement of the dependent variable of interest. This study, however, adopts methods widely used in recent literatures. Firstly, we use probit model to identify variables that can predict Thai-export contraction phrases best; same method is employed by Estrella and Mishkin (1998). Secondly, we construct the model similar to that of Stock and Watson (2003) to identify the variables that can predict the value of Thai export with highest predictive accuracy. Our evaluation of both models is of the Out-of-Sample category.

Section 4.2 reports the results of using probit model to predict the contraction phrases of Thai export. Independent variables which are common leading indicators, such as Growth of Import Price Index and Growth of Domestic Loans, are better predictors than Export

Business Indices constructed from a monthly exporter survey. Export Inventory Index is the only Export Business Index that has highest forecast accuracy and only in the case of 12-month ahead forecast.

Section 4.3 presents the results of measuring predictive performance of each indicator in forecasting Thai-export value. Similar to the outcomes shown in section 4.2, common leading indicators are better predictors of Thai-export value than Export Business Indices. Growth of Import Price Index is still the best performing indicator in most cases. In addition, Export Inventory Index is the variable with highest predictive accuracy when the forecast horizon is 12 months.

This study, however, has one important limitation: the number of data used is quite limited. Since Export Business Indices were firstly constructed by Bureau of Trade and Economic Indices, Ministry of Commerce in December 2001, data available for this study hence starts from December 2001 to May 2010. This limited time range, combined with the Out-of-Sample forecast technique, leaves us with only 50 months of data for the evaluation. An abnormality in the relationship between variables in any period within these 50 months could hence cause our result to be less accurate. Greater number of data available in the future would bring about higher creditability of the study.

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