The common sources of business cycles in Trans-Pacific countries and the U.S.? A comparison with NAFTA*

Uluc Aysun[1]
University of Central Florida

Takeshi Yagihashi[2]
Old Dominion University

Abstract
This paper uses both a nonstructural and a structural approach to investigate the drivers of the business cycles in the US and 15 Trans-Pacific (TP) countries. Our nonstructural analysis, based on a principal component methodology, reveals the shares of variation in macroeconomic variables that are due to factors common to both the US and the TP region, and factors that are region specific. We obtain similar measures by using a structural model (an estimated two country dynamic stochastic general equilibrium model) that allows for common and correlated shocks across the two regions. The clear and common finding from our analyses is that common shocks explain a substantial amount of macroeconomic variation. Comparison with the NAFTA region, along this dimension, reveals that the US economy is more similar to the TP region (a wider region that also includes Mexico and Canada) than its two neighbors.

Keyword(s): Principal component analysis, DSGE, Bayesian estimation, Trans-Pacific, NAFTA.

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[1] UCF College of Business Administration, 4000 Central Florida Blvd., P.O. Box 161400, Orlando, FL 32816. Email: uaysun@bus.ucf.edu Homepage: www.ulucaysun.com
[2] Old Dominion University, Strome College of Business, Norfolk, VA 2352. Email: tyagihas@odu.edu

1. Introduction

The Trans-Pacific Partnership (TPP) Agreement, signed February 2016, is designed to increase the economic integration of 12 economies by lowering tariff and non-tariff barriers to trade. From the perspective of the US, one impetus for the TPP is the potential diversion of trade away from China and the greater presence that US would have in the East Asian and world trade markets. The risk is that the region includes a diverse group of countries at different stages of development and thus closer ties that the US forms with this region could endanger its economic stability. There are, however, indications that these risks may not be as great as recent research, albeit mostly on advanced economies, suggests as economies in the world have become more aligned as a result of deeper financial integration and faster cross-country transmission of technological advances. The topic of this paper is very political and controversial, and recently US has withdrawn from the partnership.

In our paper, we put aside the political and social aspects of TPP and judge the potential merits of the agreement in terms of macroeconomic volatility if the US were to ratify it in the future. We do so by identifying shocks/components that affect the TP and US economies similarly and then determining their importance for volatility in the two regions. This allows us to infer, reasonably, that if shocks that are common to both regions cause substantial fluctuations of macroeconomic variables in the two regions then the two economies are similar. Conversely, if local shocks are the main drivers of local business cycles then the US and TP economies are not similar structurally and that the potential costs of joining TPP would be high for the US.[1] There is

[1] We should mention that economic integration is a broad topic including not just business cycle alignment but also similarity of sectoral composition, labor and capital mobility and policy alignment. While these aspects of integration are strongly related to business cycle alignment, we choose our approach mainly to make our analysis more focused.

one clear inference from our analysis: common shocks explain a large share of the variation in the endogenous variables in both regions and they are often more important drivers of fluctuations than local shocks. The strength of this finding comes from the fact that both a nonstructural and a structural analysis, a principal component analysis and a DSGE (Dynamic Stochastic General Equilibrium) analysis, point in the same direction. To put our findings in perspective, we use the NAFTA (North American Free Trade Agreement) region as a point of reference. Specifically, we replace TP data with those from Canada and Mexico to identify common shocks and quantify their importance for the NAFTA region. It should be noted here that Canada and Mexico are a part of both NAFTA and TPP. By comparing the US-TP and US-NAFTA groupings, therefore, we are assessing whether the U.S. economy is more aligned with a larger region with a more diverse group of countries (including Canada and Mexico) or with its two neighbors. This comparison, under both methodologies, indicates a greater degree of commonality in the US-TP grouping.

In the first half of the paper, we use a principal components methodology to identify the role of common factors that are shared among the US and TP regions from a large panel of time series data formed by key macroeconomic variables (output, consumption, investment, price of foreign goods, price of domestic goods, risk-free interest rate, risk premium, wage rate, labor supply, firms' net worth) for each region and a common exchange rate variable. Principal component analysis is often used to identify the unobservable set of factors that jointly explain the co-movements of observed variables. This method is particularly useful when the structure of the economy is unknown. In our paper, we further decompose the factor space recovered from the principal components into US/TP common factors and region-specific factors using the factor-augmented vector autoregression (FAVAR) approach. To identify US/TP common factors, we treat the region-specific factors as observed closely following the strategy in Boivin et al. (2009)

and Boivin and Giannoni (2010). The strength of our approach is that it does not require unreasonable assumptions (such as the recursiveness assumption among factors) to attain decompositions which are hard to justify based on either conceptual or empirical grounds.

We find that for ten US variables, principal components explain on average 67.2% of the variation, 44.0% of which is due to US/TP common factors and 23.2% to region-specific factors. The remaining variation is variable-specific. We find a similar result for the TP variables albeit with slightly higher numbers (74.2% of the variation explained through principal components and 40.6% through US/TP common factors). The results thus suggest a high level of similarity through common factors. When we replace TP variables with those from Canada-Mexico, we find that out of the 68.5% variation in the US explained by principal components, 37.4% is due to common factors. The corresponding shares for the Canada-Mexico region are 65.3% and 34.2%, respectively. Comparing these with those reported above, we infer that while common shocks are again important drivers of volatility, their shares are lower in the NAFTA region.

In the second half of the paper, we use the same data but we impose structural restrictions on how the two economies (US-TP or US-Canada&Mexico) behave to inform us about the degree of similarity. To do so, we build a large scale two country DSGE model that incorporates the nominal and real rigidities in Bernanke et al. (1999), Christiano et al. (2005), Smets and Wouters (2007) and shares the open economy features of Justiniano and Preston (2010). We estimate the model by using the US and TP data mentioned above and a Bayesian methodology. We then replace TP data with those for the Canada/Mexico region and repeat our estimations. These estimations allow us to identify structural shocks and determine their contribution to macroeconomic volatility. The unique part of our analysis here lies in the definition of the shock processes. Specifically, we distinguish between common and local shock, and we allow local shocks to be correlated across the two regions. Common shocks affect each region symmetrically and local shocks are transmitted to the other region. Our estimation methodology then allows us to identify the unique contributions of local and common shocks, and cross-country shock transmission to the variance decomposition of macroeconomic variables.

The results similarly demonstrate the importance of common shocks and a greater degree of similarity between the US and TP region. The share of common shocks are large (with an average share of 33.3 % and 31.0% in the forecast error variance decompositions of US and TP variables, respectively) and the contribution of common shocks to macroeconomic volatility is higher for the US-TP pairing compared to the US–Canada&Mexico pairing (with an average of 24.3% and 6.8% in the forecast error variance decompositions of 10 variables from the US and Canada/Mexico regions, respectively). The results also show, for each estimation and region pairing, that demand shocks are the main drivers of the real variables in our model (i.e., output, consumption, investment and labor supply). In addition, we find that the transmission of shocks that the US receives from Canada/Mexico (34.5%) is stronger than it is from the TP region (21.9%) and that the share of this source of macroeconomic volatility for the US is larger than common shocks. It is reasonable to infer from this that the US economy experiences a greater degree of instability through shocks originating in Canada and Mexico than it does through TP shocks.

Based on the aspects of economic similarity that we investigate in this paper, the overall conclusion that we draw is that the US economy is more similar to those in the TP region than it is with the economies of Canada and Mexico. In addition, these two countries present a greater source of external instability for the US than TP countries and thus the economic stability losses that the US would incur by joining TPP would be lower than those she incurs through NAFTA.

Our work is related to a broad literature on the sources of international business cycles (e.g. Clark and Shin, 2000; Crucini et al., 2011; Engle and Kozicki, 1993; Kose et al. 2003; Kose et al., 2012; Mumtaz et al., 2011). A majority of the studies in this literate use dynamic factor analyses to identify the regional and domestic drivers of business cycles. The evidence is mixed. While studies such as Kose et al. (2012) and Mumtaz et al. (2011) find evidence that business cycles in the world are becoming less synchronized, the findings of Crucini et al. (2011) indicate otherwise. Compared with this research, the group of countries that we consider make our analysis unique. The sources of business cycle fluctuations in TP countries and what they imply for the TP-US integration has not been determined yet to the best of our knowledge. Our main contribution, however, lies in our methodology as we deviate from the aforementioned studies in two ways. First, in addition to the common and domestic driving factors, we also include and identify the TP specific drivers of US business cycles (and vice versa). In our estimated DSGE model we find, for example, a strong degree of shock transmission in the NAFTA region. The scope of this analysis is wider than those in studies that either consider shock transmission (e.g. Schmitt-Grohe, 1998; Canova and de Nicolo, 2003) or common shocks (e.g. Crucini et al., 2011; Kose et al., 2012) as the source of business cycles. Second, while most studies investigate the comovements between real or nominal variables, we allow for and investigate the interaction between the two types.

Our finding that U.S. faces lower volatility when it is paired with the TP region, a larger and more diverse trade region compared to NAFTA, is consistent with empirical evidence. Studies such as Bejan (2006) and Cavallo (2008), for example, find lower economic volatility (especially for developed economies) with higher trade when government size and external risks are accounted for. Haddad et al. (2013) reach a similar conclusion but also find that trade diversity further reduces the volatility of output growth. There are also studies indicating that trade partnerships with larger regions of similar size (i.e., TPP for the U.S.) are associated with a higher degree of trade creation (and thus trade openness) and welfare gains (Baier and Bergstrand, 2004; Helpman, 1987; Hummels and Levinsohn, 1995). We should note here that our finding of the greater importance of common shocks for the U.S.-TP pairing does not imply that U.S. trade with this region is less diversified than its trade with Canada and Mexico. In fact, TP economies represent a diverse region in which Canada and Mexico constitute only a subset. The greater importance of common shocks that we find here simply implies that U.S. and TP economic fluctuations are due to more similar factors. The reason why this finding could imply that joining TPP poses lower risks for the U.S. than what currently NAFTA does is because research shows that higher trade prompted by trade agreements enhance economic integration through stronger financial, demand and real sector linkages (Calderon, et. al, 2007; Clark and van Wincoop, 2001; Coe and Helpman, 1995; Frankel and Rose, 1998; Kose and Yi, 2002).[2] This in turn makes it easier for shocks to be transmitted from one region to the other. If the two regions face different shocks, policy responses may also be different and an asymmetric shock in one region can destabilize the other and jeopardize the partnership. The fact that we find a stronger degree of transmission from Canada and Mexico to the U.S. than from the TP countries to the U.S. reinforces our main message that TPP would pose smaller macroeconomic risks for the U.S. economy compared to NAFTA.

Our comparison of the merits of the two trade agreements is different from the studies mentioned above in two main ways. First, we take a more general approach to assessing the

[2] The theoretical prediction in this literature is that, trade integration increases economic integration only if it leads to higher intra-industry trade than inter-industry trade (that in turn leads to specialization and unsynchronized business cycles). Empirical evidence overwhelmingly shows that trade integration increases economic integration. This result is attributed to factors such as policy coordination, more rapid diffusion of technology and knowledge, and a larger volume of cross-border portfolio holdings and banking claims that accompany higher trade integration.

benefits of economic integration. In addition to trade integration, we also consider the real sector, demand side and financial integration across economies when comparing the macroeconomic risks of NAFTA and TPP for the U.S. economy. This paper is the first to make this comparison to the best of our knowledge. Second, we investigate the comovements of economic variables by using both a nonstructural and a structural approach unlike the studies above that use one or the other.

Our structural approach is based on a DSGE framework that is related to the literature that expanded after the crisis in 2008. Research has since sought more rigorous ways of suppressing risk-sharing and consumption correlation in standard two-country models (as initially pointed out by Backus et al., 1992). This in turn allowed models to explain how a crisis depresses activity simultaneously in the world and to generate the high output correlation in the data. To find a closer data-model match researchers have included trade frictions and home-bias in portfolio holdings, allowed for incomplete asset markets, incorporated global banking activity, and production and technology alignment.[3] Our analysis is fundamentally different from these papers. Instead of including a source of friction or mechanism that can generate common shocks, we allow the data to reveal the source of these shocks and their contribution to output volatility. One could conduct a horse-race between the different mechanisms above to find the one that does a better job of absorbing common shocks. We refrain from doing so, nevertheless, as we are primarily interested in the contribution of common shocks and not their source. Imposing a parsimonious structure along the international dimension, thus, is the best way for our computational analysis.

[3] See Obstfeld and Rogoff (2001), Backus, et al. (1992), Zimmermann (1997), Ravn and Mazzenga (2004) for trade frictions and home-bias in portfolio holdings. See Kollmann (1996), Kehoe and Perri (2002), Heathcote and Perri, (2002) for incomplete asset markets. See Alpanda and Aysun (2014), Devereux and Yetman (2010), Kollmann et al. (2011) for global banking. See, Elliott and Fatás (1996), Kose and Yi (2001), Stockman and Tesar (1995), Keller (2004) for production and technology alignment.

2. Principal Component Analysis

In this section we explain how we construct our dataset, we describe our principal component methodology and we discuss the results that we obtain by using this methodology.

2.1. The Trans-Pacific region

The Trans-Pacific region generally refers to the group of countries spread across Asia, Oceania, and the Americas. In this paper, we specifically select 15 countries to represent the entire region: nine countries from Asia (Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand), two from Oceania (Australia, New Zealand), and four from Americas (Canada, Chile, Mexico, Peru). The GDP of these 15 TP countries plus US totals \$31,582.7 billion (2014, in current US dollars), which is roughly 40 percent of the world GDP. As we display in Table 1, the GDP of 15 TP countries combined is \$14,234.6 billion and the US GDP is \$17,348.1 billion. The two regions that are the focal point of our paper are similar in size and thus the two country model that we use in our structural analysis is a reasonable way to capture the dynamics and interrelations of the two regions.

Amongst the TP countries, Japan has the largest GDP, which constitutes roughly one-third of the total TP GDP. Canada and Mexico, who form North-American Free Trade Agreement (NAFTA) with the US, have a combined GDP equivalent to one-fifth of TP GDP. Eight non-OECD countries have combined GDP that is similar in size with Canada and Mexico, but their total population (518.5 million) is much larger than Canada and Mexico combined.[4] These non-OECD countries also tend to have high trade share, showing their economic dependence with larger trading partners such as US and Japan.

[4] These are Hong Kong, Indonesia, Malaysia, Peru, Philippines, Singapore, Taiwan, Thailand.

The selection of the 15 TP countries is motivated by the ongoing discussion regarding the Trans-Pacific Partnership: 9 of the 15 countries are officially participating in the negotiation process and other three have expressed their interest in joining the partnership.[5] Due to lack of interest, China and Russia are not included in our definition of the Trans-Pacific region, even though both countries play an important role in the region.[6] Although Vietnam and Brunei Darussalam are in the group of the original signatories of the agreement, they are dropped because of limited data availability. Hereafter, we use the abbreviation "TP" to collectively refer to the group of countries mentioned above.[7]

2.2. Dataset and principal component extraction

We begin our analysis by collecting the following 13 variables for the 15 TP countries: (1) output, (2) consumption, (3) investment, (4) price of foreign goods, (5) price of domestic goods, (6) risk-free interest rate, (7) short-term risk-free interest rate, (8) risk premium, (9) rental rate of capital, (1) wage rate, (11) labor, (12) net worth, and (13) exchange rate. The panel dataset that we construct is balanced and the sample period is 1991Q2 – 2014Q4 (T = 95). The data definitions are provided in Appendix A. The main reason we choose these variables is to align our principal component analysis with our DSGE analysis. As we explain in the next section, the variables listed above are commonly used in large scale DSGE models to describe the real and financial sectors of

[5] The official TPP members are Australia, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore. Countries that have expressed interest in TPP are South Korea, Taiwan, Thailand (Mercurio, 2014).

[6] Vietnam and Brunei Darussalam are also in the group of the original signatories of the agreement. We drop these two countries from our sample because of limited data availability.

[7] To abbreviate country names in tables/figures, we adopt the 3-letter codes used by the United Nations: Australia=AUS, Canada=CAN, Chile=CHL, Hong Kong=HKG, Indonesia=IDN, Japan=JPN, Korea=KOR, Malaysia=MYS, Mexico=MEX, New Zealand=NZL, Peru=PER, Phillippines=PHL, Singapore=SGP, Taiwan=TWN, Thailand=THA, United States=USA.

an economy and the price setting behavior that takes place. The sample period choice is largely dictated by data availability.

Table 2 shows some summary statistics for the US and TP variables listed above. Column (a) and (b) represents the sample mean and the sample standard deviation. During the sample period, US output grew faster than TP on average (2.59% versus 2.34%, quarterly basis) and TP variables (whose construction is described below) generally have larger standard deviations than their US counterpart. The numbers in column (g) show the pairwise correlation between US and TP variables. The correlation coefficients are high for import price inflation and short-term risk-free interest rates and low for wage inflation and home price inflation. It is important to note that the correlation coefficients of output, consumption, and investment are all positive and non-trivial in magnitude. The goal in our paper is to identify the drivers of this positive correlation.

The next step is to construct TP aggregates for each series. For this purpose, we use a Principal Component Analysis (PCA) that is, as mentioned above, a nonparametric approach designed for understanding the relationship between variables when the underlying the mechanism/structure that links the variables is unknown. Before extracting principal components, we log-difference all series, excluding rate of return measures which are linearly detrended, and we normalize series so that each has a variance of one.

We proceed by extracting the first principal component for each series j by using the following formulation:

$$X_{j,t}^{c} = \lambda_{j}^{c} f_{j,t} + e_{j,t}^{c}, \tag{1}$$

where $f_{j,t}$ is the principal component common across all countries, λ_j^c is the associated factor loading for country c, and $e_{j,t}^c$ is the error term. The above equation can be further rewritten in stacked form as

$$X_j = f_j \lambda_j^{'} + e_j \tag{2}$$

where X_j, e_j are T-by-C matrices and f_j, λ_j are vectors of T and C elements (T denoting the number of time periods and C denoting the number of countries in our sample), respectively. Following the usual practice in the literature (e.g., Bernanke et al., 2005; Stock and Watson, 2005), we separately identify f_j and λ_j by applying a two-step estimation methodology.[8] Finally, we compute a TP aggregate for each series, denoted by $X_{j,t}^{tp}$, by rescaling the extracted principal component where countries' GDPs (in current US dollars) are used as weights in the following equation:

$$X_{j,t}^{tp} = \sum_c \omega_{c,j} \bar{X}_j^c + f_{j,t} \times \frac{\sum_c \omega_{c,j} \sigma_j^c}{\sigma_{f,j}}, \tag{3}$$

where $\omega_{c,j}$ denotes these weights, $\bar{X}_j^c$, σ_j^c are the sample mean and the standard deviation for series j of country c, and $\sigma_{f,j}$ is the sample standard deviation of the principal component for series j. Following common practice, we use GDP as weights in equation (3) to rescale the extracted principal components. This is necessary since the extracted principal components do not have an economically meaningful unit of measurement.[9] The procedure also ensures that larger countries such as Japan receive a large weight relative to smaller countries in the construction of the series.

[8] In the first step, we estimate the factor f_j by minimizing the squared residuals in Equation (2) while treating the unknown loading as given. In the second step, we estimate the loading by using a PCA. We estimate the factor loading as the first eigenvector of the variance-covariance matrix of X_j, while imposing the restriction $1/T(f_j{}'f_j) = 1$ on the factors.

[9] To obtain $\omega_{c,j}$, we first calculate the output weight of individual TP countries for each year in 1991-2014. Second, we take the average across years.

2.3. Variance Decomposition Using Principal Components

In this section, we combine the TP aggregates from the previous section with US variables to identify the sources of US/TP variable co-movements. We do so by using the following PCA formulation:

$$\begin{bmatrix} X_t^{us} \\ X_{add,t}^{us} \\ X_t^{tp} \\ X_{add,t}^{tp} \end{bmatrix} = \Lambda \begin{bmatrix} F_{1,t} \\ \vdots \\ F_{K,t} \end{bmatrix} + \begin{bmatrix} e_t^{us} \\ e_{add,t}^{us} \\ e_t^{tp} \\ e_{add,t}^{tp} \end{bmatrix}, \tag{4}$$

where $X_t^{us} \equiv [X_1^{us}, \dots, X_{12}^{us}]'$ is vector of the 12 major macro series for US, $X_t^{tp} \equiv [X_1^{tp}, \dots, X_{13}^{tp}]'$ is the vector of 13 major macro series for TP, that we constructed through Equation (3), $X_{add,t}^{us}$, $X_{add,t}^{tp}$ are vectors of additional variables that we incorporate in the variance decomposition exercise (explained below), $F_t \equiv [F_{1,t}, \dots, F_{K,t}]'$ represents unobserved factors, where K represents the number of extracted principal components, Λ is the $N \times K$ matrix of factor loadings where N represents the total number of time series used in this exercise, and $e_t \equiv [e_t^{us}, e_{add,t}^{us}, e_t^{tp}, e_{add,t}^{tp}]'$ is the vector of idiosyncratic (variable-specific) component of the N series.[10] The factors in turn are subject to the following dynamic,

$$F_t = \Phi(L)F_{t-1} + v_t\ , \tag{5}$$

where $\Phi(L)$ is a lag polynomial matrix of order P and v_t represents reduced form residuals.

For this exercise, we utilize 208 variables that are relevant to the US and TP economies. The data consists of 25 major macro series (X_t^{us}, X_t^{tp}) and 183 additional variables $(X_{add,t}^{us}, X_{add,t}^{tp})$

[10] Here we count US/TP exchange rate as a TP macro series without loss of generality. This is why X_t^{tp} contains one more variable than X_t^{us}.

that are related to output, income, spending, labor, money and credit, and other nominal variables. Full description of the variables are provided in Appendix A. Using a large set of additional variables has become a standard procedure in PCA analysis after studies have revealed a more robust outcome in identifying the underlying causes of business cycles synchronization when a larger panel of time series is used.[11] Also following standard practice, we set the lag length to two ($P=2$) and based on the BIC-based information criterion (c.f. Bai and Ng, 2002; Onatski, 2010) we set the number of principal components to eight ($K=8$) in our analysis.[12]

The forecast variance decompositions (with a 10 quarter horizon) of the US variables obtained after estimating equation (4) are displayed in columns (a) and (b) of Table 3. On average, eight principal components jointly explain 67.2% of the variation of US variables. For US output, principal components explain 65.3% of the total variation, similar to the overall average. Among the 12 major variables, import price and risk-free interest rate have the highest share explained by principal components (89.4%, 86.7%), while wage inflation, net worth inflation, and home price inflation have the lowest share (39.8 - 53.1%). Columns (a) and (b) of Table 4 displays the same statistic for the selected TP variables. For this region, the principal components on average explain 74.2% of the variation in variables and 83.2% for TP output alone, both of which are higher than the US case. Other variables that have high share of variation explained by principal components are wage inflation (71.4%) and home price inflation (81.2%), which presents a contrast with the US case. However, the contribution of principal components to the variation of TP net worth, similar to their contribution to US net worth, is the lowest (49.9%).

2.4. Identifying the US / TP Common Factor

[11] See for example, Boivin and Giannoni (2010).
[12] We experimented with four lags, but the main result remains almost unchanged.

So far, we extracted principal components that generate the comovement of US and TP variables. Our next goal is to determine to what degree these principal components can be represented by common factors that affect both regions (US and TP) symmetrically, as opposed to factors that are specific to each region. To execute this comparison, we first identify the share of principal components' variation explained by region-specific factors and then use these to produce the shares explained by US/TP common factors. More specifically, we decompose the vector of *fitted* time series constructed from the principal components $\hat{X}_t \equiv [\hat{X}_{1,t}, \dots, \hat{X}_{N,t}]' = \hat{\Lambda}\hat{F}_t$, into US-specific, TP-specific, and US/TP common factor using the following vector autoregression model,

$$\tilde{F}_t \equiv \begin{bmatrix} \tilde{F}_{comm,t} \\ \hat{F}_{home,t} \\ \hat{F}_{foreign,t} \end{bmatrix} = \tilde{\Phi}(L) \begin{bmatrix} \tilde{F}_{comm,t-1} \\ \hat{F}_{home,t-1} \\ \hat{F}_{foreign,t-1} \end{bmatrix} + \begin{bmatrix} \tilde{v}_{comm,t} \\ \tilde{v}_{home,t} \\ \tilde{v}_{foreign,t} \end{bmatrix}, \tag{6}$$

where $\tilde{F}_t$ are the principal components extracted from the fitted series (which is potentially different from $\hat{F}_t$ due to rotation), $\tilde{F}_{comm,t}$ is the K_c by 1 vector of unobserved US/TP common factor, $\hat{F}_{home,t}$ is the M_h by 1 vector of home-specific observed factors, and $\hat{F}_{foreign,t}$ is the M_f by 1 vector of foreign-specific observed factors. We should note here that $\tilde{F}_t$ is not uniquely determined because there exist a large set of rotated vector of $\hat{F}_t$ that spans the same factor space. We use "~" on top of the variable to acknowledge the property of indeterminacy (we explain below how $\tilde{F}_t$ can still be used to extract common components).

Each region-specific factor is estimated as the (set of) principal components extracted from the major macro variables as follows:

$$X_{home,t} = \lambda_h F_{home,t} + e_{h,t}, \tag{7}$$

$$X_{foreign,t} = \lambda_f F_{foreign,t} + e_{f,t}. \tag{8}$$

Here i indexes home and foreign. $X_{i,t}$ denotes the 12 major macro variables for each region excluding exchange rate, $F_{i,t}$ represents the vector of M_i principal components, $e_{i,t}$ denotes the vector of residuals, and λ_i denotes the factor loadings. The numbers of factors, M_{US} and M_{TP}, are determined by studying the associated scree plots of principal components. On the scree plot the kink occurs at the second/third factor for US/TP regions, thus we adopt $M_{US} = 2$ and $M_{TP} = 3$. Note that since the total number of principal components K was previously set to eight, these choices also sets the number of US/TP common factor to three ($K_c = K - M_{US} - M_{TP} = 3$).

US/TP common factor $\tilde{F}_{comm,t}$ are identified next by using the recursive regression method described in Boivin et al. (2009) and Boivin and Giannoni (2010). This method treats $\hat{F}_{home,t}$ and $\hat{F}_{foreign,t}$ as the observed variables in the first-step estimation of the vector autoregression in Equation (6). By repeating the regression of fitted values on the principal components and the region-specific factors multiple times, it filters out the effect of region-specific factors and allows us to obtain common factors as a residual. While the time series of the $\tilde{F}_t$ itself does not represent any economic time series, its "rotated" vector still spans the exact same factor space as $\hat{F}_t$. $\tilde{F}_t$ can, therefore, be used for decomposing variance of $\hat{F}_t$ further into US-specific factor, TP-specific factor, and US/TP common factor.

Note that we implicitly assumed in Equation (4) that the three elements of vector $\tilde{F}$ are recursively ordered as common→home→foreign, in other words, an orthogonal shock to foreign-specific factors only affects the home-specific factor in the next period. This recursiveness assumption allows us to relate the vector of reduced-form residual $\tilde{v}_t \equiv [\tilde{v}_{comm,t}, \tilde{v}_{home,t}, \tilde{v}_{foreign,t}]'$ with the structural shocks to the factors in the following manner,

$$\tilde{v}_t = \mathbf{R}\tilde{\varepsilon}_t, \tag{9}$$

where **R** is a square matrix and $\tilde{\varepsilon}_t \equiv [\tilde{\varepsilon}_{comm,t}, \tilde{\varepsilon}_{home,t}, \tilde{\varepsilon}_{foreign,t}]'$ is the structural shock recovered through a Cholesky decomposition.

Columns (c) through (e) of Table 3 show how the principal components are further decomposed into US/TP common factor and region-specific factors for each of the US macro variables. On average, US/TP common factor explains 44.0% of the total variation of these macro variables, whereas US-specific factors and TP-specific factors explain 15.0% and 8.2% of the total variation, respectively. Column (f) takes the ratio of variance explained by common factor over the share of variance explained by the principal components. On average, US/TP common factor accounts for close to two-thirds (65%) of the variation explained by the eight principal components, while the region-specific factors constitute the remaining one-third. When we turn to the individual variables, we see that for output and net worth inflation US/TP common factor play a large role relative to the region-specific factors (0.82 and 0.76, respectively). Conversely, US/TP common factor play a minor role for the wage rate (0.15). Table 4 repeats the same exercise for the TP region. We find that on average US/TP common factor explains 40.6% of the total variation in variables, which is 55% of the variation explained by the principal components. With regard to the individual variables, the share of variation explained by common factor is smaller, with the exception of wage rates, compared to the results in Table 3.

Overall, our central finding is that there is a high degree of US/TP economic commonality, both in terms of real and financial variables. The importance of common factors for the TP financial variables implies that the integration of global financial market may not be limited to a handful of large and developed economies (e.g., Japan, Canada) and that it may be prevalent in the entire TP region. In addition, we find that US/TP common factor plays an important role in explaining how strongly the two regions are integrated with one another. Studying the interdependence of US/TP economies from the viewpoint of only cross-regional shock transmission is inappropriate and could lead to inaccurate inferences given the role played by common factors.

2.5. NAFTA estimations

Our results so far demonstrated that the macroeconomic volatility in US and TP countries are to a large extent driven by common factors. Using these results we cannot, however, determine whether the important role of common factors is exclusive to the US-TP pairing or if it is also common global trend. To find answers and put our initial findings in perspective, we use a relatively long-standing trade relationship that U.S. is part of, NAFTA, as a point of reference. In other words, we determine how the importance of common shocks in our baseline US-TP estimations stack up with their role in an estimation with US-Canada&Mexico data.

To make a fair comparison, we first construct the major macro variables of Canada and Mexico combined (hereafter CA&MX), exactly as we have constructed our TP variables earlier. The columns (e) and (f) in Table 2 provide the mean and standard deviation of these newly constructed macro variables. We find that many of the nominal variables (home price, wage, net worth, risk-free interest rates) as well as a few of the real variables (consumption, investment, labor) have higher means than those of the US. The pairwise correlation coefficients in column (h) confirm that the degree of economic integration between US and the two countries is high. In particular, for output growth and net worth pairwise correlation coefficients exceed those for the US/TP pairing.

We proceed by measuring the same variance decomposition statistics that distinguish common factors across the two regions, US and Canada-Mexico, from region-specific factors. The data now consists of 25 major macro series (X_t^{us}, X_t^{camx}) and 112 additional variables ($X_{add,t}^{us}$, $X_{add,t}^{camx}$) that are related to US, Canada and Mexico. We similarly set the number of lags to two *(P=2)* and based on the BIC-based information criterion, we set the number of principal component to seven (K = 7). The numbers of observed factors M_{CAMX}, is again determined by studying the associated scree plots of principal components extracted from the 12 Canada-Mexico variables. The kink occurs at the third factor, thus we adopt $M_{CAMX} = 3$. Correspondingly, the number of US/TP common factor is set to two ($K_c = K - M_{US} - M_{CAMX} = 2$).

Table 5 shows the variance decompositions for the same 12 US variables. First, note that the seven principal components on average explain 68.5% of the total variation of major variables, which is slightly higher than the corresponding figure in the US/TP estimation (67.2%). The more critical observation is that the share of total variance that common factor explains is 37.4% on average, which is lower than for the US/TP case (44.0%). The decline in the share of common factors is offset mostly by foreign factors. Specifically, foreign factors (CA&MX-specific factors) now explain 15.2% of the variation, much higher than its share in the US/TP estimation (8.2%). In the next section, we find evidence that is consistent with this greater external impact on the US economy from Canada and Mexico.

Table 6 shows the variance decompositions for the CA&MX region. The seven principal components on average explain 65.3% of the total variation, which is slightly lower than the US variables (68.5%). When this is decomposed into common and region-specific factors, the decompositions are similar to those of US variables: on average, common factors explain 34.2% of the total variation in variables, and region-specific factors explain 31.0%.

The NAFTA comparison gives us two insights that were hard to obtain from the US/TP results alone. First, we see that the degree of economic integration between US and the TP region (through common sources of volatility) is at the very least comparable to that of US and CA&MX. This is despite the fact that the TP region covers a more diverse group of countries and the economic linkages are thought to be sparse compared to NAFTA. Second, we have witnessed that US/TP economic integration assigns a relatively larger role on the common factor compared to the case of US and CA&MX. Part of this may reflect the fact that the business cycles in the TP region are more dictated by global events as opposed to local ones. Another possibility is that China, which is not included in our analysis, has a strong contemporaneous effect on both US and TP, an effect that is not as strong in NAFTA.

Our results so far have indicated that US and TP economies are strongly integrated through common factor that impact both regions symmetrically. The limit of such analysis is that we cannot tell what type of common factor is driving our result: at the broadest level, one may speculate that the common factors originating in the real sector of the economy is the main cause, while others may argue in favor of financial factors, as recently seen during the Global Recession of 2008. More importantly, it is instructional to impose a structure on the data to obtain structural shocks that are the drivers of macroeconomic fluctuations in the economies that we investigate and to determine to what extent these fluctuations are caused by common shocks. This is what we do in the next section with the help of a DSGE model that allows for various channels of shock transmission.

3. Evidence from an estimated DSGE model

In this section we estimate a two-region, open economy, DSGE model by using the data described in Section 2. The building blocks of our model are fairly standard and they are very similar to those in studies such as Bernanke et al. (1999), Christiano et al. (2005), Smets and Wouters (2007) and Justiniano and Preston (2010). We should mention that while there is a similarity in the specific components, our model is not identical to the papers mentioned above. A better characterization would be that our model includes the nominal and real rigidities in papers such as Christiano et al. (2005), Smets and Wouters (2007) and adds the open economy components in Justiniano and Preston (2010) and the financial accelerator mechanism from Bernanke et al. (1999). This approach serves three purposes. First, by including nominal and real rigidities, we are able to more closely match the stylized responses of macroeconomics variables to shocks and the business cycle moments in the data. Second, while extending the closed economy framework of Smets and Wouters (2007) to an open economy setting considerably increases the scale of our model, this allows us to consider a broad set of shocks that may affect the two economies and link them together (we describe this mechanism in more detail below). Third, including the financial accelerator mechanism provides a compact yet efficient way of accounting for financial shocks that may again affect and link the two economies.

Given that we are not deviating fundamentally from the standard DSGE frameworks mentioned above, we defer the description of our model to Appendix B. Here, we summarize the main features of our model, we discuss our estimation methodology and we describe the shock processes in the model (and the processes that govern their propagation). These process play the central role and they are the main innovative feature of analysis in this section.

The two open economies are symmetrically modelled. We assume, without loss of generality, that the US represents the domestic economy and the TP region represents the foreign economy. The two economies are linked through the trade of goods and risk-free bonds. Each economy is populated by households, final and intermediate goods producers, capital producers, entrepreneurs, labor and import intermediaries. Households consume a composite good that is an aggregate of foreign and domestic final goods. They have monopoly over their labor services and these services are hired by a labor intermediary which combines them to obtain aggregate labor supply. Households save by holding 1-period local currency denominated domestic and foreign bonds. Intermediate goods producers are monopolistically competitive. They hire labor and rent capital from entrepreneurs and sell their product at a mark-up to perfectly competitive producers that combine the intermediate goods to obtain a final good.

Entrepreneurs in the economy are risk neutral and they channel their investment to capital producers who in turn combine these investments with previous period's capital to produce new capital. Entrepreneurs finance their investment by borrowing from a single risk-neutral bank. The contract between the bank and the entrepreneurs is subject to a financial friction. Entrepreneurs face an idiosyncratic returns to capital shock that can cause a default if it is below a cutoff level. The friction here is that if there is default, the bank seizes the entrepreneurs' assets but it has to pay monitoring costs. This friction generates a wedge between the entrepreneurs' borrowing rate and the risk free rate that, in turn, depends positively on the entrepreneurs' financial leverage (debt divided by net worth). Import intermediaries are monopolistically competitive and they import goods in foreign currency, differentiate them and sell them at a mark-up in local currency to an aggregator that combines them to form aggregate imports. The model also includes a government that finances its expenditure with lump-sum taxes from households and by issuing bonds, and a central bank that follows a Taylor rule in formulating monetary policy.

Monopolistic competition amongst domestic goods producers, importers and labor suppliers here allows us to incorporate price (domestic and foreign) and wage rigidities and cost-push shocks and the behavior of importers helps us account for the incomplete exchange rate pass-through in the data. The model also includes real rigidities such as external habit formation, investment adjustment costs and capacity utilization that allows us to more closely replicate the stylized dynamic behavior of consumption and investment in standard vector autoregressive (VAR) models.

The model includes a total of 21 shocks: 3 demand shocks (consumption, investment and government spending shocks), 3 financial shocks (net worth, returns to capital and monetary policy shocks), 3 cost-push shocks (shocks to wages, domestic good prices and foreign goods prices) a productivity shock in each economy and a common exchange rate shock. These shocks can be interpreted as follows: Consumption shock appears in the utility function of the households and it affects the households' relative preference for consuming today or the next period. A positive shock here implies that households attach a greater value to today's consumption. A positive investment shock can be interpreted as an exogenous improvement in the investment specific technology function that allows entrepreneurs to obtain a higher level of capital from a unit investment. The government expenditure shock is an exogenous change in the total amount of expenditures in the economy. The monetary policy shock captures the usual tightening and loosening of the monetary policy stance. The net worth shock is an exogenous change in the survival rate of the entrepreneurs that in turn changes their level of net worth. The returns to capital shock affects the wedge between the borrowing rate and the risk free rate and it is modelled as a change in the standard deviation of the idiosyncratic returns to capital shock that entrepreneurs face. The three cost-push shocks can be interpreted as a shock to the mark-up that producers, importers and labor suppliers (the households) charge that in turn affects the level of price and wage inflation. The productivity shock appears as a systematic term in the Cobb-Douglas production function of intermediate goods producers and it generates an exogenous change in the total supply of goods. A positive exchange rate shock represents a depreciation of the US dollar against a weighted basket of TP currencies and it represents a greater risk of holding US bonds.

3.1. Methodology

To estimate the model (the structural parameters and the parameters governing the shock processes) we use 21 quarterly data series/observables (for the 1991Q2 – 2014Q4 sample period), 10 for each region and a common exchange rate variable. We choose to use 21 series since if the number of observables are less than or greater than the number of shocks, it can cause weak or over-identification problems (see Iskrev, 2010). The macroeconomic variables that we use in this section are the same as those in Section 2 and they include gross domestic product, consumption and investment expenditures, import price index, GDP deflator, interbank short-term interest rate, corporate bond yield, wage rate, number of employed, stock market index. The common variable is the nominal exchange rate (US dollar / basket of TP currencies). All of these variables, except the interest rate that are linearly detrended, are in log-differences, seasonally adjusted and demeaned.

The main distinguishing feature of our analysis lies in our shock processes. In our model we make two specifications pertaining to these processes. First, we assume, for each shock, that there is a country specific and a common component that are orthogonal to each other and follow an AR(1) process. We assume that the common shock affects each economy symmetrically. To explain this configuration more clearly, let 's assume that the net worth shock impacting the US and the TP economies are denoted by $\varepsilon_{n,t}$, $\varepsilon^{*}_{n,t}$ respectively, then these shock is defined as $\varepsilon_{n,t} = \varepsilon^{us}_{n,t}\varepsilon^{c}_{n,t}$ $\varepsilon^{*}_{n,t} = \varepsilon^{TP}_{n,t}\varepsilon^{c}_{n,t}$, where $\varepsilon^{us}_{n,t}$ and $\varepsilon^{TP}_{n,t}$ represent the US and TP specific components of the two shocks and $\varepsilon^{c}_{n,t}$ is a common net worth shock affecting both regions symmetrically. Second, we allow for regional shocks to be correlated across the two economies. This correlation is computed by using a Cholesky ordering of the two region-specific shocks and it is used to compute post-estimation statistics. The correlation coefficient determines how much and how (positively or negatively) a shock in one region affects the other region. The configuration with common and correlated shocks gives us a rich set of potential drivers of macroeconomic volatility as it allows us to distinguish between common, regional and external drivers of this volatility.

To estimate the model we use a Bayesian methodology. This methodology follows four steps. First, the model's state space representation is transformed into its reduced form in terms of the predetermined variables by following the methodology of Blanchard and Khan (1980). We assume that the orthogonal shock innovations in this reduced form are correlated across the two economies. The predetermined variables are then linked to observable variables by using a measurement equation. As a third step, a likelihood function is formed by using a Kalman filter that takes in the observables and the prior distribution of parameters. Finally, a posterior density function is derived from the likelihood function, and the parameter values that maximize this function are determined by using a Markov Chain Monte Carlo simulation.

Some model parameters are not estimated since their steady state values can be obtained from the mean values of the observables that are in turn demeaned. These parameters (i.e., level parameters) are therefore set equal to values commonly used in the literature. Appendix C displays the level parameters and the values they take in our calibration exercise. The appendix also displays the prior distribution and the posterior estimates of both the structural and shock process parameters. The prior distributions follow the formulation commonly used in the literature (e.g. Smets and Wouters, 2007 and Gilchrist et al., 2009). The posterior estimates indicate that the data we use to estimate our model are informative as posterior mean values are often noticeably different from prior means.[13]

[13] For each estimation, we find that the Fisher information matrix is full rank and thus there is no evidence for weak identification.

3.2. Results

The forecast error variance decompositions (FEVD) for US and TP endogenous variables that are obtained from the estimated model are displayed in Table 7 for two forecast horizons. These statistics, for the most part, reveal a considerable contribution of common shocks and cross-country shock transmission to the variation in the endogenous variables. This contribution is much higher for the US macroeconomic variables, exceeding 50 percent for a majority of the variables. While the contribution of common shocks and shock transmission from the US is also large for TP financial variables (i.e., interest rates, net worth and credit spreads), these are smaller compared to their US counterparts. This disparity between the two regions is much larger for nonfinancial variables with contributions at the 1 quarter forecast horizon averaging 17 percent if foreign prices are excluded. We also observe that common shocks make a more pronounced contribution to the volatility of TP variables (especially for net worth, interest rates, and wage and domestic goods inflation) at the 10 quarter horizon.

In Table 8 we report the FEVDs by type of shock. The common observation for both regions and forecast horizons is that demand, cost-push/productivity and financial shocks have the largest impact on real variables, prices and financial variables, respectively (with the exception of labor to which demand and cost-push/productivity shocks make an even contribution). In the US, while the contributions of TP and common shocks are similar for the variation in consumption, investment, interest rates and credit spreads, common shocks explain a larger share of the variation in most of the other variables (i.e., net worth, foreign and domestic goods and wage inflation and output). This observation can also be made for the TP variables. The difference between the contributions of common and TP shocks are smaller, especially for the nonfinancial variables. The inferences drawn from the 10 quarter ahead FEVDs are similar.

Next, we replicate our estimation by replacing the observations for the TP region with the corresponding values for the Canada-Mexico region. For this region, the macroeconomic variables are similarly measured in aggregate terms. The FEVDs that show the sources of macroeconomic fluctuations in the US and the Canada-Mexico region are reported in Tables 9 and 10. These statistics are then compared to our baseline results that measure US-TP integration in Table 11. The statistics in Table 11 are obtained by subtracting the FEVDs in Table 9 from the corresponding FEVDs in Table 7 and thus indicate whether the contribution of the shocks in the US-TP estimations are larger or smaller than in the US–Canada&Mexico estimations. We leave the contribution of exchange rate shocks out of this comparison and thus the numbers corresponding to the variables do not add up to zero. There are two main inferences that can be made from Table 11. First, the contribution of common shocks are mostly larger in the US-TP estimation. Specifically, except for US wage inflation and labor supply and TP/Canada&Mexico labor supply at both forecast horizons and TP/Canada&Mexico consumption at the 1 quarter horizon common shocks contribute more to the fluctuations of the macroeconomic variables in the US and in the TP countries. This disparity is largest for foreign goods inflation and interest rates and more acute at the 10 quarter horizon. In other words, import prices and interest rates in the US and TP countries are driven by common shocks to a greater degree than those in the NAFTA region.

Second, the transmission of shocks between the US and the economies of Canada and Mexico (both the transmission from US to Canada-Mexico and the transmission in the other direction) is stronger than the transmission between the US and the TP region. This evidence is also very clear as, except for a few variables, most values in the second column of each panel are negative indicating weaker cross-regional transmission in the US-TP estimation. Consistent with this observation we find that the posterior mean values (reported in the bottom panel of Table C.3 in Appendix C) for the shock correlation coefficients are larger for the US/CA&MX pairing. Table

11 also shows that while US shocks explain a larger share of the variation in US variables in the US–TP estimation, there is no clear difference between the importance of TP and Canada&Mexico shocks for the variation in their own variables.

In addition to these results, we find that the increase in the share of common shocks for the US–TP combination is in general observed for all three types of shocks (productivity/cost-push, demand and financial). These results are reported in Table 12 that compares the FEVDs of the two estimations by type of shock. The lower degree of cross-regional transmission between the US and the TP region, however, is mostly explained by productivity, cost-push and financial shocks and the transmission of demand shocks across the two regions is either stronger or not too different for the most part.

Overall, our results are in agreement with those from the previous section and they further indicate a stronger transmission from Canada&Mexico to the US compared to the transmission from the TP region to the US.

4. Conclusion

This paper demonstrated that the drivers of business cycles in the TP and US economies are to a large extent common across the two regions and that there is a substantial amount of shock transmission from one region to the other. Comparison with the NAFTA region revealed that the linkages that common shocks form between the TP countries and the US is stronger than between the US economy and the economies of Canada and Mexico. The latter countries are also a greater source of external instability for the US through cross-regional shock transmission.

The strength of our results comes from the fact that two fundamentally different approaches that we use to measure the drivers of business cycles point in the same direction. Our first approach was to use a principal component analysis to decompose the variation in major macroeconomic variables into those explained by factors that are variable specific, region specific and those that are common across the two regions. This analysis, by construction, does not impose any structural relationships between macroeconomic variables. Conversely, in our second analysis (an estimated two-country DSGE model) macroeconomic variables were linked within a given region and across the two regions based on the usual structural relationships that are derived from the optimization problems of representative agents. In addition we allowed the structural shocks in the two economies to be correlated and to carry a common component. Under both models, structural and non-structural, common shocks/factors explained a large share of the variation in the macroeconomic series for both regions. We found that this share was larger for the US/TP pairing than for the US/Canada&Mexico pairing. For both the NAFTA and TP estimations, we found that cross-regional shock transmission was strong (stronger within NAFTA) and that the variation of output was mostly due to demand shocks. The punchline from these findings is that the US economy is more similar with, and less vulnerable to, a trade bloc (TPP) that it is currently not a part of than it is with a region that it is a part of (NAFTA).

There are three natural extensions to the analyses in this paper. First, it may be interesting to analyze the effects of specific global shocks on the business cycle synchronization amongst countries in the two trade pacts to gain greater insights into the role of common shocks in the two trade pacts. Second, to get a general sense of whether it is reasonable for the US to join TPP, we used country-level GDP to weigh and construct TP level aggregates. This allows us to give a higher weight to countries (such as Japan) with larger economies that also constitute a higher share of US imports/exports and therefore to draw more sound inferences for a potential trade partnership. The high level of integration that we find, however, does not mean that the US is highly integrated with each of the 15 countries in our sample. It would be interesting to give equal weights to the TP countries and replicate our analyses to obtain a fuller picture. Third, while the two different approaches that we followed pointed in the same direction for the sample period that we covered, additional insights could be drawn by comparing the out-of-sample forecasting performance of the two models. Particularly, it would be interesting to conduct a horse-race between the PCA and DSGE analysis on the basis of their output forecasting performance and to determine the share of common shocks in the decomposition of out-of-sample forecast errors.

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Online Appendix A: Data used to construct the major variables in the PCA analysis (For online publication only)

Link: http://www.ulucaysun.com/uploads/4/6/0/1/46011955/appendix_a.pdf

Appendix B. The two-region open economy DSGE model (For online publication only)

Link: https://www.ulucaysun.com/uploads/4/6/0/1/46011955/appendixes_b_and_c.pdf

Appendix C. Calibration and the posterior estimates of the structural and shock parameters in the DSGE model (For online publication only)

Link: https://www.ulucaysun.com/uploads/4/6/0/1/46011955/appendixes_b_and_c.pdf

Table 1. Summary Statistics (GDP, Population and Trade)

Countries	GDP, current prices		Population		Trade-to-GDP ratio
	billions $		millions		in %
United States	17,348.1	54.9%	319.1	26.2%	30.0
Japan	4,602.4	14.6%	127.1	10.4%	35.1
Canada	1,785.4	5.7%	35.5	2.9%	62.0
Australia	1,442.7	4.6%	23.6	1.9%	40.9
South Korea	1,410.4	4.5%	50.4	4.1%	102.8
Mexico	1,291.1	4.1%	119.7	9.8%	64.6
Indonesia	888.6	2.8%	252.2	20.7%	48.7
Taiwan	529.6	1.7%	23.4	1.9%	n.a.
Thailand	404.8	1.3%	68.7	5.6%	132.8
Malaysia	338.1	1.1%	30.6	2.5%	142.7
Singapore	307.9	1.0%	5.5	0.4%	359.9
Hong Kong	290.9	0.9%	7.3	0.6%	455.3
Philippines	284.6	0.9%	99.4	8.2%	60.2
Chile	258.0	0.8%	17.8	1.5%	65.5
Peru	202.6	0.6%	31.4	2.6%	48.8
New Zealand	197.5	0.6%	4.6	0.4%	56.9
15 TP countries combined	14,234.6	45.1%	897.1	73.8%	-
Canada & Mexico	3,076.4	9.7%	155.2	12.8%	-
8 non-OECD countries	3,247.2	10.3%	518.5	42.6%	-
Total (US & TP)	31,582.7	100%	1,216.2	100%	-

Note: The Trans-Pacific (TP) region, as used in this study, covers a total of 15 countries. Population and GDP shares are calculated as a percentage of the total in the Trans-Pacific region and United States combined. The data for the population and GDP are obtained from the World Economic Outlook Database. The trade-to-GDP ratios are obtained from the World Bank, World Development Indicators.

Table 2. Regional Summary Statistics

	US		TP		Canada & Mexico		Correlation coefficient	
	(e) Mean growth rate	(b) St. dev	(e) Mean growth rate	(d) St. dev	(e) Mean growth rate	(f) St. dev	(g) US/TP	(h) US/ CA&MX
Output growth	2.59	2.49	2.34	4.53	2.59	3.50	0.40	0.58
Consumption growth	2.89	2.03	2.35	5.01	2.92	4.06	0.38	0.37
Investment growth	3.15	6.58	1.49	11.24	3.35	12.37	0.38	0.38
Import price inflation	1.40	11.33	1.78	15.48	1.62	7.07	0.90	0.88
Home price inflation	1.97	0.83	1.83	4.49	5.28	6.06	0.22	0.28
Risk-free interest rate	3.31	2.23	3.59	2.88	6.12	5.14	0.81	0.79
Short-term risk-free rate	3.02	2.24	3.63	3.13	7.04	5.82	0.83	0.82
Rental rate of capital	7.14	1.30	5.15	2.15	5.24	1.93	0.76	0.76
Risk premium	4.16	1.79	2.23	1.01	1.84	0.72	0.63	0.30
Wage inflation	2.47	1.17	2.55	5.77	5.44	6.35	0.13	-0.16
Labor	0.95	1.78	0.43	2.13	1.39	1.47	0.50	0.51
Net worth	7.54	27.75	3.30	44.71	11.48	41.06	0.69	0.76
Exchange rate	-	-	0.70	21.01	2.73	19.64	-	-

Notes: The Trans-Pacific (TP) region, as used in this study, covers a total of 15 countries. The means and standard deviations are expressed in terms of quarterly growth rates (%) in annual terms, except for interest rate measures that are expressed in levels (% points). The correlation coefficient is the correlation between the corresponding same variables for the US and the TP region

Table 3. Variance Decomposition, US Variables

	(a) Idiosyncratic component $X_t - \hat{X}_t$	(b) Principal components (K=8) $\hat{X}_t$	(c) Domestic factor	(d) Foreign factor	(e) US/TP common factor	(f) Ratio: (e)/(b)
Output growth	34.7	65.3	7.2	4.5	53.6	0.82
Consumption growth	33.5	66.5	15.0	5.5	46.0	0.69
Investment growth	24.7	75.3	14.5	5.1	55.7	0.74
Labor	31.9	68.1	9.7	7.3	51.1	0.75
Wage inflation	60.2	39.8	27.6	6.1	6.2	0.15
Net worth inflation	47.2	52.8	10.1	2.6	40.1	0.76
Risk-free interest rate	13.3	86.7	32.5	18.3	35.9	0.41
Import price inflation	10.6	89.4	7.4	9.9	72.1	0.81
Home price inflation	46.9	53.1	9.6	15.5	28.0	0.53
Risk premium	24.6	75.4	16.5	7.4	51.6	0.68
Average	32.8	67.2	15.0	8.2	44.0	0.65

Notes: The variance decompositions of US variables are obtained from the estimation of the VAR model in equation (4). The figures are in percentages. Column (a) shows the share of variation that is specific to a variable. Column (b) shows the share of variation that is due to a factor that is common to all the variables. Columns (c) to (e) further decomposes column (b) into domestic, foreign and US/TP common factors.

Table 4. Variance Decomposition, Trans-Pacific Variables

	(a) Idiosyncratic component $X_t - \hat{X}_t$	(b) Principal components (K=8) $\hat{X}_t$	(c) Domestic factor	(d) Foreign factor	(e) US/TP common factor	(f) Ratio: (e)/(b)
Output growth	16.8	83.2	37.5	5.2	40.5	0.49
Consumption growth	31.7	68.3	32.0	5.4	30.8	0.45
Investment growth	31.7	68.3	20.0	4.7	43.6	0.64
Labor	28.1	71.9	36.5	6.1	29.4	0.41
Wage inflation	28.6	71.4	21.0	4.3	46.1	0.65
Net worth inflation	50.1	49.9	9.3	4.5	36.1	0.72
Risk-free interest rate	6.9	93.1	54.2	6.9	32.0	0.34
Import price inflation	12.8	87.2	14.7	6.0	66.5	0.76
Home price inflation	18.8	81.2	38.6	6.5	36.2	0.45
Risk premium	32.8	67.2	14.8	7.2	45.2	0.67
Average	25.8	74.2	27.9	5.7	40.6	0.55

Notes: The variance decompositions of TP variables are obtained from the estimation of the VAR model in equation (4). The figures are in percentages. Column (a) shows the share of variation that is specific to a variable. Column (b) shows the share of variation that is due to a factor that is common to all the variables. Columns (c) to (e) further decomposes column (b) into domestic, foreign and US/TP common factors.

Table 5. Variance Decomposition, US Variables (NAFTA region)

	(a) Idiosyncratic component $X_t - \hat{X}_t$	(b) Principal components (K=7) $\hat{X}_t$	(c) Domestic (US) factor	(d) Foreign (CA&MX) factor	(e) US /CA&MX common factor	(f) Ratio: (e)/(b)
Output growth	32.5	67.5	13.4	15.9	38.2	0.57
Consumption growth	26.6	73.4	27.3	16.6	29.5	0.40
Investment growth	24.2	75.8	17.1	15.4	43.3	0.57
Labor	31.0	69.0	10.5	11.4	47.1	0.68
Wage inflation	54.4	45.6	32.5	6.8	6.4	0.14
Net worth inflation	44.7	55.3	13.8	8.9	32.6	0.59
Risk-free interest rate	11.8	88.2	20.2	20.6	47.4	0.54
Import price inflation	9.4	90.6	5.2	21.4	64.0	0.71
Home price inflation	55.4	44.6	5.8	20.1	18.7	0.42
Risk premium	25.2	74.8	13.1	14.4	47.4	0.63
Average	31.5	68.5	15.9	15.2	37.4	0.55

Notes: The variance decompositions of US variables are obtained from the estimation of the VAR model in equation (4). The figures are in percentages. Column (a) shows the share of variation that is specific to a variable. Column (b) shows the share of variation that is due to a factor that is common to all the variables. Columns (c) to (e) further decomposes column (b) into domestic, foreign and US/Canada&Mexico common factors.

Table 6. Variance Decomposition, Variables for the CA&MX region

	(a) Idiosyncratic component $X_t - \hat{X}_t$	(b) Principal components (K=7) $\hat{X}_t$	(c) Domestic (CA&MX) factor	(d) Foreign (US) factor	(e) US /CA&MX common factor	(f) Ratio: (e)/(b)
Output growth	17.3	82.7	30.8	3.1	48.8	0.59
Consumption growth	35.9	64.1	26.9	5.4	31.9	0.50
Investment growth	24.6	75.4	38.8	6.1	30.5	0.40
Labor	31.9	68.1	19.9	6.8	41.4	0.61
Wage inflation	66.0	34.0	13.9	6.5	13.6	0.40
Net worth inflation	49.9	50.1	10.6	5.3	34.2	0.68
Risk-free interest rate	9.8	90.2	48.0	9.0	33.3	0.37
Import price inflation	11.2	88.8	32.1	3.4	53.4	0.60
Home price inflation	32.3	67.7	30.0	3.5	34.3	0.51
Risk premium	68.8	31.2	9.4	0.6	21.2	0.68
Average	34.7	65.3	26.0	5.0	34.2	0.52

Notes: The variance decompositions of the variables for the Canada&Mexico region are obtained from the estimation of the VAR model in equation (4). The figures are in percentages. Column (a) shows the share of variation that is specific to a variable. Column (b) shows the share of variation that is due to a factor that is common to all the variables. Columns (c) to (e) further decomposes column (b) into domestic, foreign and US/Canada&Mexico common factors.

Table 7. Forecast Error Variance Decomposition, US, TP versus Common shocks

	Horizon = 1 quarter			Horizon = 10 quarters		
	U.S. shocks	Trans-Pacific shocks	Common shocks	U.S. shocks	Trans-Pacific shocks	Common shocks
U.S. endogenous variables						
output	49.93	33.05	15.81	46.61	32.77	19.19
consumption	33.92	32.08	33.82	33.51	31.22	34.93
investment	54.71	22.52	22.62	53.31	22.25	24.10
labor	57.53	28.51	12.74	56.29	28.42	13.95
wage inflation	63.58	15.16	21.00	56.74	16.14	24.49
net worth	21.84	15.97	61.41	22.88	17.20	58.28
interest rates	32.34	29.98	35.56	29.90	28.10	37.69
inflation, foreign goods	13.00	4.98	74.14	12.23	7.04	73.45
inflation, domestic goods	42.24	20.77	36.66	37.73	18.65	40.85
credit spread	70.74	16.83	12.43	70.28	17.13	12.53
Trans-Pacific endogenous variables						
output	9.52	83.06	6.98	9.25	79.80	10.47
consumption	8.54	82.74	8.65	8.26	79.39	12.10
investment	9.74	80.09	9.77	9.07	77.26	13.00
labor	8.96	83.85	6.60	8.85	83.25	7.31
wage inflation	6.60	83.20	10.00	3.94	48.35	46.94
net worth	6.53	61.00	32.05	4.13	39.11	55.76
interest rates	11.48	52.45	34.98	3.37	21.83	73.54
inflation, foreign goods	2.80	2.15	90.30	1.74	3.17	91.32
inflation, domestic goods	3.40	81.37	15.10	2.18	32.36	64.83
credit spread	19.92	65.57	14.51	19.22	65.16	15.60

Notes: FEVDs are obtained by using parameters' posterior mean values.

Table 8. Forecast Error Variance Decomposition, types of shocks

horizon = 1 quarter

	U.S. shocks			Trans-Pacific shocks			Common shocks			
U.S. endogenous variables	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Exchange rate shocks
output	0.14	48.71	1.08	0.01	32.43	0.60	1.06	13.62	1.14	1.21
consumption	0.24	32.31	1.36	0.14	30.60	1.35	1.06	31.16	1.61	0.18
investment	0.30	53.77	0.65	0.07	21.99	0.45	0.18	20.91	1.53	0.15
labor	30.77	26.22	0.54	10.93	17.42	0.16	5.06	7.15	0.53	1.22
wage inflation	62.21	1.28	0.10	13.44	1.65	0.07	19.78	1.10	0.13	0.25
net worth	2.41	0.70	18.73	1.29	0.64	14.04	5.32	0.24	55.85	0.78
interest rates	3.77	6.31	22.26	2.27	5.08	22.63	9.33	2.06	24.16	2.12
inflation, foreign goods	12.64	0.32	0.03	2.31	0.05	2.62	74.01	0.00	0.13	7.88
inflation, domestic goods	42.02	0.20	0.01	20.44	0.30	0.03	36.46	0.14	0.06	0.32
credit spread	0.01	0.02	70.71	0.00	0.02	16.81	0.01	0.01	12.42	0.01
TP endogenous variables										
output	0.34	8.18	1.00	2.63	74.28	6.15	0.12	5.25	1.61	0.44
consumption	0.06	7.68	0.80	0.34	78.93	3.47	0.10	7.42	1.13	0.07
investment	0.12	8.80	0.82	2.54	73.12	4.43	0.25	7.95	1.58	0.39
labor	5.63	3.03	0.29	55.57	26.00	2.28	4.39	1.71	0.51	0.58
wage inflation	4.88	1.31	0.40	69.02	11.94	2.24	8.26	1.12	0.63	0.20
net worth	0.67	0.07	5.79	3.20	0.15	57.65	6.07	0.02	25.96	0.42
interest rates	0.65	0.36	10.47	5.77	1.83	44.85	21.22	0.14	13.62	1.09
inflation, foreign goods	2.55	0.22	0.03	0.69	0.02	1.45	90.19	0.00	0.10	4.76
inflation, domestic goods	3.34	0.05	0.01	81.03	0.25	0.09	15.06	0.01	0.02	0.13
credit spread	0.00	0.00	19.91	0.04	0.00	65.53	0.12	0.00	14.39	0.00

horizon = 10 quarters

	U.S. shocks			Trans-Pacific shocks			Common shocks			
U.S. endogenous variables	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Exchange rate shocks
output	0.26	44.98	1.37	0.16	31.65	0.96	4.03	13.48	1.69	1.43
consumption	0.52	31.29	1.70	0.32	29.22	1.68	2.96	29.86	2.11	0.34
investment	0.52	50.81	1.99	0.20	20.94	1.12	0.31	19.82	3.97	0.33
labor	31.35	24.25	0.69	11.02	17.04	0.36	6.03	7.09	0.82	1.35
wage inflation	53.51	3.01	0.22	11.78	3.99	0.37	21.75	2.08	0.67	2.62
net worth	3.83	1.46	17.59	2.44	1.53	13.23	9.55	0.67	48.06	1.64
interest rates	6.68	7.21	16.01	4.28	7.20	16.61	16.30	3.13	18.26	4.31
inflation, foreign goods	11.82	0.37	0.05	4.46	0.17	2.40	73.23	0.06	0.16	7.27
inflation, domestic goods	35.76	1.82	0.15	15.58	2.65	0.42	38.86	1.26	0.73	2.77
credit spread	0.08	0.13	70.07	0.03	0.07	17.03	0.06	0.04	12.42	0.07
TP endogenous variables										
output	0.84	7.24	1.18	8.65	64.32	6.84	3.74	4.81	1.92	0.47
consumption	0.21	7.13	0.92	2.27	73.18	3.95	3.93	6.83	1.33	0.25
investment	0.52	7.49	1.06	8.17	62.60	6.48	4.03	6.65	2.32	0.67
labor	5.58	2.91	0.37	56.02	24.62	2.61	4.95	1.72	0.64	0.58
wage inflation	3.09	0.63	0.22	42.29	4.60	1.46	46.13	0.40	0.41	0.77
net worth	0.94	0.17	3.03	9.63	0.57	28.92	42.84	0.03	12.89	1.00
interest rates	0.96	0.30	2.11	11.80	1.27	8.76	70.58	0.07	2.89	1.26
inflation, foreign goods	1.51	0.20	0.03	2.10	0.10	0.97	91.23	0.01	0.08	3.77
inflation, domestic goods	1.92	0.23	0.03	31.15	0.93	0.28	64.71	0.04	0.09	0.62
credit spread	0.03	0.02	19.17	0.38	0.15	64.63	0.34	0.01	15.25	0.02

Notes: FEVDs are obtained by using parameters’ posterior mean values.

Table 9. Forecast Error Variance Decomposition, US, CA&MX versus Common shocks

	Horizon = 1 quarter			Horizon = 10 quarters		
	U.S. shocks	CA&MX shocks	Common shocks	U.S. shocks	CA&MX shocks	Common shocks
U.S. endogenous variables						
output	47.09	37.80	15.06	45.44	38.47	15.92
consumption	36.89	30.11	32.96	36.33	31.81	31.79
investment	46.01	32.42	21.56	44.30	32.55	23.10
labor	47.88	35.18	16.89	48.03	35.98	15.87
wage inflation	35.01	31.82	33.15	34.26	33.22	32.38
net worth	20.17	29.91	49.91	21.88	31.72	46.29
interest rates	22.46	58.41	19.07	22.43	58.15	19.08
inflation, foreign goods	67.92	18.74	12.97	65.64	20.99	12.60
inflation, domestic goods	30.57	36.83	32.59	30.26	37.39	32.26
credit spread	59.62	28.43	11.95	59.21	29.41	11.38
CA&MX endogenous variables						
output	9.22	86.63	4.14	8.34	88.28	3.38
consumption	9.16	80.97	9.82	9.25	82.23	8.41
investment	8.85	85.51	5.59	8.46	86.25	5.23
labor	12.78	79.12	8.10	12.21	79.90	7.87
wage inflation	2.95	95.13	1.91	5.84	92.57	1.51
net worth	6.93	83.97	9.09	7.41	86.68	5.83
interest rates	8.36	88.54	3.07	8.06	89.77	2.03
inflation, foreign goods	50.70	19.89	28.86	39.67	40.41	18.91
inflation, domestic goods	4.42	94.98	0.60	5.38	94.20	0.40
credit spread	13.35	81.23	5.42	13.01	81.19	5.79

Notes: FEVDs are obtained by using parameters' posterior mean values.

Table 10. Forecast Error Variance Decompositions by type of shock, NAFTA

horizon = 1 quarter

	U.S. shocks			CA&MX shocks			Common shocks			
U.S. endogenous variables	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Exchange rate shocks
output	1.91	44.03	1.14	0.81	31.27	5.72	1.59	12.38	1.09	0.05
consumption	0.55	34.08	2.27	0.82	20.67	8.62	0.23	30.08	2.65	0.03
investment	0.18	45.07	0.76	0.24	30.62	1.56	0.10	19.78	1.68	0.01
labor	22.33	24.91	0.64	14.39	17.62	3.17	9.40	6.89	0.60	0.04
wage inflation	34.64	0.34	0.03	31.34	0.37	0.11	32.81	0.27	0.08	0.01
net worth	4.05	0.87	15.25	2.30	0.63	26.98	1.63	0.25	48.03	0.01
interest rates	3.35	5.16	13.95	2.91	3.78	51.73	1.54	1.48	16.06	0.05
inflation, foreign goods	67.91	0.00	0.00	18.67	0.06	0.00	12.96	0.00	0.00	0.38
inflation, domestic goods	30.53	0.03	0.01	36.76	0.04	0.03	32.55	0.01	0.03	0.01
credit spread	0.01	0.02	59.59	0.01	0.01	28.40	0.00	0.01	11.94	0.00
CA&MX endogenous variables										
output	0.98	7.87	0.38	21.21	60.71	4.72	0.12	3.85	0.18	0.00
consumption	1.39	6.66	1.10	8.91	57.30	14.75	0.52	8.93	0.37	0.05
investment	0.85	7.91	0.09	13.50	70.45	1.57	0.11	5.26	0.22	0.04
labor	7.91	4.66	0.22	40.56	35.82	2.75	5.76	2.23	0.10	0.00
wage inflation	2.93	0.02	0.00	94.89	0.18	0.06	1.89	0.03	0.00	0.01
net worth	2.35	0.03	4.55	10.56	0.23	73.18	1.55	0.02	7.53	0.01
interest rates	3.89	0.08	4.39	28.79	0.56	59.19	1.71	0.04	1.32	0.04
inflation, foreign goods	50.69	0.01	0.00	19.81	0.07	0.01	28.86	0.00	0.00	0.54
inflation, domestic goods	4.41	0.00	0.00	94.94	0.03	0.01	0.60	0.00	0.00	0.01
credit spread	0.02	0.00	13.34	0.08	0.01	81.14	0.01	0.00	5.41	0.00

horizon = 10 quarters

	U.S. shocks			CA&MX shocks			Common shocks			
U.S. endogenous variables	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Productivity & cost-push shocks	Demand shocks	Financial shocks	Exchange rate shocks
output	3.64	40.30	1.50	1.80	30.11	6.57	2.18	11.96	1.79	0.16
consumption	1.01	32.72	2.59	2.03	20.16	9.62	0.42	28.34	3.03	0.08
investment	0.32	41.41	2.56	0.60	28.14	3.81	0.19	18.21	4.70	0.05
labor	25.77	21.48	0.78	16.61	15.96	3.41	8.70	6.26	0.90	0.12
wage inflation	32.95	1.05	0.26	31.12	1.25	0.85	30.93	0.63	0.82	0.14
net worth	4.97	1.21	15.70	3.94	1.08	26.70	2.16	0.43	43.70	0.10
interest rates	4.36	5.49	12.58	6.53	4.88	46.75	2.31	1.88	14.89	0.34
inflation, foreign goods	65.60	0.03	0.01	20.66	0.32	0.02	12.55	0.02	0.03	0.77
inflation, domestic goods	29.59	0.46	0.20	36.23	0.58	0.59	31.49	0.20	0.56	0.10
credit spread	0.08	0.12	59.01	0.10	0.07	29.24	0.04	0.04	11.30	0.00
CA&MX endogenous variables										
output	2.10	5.90	0.35	38.84	45.14	4.30	0.15	3.01	0.22	0.00
consumption	2.57	5.78	0.89	21.27	49.00	11.96	0.64	7.46	0.31	0.11
investment	1.39	6.80	0.26	21.20	60.94	4.11	0.21	4.52	0.50	0.07
labor	7.60	4.37	0.24	43.39	33.47	3.04	5.54	2.19	0.14	0.02
wage inflation	5.78	0.05	0.00	92.08	0.38	0.10	1.46	0.04	0.01	0.08
net worth	4.84	0.03	2.54	45.68	0.21	40.80	1.48	0.02	4.32	0.08
interest rates	6.00	0.07	2.00	62.51	0.40	26.86	1.38	0.03	0.61	0.13
inflation, foreign goods	39.60	0.07	0.01	39.91	0.44	0.05	18.84	0.03	0.03	1.01
inflation, domestic goods	5.35	0.03	0.00	93.97	0.19	0.04	0.37	0.02	0.00	0.03
credit spread	0.16	0.01	12.84	1.44	0.08	79.68	0.06	0.01	5.73	0.00

Notes: FEVDs are obtained by using parameters' posterior mean values.

Table 11. Relative FEVDs, TP compared to CA&MX

	Horizon = 1 quarter			Horizon = 10 quarters		
	U.S. shocks	CA&MX or TP shocks	Common shocks	U.S. shocks	CA&MX or TP shocks	Common shocks
U.S. endogenous variables						
output	2.85	-4.76	0.75	1.17	-5.71	3.27
consumption	-2.98	1.97	0.86	-2.82	-0.59	3.15
investment	8.70	-9.90	1.07	9.02	-10.30	1.01
labor	9.65	-6.67	-4.15	8.25	-7.56	-1.92
wage inflation	28.57	-16.66	-12.15	22.48	-17.07	-7.88
net worth	1.67	-13.94	11.49	1.00	-14.53	11.99
interest rates	9.88	-28.43	16.49	7.48	-30.06	18.61
inflation, foreign goods	-54.92	-13.76	61.18	-53.41	-13.96	60.85
inflation, domestic goods	11.67	-16.06	4.07	7.47	-18.74	8.59
credit spread	11.12	-11.60	0.48	11.07	-12.28	1.15
CA&MX or TP endogenous variables						
output	0.30	-3.57	2.84	0.91	-8.48	7.09
consumption	-0.63	1.78	-1.17	-0.98	-2.84	3.69
investment	0.89	-5.42	4.18	0.62	-8.99	7.77
labor	-3.82	4.73	-1.49	-3.36	3.35	-0.56
wage inflation	3.65	-11.92	8.09	-1.89	-44.22	45.43
net worth	-0.41	-22.97	22.96	-3.27	-47.57	49.93
interest rates	3.12	-36.09	31.92	-4.69	-67.94	71.50
inflation, foreign goods	-47.90	-17.75	61.43	-37.93	-37.24	72.41
inflation, domestic goods	-1.01	-13.61	14.50	-3.20	-61.84	64.44
credit spread	6.56	-15.65	9.09	6.20	-16.04	9.81

Notes: FEVDs are obtained by using parameters' posterior mean values. The values in the table are obtained by subtracting the values in Table 9 from the corresponding values in Table 7. The values in this table therefore reflect the contribution of shocks to variance decompositions in the US/TP estimations relative to their contributions in the US/CA&MX estimations.

Table 12. Relative FEVDs, TP compared to CA&MX, by type of shock

horizon = 1 quarter

U.S. endogenous variables	U.S. shocks: Productivity & cost-push shocks	U.S. shocks: Demand shocks	U.S. shocks: Financial shocks	CA&MX / TP shocks: Productivity & cost-push shocks	CA&MX / TP shocks: Demand shocks	CA&MX / TP shocks: Financial shocks	Common shocks: Productivity & cost-push shocks	Common shocks: Demand shocks	Common shocks: Financial shocks	Common shocks: Exchange rate shocks
output	-1.77	4.69	-0.07	-0.79	1.15	-5.12	-0.53	1.23	0.05	1.16
consumption	-0.31	-1.77	-0.91	-0.68	9.92	-7.27	0.82	1.08	-1.04	0.15
investment	0.12	8.70	-0.11	-0.16	-8.63	-1.11	0.08	1.13	-0.15	0.13
labor	8.44	1.31	-0.10	-3.47	-0.20	-3.00	-4.34	0.26	-0.07	1.18
wage inflation	27.56	0.94	0.07	-17.90	1.28	-0.04	-13.03	0.83	0.05	0.24
net worth	-1.64	-0.17	3.48	-1.01	0.01	-12.94	3.68	0.00	7.81	0.77
interest rates	0.42	1.15	8.31	-0.64	1.30	-29.10	7.80	0.58	8.10	2.07
inflation, foreign goods	-55.27	0.32	0.03	-16.36	-0.01	2.62	61.05	0.00	0.13	7.51
inflation, domestic goods	11.49	0.17	0.00	-16.32	0.26	0.00	3.92	0.13	0.03	0.32
credit spread	0.00	0.00	11.12	-0.01	0.00	-11.59	0.00	0.00	0.47	0.01
CA&MX/TP endo. vars.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
output	-0.64	0.32	0.62	-18.58	13.57	1.43	0.00	1.40	1.44	0.44
consumption	-1.34	1.02	-0.31	-8.57	21.63	-11.29	-0.41	-1.51	0.76	0.02
investment	-0.73	0.89	0.72	-10.95	2.67	2.86	0.13	2.69	1.36	0.35
labor	-2.27	-1.62	0.07	15.01	-9.82	-0.46	-1.37	-0.52	0.41	0.58
wage inflation	1.96	1.29	0.40	-25.87	11.76	2.18	6.37	1.09	0.62	0.19
net worth	-1.69	0.04	1.24	-7.36	-0.07	-15.53	4.52	0.00	18.44	0.41
interest rates	-3.24	0.28	6.08	-23.02	1.28	-14.34	19.52	0.10	12.30	1.05
inflation, foreign goods	-48.15	0.22	0.03	-19.13	-0.05	1.43	61.34	0.00	0.09	4.22
inflation, domestic goods	-1.07	0.04	0.01	-13.91	0.23	0.08	14.46	0.01	0.02	0.12
credit spread	-0.01	0.00	6.58	-0.04	0.00	-15.61	0.11	0.00	8.98	0.00

horizon = 10 quarters

U.S. endogenous variables	U.S. shocks: Productivity & cost-push shocks	U.S. shocks: Demand shocks	U.S. shocks: Financial shocks	CA&MX / TP shocks: Productivity & cost-push shocks	CA&MX / TP shocks: Demand shocks	CA&MX / TP shocks: Financial shocks	Common shocks: Productivity & cost-push shocks	Common shocks: Demand shocks	Common shocks: Financial shocks	Common shocks: Exchange rate shocks
output	-3.38	4.68	-0.14	-1.63	1.54	-5.61	1.85	1.52	-0.10	1.27
consumption	-0.49	-1.44	-0.89	-1.71	9.07	-7.95	2.54	1.52	-0.91	0.26
investment	0.19	9.40	-0.57	-0.40	-7.20	-2.69	0.12	1.61	-0.73	0.28
labor	5.59	2.76	-0.09	-5.58	1.08	-3.06	-2.67	0.83	-0.08	1.23
wage inflation	20.56	1.95	-0.03	-19.34	2.74	-0.48	-9.18	1.45	-0.15	2.48
net worth	-1.14	0.25	1.89	-1.51	0.45	-13.47	7.39	0.24	4.36	1.54
interest rates	2.32	1.72	3.43	-2.25	2.33	-30.13	13.99	1.25	3.37	3.97
inflation, foreign goods	-53.78	0.34	0.04	-16.20	-0.15	2.39	60.68	0.04	0.14	6.51
inflation, domestic goods	6.16	1.36	-0.04	-20.64	2.07	-0.16	7.37	1.06	0.17	2.67
credit spread	0.00	0.01	11.06	-0.06	0.00	-12.21	0.03	0.01	1.12	0.06
CA&MX/TP endo. vars.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
output	-1.26	1.34	0.83	-30.19	19.18	2.54	3.59	1.80	1.71	0.47
consumption	-2.36	1.35	0.03	-19.00	24.17	-8.02	3.30	-0.63	1.02	0.14
investment	-0.87	0.68	0.80	-13.02	1.66	2.37	3.82	2.13	1.82	0.60
labor	-2.02	-1.46	0.12	12.62	-8.84	-0.42	-0.58	-0.47	0.50	0.57
wage inflation	-2.69	0.58	0.22	-49.80	4.22	1.36	44.67	0.35	0.40	0.69
net worth	-3.90	0.13	0.49	-36.05	0.36	-11.88	41.35	0.02	8.56	0.91
interest rates	-5.03	0.24	0.11	-50.71	0.87	-18.10	69.20	0.03	2.27	1.12
inflation, foreign goods	-38.09	0.13	0.02	-37.81	-0.35	0.91	72.38	-0.02	0.05	2.76
inflation, domestic goods	-3.43	0.20	0.03	-62.82	0.74	0.24	64.34	0.02	0.08	0.59
credit spread	-0.13	0.01	6.33	-1.06	0.07	-15.05	0.28	0.01	9.52	0.02

Notes: FEVDs are obtained by using parameters' posterior mean values. The values in the table are obtained by subtracting the values in Table 9 from the corresponding values in Table 7. The values in this table therefore reflect the contribution of shocks to variance decompositions in the US/TP estimations relative to their contributions in the US/CA&MX estimations.