Proposal: Fiscal Policy in Heterogeneous Agent Models with Exotic Preferences

November 20, 2016

The seminar work Backus et. al. (2004) summarizes the theoretical framework of non-standard preferences frequently adopted by macroeconomist besides the standard additive preference. However, very few of these preferences have been applied to the incomplete market with heterogeneous agents, with a few exceptions (for example, Gomes and Michaelides (2008)). How does the behavior, like ambiguity aversion and hyperbolic discounting affect the equilibrium wealth and consumption density? Our simulation result in Figure 1 shows that households with ambiguity aversion do not necessarily save more. That is, the so-called "Ambiguity Prudence" from Berger (2014) and Baillon (2016) might not hold in heterogeneous agents framework. More specifically, ambiguous households with a low wealth level tend to save more while those with a high wealth level save less, compared to the ambiguity neutral environment. Hence, our result reveals that the impact of ambiguity aversion across different types of households is asymmetry. Ambiguous households are willing to postpone their consumption when they are poor, due to their aversion to the uncertainty of the endowment shock. On the other hand, the rich households are not affected much by this uncertainty, as they are expected to save more when they were poor. In summary, ambiguity narrow down the wealth inequality as shown in Figure 2.

However, the narrow wealthier inequality does not imply an increase in welfare. As shown in Nuno and Moll (2016) that the decentralized economy without ambiguity is in the first best allocation. The economy with ambiguity is more likely inefficient in the sense that the poor are over-save and the rich are under-save. Could different taxation policies improve the welfare and at the same time preserve the low wealth inequality generated in the ambiguity economy? This is the question to address in this paper.

Background: Standard Additive Utility

Achdou et. al. (2015) present the continuous time formulation of the Huggurt-Bewley-Aiyagari model. In their model, there are continuum of households in an economy. Each of whom faces an idiosyncratic shock in each period. Each household maximize the discounted sum of expected utility by choosing a consumption path c

$$\max_c E_0 \int_0^\infty e^{-\rho t} u(c(s)) ds \tag{1}$$

subject to the evolution of wealth

$$da = (ra + wz - c)dt \tag{2}$$

with the borrowing constraint

$$a \geq \underline{a} \tag{3}$$

where $r > 0$ is an interest rate, $\rho > 0$ is a discount rate and $w > 0$ is the wage rate. The labor endowment z evolves stochastically as

$$d\log(z) = -\theta \log(z)dt + \sigma dW \tag{4}$$

Solving the above equations (1) - (4) yields the Hamiltonian Jacobi Bellman (HJB) and Kolmogorov forward equation:

$$\rho V(a,z,t) = \max_c (ra + wz - c)\partial_a V(a,z,t) + \partial_z V(a,z,t)\mu(z) + \frac{1}{2}(\sigma z)^2 \partial_{zz} V(a,z,t) + \partial_t V(a,z,t)$$

$$\partial_t g(a,z,t) = -\partial_a((ra + wz - c^*)g(a,z,t)) - \partial_z(\mu(z)g(a,z,t)) + \frac{1}{2}\sigma^2 \partial_{zz} g(a,z,t)$$

where $\mu(z) = (-\theta \log(z) + \sigma^2/2)z$. The boundary condition includes $\partial_a V(\underline{a}, z, t) = 0$, $\partial_z V(a, z_{min}, t) = 0$ and $\partial_z V(a, z_{max}, t) = 0$. Also, we need $\int\int g(a,z,t)dadz = 1$ and the transversality condition for $V(a,z,t)$.

Stochastic Differential Utility

For the case of the stochastic differential utility (SDU), Households maximize the following function instead of (1).

$$V_t = \max_{c_t} E\left[\int_t^\infty \left(f(c_s, V_s) + \frac{1}{2}A(V_s)\frac{d}{ds}[V]_s\right)ds\right] \tag{5}$$

where $f(c,V)$ is called the "aggregator" function and $[V]_t \equiv \int_0^t \sigma_V^2(s)ds$ is the quadratic variation process for V. Still, they subject to the budget constraint (2), (3) and (4). According to Duffie and Epstein (1992), the value function V from (5). has the following stochastic differential representation:

$$dV = \mu dt + \sigma_V dB \tag{6}$$

where $\mu = -f(c,V) - \frac{1}{2}A(V)\sigma_V^2$ is a progressive meaurable process. As shown by Duffie and Lions (1992), there is a PDE expression for (6)

$$\max_c (ra+wz-c)V_a(a,z,t) + V_z(a,z,t)\mu(z) + \frac{1}{2}\sigma^2 V_{zz}(a,z,t) + A(V)\left(\frac{1}{2}(\sigma z)^2 V_z^2\right) + V_t(a,z,t) + f(c,V) = 0 \tag{7}$$

Hansen (2004) summarizes three important special case for the SDU preference:

- Standard additive utility: $f(c,V) = u(c) - \rho V$ and $A(V) = 0$.
- Other wide class: $f(c,V) = u(c) - \rho V$ and $A(V) = h''(V)/h'(V)$. According to Hansen (2004), if we set $h(V) = -\alpha \exp(-U/\alpha)$, this becomes multiplier preference for Ambiguity by Hansen and Sargent (2008) with $\alpha > 0$ controls the degree of ambiguity aversion. The less the α, the more ambiguous the household is.

- Kreps–Porteus (also named as Epstein–Zin) utility: $f(c, V) = u(c) - \rho V$ and $A(V) = \mu/V$, $\mu \in (-1, 0)$ and $\mu < -1$.

We focuses on the multiplier preference for ambiguity and the simulation results are shown in Figure 1 - 3.

Fiscal Policy

The proportional wealth income tax t_C and labor income tax t_L can be imposed by changing the evolution of wealth (2) into

$$da = (r(1 - t_C)a + (1 - t_L)wz - c)dt \tag{8}$$

Similarly, the progressive labor endowment tax t_p can be imposed into the evolution of wealth in the way that

$$da = (ra + (wz)^{1-t_P} - c)dt \tag{9}$$

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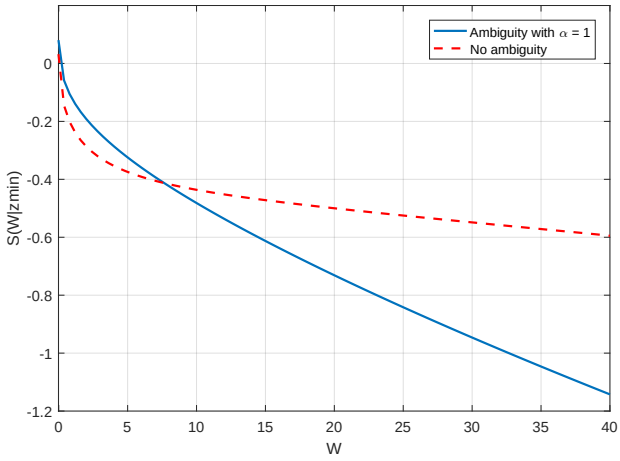
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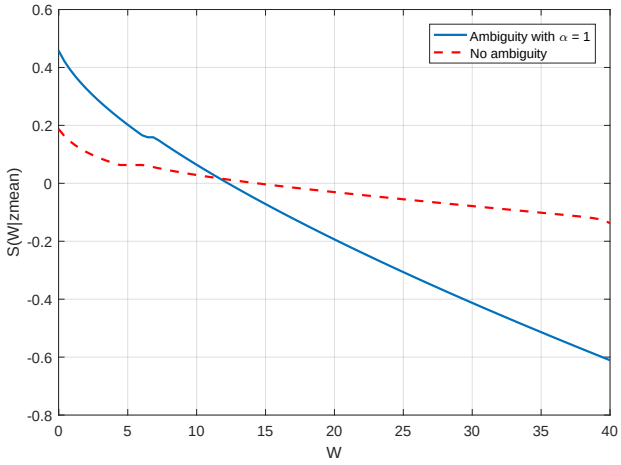
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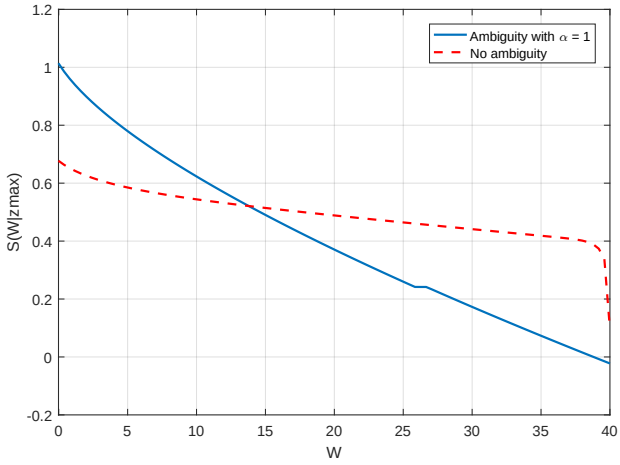
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(a) $z = z_{min}$

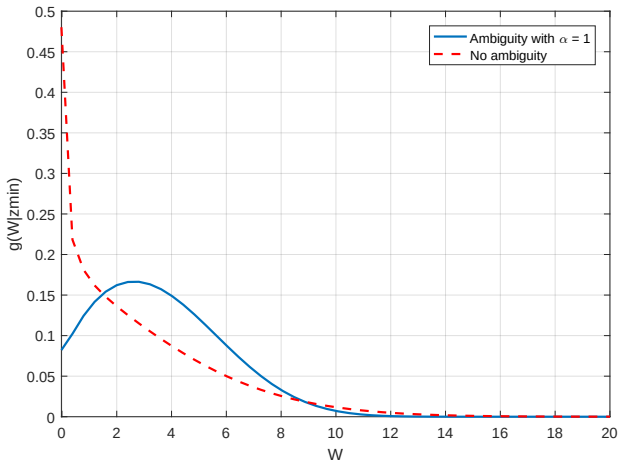


(b) $z = z_{mean}$

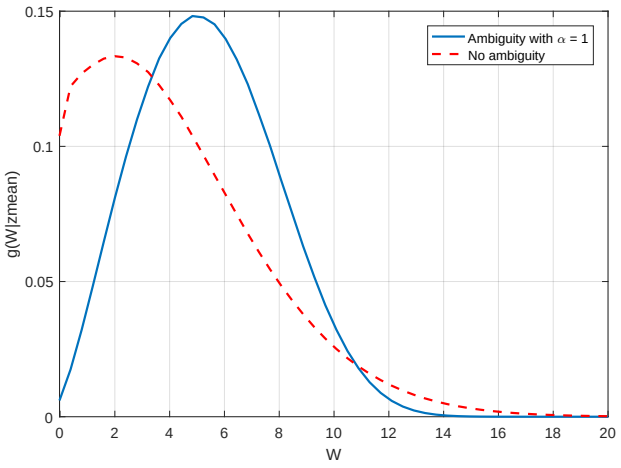


(c) $z = z_{max}$

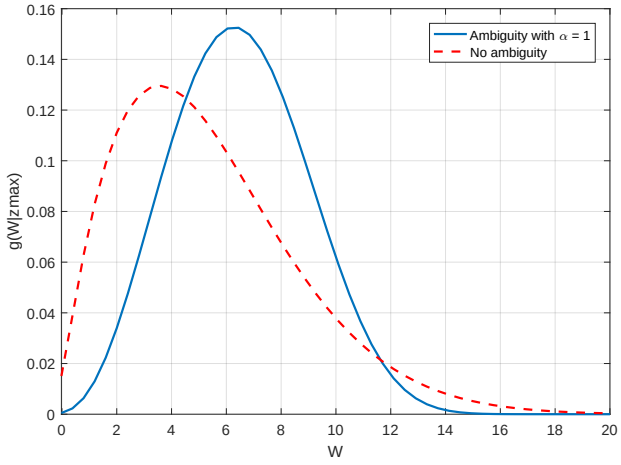
Figure 1: Saving functions against wealth level W given different labor endowments.



(a) $z = z_{min}$



(b) $z = z_{mean}$



(c) $z = z_{max}$

Figure 2: Wealth densities in the stationary equilibrium conditional on different labor endowments.

Ying Tung Chan

November 2016

McGill University
Department of Economics
855 Sherbrooke Street West
Montreal, QC, H3A 2T7, Canada

Tel: 1-514-758-7486
Email: ying.chan@mail.mcgill.ca
Webpage: http://ytungchan.weebly.com/
Citizenship: Hong Kong, China

Education

2012 - 2017 Ph.D. in Economics, McGill University

2010 - 2012 M.Phil. in Economics, The Chinese University of Hong Kong

2007 - 2010 B.Soc.Sc. in Economics, The Chinese University of Hong Kong
(First Class Honor) Double Minors in Mathematics and Statistics.

Research Fields

Macroeconomics, Behavioral Economics, Labor Economics

Dissertation

Three Essays in Macroeconomics with Heterogeneous Agents

Committee

Professor Ngo Van Long
Professor Francisco Alvarez-Cuadrado
Professor Hassan Benchekroun

Working Papers

"On the Generalized Consumption Externality with Heterogeneous Agents" [Job Market Paper]
(Third-Year Best Paper Prize, Economics Department, McGill University)

"On the Ambiguity of Job Search" (with Chi Man Yip)
Submitted (Presented at the SOLE/EALE World Conference 2015)

"Globalization and Rising Urban-Rural Income Inequality in China: Trade, Specialization and Technology" (with Qian Sun)
R & R at China Economic Review
(Originated from my Master thesis: "Real exchange rate, Nature of Export Market and Intra-provincial Income Inequality in China")

"Search Relativity" (with Chi Man Yip)
(will be presented at AEA 2017)

"Shock Propagation and Global Market Structure"

Selected Work In Progress

"Large-Scale Social Network Games"

"Estimating DSGE Model with Non-Parametric Technology Shock"

"Trading Goods and Trading Tasks: A Simple Model of Firm Heterogeneity with Innovation" (with Maxwell Tuuli)

"A Robust Mortensen and Pissarides Model" (with Chi Man Yip)

"Ambiguous Business Cycles in Emerging Economics with Application in China"

Working Experience

2016 Course Lecturer, McGill University
ECON633 Mathematics for economists (Master and Ph.D. level)
Course Webpage: https://sites.google.com/site/2016econ633/
Math-Camp with an introduction to Matlab and Julia

	2015 - 2016	Research Assistant for Prof. Hassan Benchekroun, McGill University *Duties: Coding using Matlab and Mathematica*
	2012 -	Teaching Assistant, McGill University *Microeconomics Theory 1 (Master and Ph.D. level)* *Macroeconomics Theory 1 (Master and Ph.D. level)* *Macroeconomics - Honours* *Macroeconomics Theory* *Current Economic Problems*
	2010 - 2012	Teaching Assistant, CUHK *International Finance*
	2011	Research Assistant for Prof. Shi Kang, CUHK *Duties: Preparing and cleaning the dataset*

Honors and Awards

2012 - 2016	Graduate Excellence Award, McGill
2014	Third-Year Best Paper Prize, Department of Economics, McGill
2014	Gordon Whitehorne Fellowship
2013	Roland Family Fellowship
2013	WYNG Trust Fellowship
2012	Pilarczyk Fellowship
2010 - 2012	MPhil. Studentship, CUHK
2008, 2010	Dean's List, Chung Chi College, CUHK
2008	Chung Chi College Scholarship, CUHK

Research Grant

2011	I.CARE Programme Research Grant, "The relationship between labor market structure and the rising Sub-divided units in Hong Kong" (Sole investigator)

Presentations

2016	Department Seminar, McGill
2016	Annual Conference of the CEA, Canadian Economics Association, Ottawa
2016	Twelfth CIREQ Ph.D. Students' Conference, Montreal
2015	Fourth Society of Labor Economists (SOLE) / European Association of Labour Economists (EALE) World Conference, Montreal
2015	Canadian Labour Market and Skills Researcher Network (CLSRN) Conference, Toronto
2015	Eleventh CIREQ Ph.D. Students' Conference, Montreal

Programming Languages

Matlab, Mathematica, Python (Scientific Computing), Julia, R, Stata, LaTeX

Languages

English (Fluent), Mandarin Chinese (Fluent), Cantonese Chinese (Native)

References

Prof. Ngo Van Long
Department of Economics
McGill University
855 Sherbrooke Street West
Montreal, Quebec, H3A 2T7
1-514-0398-4400
ngo.long@mcgill.ca

Prof. Francisco Alvarez-Cuadrado
Department of Economics
McGill University
855 Sherbrooke Street West
Montreal, Quebec, H3A 2T7
1-514-398-8804
francisco.alvarez-cuadrado@mcgill.ca

Prof. Hassan Benchekroun
Department of Economics
McGill University
855 Sherbrooke Street West
Montreal, Quebec, H3A 2T7
1-514-398-6064
hassan.benchekroun@mcgill.ca

WORKING PAPERS
ABSTRACTS

"On the Generalized Consumption Externality with Heterogeneous Agents" [Job Market Paper]
This paper provides a novel explanation for the Easterlin paradox in the United States: Whereas the real GDP per capita has doubled in the past four decades, there has been almost no change in happiness. We propose an "inequality aversion" hypothesis to explain this puzzle. While the rise in average consumption increases agents' utility, the increase in the variance of consumption lowers one's utility due to the inequality aversion preference. We show that the inequality aversion hypothesis better explains the paradox than the standard relative income hypothesis. This paper presents a continuous time heterogeneous agent model with highly generalized consumption externality. Consumption externality is modeled as a dependence of agents' utility on an arbitrary functional of consumption distribution which is endogenously determined. Our framework, first, generalises the "relative consumption" model in Dupor and Liu (2003) to a stochastic environment with heterogeneous agents. Second, it encompasses the inequality aversion preference by Fehr and Schmidt (1999) and other psychological behaviours such as symmetric desire, hostility to the rich, and sympathy for the poor. In contrast to the literature, the socially optimal consumption plan we derived reveals that negative externality does not always lead to over-consumption. Under-consumption or the co-existence of over- and under-consumption could happen, depending on the type of externality assumed. The model with an inequality averse preference is the most consistent with the observed US consumption patterns.

"On the Ambiguity of Job Search" (with Chi Man Yip)
Prior search and matching models of unemployment assume common knowledge on a productivity distribution. However, the true distribution is likely to be unknown. How does such ambiguity affect labour market outcomes? This paper examines the relationship between ambiguity aversion and unemployment. We develop an analytically tractable version of a search equilibrium model that features ambiguity aversion. We show that the ambiguity-averse unemployed workers tend to believe that the realized productivity is lower, and thus they possess a lower reservation wage, leading to a lower unemployment rate. Our model shows that the US unemployment could have increased if both workers and firms became ambiguity neutral. Such an increase is larger in slumps than in booms and could be as large as 19 percent of the actual unemployment. Meanwhile, our counterfactual analysis indicates that the ambiguity aversion intensifies the responsiveness of unemployment to unemployment benefit, matching better with the data.

"Globalization and Rising Urban-Rural Income Inequality in China: Trade, Specialization and Technology" (with Qian Sun)
This paper investigates the theoretic and empirical relationship between globalization and urban-rural inequality in China. We decompose the change in urban-rural inequality into a volume effect from trade, a composition effect from specialization and a price effect from technology. We empirically estimate this relationship using annual province level data from 28 Chinese provinces during 1995-2008. We show that omitting the composition effect can bias the estimate of the volume effect. We use total export's real exchange rate elasticity to control export composition. Once export composition is controlled, the effect of trade on urban-rural inequality is negative. We also estimate that the composition effect is positive. Thus export composition is the larger contributor to the rise in urban-rural inequality relative to export volume. What is exported matters more than how much is exported in explaining a wider urban-rural income gap.

"Search Relativity" (with Chi Man Yip)
We construct a search equilibrium model, where unemployed workers with heterogeneous productivity compete with one another during a job search process according to their relative position of search intensity. The transition rate to employment increases with the relative position of the search intensity, not its level. Our model derives (i) a simple formula that disaggregates an overall unemployment rate (OUR) into an unemployment rate by educational attainment, (ii) a formula of the fundamental frictional unemployment rate, which is the unemployment rate driven sheerly by a search friction, abstracting other factors like search intensity or productivity, and (iii) a closed-form formula to quantify the Macro elasticity of the educational unemployment rate with respect to the OUR. In particular, our model indicates that the educational unemployment rate of the post-graduate workers is as simple as

$u/(2-u)$, where u is an OUR. Our statistical tests cannot reject the null hypotheses that the derived and the observed rates are from the same distribution in Canada, UK.

"Shock Propagation and Global Market Structure"
The paper presents a social network game of oligopoly, where firms are heterogeneous in term of their goods substitutability. We distinguish the concept between local and global market structure. The former (latter) refers to the market structure with (without) restricting to a subset of firms in an economy. This allows us to nest the conventional market structures, including monopoly, homogeneous oligopoly and perfect competition in one setting. In our model, when two firms producing substitute goods and with common competitors, reducing the price of a good could rise the demand for another good, which is due to the weakening their common competitors. Then, we examine how the idiosyncratic shocks are propagated under different types of market structure. On the one hand, a monopoly contributes its shock more to the aggregate volatility due to its large market share. On the other hand, the interaction between small firms could cushion or amplify their shocks depending on the market structure. This studies the shock propagation in the demand side perspective, in contrast to the supply side analysis in Acemoglu, et. al. (2015). We also show how the heterogeneous market power induced by production differentiation could lead to economic growth and capital misallocation.

WORKING IN PROGRESS ABSTRACTS

"Large-Scale Social Network Games"
This paper proposes a way to model social network games with the number of players tends to infinity. Loász (2012) proved that when the number of nodes of a network/graph tends to infinity, its limit (under certain conditions) can be characterized by a two-dimensional kernel function called "Graphon". We show that as a network tends to a "Graphon", the first order condition would tend to an integral equation, which can be studied explicitly. We then study the large-scale social network in a dynamic setting. This is the first paper to study a social network game with infinitely many agents.

"Estimating DSGE Model with Non-Parametric Technology Shock"
This paper proposes a new method to estimate dynamic stochastic general equilibrium model (DSGE) with non-parametric technology shock. By assuming the shock follows the different stationary Gaussian processes (e.g. Gaussian process with Matern Class of Covariance function, Squared and γ- Exponential function, etc.), it is shown that we can incorporate the non-parametric process into the standard state space representation, and can then be estimated by the standard Filtering method (either by Kalman Filter or particle Filter). In the simulation study, I find that the non-parametric shock outperform the conventional autoregressive technology shock, which tends to over-smooth the actual shock.

"Trading Goods and Trading Tasks: A Simple Model of Firm Heterogeneity with Innovation" (with Maxwell Tuuli)
This paper provides a link between trade in good and trade in task through the change in innovation spending. By incorporating the trade-in-task model in Grossman and Rossi-Hansberg (2008) into the model in Melitz (2003), I first show that there are two opposite effects determine the movement of R& D spending and the number of tasks offshored, namely, the concentration effect and the volume effect. If the first one dominates, there is a co-movement between R& D spending and the degree of offshoring, and vice versa. After trade liberalization, export firms tend to reduce their spending on R&D, and this reduction is less severe when there is a decrease in iceberg cost. While the impact of trade liberalization on the number of tasks offshored is still determined by the concentration effect and volume effect. In the dynamic setting of the model, we introduce uncertainty to innovation and find that in the presence of uncertainty there is less expenditure on R&D.

"A Robust Mortensen and Pissarides Model" (with Chi Man, Yip)
The present paper generalizes the Mortensen and Pissarides (1994) model by allowing incomplete information about the data generating process in the economy. An agent could use an approximating model but at the same time worry about model misspecification. Using robust control techniques as

in Hansen and Sargent (2008), a robust agent optimally chooses his model, according to his degree of ambiguity aversion, to make decisions on job search, job destruction and vacancy creation. Our robust model not only provides analytically tractable framework, but also provides additional insight on how ambiguity aversion influences workers' and vacancies' decision, and preserves most of the generally intuitive comparative statics as in the original model even under workers' and vacancies' ambiguity aversion. Recent literature criticizes the Mortensen and Pissarides (1994) model in its inability to generate the volatility of market tightness in the United States. Our generalized model succeeds in replicating a similar volatility of the market tightness as in the US data, resolving the unemployment volatility puzzle. Our calibration exercise supports that incorporating ambiguity aversion is a substantial improvement over standard search and matching models.

"Ambiguous Business Cycles in Emerging Economics with Application in China"
This paper investigates how ambiguity aversion could explain the characteristics of business cycles in the emerging economies. Model misspecification concerns by Hansen and Sargent (2007) will be incorporated into the small open economy model of Devereux, Lane, and Xu (2006). Households who are uncertain about the true model tend to hold less international bonds in the presence of the world interest rate shock. This leads to inadequate consumption smoothing and hence a more volatile consumption and investment. The model potentially provides an alternative explanation that besides different source of frictions, the factors that cause informational uncertainty (e.g. frequent institutional changes) could result in different shock reactions and hence different volatility and persistence of macroeconomics variables in emerging economies. The home bias bond holding by the ambiguous Households is useful in solving the Feldstein-Horioka Puzzle.

McGill

Department of Economics
McGill University

855 Sherbrooke Street West, Room 414
Montreal, Quebec, Canada H3A 2T7

Département de sciences économiques
Université McGill

855, rue Sherbrooke ouest, Bureau 414
Montréal (Québec) Canada H3A 2T7

Telephone:(514) 398-3030
Facsimile: (514) 398-4938

October 9, 2016

To Whom It May Concern:

Mr Ying Tung Chan is applying for a position in your department and asked me to write a reference letter on his behalf.

I am delighted to do so. Before getting into the details, I would like to state that Tung is one of the most brilliant doctoral students I have met in my 18 years of experience.

I have recruited Tung as a research assistant more than two years ago. I am also quite familiar with his research agenda.

Tung's job market paper is about consumption externalities, that is, situations where utility of an agent depends not only her own consumption but also on the consumption of other agents. A growing literature has developed to model behavior such as envy, catching-up with the Jones, jealousy, inequity aversion and other sources of consumption externalities. The applications have been very successful in particular for asset pricing, economic growth problems and public policy assessments. For each type of externality an ad-hoc framework is typically used and results generated are specific to the given framework. What Tung does in his main essay is to offer a unifying model that allows capturing all this consumption externalities within a single model, which allows for agents' heterogeneity. He considers a fully dynamic model where an individual agent makes a decision regarding the allocation of income and wealth between consumption and savings. Wealth accumulation is stochastic. Within a very general setup Tung is able to characterize the stationary equilibrium value function, consumption and saving. This is done analytically for special types of income distributions and numerically for the general case. This achievement is remarkable given the technical difficulties involved. The analytical material involves familiarity with highly technical tools that are not covered in graduate courses. He also put forward the algorithm and built the numerical tools to solve for the consumption rule in the general case. The essay is complemented with a section using real data to identify, using the generalized framework, the contribution of each type of externality. This is a strong piece of work that is of great interest to both theorists and policy makers. This essay is very good and I find it publishable in the top field journal or a very good general economics general, perhaps even one of the top five if carefully revised.

I hired Tung to work for me as a research assistant for the past two years. The projects on which I asked for his help are related to strategic behavior in natural resource extraction (renewable and nonrenewable) as well as in environmental economics (international environmental agreements). The topics are thus somewhat remote from his research agenda. His tasks varied over time. They initially involved writing codes in Mathematica and Matlab. His assignments quickly grew in complexity as he very efficiently solved all of the tasks I had. I have been struggling for years and with several other research assistants in the past to get some codes implemented. Tung was able to get to the issues I had in mind extremely quickly and comes up with a solution in record time. Most of our interactions for this research assistance jobs have been via email, and required, on my part, only a very minimum amount of explanations of the needs. I will miss him tremendously as a research assistant. I do hope that in time I will be able to work with him on research topics of common interest. I see him more as a junior colleague than a research assistant.

Tung taught the math prep course last summer. This is an intensive course of 39 hours over 3 weeks and takes place just before the Fall semester starts. It covers essential mathematical tools in economics for entering graduate students. I had very good feedback on Tung's performance as a teacher. This is not an easy course to teach given the level of the material, the fast pace and the heterogeneity in students' background. Tung's success in that course is a clear evidence of his teaching abilities.

Tung is a very mature, polite and well-mannered young man, with a great sense of integrity. He will be a great colleague.

Overall, Tung's technical expertise, his ability to contribute to relevant research problems both quantitatively and qualitatively, his exceptional efficiency in providing solutions and delivering results for the difficult problems I assigned to him, are all reasons that make me very confident that he will turn into a productive and successful scholar.

I recommend Tung very highly and I would be more than happy to provide any further information you may need.

Yours sincerely,



H. Benchekroun, Professor
Department of Economics
McGill University

McGill

Department of Economics
McGill University

855 Sherbrooke Street West
Montreal, Quebec, Canada H3A 2T7

Département de sciences économiques
Université McGill

855, rue Sherbrooke ouest
Montréal (Québec) Canada H3A 2T7

Telephone: (514) 398-3030
Facsimile: (514) 398-4938
Web Site: http://www.mcgill.ca/economics/

October, 16, 2016

Dear Sir or Madam:

I am delighted to have this opportunity to write to you on behalf of Mr. **Ying Tung Chan** and endorse with full enthusiasm his application for a position at your institution. In my view Tung is one of the two strongest candidates McGill has had in the market over the last three years. Academic institutions and research-oriented non-academic institutions should take a careful look at his file.

Tung's main strength lies in his analytical capability that complements with an outstanding, most of it self-taught, technical training. This is reflected in the scope of his research at this early stage of his career. Aside from his job market paper, which received the prize to best third year paper in our department, he has another 4 completed papers, 2 notes and 5 projects at different stages of completion. This is surprising for someone coming out of graduate school. These projects include a variety of topics, including unemployment, trade, and auction theory. The core of his work is in applied theory addressing questions that are always motivated by empirical observations, probably with the sole exception of his job market paper where the contribution is mainly theoretical.

In this paper, Tung incorporates interdependent preferences into a standard incomplete markets model. Aside from the conventional interaction trough market prices, households in this model also interact through preferences, with an individual's choices having an impact non only on her own welfare but also on that of her peers and therefore in their choices. In recent years there has been a growing interest in models of interdependent preferences. The experimental literature has identifies several departures from narrowly defined selfish behaviour. The macro literature has introduced interdependent preferences to rationalize several empirical departures from the implications of the standard theory that assumes that preferences are independent across individuals. Most of these models have restricted their attention to the first moment of the consumption distribution, average consumption, as the relevant reference point. Tung relaxes this restrictive assumption by allowing any moment of the income distribution to play a relevant role. For instance, his model nests as special cases "catching up with the Joneses", inequality aversion or distaste for the rich. Then using data on the cross-sectional distribution of consumption he conducts a preliminary empirical analysis to pin down which moments of this distribution lie at the source of interpersonal comparisons. The results of this exercise suggest the importance of inequality aversion as an important determinant of individual choices. The paper is well-crafted, the idea is novel and very interesting, and once Tung refines the motivation of his exercise, it is not easy to address simultaneously two audiences --the users of incomplete markets models and those of interdependent preferences--, and improves the empirical analysis I would expect the paper to be placed in a top-field journal, such as the Journal of Public Economics.

Instead of discussing each one of Tung's papers, I will simply concentrate in another one I really like. In "Search Relativity" (jointly authored with Chip Man Yip, a former McGill MA student now completing his PhD at Calgary) Tung models a search and matching labor market with agents with different educational attainments in which an unemployed worker's job finding probability depends on her search intensity relative to the effort exerted by other unemployed workers. Aside from characterizing the aggregate (frictional) unemployment rate, they characterize (frictional) unemployment rates for each level

of educational attainment, for instance the one for college graduates is given by a simple formula, $\frac{u}{2-u}$, where u is the aggregate unemployment rate. Their model successfully predicts the average variation in unemployment rates across educational attainments for Canada. This is another nice example of Tung's work. He takes a simple idea, builds a model to assess its implications, and takes some data to contrast them.

In terms of teaching, Tung has led several conference sessions for various courses in the department. In particular he has been my TA for the last two years in macroeconomics at the honours level. From my perspective his help with this course was invaluable. I have never had before such a well-organized and diligent TA. Tung made my life easy. From the student perspective Tung seems to be even better. For instance, last year one of the students wrote in his anonymous evaluation of Tung *"It was as if there are 2 professors in this course"* while another thought *"Tung is the very best TA I have ever seen. The information he gives is relevant, he is available for students. He synthesizes the material so well, everything falls into place. He really helped me get a deeper understanding of the material"*. Overall, any comments I have ever received concerning Tung's pedagogical skills were always extremely positive. The department became aware of his capacity and this last summer Tung was chosen to teach the math camp for our incoming MA and PhD students. To my knowledge, this is the first time in our department that a PhD student is assigned to teach a PhD course. The results have been excellent. Overall, his capacity to synthetize complex concepts and his ability to communicate them, together with a strong work ethic and a true concern for the student's learning experience, lies behind his success as a teacher. In the future, as he gains more experience, I only expect his teaching skills to improve even more.

Within the community of graduate students at McGill Tung is very highly respected. He has co-authored with three of our PhD students, something that is again unprecedented. Tung is the reference for the other students in his cohort. He has regularly participated in the organization of activities in our Department. Furthermore he has been an active presenter both in our departmental workshop and in Canadian and US conferences, for instance this year he is scheduled to present a paper in the ASSA meetings.

At the personal level, Tung is very social, generous with his time, with a good sense of humour, and although very smart also very down to earth. For me it has been an enriching experience first as my student, then interacting with him as his second advisor, or teaching courses where he helped me as a TA.

Overall, I expect that Tung will excel in an environment that values research and I would highly recommend him for such positions in universities or research-oriented non-academic institutions, such as the World Bank or the IMF.

If I can provide any further information about Ying Tung Chang, please do not hesitate to contact me at 1-514-398-8804 francisco.alvarez-cuadrado@mcgill.ca.

Sincerely,



Francisco Alvarez-Cuadrado
Associate Professor
Department of Economics